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INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

RED BOOK

VOLUME VI – FASCICLE VI.1

**GENERAL RECOMMENDATIONS ON
TELEPHONE SWITCHING AND
SIGNALLING**

**INTERFACE WITH THE MARITIME MOBILE
SERVICE AND THE LAND MOBILE SERVICE**

RECOMMENDATIONS Q.1-Q.118bis



VIIITH PLENARY ASSEMBLY

MALAGA-TORREMOLINOS, 8-19 OCTOBER 1984

Geneva 1985



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**CONTENTS OF THE CCITT BOOK
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- FASCICLE II.3 – International telephone service – Network management – Traffic engineering. Recommendations E.401-E.600 (Study Group II).
- FASCICLE II.4 – Telegraph Services – Operations and Quality of Service. Recommendations F.1-F.150 (Study Group I).
- FASCICLE II.5 – Telematic Services – Operations and Quality of Service. Recommendations F.160-F.350 (Study Group I).

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- FASCICLE III.2 – International analogue carrier systems. Transmission media – characteristics. Recommendations G.211-G.652 (Study Group XV and CMBD).
- FASCICLE III.3 – Digital networks – transmission systems and multiplexing equipments. Recommendations G.700-G.956 (Study Groups XV and XVIII).
- FASCICLE III.4 – Line transmission of non telephone signals. Transmission of sound-programme and television signals. Series H, J Recommendations (Study Group XV).
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- FASCICLE IV.2 – Maintenance; international voice frequency telegraphy and facsimile, international leased circuits. Recommendations M.800-M.1375 (Study Group IV).
- FASCICLE IV.3 – Maintenance; international sound programme and television transmission circuits. Series N Recommendations (Study Group IV).
- FASCICLE IV.4 – Specifications of measuring equipment. Series O Recommendations (Study Group IV).

Volume V – Telephone transmission quality. Series P Recommendations (Study Group XII).

Volume VI – (13 fascicles, sold separately)

- FASCICLE VI.1 – General Recommendations on telephone switching and signalling. Interface with the maritime mobile service and the land mobile services. Recommendations Q.1-Q.118 *bis* (Study Group XI).
- FASCICLE VI.2 – Specifications of Signalling Systems Nos. 4 and 5. Recommendations Q.120-Q.180 (Study Group XI).
- FASCICLE VI.3 – Specifications of Signalling System No. 6. Recommendations Q.251-Q.300 (Study Group XI).
- FASCICLE VI.4 – Specifications of Signalling Systems R1 and R2. Recommendations Q.310-Q.490 (Study Group XI).
- FASCICLE VI.5 – Digital transit exchanges in integrated digital networks and mixed analogue-digital networks. Digital local and combined exchanges. Recommendations Q.501-Q.517 (Study Group XI).
- FASCICLE VI.6 – Interworking of signalling systems. Recommendations Q.601-Q.685 (Study Group XI).
- FASCICLE VI.7 – Specifications of Signalling System No. 7. Recommendations Q.701-Q.714 (Study Group XI).
- FASCICLE VI.8 – Specifications of Signalling System No. 7. Recommendations Q.721-Q.795 (Study Group XI).
- FASCICLE VI.9 – Digital access signalling system. Recommendations Q.920-Q.931 (Study Group XI).
- FASCICLE VI.10 – Functional Specification and Description Language (SDL). Recommendations Z.101-Z.104 (Study Group XI).
- FASCICLE VI.11 – Functional Specification and Description Language (SDL), annexes to Recommendations Z.101-Z.104 (Study Group XI).
- FASCICLE VI.12 – CCITT High Level Language (CHILL). Recommendation Z.200 (Study Group XI).
- FASCICLE VI.13 – Man-Machine Language (MML). Recommendations Z.301-Z.341 (Study Group XI).

Volume VII – (3 fascicles, sold separately)

- FASCICLE VII.1 – Telegraph transmission. Series R Recommendations (Study Group IX). Telegraph services terminal equipment. Series S Recommendations (Study Group IX).
- FASCICLE VII.2 – Telegraph switching. Series U Recommendations (Study Group IX).
- FASCICLE VII.3 – Terminal equipment and protocols for telematic services. Series T Recommendations (Study Group VIII).

Volume VIII – (7 fascicles, sold separately)

- FASCICLE VIII.1 – Data communication over the telephone network. Series V Recommendations (Study Group XVII).
- FASCICLE VIII.2 – Data communication networks: services and facilities. Recommendations X.1-X.15 (Study Group VII).
- FASCICLE VIII.3 – Data communication networks: interfaces. Recommendations X.20-X.32 (Study Group VII).
- FASCICLE VIII.4 – Data communication networks: transmission, signalling and switching, network aspects, maintenance and administrative arrangements. Recommendations X.40-X.181 (Study Group VII).
- FASCICLE VIII.5 – Data communication networks: Open Systems Interconnection (OSI), system description techniques. Recommendations X.200-X.250 (Study Group VII).
- FASCICLE VIII.6 – Data communication networks: interworking between networks, mobile data transmission systems. Recommendations X.300-X.353 (Study Group VII).
- FASCICLE VIII.7 – Data communication networks: message handling systems. Recommendations X.400-X.430 (Study Group VII).

Volume IX – Protection against interference. Series K Recommendations (Study Group V). Construction, installation and protection of cable, and other elements of outside plant. Series L Recommendations (Study Group VI).

Volume X – (2 fascicles, sold separately)

- FASCICLE X.1 – Terms and definitions.
- FASCICLE X.2 – Index of the Red Book.
-

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CONTENTS OF FASCICLE VI.1 OF THE RED BOOK

Part I – Recommendations Q.1 and Q.2

Signalling in the international manual service

Rec. No.		Page
Q.1	Signal receivers for manual working	3
Q.2	Signal receivers for automatic and semi-automatic working, used for manual working	4

Part II – Recommendations Q.4 to Q.49

General Recommendations relating to signalling and switching in the automatic and semi-automatic services

SECTION 1 – *CCITT basic Recommendations on international automatic and semi-automatic working*

Q.4	Automatic switching functions for use in national networks	9
Q.5	Advantages of semi-automatic service in the international telephone service	17
Q.6	Advantages of international automatic working	17
Q.7	Signalling systems to be used for international automatic and semi-automatic telephone working	18
Q.8	Signalling systems to be used for international manual and automatic working on analogue leased circuits	23
Q.9	Vocabulary of switching and signalling terms	39

SECTION 2 – *Numbering plan and dialling procedures in the international service*

Q.10	Definitions relating to national and international numbering plans	105
Q.11	Arrangement of figures, letters and symbols on rotary dials and pushbutton telephone sets	106

Rec. No.		Page
Q.11 <i>bis</i>	Numbering plan for the international telephone service	113
Q.11 <i>ter</i>	Ship station identification for VHF/UHF and maritime mobile-satellite services	120
Q.11 <i>quater</i>	Numbering and dialling procedures for VHF/UHF and maritime mobile-satellite telephone services	126

SECTION 3 — *Routing plan for international service*

Q.12	Overflow-alternative routing-rerouting-automatic repeat attempt	139
Q.13	International telephone routing plan	140
Q.14	Means to control the number of satellite links in an international telephone connection	150

SECTION 4 — *General recommendations relative to signalling and switching systems (national or international)*

4.1 Power limits of signals of a signalling system

Q.15	Nominal mean power during the busy hour'	153
Q.16	Maximum permissible value for the absolute power level of a signalling pulse	155

4.2 Signalling in the speech frequency band and outside the speech frequency band

Q.20	Comparative advantages of "in-band" and "out-band" systems	155
Q.21	Systems recommended for out-band signalling	157
Q.22	Frequencies to be used for in-band signalling	158

4.3 Signalling frequencies for push-button telephone sets and reception of those signals in exchanges

Q.23	Technical features of push-button telephone sets	158
Q.24	Multifrequency push-button signal reception	160

4.4 Protection of "in-band" signalling systems against each other

Q.25	Splitting arrangements and signal recognition times in "in-band" signalling systems	163

4.5 Miscellaneous provisions

Q.26	Direct access to the international network from the national network	165

Rec. No.		Page
Q.27	Transmission of the answer signal	165
Q.28	Determination of the moment of the called subscriber's answer in the automatic service	166
Q.29	Causes of noise and ways of reducing noise in telephone exchanges	166
Q.30	Improving the reliability of contacts in speech circuits	169
Q.31	Noise in a national 4-wire automatic exchange	169
Q.32	Reduction of the risk of instability by switching means	169
Q.33	Protection against the effects of faulty transmission on groups of circuits	171
SECTION 5 — <i>Tones for use in national signalling systems</i>		
Q.35	Technical characteristics of tones for the telephone service	185
Q.36	Customer recognition of foreign tones	192
SECTION 6 — <i>General characteristics for international telephone connections and international telephone circuits</i>		
6.0	General	
Q.40	The transmission plan	193
6.1	General recommendations on the transmission quality for an entire international telephone connection	
Q.41	Mean one-way propagation time	197
6.2	General characteristics of national systems forming part of international connections	
6.3	General characteristics of the "4-wire chain" formed by the international circuits and national extension circuits	
Q.42	Stability and echo (echo suppressors)	200
6.4	General characteristics of the 4-wire chain of international circuits; international transit	
Q.43	Transmission losses, relative levels	200
Q.44	Attenuation distortion	205
Q.45	Transmission characteristics of an international analogue exchange	207
SECTION 7 — <i>PCM multiplex equipment and utilization of CCITT signalling systems on PCM links</i>		
Q.46 and Q.47	Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s and 1544 kbit/s	215

Rec. No.		Page
SECTION 8 – <i>Signalling for satellite systems</i>		
Q.48	Demand assignment signalling systems	217
SECTION 9 – <i>Automatic testing equipment</i>		
Q.49	Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2	221
 Part III – Recommendations Q.60 to Q.62		
Interworking with the Maritime Mobile-Satellite Service		
Q.60	General requirements for the interworking of the terrestrial telephone network and the first generation INMARSAT system	225
Q.61	Interworking with Signalling System R2	240
Q.62	Interworking with Signalling System No. 5	248
 Part IV – Recommendation Q.70		
Interworking with the international automatic land mobile service		
Q.70	Interworking of the international automatic land mobile service and the public switched telephone network	257
 Part V – Recommendations Q.101 to Q.118 bis		
Clauses applicable to CCITT standard systems		
SECTION 1 – <i>General clauses</i>		
Q.101	1.1 Facilities provided in international semi-automatic working	269
Q.102	1.2 Facilities provided in international automatic working	271
Q.103	1.3 Numbering used	271
Q.104	1.4 Language digit or discriminating digit	272
Q.105	1.5 National (significant) number	273
Q.106	1.6 The sending-finished signal	273

Rec. No.			Page
Q.107		Standard sending sequence of forward address information	274
Q.107 <i>bis</i>		Analysis of forward address information for routing	282
Q.108	1.8	One-way or both-way operation of international circuits	285
Q.109	1.9	Transmission of the answer signal in international exchanges	286

SECTION 2 – *Transmission clauses for signalling*

A: **Signalling on PCM links**

Q.110	2.0	General aspects of the utilization of standardized CCITT signalling systems on PCM links	287

B. **Clauses common to signal receivers (and senders) for Signalling Systems No. 4, No. 5, R1 and R2**

Q.112	2.1	Signal levels and signal receiver sensitivity	288
Q.113	2.2	Connection of signal receivers in the circuit	289
Q.114	2.3	Typical transmission requirements for signal senders and receivers	290

SECTION 3 – *Control of echo suppressors*

Q.115	3	Control of echo suppressors	293

SECTION 4 – *Abnormal conditions*

Q.116	4.1	Indication given to the outgoing operator or calling subscriber in case of an abnormal condition	299
Q.117	4.2	Alarms for technical staff and arrangements in case of faults	299
Q.118	4.3	Special release arrangements	300
Q.118 <i>bis</i>	4.4	Indication of congestion conditions at transit exchanges	300

Part VI – **Supplements to the Series Q Recommendations**

Supplement No. 1	Report on the energy transmitted by control signals and tones	303
Supplement No. 2	Characteristics of speech interpolation systems affecting signalling	303
Supplement No. 3	Information received on national voice-frequency signalling systems	308
Supplement No. 4	Various tones used in national networks	312
Supplement No. 5	North American precise audible tone plan	312
Supplement No. 6	Treatment of calls considered as “terminating abnormally”	313

	Page
Supplement No. 7 Measurements of impulsive noise in a 4-wire telephone exchange	313
Supplement No. 8 Signalling for demand assignment satellite systems	313
Supplement No. 9 Definition of relative levels, transmission loss and attenuation/frequency distortion for digital exchanges with complex impedances at Z interfaces	313
Supplement No. 10 Impedance strategy for telephone instruments and digital local exchanges in the British Telecom network	315

REMARKS

1 The Recommendations in Volume VI of the *Red Book* are in agreement with Series E of the CCITT Recommendations (Fascicles II.2 and II.3 of the *Red Book* and with the provisions of the *Instructions for the International Telephone Service*.

2 The following expressions, which are in conformity with the CCITT *Terms and Definitions* have been used in Volume VI of the *Red Book*.

a) *Semi-automatic service* (or working), to designate a "service in which the calling subscriber's booking is given to an operator in the outgoing exchange, who completes the call through automatic switches".

b) *Automatic service* (or working), to designate a "system in which the switching operations are performed without the intervention of operators, the calling subscriber dialling (or keying) the called subscriber direct". This expression must be used to the exclusion of all others, such as "fully automatic service".

 If a recommendation applies to both automatic and semi-automatic working, this should be explicitly specified in each sentence, since the CCITT has not defined a general expression to cover both of these services.

 However, it has been agreed that the expressions

"automatic circuit" and "automatic equipment"

should, unless otherwise stated, be taken to indicate circuits or equipment which may be used either for semi-automatic or for automatic working.

3 The strict observance of the specifications for standardized international signalling and switching equipment is of the utmost importance in the manufacture and operation of the equipment. Hence these specifications are obligatory except where it is explicitly stipulated to the contrary.

 The values given in Fascicles VI.1 to VI.9 are imperative and must be met under normal service conditions.

4 The Questions entrusted to each Study Group for the Study Period 1985-1988 can be found in Contribution No. 1 to that Study Group.

5 In this Fascicle, the expression "Administration" is used for shortness to indicate both a telecommunication Administration and a recognized private operating agency.

PART I

Recommendations Q.1 and Q.2

SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE

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SIGNAL RECEIVERS FOR MANUAL WORKING

In 1934 (CCIF *White Book*, Volume III, Xth Plenary Assembly, Budapest, 1934), a signalling current having a frequency of $500\text{ Hz} \pm 2\%$, interrupted at a frequency of $20\text{ Hz} \pm 2\%$ was provisionally chosen for manually-operated international circuits.

500 Hz was chosen as the frequency to be transmitted, under normal conditions, by carrier terminal equipment and line repeaters. To avoid false operation due to speech currents, it was also considered desirable to interrupt the 500 Hz signalling current at low frequency. The use of a uniform interruption frequency of 20 Hz enables a high degree of selectivity to be obtained in signal receivers.

The effective power produced by the signalling current, when not interrupted, is fixed at 1 milliwatt at a zero relative level or an absolute power level of zero (with a tolerance of ± 1 decibel) which corresponds to an average power for the interrupted signalling current of 0.5 milliwatt, with a tolerance of ± 1 decibel.

The power levels specified above were chosen in 1954 (XVIIth CCIF Plenary Assembly, Geneva, 1954) on the basis of the limit imposed for the maximum energy which can be transmitted by signals during the busy hour; it must not exceed 2.5 microwatthours or 9000 microwattseconds at a zero relative level point. A reasonable value for the number of calls, or attempted calls, on a circuit during the busy hour was assumed and 2 seconds was assumed to be the sending duration of the signalling current to line by operation of the operator's ringing key.

On outgoing circuits from an international exchange, where the 500/20 Hz signals are liable to be sent over wideband carrier systems (coaxial carrier systems) it is desirable, to avoid overloading the repeaters, that the duration of the 500/20 Hz signals sent to line should not exceed 2 seconds and they should be limited to this value by automatic means.

Since, in general, the *Instructions for the International Telephone Service* (Article 32) [1] require the signalling current sent over an international circuit to have a duration of at least 2 seconds to avoid the risk of signals being undetected at the incoming end, the means for limiting the sending duration of the signalling current will generally consist of an arrangement which controls the sending duration independently of the time the ringing key is operated and which automatically fixes that duration at 2 seconds.

Note — In the case of short 2-wire circuits, it may be economical to use, by agreement between the Administrations concerned, a low-frequency signalling current (either between 16 and 25 Hz or 50 Hz).

ANNEX A

(to Recommendation Q.1)

Basic technical clauses of a model specification for the provision of 500/20-Hz voice-frequency signalling sets (signal transmitters and receivers) intended for manually-operated circuits

A.1 *Sending of signals*

Power — The signal transmitted shall supply a sinusoidal current at a frequency of $500\text{ Hz} \pm 2\%$ interrupted at a frequency of $20\text{ Hz} \pm 2\%$.

The effective mean power of the 500/20-Hz current is fixed at 0.5 milliwatt or an absolute power level of -3 dBm (with a tolerance of $\pm 1\text{ dB}$) at a zero relative level point.

Every precaution should be taken to avoid unbalance effects in the circuit during the transmission of a 500/20-Hz signalling current.

A.2 Reception of signals

Sensitivity — The signal receiver shall operate correctly when the 500/20-Hz current at the input to the signal receiver is within the following limits:

$$-8.5 + n \leq N \leq +2.5 + n \text{ dB}$$

where n is the relative power level at the point of the circuit at which the signal receiver is connected.

The limits take account of the tolerances indicated above for the transmitted power level and include a margin of ± 4.5 decibels on the nominal absolute power level of the 500/20 Hz current received at the input to the signal receiver. This margin allows for variations in transmission conditions on international circuits.

Tuning — Tuning should be such that the signal receiver operates only at a frequency of 500 Hz guaranteed to within $\pm 2\%$ and at an interrupting frequency of 20 Hz guaranteed to within $\pm 2\%$.

Delay — The delay, i.e. the time which elapses between the application of the signalling voltage and the operation of the signal receiver, must be long enough for the signal receiver to remain insensitive to all speech currents which normally flow in the circuit to which it is connected. The duration of this delay must, however, be less than 1200 milliseconds. (In other words, 1200 milliseconds is the maximum signal recognition time within which a signal has to be recognized).

Selectivity (resulting from the tuning of the resonant circuit and the delay mentioned above) — The receipt of a speech (or noise) current circulating in the circuit must not give rise to a current liable to cause the operation of the signalling equipment and, in consequence, to cause a wrong indication to be given on the international positions even though the speech (or noise) voltage reaches the maximum value likely to be met in practice. In particular, the signal receiver must not operate when a speech power not exceeding 6 milliwatts is applied at a zero relative level point.

Insertion loss — The insertion loss introduced by the signal receiver in the circuit with which the signalling set is associated must be less than 0.3 dB for any frequency effectively transmitted by the circuit.

Reference

- [1] *CCITT Instructions for the international telephone service (1 October 1981)*, ITU, Geneva, 1981.

Recommendation Q.2

SIGNAL RECEIVERS FOR AUTOMATIC AND SEMI-AUTOMATIC WORKING, USED FOR MANUAL WORKING

The directives relating to 500/20-Hz signalling sets are provisional. An Administration intending to purchase new signalling sets for use on international circuits which for the time being are to be operated on a manual basis, may find it advantageous, by agreement with the Administrations interested in the operation of the circuits concerned, to use signal receivers and transmitters conforming to the specifications for international automatic equipment. This will permit a greater technical uniformity of installations and will avoid having to replace the signal receivers when, ultimately, these circuits are operated on an automatic or semi-automatic basis.

The signal receivers must therefore conform with the specifications for the applicable recommended CCITT systems.

Sending of signals

The frequency and power level of the signalling current must be in accordance with the specifications for international automatic equipment. If two-frequency signal receivers are concerned, the two frequencies (compound signal) must be transmitted simultaneously.

The nominal duration of a signal sent to line is fixed at 2 seconds so as to be the same as that specified for 500/20 Hz signalling.

Reception of signals

At the receiving end, provision must be made for a splitting arrangement conforming to the specifications for international automatic equipment. This splitting arrangement can be:

- either an integral part of the signal receivers, or
- placed at the end of the circuit after the signal receiver.

The signalling equipment (at the output of the signal receiver) which causes the lighting of the calling and clearing lamps shall have a signal recognition time of between 100 and 1200 milliseconds:

- the minimum duration of 100 ms has been chosen so as to avoid the recognition of false signals due to imitation by speech currents;
- the maximum duration of 1200 ms has been chosen so as to permit the partial use of 500/20-Hz signal-receiver equipment.

Note 1 – The characteristics of signal receivers of the types used for automatic or semi-automatic working could possibly also be used to provide signals and supplementary facilities for operators if the Administrations concerned consider that the operational advantages to be obtained justify the equipment modifications involved at the international exchanges.

Note 2 – The time quoted in this Recommendation for the signal length and the signal recognition times would also be appropriate for out-band signalling systems using discontinuous signals for a manual service.

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PART II

Recommendations Q.4 to Q.49

GENERAL RECOMMENDATIONS RELATING TO SIGNALLING AND SWITCHING IN THE AUTOMATIC AND SEMI-AUTOMATIC SERVICES

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SECTION 1

CCITT BASIC RECOMMENDATIONS ON INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING

Recommendation Q.4

AUTOMATIC SWITCHING FUNCTIONS FOR USE IN NATIONAL NETWORKS

1 Preamble

The CCITT,

considering

(1) that a large amount of switching equipment will be installed in the next few years, especially in areas of low subscriber density;

(2) the continuous rapid development of new switching techniques results in different generations of equipment having to co-exist;

(3) that some degree of compatibility in the installed switching equipment is required in the world-wide automatic network;

(4) that the introduction of newly developed switching systems presents Administrations with an ever increasing number of engineering, staff training, maintenance and other operational considerations,

and also considering

(5) that Recommendations originally intended for international application only are increasingly being applied to national networks, or could be so applied;

(6) that many current studies are aimed at producing Recommendations primarily applicable to national networks,

recommends

the following guidelines for use by Administrations establishing national switching standards or, if desired, for updating existing standards. Each Administration may select those guidelines it deems applicable to its own situation.

2 Automatic switching functions for use in national networks

Table 1/Q.4 lists the functional switching capabilities of an exchange which will, or may in some instances, according to the role of the exchange in a network, need to be technically specified in order that the Administration concerned can be assured that the exchange will satisfy existing and foreseen future needs of the network. For the required capabilities, references are given to CCITT texts which should be taken into account when decisions on national standards are taken; some make positive recommendations, others give guidelines or background information. Table 2/Q.4 provides full titles for those referenced texts, and for others applicable to national switching, in order to provide more specific information about the subject matter.

Some of the functions listed are required in all types of exchanges. Others may or may not be, according to the role of the exchange, e.g. local, combined local/transit, transit, international, etc.

It is not always necessary that a precise technical specification be given, e.g., in a tender specification, for each switching function. In some instances, it may be sufficient to state the requirements broadly, possibly including desired ranges of parameter values, and to invite a tenderer to make his own specific proposals for evaluation.

3 Requirements for ISDN

As Recommendations for the ISDN are being developed concurrently, it is difficult to reference them in this Recommendation. All Recommendations relevant to the ISDN will be published in a single volume at the end of this Study Period 1981-1984 (Fascicle III.5).

4 Requirements other than automatic switching functions

The technical specifications of the required automatic switching functions of an exchange do not, in themselves, constitute a complete specification. Other aspects possibly needing to be covered, which are particular to an exchange or to a group of exchanges and not included within the scope of automatic switching functions are:

- traffic (dimensioning and service performance);
- specifications dictated by the equipment environment (building constraints, power supplies, climatic conditions, etc.);
- installation, including testing, acceptance, post-acceptance technical support, etc.;
- training and documentation;
- support of system design and software, e.g., CCITT Recommendation Z.100 (SDL) series and CCITT Recommendation Z.200 (CHILL) series.

5 Technical cooperation possibilities

The CCITT Recommendations already established so far do not themselves suffice to cover all the points of a specification dealing with the functions to be performed by switching equipment. It is unavoidable, if national standards are to match the requirements and circumstances of a particular network, that the responsible Administration itself exercise a number of choices.

An Administration seeking advice or guidance beyond that indicated in CCITT texts may, by approaching the ITU Secretariat, obtain information on the standards adopted by other Administrations.

6 Definition of requirements in terms of services and facilities

6.1 Fundamental decisions as to range of service(s) and facilities to be provided must be made by the Administration. Descriptions and other information on the various services normally provided by a switching system may be found as indicated in the following:

- types of services (GAS 6, Chapter II, § 3; Chapter III, § 3.2),
- basic services (GAS 6, Chapter IV, § 1.2),
- supplementary services (GAS 6, Chapter IV, § 1.4); Recommendations E.130, E.132, E.151; Supplement No. 1 to Series E Recommendations.

6.2 A list of possible telephony subscriber services and facilities has been extracted from the GAS 6 Handbook, Chapter IX, § 1.3.2 and is shown in *Annex A*.

TABLE 1/Q.4

CCITT texts (Recommendations and GAS Handbooks) relevant to the technical specification of automatic switching functions of exchanges in national networks

Item	Reference
A. Switching	
<i>Type of switch:</i> analogue (2- or 4-wire)/digital, space or time division	GAS 6 II 1, VI 1.1 GAS 3 III, Annex 1 Recs. Q.501, Q.511
<i>Type of control:</i> distributed/centralized	GAS 6 VI 1.2
<i>Subscriber classification</i>	GAS 6 VI 1.2.1
B. Routing and selection	
<i>Classification of exchange inlets and outlets:</i> according to types of inter-exchange circuits to be connected: taking into account the line, inter-register, etc., signalling arrangements and the transmission, operating, testing, network management, etc., requirements	GAS 6 IV 5.6-7 VI 1.4.1 and 4 Recs. E.543 Q.7, Q.48, Q.49, Q.108, Q.110, Q.251-Q.300, Q.310-Q.331, Q.400-Q.480, Q.501-Q.507, Q.511-Q.517
<i>Number analysis functions:</i> required capacity and depth of analysis for routing, determination of number length, barring, digit insertion/deletion, charging, echo control, etc.	GAS 6 IV 6, VI 1.4.6 Recs. E.160, E.161, E.163 Q.103, Q.105, Q.106, Q.107, Q.107 bis, Q.115
<i>Choice of outgoing circuit:</i> search procedure, dual seizures, alternative routing, repeat attempts, etc.	GAS 6 VI 1.4.2, 3 and 5 Recs. E.170, E.171 Q.12, Q.263
<i>Network management functions:</i> circuit group denial, alternative routing cancellation, exchange load control, etc.	GAS 6 VI 1.4.7 Recs. E.170, E.410, E.411, E.412, E.413 Q.506, Q.516
C. Charging	
<i>Methods:</i> local, long-distance, international, non-chargeable, payphone, etc., calls	GAS 6 IV 7.1-2, VI 1.5.1 Recs. E.230-E.232
<i>Charge determination:</i> principles and parameters	GAS 6 IV 7.3, VI 1.5.2
D. Transmission characteristics	
<i>Interfaces:</i> specification of the transmission characteristics of the interfaces, or the identification of the standard interfaces, at which the exchange is to interconnect with external facilities and systems	GAS 3 III Recs. G.703, G.704, G.705, G.731-G.739, G.741-G.746, Q.502, Q.512
<i>Exchange transmission performance:</i> Limits for the levels of transmission impairments attributable to the exchange and for characteristics affecting performance, taking account of all possible types of connection through the exchange	GAS 6 VI 1.8 Recs. G.121, G.122, G.123 Q.45, Q.507, Q.517
E. Synchronization and timing	Recs. G.811, G.822 Q.502, Q.503, Q.512, Q.513
F. Tones and recorded announcements	
Scope and applications; tones; announcements	GAS 6 VI 1.7 Recs. E.180 (Q.35), E.181 (Q.36), E.182 Supplement No. 2 to Series E Recommendations Rec. Q.24

TABLE 1/Q.4 (cont.)

Item	Reference
G. Subscriber line characteristics 1. Analogue subscriber line <i>Subscriber line standards:</i> limits for loop resistance, loop insulation, overall line attenuation, etc. <i>Subscriber line signals:</i> supervision address information, ringing, metering, tones, etc. 2. Digital subscriber line Exchange interfaces signalling for digital access	GAS 2 V 3.2, 3.3 GAS 6 VI 1.3.1 GAS 3 II 3.1 Recs. G.120-G.123 GAS 2 V 6.2 GAS 6 IV 8, VI 1.3.2 Recs. E.131 Q.16, Q.23, Q.35 (E.180), Q.118 Recs. I.412 Q.512, Q.920, Q.921, Q.930, Q.931
H. Inter-exchange signalling Specification of required exchange functions by identification of existing and planned inter-exchange signalling arrangements <i>Signalling philosophies and types of signalling</i> <i>Signalling system specifications</i> (channel associated and common channel, as appropriate) <i>Interworking of signalling systems</i>	GAS 6 II 2, IV 8, VI 1.6 GAS 3 II 3.2 Recs. Q.7, Q.21 Supplement No. 3 to Series Q Recommendations Recs. Q.101-Q.103, Q.105-Q.118 <i>bis</i>, Q.251-Q.300, Q.310-Q.331, Q.400-Q.490, Q.701-Q.795 Recs. Q.601-Q.685
I. Operation The specification of exchange features designed to facilitate the operation of the exchange with respect to the administrations of: – subscribers – routing – traffic – tariffs and charging – recording and billing – system control taking into account remote control possibilities	GAS 6 IV 7.4-7, 9.1-2 VI 1.5.3-4, 1.9 Recs. E.500 Q.505, Q.506, Q.515, Q.516 Z.331-Z.333
J. Maintenance The specification, with respect to maintenance, of: – subscriber lines – inter-exchange circuits – switching network – control system the specification of testing and maintenance features, taking into account the objectives of: – minimization of the fault rate – simplification of maintenance activities – adequate equipment repair facilities – maximization of immunity to failures – optimizing maintenance centralization	GAS 6 IV 9.1, 9.3, VI 1.10 Recs. G.231 M.565 O.22 (Q.49) Q.506, Q.516 Z.301, Z.331-Z.333
L. Input/output devices for operation and maintenance	GAS 6 VI 1.11 Recs. E.220, E.221 Z.301-Z.302, Z.311-Z.317, Z.321-Z.323

TABLE 2/Q.4

**Titles of CCITT texts (Recommendations and GAS Handbooks)
relevant to national switching applications**

- CCITT Manual *Local telephone networks*, ITU, Geneva, 1968 (Gas 2 Handbook).
- CCITT Manual *Transmission planning of switched telephone networks*, ITU, Geneva, 1976 (Gas 3 Handbook).
- CCITT Manual *Economic and technical aspects of the choice of telephone switching systems*, ITU, Geneva, 1981 (GAS 6 Handbook).
- CCITT Manual *Economic and technical aspects of the transition from analogue to digital telecommunication networks*, ITU, Geneva, 1984 (GAS 9 Handbook).
- CCITT Rec. E.130 *Choice of the most useful and desirable supplementary telephone services.*
- CCITT Rec. E.131 *Subscriber control procedures for supplementary services.*
- CCITT Rec. E.132 *Standardization of elements of control procedures for supplementary telephone services.*
- CCITT Rec. E.151 *Conference calls.*
- CCITT Rec. E.160 *Definitions relating to national and international numbering plans.*
- CCITT Rec. E.161 *Arrangement of figures, letters and symbols on rotary dials and pushbutton telephone sets.*
- CCITT Rec. E.163 *Numbering plan for the international telephone service.*
- CCITT Rec. E.170 *Overflow – alternative routing – rerouting – automatic repeat attempt.*
- CCITT Rec. E.171 *International routing plan.*
- CCITT Rec. E.180 *Characteristics of the dial tone, ringing tone, busy tone, congestion tone, special information tone and warning tone.*
- CCITT Rec. E.181 *Customer recognition of foreign tones.*
- CCITT Rec. E.182 *Application of tones and recorded announcements in telephone services.*
- CCITT Rec. E.211 *Numbering and dialling procedures for VHF/UHF and maritime mobile satellite services.*
- CCITT Rec. E.220 *Ergonomic aspects of visual display terminals.*
- CCITT Rec. E.221 *Human interface to visual display terminals.*
- CCITT Recs. E.230-E.232 *Charging (determination of collection charges) in the international telephone service.*
- CCITT Rec. E.500 *Measurement and recording of traffic.*
- CCITT Rec. E.521 *Calculation of the number of circuits in a group carrying overflow traffic.*
- CCITT Rec. E.543 *Grades of service in analogue/digital international telephone exchanges.*
- CCITT Rec. E.410, E.411, E.412 and E.413 *Network management.*
- CCITT Series E. Recommendations Supplement No. 1 *List of possible supplementary telephone services which may be offered to subscribers.*
- CCITT Series E. Recommendations Supplement No. 2 *Various tones used in national networks.*
- CCITT Recs. G.120-G.123 *General characteristics of national systems forming part of international connections.*
- CCITT Rec. G.121 *Corrected reference equivalents (CREs) of national systems.*
- CCITT Rec. G.122 *Influence of national networks on stability and echo losses in national systems.*

CCITT Rec. G.123 *Circuit noise in national networks.*

CCITT Rec. G.231 (2) *Use of standard components in transmission equipment.*

CCITT Rec. G.703 *General aspects of interfaces.*

CCITT Rec. G.704 *Functional characteristics of interfaces associated with network nodes.*

CCITT Rec. G.705 *Characteristics required to terminate digital paths on a digital exchange.*

CCITT Recs. G.731-G.739 *Principal characteristics of primary multiplex equipment.*

CCITT Recs. G.741-G.746 *Principal characteristics of second order multiplex equipments.*

CCITT Rec. G.811 *Performance of clocks suitable for plesiochronous operation of international digital links.*

CCITT Rec. G.822 *Controlled slip rate objectives on an international digital connection.*

CCITT Rec. I.412 *ISDN user-network interfaces-channel structures and access capabilities.*

CCITT Rec. M.565 *Access point for international telephone circuits.*

CCITT Rec. O.22 *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2.*

CCITT Rec. Q.7 *Signalling systems to be used for international automatic and semi-automatic telephone working.*

CCITT Rec. Q.12 *Overflow-alternative routing – rerouting – automatic repeat attempt.*

CCITT Rec. Q.14 *Means to control the number of satellite links in an international telephone connection.*

CCITT Rec. Q.15 *Nominal mean power during the busy hour.*

CCITT Rec. Q.16 *Maximum permissible value for the absolute power level of a signalling pulse.*

CCITT Rec. Q.21 *Systems recommended for out-band signalling.*

CCITT Rec. Q.23 *Technical features of push-button telephone sets.*

CCITT Rec. Q.24 *Multi-frequency push-button signal reception.*

CCITT Rec. Q.33 *Protection against the effects of faulty transmission on groups of circuits.*

CCITT Rec. Q.35 *Characteristics of the dial tone, ringing tone, busy tone, congestion tone, special information tone and warning tone.*

CCITT Rec. Q.45 *Transmission characteristics of an international exchange.*

CCITT Rec. Q.48 *Demand assignment signalling systems.*

CCITT Rec. Q.49 *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2.*

CCITT Recs. Q.101-Q.103, Q.105-Q.118 *bis* *Clauses applicable to CCITT standard systems.*

CCITT Rec. Q.103 *Numbering used.*

CCITT Rec. Q.105 *National (significant) number.*

CCITT Rec. Q.106 *The sending-finished signal.*

CCITT Rec. Q.107 *Standard sending sequence of forward address information.*

CCITT Rec. Q.107 *bis* *Analysis of forward address information for routing.*

CCITT Rec. Q.108 *One-way or both-way operation of international circuits.*

CCITT Rec. Q.110 *General aspects of the utilization of standardized CCITT signalling systems on PCM links.*

CCITT Rec. Q.115 *Control of echo suppressors.*

CCITT Recs. Q.118 *Special release arrangements.*

CCITT Recs. Q.251-Q.300 *Specifications of Signalling System No. 6.*

CCITT Rec. Q.263 *Double seizing with both-way operation.*

CCITT Recs. Q.310-Q.331 *Specifications of Signalling System R1.*

CCITT Recs. Q.400-Q.490 *Specifications of Signalling System R2.*

CCITT Recs. Q.501-Q.507 *Digital transit exchanges for national and international applications.*

CCITT Rec. Q.501 *Introduction, field of application and basic functions.*

CCITT Rec. Q.502 *Interfaces.*

CCITT Rec. Q.503 *Connections, signalling, control, call handling and ancillary functions.*

CCITT Rec. Q.505 *Traffic measurements.*

CCITT Rec. Q.506 *Network management functions.*

CCITT Rec. Q.507 *Transmission characteristics for telephony of digital transit exchanges.*

CCITT Recs. Q.511-Q.517 *Digital local and combined exchanges.*

CCITT Rec. Q.511 *Introduction, field of application and basic functions.*

CCITT Rec. Q.512 *Interfaces.*

CCITT Rec. Q.513 *Connections, signalling, control, call handling and ancillary functions.*

CCITT Rec. Q.515 *Exchange measurements.*

CCITT Rec. Q.516 *Operation and maintenance functions.*

CCITT Rec. Q.517 *Transmission characteristics.*

CCITT Recs. Q.601-Q.685 *Interworking of signalling systems.*

CCITT Recs. Q.701-Q.795 *Specifications of Signalling System No. 7.*

CCITT Rec. Q.920 *ISDN user-network interface data link layer – General aspect.*

CCITT Rec. Q.921 *ISDN user-network interface data link layer specification.*

CCITT Rec. Q.930 *ISDN user-network interface layer 3 – General aspects.*

CCITT Rec. Q.931 *ISDN user-network interface layer 3 specification.*

CCITT Series Q. Recommendations Supplement No. 3 *Information received on national voice-frequency signalling systems.*

CCITT Rec. Z.100 Series – *Functional specification and description language (SDL).*

CCITT Rec. Z.200 Series – *CCITT high level language (CHILL).*

CCITT Rec. Z.300 Series – *Man-machine language (MML).*

CCITT Recs. Z.301-Z.302 – *General principles.*

CCITT Rec. Z.301 – *Introduction to the CCITT man-machine language.*

CCITT Recs. Z.311-Z.317 – *Basic syntax and dialogue procedures.*

CCITT Recs. Z.321-Z.323 – *Extended MML for visual display terminals.*

CCITT Recs. Z.331-Z.333 – *Specification of man-machine interface.*

ANNEX A

(to Recommendation Q.4)

List of possible subscriber services and facilities

Subscriber services

Basic services

- subscriber dialled local, long distance, and international calling with automatic charging
- PBX line hunting, night service, and direct dialling-in
- payphone
- access to operators for assistance and information
- access to community services (police, fire brigade, etc.)
- access to recorded announcements
- call barring
- malicious call trace
- interception of calls
- absent subscriber
- line observation

Supplementary services

- abbreviated dialling
- alarm call
- hot line
- outgoing service restriction
- call diversion
- call waiting
- do not disturb
- call completion to busy subscribers
- switching-in not permitted
- call charge indicator at subscriber's premises
- immediate call charge announcement
- priority line
- two party line
- multiparty line
- multifrequency push-button (MFPB) dialling
- mobile subscriber
- conference service
- Centrex services
- other services

Recommendation Q.5

ADVANTAGES OF SEMI-AUTOMATIC SERVICE IN THE INTERNATIONAL TELEPHONE SERVICE

(Geneva, 1954)

The CCITT,

considering

- (a) the large economies in personnel that can result from the introduction of semi-automatic service at the incoming exchange;
- (b) the very small number of faults due to the equipment used for the international semi-automatic service;
- (c) the improvement in the "efficiency" (ratio of chargeable time to total holding time) of circuits using semi-automatic service compared with the efficiency of manual circuits operated on a demand basis;
- (d) the improvement in the quality of the service given to users due to the reduction in the time of setting up a call;
- (e) the fact that any type of call can be set up without difficulty over semi-automatic circuits, so that semi-automatic circuits can be used exclusively on an international relation;

draws the attention of Administrations

to the advantages of semi-automatic service from the point of view of economy and of the quality of service given to subscribers.

Recommendation Q.6

ADVANTAGES OF INTERNATIONAL AUTOMATIC WORKING

(New Delhi, 1960)

The CCITT,

considering

- (a) that the advantages of semi-automatic working mentioned in Recommendation Q.5 apply as well to automatic working in respect of reliability, circuit efficiency and the satisfaction given to subscribers;
- (b) that the advantages of automatic working are even greater as regards staff economy, since outgoing operators are dispensed with;
- (c) that the changeover from semi-automatic to automatic working may be accomplished without any major modification to the international circuits or to the switching equipment at transit and incoming exchanges;
- (d) that by 1960 the above advantages had been widely confirmed by experience on a number of international relations which had been using automatic service up to that time;
- (e) that such experience has also shown that when a relation changes from demand working (manual or semi-automatic) to automatic working, there is a considerable increase in traffic;
- (f) that the introduction of an international automatic service follows logically on the introduction of a national automatic service;

draws the attention of Administrations

to the additional advantages resulting from the introduction of an international automatic service.

**SIGNALLING SYSTEMS TO BE USED FOR INTERNATIONAL AUTOMATIC
AND SEMI-AUTOMATIC TELEPHONE WORKING**

(Geneva, 1954 and 1964, Mar del Plata, 1968,
Geneva, 1976 and 1980)

The CCITT,

considering

(a) that standardization of the signalling systems to be used for international automatic and semi-automatic telephone working is necessary to keep to a minimum the number of different types of equipment serving the various routes at any one exchange;

(b) that the following signalling systems have been standardized and are applicable for *general use* in international automatic and semi-automatic working:

- Signalling System No. 4, standardized by the CCIF in 1954;
- Signalling System No. 5, standardized by the CCITT in 1964;
- Signalling System No. 6, standardized by the CCITT in 1968;
- Signalling System No. 7, standardized by the CCITT in 1980;

(c) that the following signalling systems have been standardized and are applicable for *regional use* in international automatic and semi-automatic telephone working:

- Signalling System R1 (Regional Signalling System No. 1, formerly called the North American System), standardized by the CCITT in 1968;
- Signalling System R2 (Regional Signalling System No. 2, formerly called the MFC Bern System), standardized by the CCITT in 1968;

(d) that, under the conditions and subject to the reservations stated below, these signalling systems may be expected to give acceptable results for international automatic and semi-automatic telephone working;

desiring

that the CCITT Recommendation concerning the signalling systems for international automatic and semi-automatic telephone working be generally applied by all Administrations;

unanimously recommends

that, under the conditions and subject to the reservations stated below, Administrations should use, for international automatic and semi-automatic telephone working, one or more of the standard signalling systems mentioned in (b) and (c) above.

1 Criteria for selecting a signalling system

Many factors influence the selection of a given signalling system for a particular application. Factors that should be considered include:

1.1 Satellite systems because of long round trip propagation delays (540 ± 40 ms).

The inclusion of one satellite link in a telephone connection requires subscribers to keep more discipline than usual during a conversation. If use is made of two satellite links in tandem, requirements are even more stringent. In addition, there is the question of what transmission objectives are attainable on such a connection.

According to Recommendation Q.13 the inclusion of two satellite links in a connection should be avoided in all but exceptional cases. To facilitate the observance of this Recommendation, it is advisable to inform the subsequent transit centres by means of signalling that a satellite link is already included in the connection. During the following routing process the transit centre(s) should select a terrestrial link.

1.2 *Echo suppressors*

Both long terrestrial telephone links and satellite links call for the insertion of echo suppressors. Recommendations G.131 [1] and Q.115 include basic requirements for the insertion of echo suppressors.

Therefore, signalling systems should be arranged to act in cooperation with switching equipment to achieve the goals covered by Recommendations G.131 [1] and Q.115. This would be facilitated where the signalling system to be used provides the possibility of controlling the inclusion of echo suppressors.

In the future, the use of echo cancellers may need to be considered (see Recommendation G.165 [2]).

1.3 *Speech interpolation systems (e.g. TASI)*

In the case of a transmission system with speech interpolation, it must be ensured that the signalling system to be used is compatible with speech interpolation.

2 Further criteria for selecting a signalling system

Once Administrations decide to establish a route, they will have to specify the general requirements to be met by the signalling system.

In the following, some questions are drawn up which may serve as a guideline:

- a) Does the transmission system provide for sufficient bandwidth (e.g. for outband line signalling)?
- b) Is the signal capacity sufficient to allow the setting-up of an ordinary connection?
- c) Is an additional exchange of information required, e.g.:
 - for echo suppressor control,
 - to increase routing facilities,
 - to obtain or to offer detailed information on congestion,
 - to obtain or to offer information on the condition of the called subscriber line,
 - to obtain or to offer information on the nature of the call:
 - i) for identification or
 - ii) for management purposes?
- d) What requirements have to be set for the speed of the signalling system? What post-dialling and answering delays are to be tolerated?
- e) Is there any interdependence between the minimum bundle size and signalling (e.g., as in the case of pilot interruption control of Signalling System R2)?
- f) In the case of satellite systems, does the earth station require an extra interface between the terrestrial access circuits and the satellite links?
- g) Is it necessary to introduce a new signalling system?
- h) Is the signalling system suitable for application to the particular exchange type, e.g., electro-mechanical exchanges?

3 Characteristics of the standard CCITT Signalling Systems for general use

3.1 *Signalling System No. 4*

Described and specified in Fascicle VI.2.

Suitable for one-way operation.

Suitable for terminal and transit working; in the latter case two or three circuits equipped with Signalling System No. 4 may be switched in tandem.

Signalling System No. 4 is used in Europe and the Mediterranean Basin.

It makes use of a two-frequency code within the speech band.

A four-element binary code is employed for interregister signalling. Each of these elements consists of one of the two signal frequencies.

Each digit is acknowledged. In the case of long propagation times, these acknowledgements have an adverse effect because the propagation time is included twice in one signalling cycle. This disadvantage is more or less compensated for by the overlap mode of operation.

Signalling System No. 4 has a signal capacity of 16 codes for forward interregister signals and no register signals in the backward direction other than the acknowledgement signals.

One signal is provided for echo suppressor control on mutual agreement.

A signal is not provided to indicate whether the connection already includes a satellite link.

Not suitable for operation on transmission systems with speech interpolation.

3.2 *Signalling System No. 5*

Described and specified in Fascicle VI.2.

Suitable for both-way operation.

Suitable for terminal and transit working; in the latter case two or three circuits equipped with Signalling System No. 5 may be switched in tandem.

A multifrequency code (MFC: 2 out of 6) within the speech band is used for interregister signalling. The line signals consist of 1 or 2 frequencies within the speech band.

The entire address information is stored up to the last signal. It is then transmitted en bloc as a rapid sequence of pulsed multifrequency code signals.

The application of the en bloc mode of operation may result in an increased post-dialling delay, especially if the ST condition is determined by time out.

Signalling System No. 5 has a signal capacity of 15 codes for forward interregister signals and no backward interregister signals.

Signals are not provided either for echo suppressor control or for indicating whether the connection already includes a satellite link.

Suitable for operation on transmission systems with speech interpolation and on satellite links.

3.3 *Signalling System R1*

Described and specified in Fascicle VI.4.

Signalling System R1 is mainly used in North America.

Suitable for both-way operation.

Specified for terminal working.

A multifrequency code (MFC: 2 out of 6) within the speech band is used for interregister signalling.

In the analogue version of the Signalling System R1 line signalling, one frequency within the speech band is used. In the digital version of the Signalling System R1 line signalling, the two resultant signalling channels per speech circuit may be regarded as outband channels.

The following three modes of operation can be used to transmit the address information:

- en bloc,
- en bloc/overlap, or
- overlap.

The mode of operation selected influences:

- the seizing time of the next link, as well as
- the post-dialling delay.

The address information is transmitted as pulsed MFC signals.

Signalling System R1 has a signal capacity of 15 codes for forward interregister signals but no backward interregister signals.

Signals are not provided either for echo suppressor control or for indicating whether the connection already includes a satellite link.

Signalling System R1 can be used on satellite links. A variant of Signalling System R1 may be suitable for operation on transmission systems with digital speech interpolation, provided that the systems are designed and engineered to be transparent to pulsed interregister signals.

3.4 *Signalling System R2*

Described and specified in Fascicle VI.4.

Used for one-way operation on analogue transmission systems. Both-way operation is possible on digital transmission systems.

Suitable for terminal and transit working.

Signalling System R2 is used in both national and international telephone networks in several regions of the world.

A multifrequency code (MFC: 2 out of 6) within the speech band is used for interregister signalling. Since two different sets of six frequencies in separate bands are defined for forward and backward interregister signals, Signalling System R2 interregister signalling is suitable for use on 2-wire circuits as well as on 4-wire circuits.

For the analogue version of the Signalling System R2 line signalling, use is made of a low-level tone-on-idle method out of band. In addition, pilot interruption control is used.

The digital version of the line signalling uses two signalling channels to transmit the signalling information and for circuit supervision. For 2048 kbit/s PCM systems, the signalling information of the 30 speech circuits is transmitted in the Time Slot 16 (see Recommendation G.732 [3]).

It should be noted that the analogue version of the line signalling can be used on digital links; the signalling states are sent coded on one signalling channel. This use of the analogue version on digital links is not recommended on international circuits.

When a circuit is composed of both digital and analogue links, a conversion between the two versions of the line signalling can occur at the interface (see Recommendation Q.430).

Compelled signalling is used to transmit the address information in the overlap mode as multifrequency code signals, i.e., each forward interregister signal is acknowledged by a backward interregister signal. Considering that four times the propagation time is to be included in one signalling cycle, the exchange of signals is rather slow if the propagation time is long. This disadvantage is more or less compensated for by the overlap mode of operation.

Signalling System R2 has a higher signalling capacity than Signalling Systems No. 4, No. 5 and R1. The interregister signals allow, amongst others:

- improved routing,
- detailed information on congestion,
- information on:
 - i) the nature of call,
 - ii) the condition of the called subscriber line,
- no-charge calls, and
- address-complete information.

Signalling System R2 includes both forward and backward interregister signals for echo suppressor control.

In Signalling System R2, two signals are specified which indicate whether *or not* the connection already includes a satellite link.

Signalling System R2 may be suitable for use on satellite circuits, especially when it is already employed in the national or regional telephone networks concerned.

When Signalling System R2 is to be used on satellite links, the following must be borne in mind:

- In the case of analogue line signalling, intervals T1 and T2 have to be adapted.
- Pilot interruption control requires bundles comprising a multiple of 12 speech circuits.
- The register at the incoming end of a satellite link using Signalling System R2 shall be operated as an outgoing R2 register.
- The guard time for blocking and recognition of forward signals when pulsed signals are transmitted should be adapted to the propagation time on the satellite link.

Signalling System R2 may be suitable for operation on transmission systems with digital speech interpolation, provided the systems are designed and engineered to be transparent to pulsed interregister signals.

With 3 kHz spaced channels, the interregister signalling of Signalling System R2 may be used with the line signalling of Signalling System No. 4.

3.5 *Signalling System No. 6*

Fully described and specified in Fascicle VI.3.

Suitable for both-way operation.

Suitable for terminal and transit working.

During the period from 1970 to 1972 Signalling System No. 6 was tested internationally.

Some Administrations have introduced it for international telephone traffic. A variant of Signalling System No. 6 is employed in the national telephone network of the United States.

A common signalling link is used for signalling.

May be used in either an associated or quasi-associated mode of operation. Use in a quasi-associated mode may be more economic for small bundles of circuits.

Signalling is performed by means of signal units. Each unit is 28 bits in length, including 8 check bits. Transmission is at a speed of 2400 bit/s for the analogue version and 4 kbit/s (optionally 56 kbit/s) for the digital version.

Each signal unit within a block of 11 signal units is acknowledged and retransmitted in case of errors.

The address information can be transmitted en bloc and in the overlap mode. Because the transmission speed of Signalling System No. 6 is considerably higher than that of channel-associated signalling systems, the influence of the mode of operation on the post-dialling delay is reduced substantially.

The signal capacity (including the spare codes) of Signalling System No. 6 is much higher than that of Signalling Systems No. 4, No. 5, R1 and R2.

Signalling System No. 6 contains signals for echo suppressor control as well as signals indicating whether a satellite link is already included in the connection.

Signalling System No. 6 can be used for all types of telephone circuits including those with speech interpolation.

Signalling System No. 6 can be used on satellite links.

3.6 *Signalling System No. 7*

Fully described and specified in Fascicle VI.6.

Suitable for both-way operation.

Suitable for terminal and transit working.

A common signalling link is used for signalling.

Signalling System No. 7 can be used in national and international telecommunication networks.

Signalling System No. 7 can be used for dedicated networks (e.g. data transmission, telephone) and within an integrated services digital network. It is the preferred signalling system between Integrated Digital Network (IDN) exchanges and within the Integrated Services Digital Network (ISDN).

Signalling System No. 7 may be used in either an associated or quasi-associated mode of operation. Use in a quasi-associated mode may be more economical for small bundles of circuits.

Variable length signal units with an integer number of octets are used of which 6 perform message transfer part functions. Signalling System No. 7 is optimized for a digital bearer with transmission speed of 64 kbit/s, but operation at lower speeds (e.g. 4.8 kbit/s) on analogue bearers is possible.

Two error control methods (basic and preventive cyclic retransmission) are specified, each with its own field of application. In the basic method each signal unit is acknowledged and retransmitted in case of errors while in the preventive cyclic retransmission method no negative acknowledgements occur and error correction is performed by retransmission during idle periods of not yet acknowledged signal units.

The address information can be transmitted en bloc and in the overlap mode. Because the transmission speed of Signalling System No. 7 is considerably higher than that of channel-associated signalling systems, the influence of the mode of operation on the post-dialling delay is reduced substantially.

The signal capacity (including the spare codes) of Signalling System No. 7 is much higher than that of Signalling Systems No. 4, No. 5, R1 and R2.

Signalling System No. 7 contains signals for echo suppressor control as well as signals indicating whether a satellite link is already included in the connection.

Signalling System No. 7 can be used for all types of telephone circuits including those with speech interpolation.

Signalling System No. 7 can be used on satellite links.

References

- [1] CCITT Recommendation *Stability and echo*, Vol. III, Rec. G.131.
- [2] CCITT Recommendation *Echo cancellers*, Vol. III, Rec. G.165.
- [3] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s*, Vol. III, Rec. G.732.

Recommendation Q.8

SIGNALLING SYSTEMS TO BE USED FOR INTERNATIONAL MANUAL AND AUTOMATIC WORKING ON ANALOGUE LEASED CIRCUITS

The CCITT,

considering

(a) that standardization of signalling systems to be used for international manual and automatic working on analogue leased circuits brings advantages to Administrations, manufacturers and users;

(b) that manual and automatic operation of international leased circuits require different technical arrangements;

(c) that the standard signalling systems set out in Recommendation Q.7 are primarily intended for the public service;

(d) that the national circuit sections of international leased circuits may need to conform to local regulations of the Administration(s) concerned;

(e) that the method of signalling will be affected by the type of transmission and vice versa;

(f) that the method of signalling will be affected by the characteristics of the service(s) carried on the circuit;

recommends

that Administrations should use for manual international analogue leased circuits the standard signalling system specified in § 1 below;

and *draws the attention* of Administrations

to the guidance clauses and related annexes concerning automatic signalling on international analogue leased circuits, as set out in § 2 below.

1 Signalling on manual international analogue leased circuits

1.1 Signalling shall take place by the transmission of a single frequency signalling current, analogous to the signalling method used in the international manual service and specified in Recommendations Q.1 and Q.2.

1.2 The signalling current shall have a nominal frequency of either 2280 Hz or 2600 Hz. One of these frequencies shall be chosen for both directions of transmission by bilateral agreement between the Administrations concerned. Failing such an agreement, each Administration shall determine which of the two frequencies it wishes to receive.

1.3 The duration of the transmitted tone shall be between 300 ms and 2 seconds. The upper limit of 2 seconds allows the partial use of signalling equipment designed for 500/20 Hz working according to Recommendation Q.1.

1.4 The signal recognition time shall be between 100 ms and 200 ms:

- The minimum duration of 100 ms has been chosen so as to avoid the recognition of false signals due to imitation by speech currents;
- The maximum duration of 200 ms has been chosen so as to allow a safe margin between this time and the minimum transmission time.

Exceptionally, a maximum signal recognition time of 1200 ms may be used where it is known that the transmitted signal has a 2 second duration. Such arrangements allow the partial use of signalling equipment designed for 500/20 Hz working according to Recommendation Q.1.

1.5 Other technical clauses for 2280 Hz signalling are set out in Annex A to this Recommendation.

1.6 Other technical clauses for 2600 Hz signalling are set out in Annex B to this Recommendation.

2 Signalling on automatic international analogue leased circuits

2.1 This section refers to international analogue leased circuits employing automatic signalling. Such circuits are considered to form part of a private network extending across international frontiers and linking exchanges carrying out the switching function in a private network. The exchanges may be Private Automatic Branch Exchanges (PABXs), Private tandem exchanges, or switching equipments provided by the Administration to carry out switching functions in a private network. Where the exchanges are privately owned, part of the signalling function may be provided by the Administration.

This Recommendation does not cover the case of international leased circuits directly connecting subscriber lines to remote switching equipment. However, most of the following text is equally applicable to this case. Annex D, § D.3 and Annex E give further information on such signalling.

2.2 Many Administrations have regulations concerning the use of signalling frequencies on leased circuits and these may apply to international leased circuits also. These regulations are intended to ensure non-interference between parts of the voice spectrum used for signalling and those available for use by subscriber apparatus. This does not create exceptional difficulties for manual working since the frequencies used (2280 Hz, 2600 Hz) can be converted to other acceptable frequencies at the Terminal International Centre. However, for automatic circuits it should be the aim to provide an uninterrupted path between the ends of the leased circuit.

Some World regions have existing or proposed signalling systems which meet the regulatory arrangements in those regions and a summary of two such systems are given in Annexes C and D to this Recommendation. Administrations are invited to note these existing systems that may meet their needs for automatic signalling on analogue leased circuits.

2.3 In order to reduce the cost of providing leased circuits some inter-regional leased circuits may be provided with various forms of bandwidth economizing systems, such as speech interpolation systems and digital voice compression. These systems usually have their own internal digital signalling capability and these are not covered by this Recommendation, except that the effect that speech interpolation equipment has on analogue signalling is discussed.

2.4 In the most general case, the choice of signalling and transmission in a private network will be determined by the availability of suitable equipment, and by the decisions of the network user and the Administrations concerned. The following sections give guidance on transmission factors which affect signalling, the important characteristics of signalling systems which could affect the choice of transmission medium, and the interaction between signalling and non-voice services.

2.5 *Transmission factors*

2.5.1 Recommendations for the transmission characteristics of leased circuits forming part of a private telephone network are given in Recommendation G.171.

2.5.2 Where large groups of circuits are concerned and the transmission multiplex equipment is on the renter's premises, it is advisable to protect against the effects of faulty transmission on groups of circuits. Recommendation Q.33 gives details of such measures.

2.5.3 *Satellite systems*

- i) Some signalling systems will not function correctly over satellite links since the long propagation delay (270 ± 20 ms one way) exceeds that assumed by the line signalling specification. Amongst the standard systems for public telephony, Signalling System R2 incorporates special precautions because of this delay. In addition the speed of multi-frequency compelled interregister signalling is affected, which may cause undesirable post-dialling delay. If signalling systems based on R2 are used in private networks then reference should be made to information contained in Recommendations Q.7 and Q.400 to Q.490.
- ii) Consideration should be given to the possibility that two satellite links may, in some cases, need to be connected in tandem. Means to prevent this may also need to be considered. (Further information is contained in Recommendations E.171, G.131, Q.14 and Q.115.)
- iii) If satellite links via Time Division Multiple Access Systems with Digital Speech Interpolation (TDMA/DSI) are used, then guidance on circuit supervision signalling arrangements can be found in Recommendation Q.33. However, Digital Non-Interpolated (DNI) channels are usually assigned for leased circuits and these exhibit fewer problems for signalling.
- iv) If satellite links via Single Channel Per Carrier (SCPC) systems are used, then it should be noted that these systems employ voice activated carriers for telephony type circuits. On transmission systems of this type, the use of tone-on-idle signalling systems should be avoided, since such signalling systems would override the voice activation feature of SCPC systems.

2.5.4 *Echo control*

§ 9 of Recommendation G.171 should be observed concerning the location of echo control devices where these are required. All analogue channel associated signalling systems operate more effectively if the line signal receiver, and often the line signal sender also, are located on the line side of any echo control device. In addition, some signalling systems require echo control devices to be locally disabled during interregister signalling. For these reasons, the echo control device should be located at the private renter's premises and not the terminal international centre.

2.5.5 *Speech interpolation*

Some signalling systems may not be compatible with speech interpolation systems for the following reasons:

- i) Signalling systems employing continuous state tone signalling will cause permanent operation of the speech detectors and thus permanent trunk to channel association. This prevents the correct operation of the interpolation process.
- ii) The speech interpolation equipment may not be transparent to out-band signalling.

- iii) The speech interpolation equipment may cause excessive clipping of pulse signals resulting in their non-recognition by the distant signalling equipment.
- iv) The speech interpolation equipment may not provide sufficient speech detector hangover to allow the successful transmission of some signals, e.g. en bloc multi-frequency signals.

Information on the characteristics of some speech interpolation systems is given in Supplement No. 2 of Fascicle VI.1, though different systems may also be used on leased circuits.

In the case of continuous state tone signalling, compatibility with speech interpolation systems can be achieved by converting the tone signalling to interface with any in-built signalling capability the system may provide. If the transmission difficulty only exists in the interregister signalling phase, then this can be obviated by the simultaneous transmission of a speech interpolation locking tone, e.g. 2800 Hz.

Note that fully compelled signalling techniques are compatible with speech interpolation systems.

2.6 *Characteristics of signalling systems*

2.6.1 *Line signalling systems*

Analogue line signalling systems can be divided into in-band and out-band systems. In addition, two signalling techniques may be employed: pulse signalling or continuous signalling.

Information on the comparative advantages of in-band and out-band systems can be found in Recommendation Q.20. General requirements for signalling equipment are contained in Recommendations Q.112 to Q.114.

i) *In-band systems*

According to Recommendation Q.22, signalling frequencies above 2000 Hz should be used (but see also §§ 2.7.1 and 2.7.2 below).

The preferred power level for in-band signalling is -9 dBm0 for pulsed signals and -20 dBm0 for continuous signals (also see Recommendation Q.16).

In-band systems require the use of a guarding characteristic to prevent false operation of the signalling equipment by speech currents. Even so, occasional receiver misoperation by speech can occur, and thus in the speech phase a suitable minimum signal recognition time should be chosen.

In-band systems require the use of splitting techniques in order to confine the signalling frequencies to the link concerned, and this has an impact on minimum signal recognition times. Further information can be found in Recommendation Q.25.

If the leased circuit contains a digital transmission system in the terminal national section and this connects directly to a renter's digital PABX using a first order PCM system, then the detection of in-band signalling requires digital filtering techniques.

ii) *Out-band systems*

Recommendation G.171 does not provide for the use of out-band signalling on leased circuits. Because of the frequencies used, out-band signalling requires the use of a transparent 4 kHz bandwidth between the two signalling equipments. Part of the signalling equipment is usually provided within the transmission equipment.

Nevertheless, where the required transmission facilities can be assured, out-band signalling may provide a useful alternative to in-band signalling. Preferred signalling frequencies and power levels for out-band signalling are set out in Recommendation Q.21.

iii) *Pulsed signalling*

Pulsed signalling allows a greater signal repertoire than continuous signalling, but requires more complex signal recognition arrangements. In general, the signalling tone is recognized by the signal receiver but requires persistence checking and correlation with the circuit state before the signal is validated.

iv) *Continuous signalling*

Usually continuous signalling is arranged to operate with “*tone-on-idle*”. Such systems have the inherent advantage of allowing immediate identification of circuit availability.

Since only two signal states are available in each direction, the possible signal repertoire is lower than pulsed systems, but recognition arrangements are simpler. A single persistence timing is usually provided to validate changes of signalling state.

Where continuous in-band signalling uses the “*tone-on*” condition after the interregister signalling phase, means must be provided to prevent the calling or called parties from hearing the signalling tone without undue interference to the transmission of speech currents and tones. A band stop filter as used in Signalling System R1 (see Recommendation Q.313, § 2.3.4) may be suitable. Alternatively, to obviate these difficulties, pulsed signalling could be used in the speech phase.

2.6.2 *Interregister signalling*

The following types of interregister signalling may be suitable for use on leased circuits:

i) *Decadic signalling*

Signalling takes place using the same frequency and sender/receiver equipment as the line signalling. Forward signals are composed of a sequence of tone pulses analogous to subscriber line signalling employing rotary dials. Backward signals may not always be provided, but *proceed-to-send* and *address complete* signals can be used to advantage.

ii) *Multi-frequency signalling*

Multi-frequency (MF) signalling has the advantage of greater speed and signal repertoire than decadic systems. To provide both an adequate repertoire and signalling reliability, signals are composed of two frequencies from a set of 4, 5, 6 or 8 frequencies. Different frequencies may be used for signalling in the backward direction. The frequencies used for MF signalling should lie below 2000 Hz in order that they do not interfere with in-band line signalling.

MF systems may transmit signals in pulse form, or in a compelled sequence with signals in the opposite direction. The preferred signal power level is -9 dBm0 for each constituent tone.

Three existing MF systems may be suitable as the basis for signalling on leased circuits. These are:

- 1) The dual tone multi-frequency system as specified in Recommendation Q.23 and modified to act as an interregister signalling system. (Recommendation Q.24 also refers.)
- 2) Signalling System R1. See Recommendations Q.7 and Q.310 to Q.331.
- 3) Signalling System R2. See Recommendations Q.7 and Q.400 to Q.490.

2.6.3 *Overall signalling repertoire*

Consideration should be given to providing a set of signals capable of being adapted for different situations to provide a signal capability for extending the scope of PABX supplementary services to encompass the private network as a whole, and to provide other network facilities. This is best achieved by the inclusion in the signalling repertoire of a set of auxiliary signals that are separate from the basic call set-up and supervisory signals and can therefore be allocated in a flexible manner to the required function.

2.6.4 *Position of signalling equipment*

Normally all signalling equipment for automatic leased circuits will be located at the renter's premises. Some Administrations may wish or may be able to provide part of the signalling equipment at the Terminal National Centre or the Terminal International Centre. In these cases, suitable signalling arrangements need to be made to interconnect the exchange at the renter's premises with the remote elements of the signalling equipment. This will be determined by the Administration concerned. Any echo control device could in this case also be remote, but see Recommendation G.171, § 9.2.

2.7 *Interaction between signalling and non-voice services*

As well as normal speech transmission, leased circuits can be used to provide for other types of service (see Recommendation M.1015).

The most common types are:

- Voice-frequency telegraphy,
- Data transmission,
- Facsimile,
- Phototelegraphy.

Since these services use in-band frequencies, there is a possibility of interaction with signalling, and the following general guidance is given below.

2.7.1 *Voice-frequency telegraphy*

Where voice-frequency telegraphy is carried on a telephone-type leased circuit it will be by one of two methods:

- *Alternate use* (see Recommendation M.1015). The circuit is switched at both ends between the telephone equipment and the photo-telegraph equipment.
- Subdivision of the frequency band between telephone and telegraph services. (See Recommendation H.34.)

In the former case, the signalling equipment is disconnected during telegraph use and no interaction can take place. (Outgoing telephone circuits should be removed from service and blocked prior to service switching).

In the latter case, the in-band telephone signalling must be confined to frequencies below 2500 Hz since the attenuation at higher frequencies due to the separation filter cannot provide a reliable signalling path.

2.7.2 *Data transmission*

Data transmission systems for use over leased circuits are specified in Recommendations V.16, V.19 to V.23, V.26 and V.27. These systems do not interact with the Standard Systems for the following reasons:

- i) In most cases, the data carriers lie below 2000 Hz and thus below the range for voice frequency line signalling. However, when the carrier is modulated, energy may be present in the signalling band but false receiver operation is prevented by there being at all times a greater energy in the pass-band of the guard circuit.
- ii) In some cases, the carriers do lie in the signalling band above 2000 Hz, but with constant phase modulation the guard circuit will operate as outlined in i) above. In the case of 1200 bits/sec duplex transmission according to Recommendation V.22, a guard tone of 1800 Hz is required in order to ensure guard circuit operation.

For signalling systems on automatic leased circuits therefore, providing the signalling frequency is above 2000 Hz and that a guard circuit with a pass-band covering the common data carrier frequencies is used, no problems are foreseen with interaction.

In order that duplex data transmission can take place on circuits equipped with echo control devices, the data set will transmit a tone disabling signal with the following characteristics (see also Recommendation G.164).

2100 ± 15 Hz at a level of -12 ± 6 dBm0

Duration greater than 400 ms

In order that false operation of signalling equipment does not take place it is essential that the lowest possible operating frequency of the signalling receiver be above the highest possible tone disabling frequency. This requires that the lowest usable signalling frequency be higher than the 2000 Hz referred to above in § 2.6.1.

For example:

Highest tone disabling frequency	=	2115 Hz
Allowance for frequency deviation in channel	=	5 Hz
Margin of safety	=	30 Hz
Typical maximum receiver deviation for operation	=	75 Hz
Giving		2225 Hz

Thus on the basis of this example, frequencies above 2225 Hz should be suitable for signalling.

Since the tone disabling circuit of echo control devices may respond in the range 1900-2350 Hz, the unintentional disabling of echo control devices may occur during signalling if this frequency range is used. However, this is not considered detrimental since the echo control device serves no essential function during the time when signalling tones are present on the circuit.

2.7.3 Facsimile

Facsimile apparatus for use on telephone circuits are specified in Recommendation T.2, T.3 and T.4. Recommendation T.10 also refers.

i) Group 1 apparatus (Recommendation T.2)

Since leased circuits in an automatic private network form part of a switched connection, the centre frequency f_0 should be 1700 Hz as used on the public switched network. This implies, for frequency modulation, a transmitted frequency between 1300 Hz (white) and 2100 Hz (black). With a maximum frequency deviation of 32 Hz, and by analogy with the calculations in § 2.7.2 above, frequencies above 2242 Hz should be suitable for signalling. This must be carefully observed since facsimile transmission may result in a single tone for a significant period, and without energy in the pass-band of the guard circuit.

ii) Group 2 apparatus (Recommendation T.3)

The transmission method for Group 2 machines uses vestigial sideband amplitude modulation. The 2100 Hz carrier frequency is permanently modulated and the effect of this and the vestigial sideband filter is such that the energy spectrum of the transmitted signal is biased towards frequencies in the pass-band of the guard circuit and receiver misoperation should not occur.

iii) Group 3 apparatus (Recommendation T.4)

The transmission method for Group 3 machines uses the data transmission method of Recommendation V.27 *ter* or V.29. False operation should not occur for the reasons described in § 2.7.2 above.

2.7.4 Phototelegraphy

For Phototelegraphy on leased circuits, Recommendations T.1 and T.11 apply.

The transmitted centre frequency is 1900 Hz with deviation (in the case of frequency modulation) from 1500 Hz (white) to 2300 Hz (black). For amplitude modulated systems the carrier may be between 1300 and 1900 Hz.

In many cases a phototelegraph circuit is derived by *alternate use* where the telephone signalling equipment is disconnected. However, where automatic switching of phototelegraph circuits is required, the guidance of Recommendation T.11, § 3.2 applies; that is, a guard tone (*blocking signal*) should be transmitted in order to prevent false receiver operation on single-frequency signalling systems.

2.7.5 Interference of service signals

With the systems referred to in §§ 2.7.1-2.7.4 above, the precautions included to prevent false recognition of service signals will usually be reliable. However, where the precautions are dependent on the statistical probability of the transmitted power spectrum operating the guard circuit, there is always a small risk of receiver operation for very short periods (in a similar fashion to the occasional false operation by speech). It should be noted that if such operation persists long enough, then the receiver splitting function will operate and thus cause a discontinuity in the service signal. This should be borne in mind when deciding the minimum receiver splitting time. In the call connected phase it is advisable that the minimum tone recognition time for a valid signal should be chosen such that occasional short receiver operation does not cause a change of signalling state.

Technical clauses for 2280 Hz signalling on manual circuits**A.1 Signal sender****A.1.1 Signalling frequency**

2280 ± 5 Hz.

A.1.2 Transmitted signal level

-13 ± 1 dBm0.

The permissible noise level measured at the output of the signal sender shall be as low as practicable, but in any event at least 35 dB below signal level.

The level of leak current transmitted to line should be at least 50 dB below signal level.

A.2 Signal receiver**A.2.1 Operating limits**

The signal receiver must operate satisfactorily if a signal is received satisfying the following conditions:

- a) the frequency received is within 2280 ± 15 Hz;
- b) the absolute power level N of each unmodulated signal shall be within the limits $(-19 + n \leq N \leq -7 + n)$ dBm where n is the relative power level at the receiver input.

The limits give a margin of ± 6 dB on the nominal absolute power level of the 2280 Hz signal received at the receiver input, to allow for variations in transmission conditions on the international circuits.

A.2.2 Non-operate conditions**a) Selectivity**

The signal receiver shall not operate on a signal having an absolute power level at the receiving end within the limits specified in § 2.1 b) when the frequency is outside: 2280 ± 75 Hz.

b) Maximum sensitivity of the signal receiver

The signal receiver shall not operate on a signal in the range 2280 ± 15 Hz whose absolute power level at the point of connection of the receiver is $(-29 - 13 + n)$ dBm, n being the relative power level at this point.

A.2.3 Guard circuit**A.2.3.1 Efficiency of the guard circuit**

The signal receiver must be protected by a guard circuit against false operation due to speech currents, circuit noise, or other currents of miscellaneous origin circulating in the line.

The purpose of the guard circuit is to prevent signal imitation, and operation of the splitting device by interfering speech.

To minimize signal imitation by speech current it is advisable that the guard circuit be tuned as follows:

To minimize signal interference by low-frequency noise it is advisable that the response of the guard circuit falls off towards the lower frequencies and that the sensitivity of the guard circuit at 200 Hz is at least 10 dB less than at 1000 Hz.

An indication of the efficiency of the guard circuit is given by the following:

- a) during 10 hours of speech, normal speech currents should not, on average, cause more than one false operation of the receiver lasting more than the minimum recognition time of the signal;
- b) the number of false splits of the speech path caused by speech currents should not cause an appreciable reduction in the transmission quality of the circuit.

A.2.3.2 *Guard circuit limits*

Considering:

- a) that unweighted noise of a level -40 dBm0 and uniform spectrum energy may arise on the longest international circuit;
- b) that an oversensitive guard circuit might give rise to signalling difficulties.

It is recommended that, the guard circuit shall not operate in the presence of noise at a level of less than -35 dBm0 and uniform spectral energy over the frequency range 300-3400 Hz.

A.3 *Splitting arrangements*

Sending and receiving line splitting shall be provided.

A.3.1 *Sending line split*

- a) the sending line transmission path of the signalling termination shall be disconnected 30-50 ms before a voice-frequency signal is sent over the circuit;
- b) the sending line transmission path of the signalling termination will not be reconnected for 30-50 ms following the end of the sending of a voice-frequency signal over the circuit.

A.3.2 *Receiving line split*

- a) the receiving line transmission path of the signalling termination shall be split when the 2280 Hz signal is received. The splitting time should be less than 20 ms;
- b) the split must be maintained for the duration of the signal but must cease within 25 ms of the cessation of the 2280 Hz signal;
- c) the splitting device may be any suitable arrangement for example, physical line disconnection, insertion of a bandstop filter, etc. The level of leak current transmitted to the subsequent circuit should be at least 40 dB below the received signal level.

ANNEX B

(to Recommendation Q.8)

Technical clauses for 2600 Hz signalling on manual circuits

B.1 *Signalling sender*

B.1.1 *Signalling frequency*

2600 $\pm$ 5 Hz.

B.1.2 *Transmitted signal level*

The transmitted signal level shall be -8 ± 1 dBm0 for the duration of the signal or for a minimum of 300 ms (whichever is shorter) and for a maximum of 550 ms after which the level of the signal shall be reduced to -20 ± 1 dBm0.

B.1.3 *Signal frequency leak*

The level of signal frequency leak power transmitted to the line should not exceed -70 dBm0, during the tone-off condition.

B.1.4 *Extraneous frequency components*

The total extraneous frequency components accompanying a tone signal should be at least 35 dB below the fundamental signal power.

B.1.5 *Sending line split*

The following splitting arrangements are required when transmitting line signals to prevent incorrect operation of the receiving equipment:

- a) when a tone-on signal is to be transmitted, the sending line transmission path shall be split, within an interval from 20 ms before, to 5 ms after tone is applied to the line, and remain split for a minimum of 350 ms and a maximum of 750 ms;
- b) when a tone-off signal is to be transmitted, the sending line transmission path shall be split, within an interval from 20 ms before, to 5 ms after tone is removed from the line, and remain split for a minimum of 75 ms and a maximum of 160 ms after the tone is removed.

Further details are given in § 2.2.6 of Recommendation Q.313.

B.2 *Signal receiver*

B.2.1 *Operating limits*

The receiving equipment shall operate on a received tone signal that meets the conditions listed below:

- a) 2600 ± 15 Hz;
- b) to ensure proper operation in the presence of noise, the signal level of the initial portion of each tone-on signal is augmented by 12 dB. The absolute power level of the signal shall be within the limits $(-27 + n \leq N \leq -1 + n)$ dBm where n is the relative power level at the input to the receiving equipment.

B.2.2 *Non-operate limits*

- a) The receiving equipment shall neither operate on signals originating from subscriber stations (or other sources) if the total power in the band from 800 Hz to 2450 Hz equals or exceeds the total power present at the same time in the band from 2450 Hz to 2750 Hz as measured at the station, nor degrade these signals.
- b) The receiving equipment shall not operate on any tone or signal whose absolute power level at the point of connection of the receiving equipment is $(-17 - 20 + n)$ dBm or less, n being the relative power level at this point.

On average during 10 hours of speech, normal speech currents should not cause more than one operation lasting more than 50 ms.

B.2.3 *Receiving line split*

To prevent line signals of the signalling system from causing disturbances to signalling systems on subsequent circuit sections, the receiving line transmission path should be split when the signal frequency is received to ensure that no portion of any signal exceeding 20 ms duration may pass out of the circuit section.

This should be achieved by use of a bandstop filter in which case the level of signal leak current transmitted to the subsequent circuit section with the bandstop filter inserted should be at least 35 dB below the received signal level. In addition, the bandstop filter must not introduce more than 5 dB loss at frequencies 200 Hz or more above or below the midband frequency nor more than 0.5 dB loss at frequencies 400 Hz or more above or below the midband frequency.

The receiving line split must be maintained for the duration of the incoming tone signal, but must cease within 300 ms of tone removal.

Note — In some existing designs, the initial cut may be a physical line disconnection but the filter must be inserted within 100 ms of tone reception.

(to Recommendation Q.8)

The standard European inter-PABX signalling system**C.1 Introduction**

Recognizing the increasing use of leased lines between private automatic branch exchanges (PABXs) in the European telecommunication networks, a specification has been developed covering the need for signalling on such lines. The system emerged is called Signalling System L1. Distinction is made between line signalling (call supervisory signals) and interregister signalling (set-up including routing and additional service control). Taking into account different applications, existing interregister signalling techniques have been adopted for use with the basic line signalling as follows:

- decadic pulsing (DP);
- multi-frequency pushbutton (MFPB) type signalling;
- System R2 multi-frequency code (MFC) type signalling.

C.2 Principles and field of application

C.2.1 The line signalling system is to provide automatic and semi-automatic working between PABXs in different countries.

C.2.2 The signalling system is a single voice frequency (1 vf) tone-on-idle line signalling system using a signalling frequency of 2280 Hz. The use of voice frequency signals renders the system suitable for all voice transmission media, except those using speech interpolation.

C.2.3 The system is intended for use on bothway inter-PABX circuits, with first party clearing.

C.2.4 Either decadic pulsing or multi-frequency interregister signalling may be used with the line signalling system. The provision of particular line signals will depend upon the requirements of the associated interregister signalling system.

C.2.5 The system operates on a four-wire basis, forward and backward signals being segregated by utilizing the four-wire circuits as two separate signalling paths.

C.2.6 In addition to the application or removal of signalling frequency (tone-on and tone-off) in continuous form, the transmission of pulses of signalling frequency is applied.

C.2.7 When in the idle condition, the signalling frequency applied to the line is reduced in power level to conform to the transmission loading requirements of Recommendation Q.15.

C.2.8 The line signalling operates on a link-by-link basis and may be used to establish a multi-link tandem connection using one or more private automatic exchange(s) as a transit switch. In accordance with Recommendation Q.25 sending line and receiving line splitting arrangements are provided so that signals are contained within the appropriate link and are not allowed to spill over into subsequent or preceding links.

C.3 Line signal conditions and signalling codes

C.3.1 The line signal conditions and the signalling codes shall be as shown in Table C-1/Q.8. Signal sending and detection requirements are given in §§ C.3.2 and C.3.3.

C.3.2 A continuous tone-on condition shall be the application of the signalling frequency to the send signalling path for a period exceeding 300 ms.

A tone-on pulse signal shall be the application of the signalling frequency to the send signalling path for a period of 45-135 ms. A continuous tone-off condition shall exist when any signalling frequency is absent from the send signalling path for a period exceeding 80 ms.

TABLE C-1/Q.8

Line signal conditions and signalling codes

Signal	From outgoing PABX	From incoming PABX
Idle	Continuous tone-on	Continuous tone-on
Seizing	Continuous tone-off	Continuous tone-on
Seizing-acknowledgement or Proceed-to-send	Continuous tone-off	Continuous tone-off
Answer	Continuous tone-off	Single tone-on pulse
Clear-forward	Continuous tone-on	Continuous tone-on or tone-off
Clear-back	Continuous tone-off	Continuous tone-on

C.3.3 A tone-on condition applied to the receive signalling path PABX termination may be recognized as a continuous tone-on condition for signalling when it has persisted for 150 ms, while for a tone-off condition a value of 40 ms has to be taken into account.

A tone-on condition applied to the receive signalling path PABX termination and persisting for 35-150 ms, followed by a tone-off condition longer than 200 ms, may be recognized as a pulse tone-on signal.

C.4 *Line signalling transmission requirements*

C.4.1 *Signal sender*

C.4.1.1 The signalling tone shall be at a frequency of 2280 ± 5 Hz.

C.4.1.2 The tone-on condition shall have two power levels: a high level and a low level.

A high level tone shall be sent for the duration of the signal or for a minimum of 300 ms (whichever is shorter) and for a maximum of 550 ms after which it must be reduced to low level.

- A high level tone-on condition shall be a signalling tone transmitted at a level of $-10 \text{ dBm}_0 \pm 1 \text{ dB}$.
- A low level tone-on condition shall be a signalling tone transmitted at a level of $-20 \text{ dBm}_0 \pm 1 \text{ dB}$.

C.4.2 *Signal receiver*

C.4.2.1 A frequency within the range 2280 ± 15 Hz at an absolute level N , within the range $(-30 + n \leq N \leq -4 + n) \text{ dBm}$, shall be recognized as a tone-on condition; where n is the relative power level at the receive signalling path PABX termination (see Recommendation G.171).

C.4.2.2 Any frequency or combination of frequencies having a total absolute power level or less than $(-40 + n) \text{ dBm}$ shall be recognized as a tone-off condition; where n is the relative power level at the receive signalling path PABX termination as in § C.4.2.1.

C.5 *General line signal transfer procedures*

C.5.1 Depending upon the capabilities of the incoming PABX, recognition of the seizing signal will initiate either proceed-to-send or seizing acknowledgement. The sending of the latter signal does not imply that the incoming PABX is ready to receive address information.

C.5.2 Some PABXs do not use the answer signal, others require it for correct operation. Therefore the answer signal is optional and subject to mutual agreement.

C.5.3 A continuous tone-on signal shall be applied when, after recognition of a seizing signal, no address or incomplete address information is received and the incoming PABX times-out.

A continuous tone-on signal may be applied when an incoming PABX encounters congestion or an engaged extension.

C.6 *Decadic pulsing*

For decadic pulsing interregister signalling the 2280 Hz line signalling is used. Some characteristics are given below.

C.6.1 The break periods of dial pulses shall be applied to the send signalling path as pulses of tone-on condition within the following limits.

SPEED (pulses per sec.)	7		9		11		12	
BREAK PULSE								
DURATION (ms)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
	45	112	45	81	45	61	45	52

C.6.2 Pulses of tone-on condition applied to the receive signalling path PABX termination and consistent with the following speed and duration limits, are break periods of dial pulses (address signal).

SPEED (pulses per sec.)	7		9		11		12	
BREAK PULSE								
DURATION (ms)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
	35	122	35	91	35	71	35	62

ANNEX D

(to Recommendation Q.8)

A typical North American private analogue network signalling system

D.1 *Introduction*

D.1.1 A Private Switched Network is a common control switching arrangement which provides interconnections of subscriber locations via dedicated access lines and inter-exchange circuits and shared common control switching with the Public Switched Telephone Network. The Private Switched Networks are terminated at the subscriber location by directly-homed telephone sets, multi-line telephone systems or by main PBX or PABXs. This annex describes the signalling on a typical North American switched private network.

D.2 *General signalling applications*

D.2.1 The line signalling system provides for semi-automatic and automatic working between subscribers on the private network and the ability to go off network to the Public Switched Network.

D.2.2 In general, four-wire transmission links employing an in-band single frequency of 2600 Hz, tone-on-idle, are used on the inter-exchange circuits, directly-homed stations and PBX access lines.

D.2.3 Signalling on an inter-exchange circuit is in accordance with Recommendations Q.310 to Q.331 – System R1 signalling.

D.2.4 Either decadic pulsing (DP) or multi-frequency pushbutton is used for address signalling on access lines.

- D.2.5 Multi-frequency pushbutton signalling is in accordance with Recommendation Q.23. Q.24 also refers.
- D.2.6 Address signalling on inter-exchange circuits is multi-frequency (MF) using a combination of two out of six frequencies in accordance with Recommendations Q.320 to Q.326.
- D.2.7 Interregister signalling techniques are used for controlling outpulsing to accommodate different equipment designs and to improve register usage.

D.3 *Signalling on access lines*

- D.3.1 Either decadic pulsing (DP) or Multi-frequency Pushbutton (MFPB) is used on access lines for address signalling.
- D.3.2 Supervisory signalling may use either the single frequency 2600 Hz or direct current loop.
- D.3.3 Called party ringing is controlled by the terminating exchange or PABX in a conventional manner.

D.4 *Signalling on inter-exchange trunks*

- D.4.1 Supervisory signalling is single frequency 2600 Hz in accordance with Recommendations Q.310 to Q.313, Q.317 and Q.318.
- D.4.2 Register signalling uses multi-frequency (MF) signals consisting of two out of six frequencies in accordance with Recommendation Q.320.

D.5 *Decadic pulsing*

The decadic pulsing represents the numeric value of each digit by the number of on-hook intervals in a train of pulses.

- D.5.1 The general characteristics of decadic pulsing are shown below:

<i>Equipment</i>	<i>Pulsing Speed (PPS)</i>	<i>Percent Break (BK)</i>
Customer Dial	8-11 PPS	58-64 BK
10-PPS PBX	10 ± 0.3 PPS	62-66 BK
Sender Pulsing	10 ± 1 PPS	57-64 BK

D.6 *Multi-frequency pushbutton*

See Recommendations Q.11, Q.23 and Q.24. Signal combinations A-D are not usually used in North American private switched networks.

ANNEX E

(to Recommendation Q.8)

**The standard European signalling system for leased
circuits connecting subscribers to remote PABXs
and public exchanges**

E.1 *Introduction*

Recognizing the increasing use of leased lines for interconnection of telephone instruments and public exchanges or private automatic branch exchanges (PABXs) in the European telecommunication networks, a specification has been developed covering the need for signalling on such lines. The system emerged is called Signalling System L2. Distinction is made between line signalling (call supervisory signals) and interregister signalling (set-up including routing and additional service control). Taking into account different applications, existing interregister signalling techniques have been adopted for use with the basic line signalling as follows:

- decadic pulsing (DP);
- multi-frequency pushbutton (MFPB) type signalling.

E.2 Principles and fields of application

E.2.1 The line signalling system is to provide supervisory signals (e.g. loop signalling in one direction and ringing in the other) between a telephone instrument or its equivalent and a public exchange or PABX in different countries, via an extra long line.

E.2.2 For the purpose of description, this specification refers to an instrument signalling unit (ISU) and an exchange signalling unit (ESU).

E.2.3 The system is intended for use over four-wire circuits but, as an option for national use, it may be used over two-wire circuits. In the four-wire case, forward and backward signals are segregated by utilizing the four-wire circuit as two separate signalling paths.

E.2.4 The system is a single voice frequency (1 vf) line signalling system using a signalling frequency of:

- 2280 Hz in both directions on four-wire circuits;
- 2280 Hz in the direction ISU to ESU and 2400 Hz in the direction ESU to ISU on two-wire circuits (national).

The use of voice frequency signals renders the system suitable for all voice transmission media, except those using speech interpolation.

E.2.5 In addition to the application or removal of signalling frequency (tone-on and tone-off) in continuous form, the transmission of pulses of signalling frequency is applied.

E.2.6 When in the idle condition, the signalling frequency applied to the line by the ISU is reduced in power level to conform to the transmission loading requirements of Recommendation Q.15.

E.2.7 In accordance with Recommendation Q.25, sending and receiving line splitting arrangements are provided so that signals are contained within the ISU-ESU link and not allowed to spill over into the next link.

E.2.8 When making an outgoing call, a through speech path shall be provided in the direction ESU-ISU prior to the answered state.

E.2.9 Signals may be passed in the direction ISU to ESU while speech or audible indications are being received in the direction ESU to ISU.

E.3 Line signal conditions and signalling codes

E.3.1 The line signal conditions and the signalling codes shall be as shown in Tables E-1/Q.8 and E-2/Q.8. Signal sending and detection requirements are given in §§ E.3.2 and E.3.3.

TABLE E-1/Q.8

Calls originated by the telephone instrument

Signal	Conditions from ISU	Conditions from ESU
Idle	Continuous tone-on	Continuous tone-off
Seizing	Continuous tone-off	Continuous tone-off
Answer	Continuous tone-off	Tone-on pulse
Recall	Recall tone-on pulse	Continuous tone-off
Clear	Continuous tone-on	Continuous tone-off

TABLE E-2/Q.8

Calls from the exchange

Signal	Conditions from ESU	Conditions from ISU
Idle	Continuous tone-off	Continuous tone-on
Calling	Calling tone-on-pulse	Continuous tone-on
Answer	Continuous tone-off	Continuous tone-off
Recall	Continuous tone-off	Recall tone-on pulse
Clear	Continuous tone-off	Continuous tone-on

E.3.2 A continuous tone-on condition shall be the application of the signalling frequency to the send signalling path for a period exceeding 350 ms. A tone-on pulse signal shall be the application of the signalling frequency to the send signalling path for a period of 45-135 ms or 210-240 ms (see § E.5.2).

A continuous tone-off condition shall exist when any signalling frequency is absent from the send signalling path for a period exceeding 80 ms.

E.3.3 A tone-on condition applied to the receive signalling path line termination may be recognized as a continuous tone-on condition for signalling, when it has persisted for 250 ms, while for a tone-off condition a value of 40 ms has to be taken into account.

A tone-on condition applied to the receive signalling path line termination, and persisting for a period of 35-150 ms or 200-250 ms (see § E.5.2) may be recognized as a tone-on pulse signal.

E.4 *Line signalling transmission requirements*

E.4.1 *Signal sender*

E.4.1.1 The signalling tone shall be at a frequency of 2280 (2400 Hz in the ESU for two-wire working) ± 5 Hz.

E.4.1.2 The tone-on condition shall have two power levels: a high level and a low level.

A high level tone shall be sent for the duration of the signal or for a minimum of 300 ms (whichever is shorter), and for a maximum of 550 ms after which it must be reduced to low level.

- A high level tone-on condition shall be a signalling tone transmitted at a level of $-10 \text{ dBm}_0 \pm 1 \text{ dB}$.
- A low level tone-on condition shall be a signalling tone transmitted at a level of $-20 \text{ dBm}_0 \pm 1 \text{ dB}$.

E.4.2 *Signal receiver*

E.4.2.1 A frequency within the range 2280 (2400 Hz in the ISU for two-wire working) ± 15 Hz at an absolute level N , within the range $(-30 + n \leq N \leq -4 + n) \text{ dBm}$ shall be recognized as a tone-on condition; where n is the relative power level at the receive signalling path line termination (see Recommendation G.171).

E.4.2.2 Any frequency or combination of frequencies having a total absolute power level of less than $(-40 + n) \text{ dBm}$ shall be recognized as a tone-off condition; where n is the relative power level at the receive signalling path line termination as in § E.4.2.1.

E.5 *General line signal transfer procedures*

E.5.1 The calling signal is a series of tone-on pulses with a duration of each pulse according to the length of the original ringing pulse and in step with the period of the ringing signal.

E.5.2 As an option and subject to mutual agreement by the parties involved, the ISU applies a recall signal in the form of a tone-on pulse to the signalling path.

 The length of tone-on pulse applied by the ISU depends upon the type of recall employed by the associated telephone, e.g. timed break or earthed loop.

E.5.3 As an option and subject to mutual agreement by the parties involved, the answer signal is sent by the ESU.

E.6 *Decadic pulsing*

 For decadic pulsing interregister signalling, the 2280 Hz line signalling is used. Some characteristics are given below.

E.6.1 The break periods of decadic pulses shall be applied to the send signalling path of the ISU, as pulses of tone-on condition within the following limits.

SPEED (pulses per sec.)								
BREAK PULSE	7		9		11		12	
DURATION (ms)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
	45	112	45	81	45	61	45	52

E.6.2 Pulses of tone-on condition applied to the receive signalling path line termination of the ESU, consistent with the following speed and duration limits, are break periods of dial pulses (address signal).

SPEED (pulses per sec.)								
BREAK PULSE	7		9		11		12	
DURATION (ms)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
	35	122	35	91	35	71	35	62

Recommendation Q.9

VOCABULARY OF SWITCHING AND SIGNALLING TERMS

(Geneva, 1980; Malaga-Torremolinos, 1984)

1 This Recommendation provides a vocabulary of terms and definitions which have been studied for application in documentation on switching and signalling in telephone networks. The possible evolution toward integrated digital networks and integrated services digital networks has been taken into account.

2 The terms are grouped in sections and within each section terms belonging to the same area of concepts are assembled. While such grouping in logical order may ease overview, it was not established according to firm principles and arbitrary placing of certain terms was accepted.

3 Part of the terms and definitions in this Recommendation also are contained in specialized glossaries which are attached to certain Recommendations of the G, Q and Z Series. Care has been taken then that identical texts appear in both the Recommendation and the glossary.

CONTENTS

- 0 – General terms (basic terms and terms common to several of the areas covered by the following sections)
- 1 – Switching functions and techniques
- 2 – Signalling functions and techniques
- 3 – Control functions
- 4 – Interface functions (machine-machine)
- 5 – Equipment and hardware
- 6 – Executive software
- 7 – Spare
- 8 – Mobile station networks
- 9 – Telephone subscriber's equipment and local lines (still to be prepared)

Alphabetical list of terms defined in this Recommendation.

According to the conventions applied in the lists, indications in round brackets are qualifiers or alternative terms in general use in addition to the principal term.

Examples: **call** (in software)

exchange (switching exchange, switching centre)

Terms in square brackets are deprecated.

The indication (*USA*) after a term in English means that the term is used in the United States, and is different from that current in the United Kingdom. The indication (*UK*) means the reverse.

A number (1) or (2) after a term indicates that more than one definition is given (when the term acquires another meaning depending on the context).

Cross-references to the sources in §§ 1 to 9 are given, where of interest, at the right-hand side of the line following the end of a definition.

Sources quoted are ISO, Recommendation G.702 [1], *List of Essential Telecommunication Terms* [2], the International Electrotechnical Vocabulary (IEV), Recommendations E.100 and E.600 [3]. The name of ISO and Recommendation G.702 are expressly mentioned each time along with a number; the terms derived from the "List of Essential Telecommunications Terms" and Supplement No. 7 give only a four digit number. The four digit number from E Recommendations [3] is preceded by the designation "Study Group II". Numbers beginning with 714 ... refer to Chapter 714 (Switching) of IEV.

0 General terms

General terms and definitions as shown in § 0 have in many cases not been elaborated by Study Group XI. However, they need to be used in certain definitions for which the Study Group is responsible. A cross-reference to the source is given wherever possible. If no cross-reference is given, the term is quoted with the provisional meaning that Study Group XI adopted for it. Such definitions will be substituted by the definition of the competent body when available. It should be noted that the terms concerned will not necessarily be classified by the responsible body as "general" in the sense applied to § 0.

0001 communication (1)

F: communication (1)

S: comunicación (1)

Information transfer according to agreed conventions.

Note 1 – In the context of the present vocabulary, the ordinary dictionary meaning of the term is appropriate and sufficient.

Note 2 – The French term "communication" and the Spanish term "comunicación" have the current meaning given in this definition, but they also acquire a more specific meaning in telecommunication (see 0009, 0010 and 0011).

0002 **telecommunication**

F: télécommunication

S: telecomunicación

Any process that enables a correspondent to pass to one or more given correspondents (telegraphy or telephony), or possible correspondents (broadcasting), information of any nature delivered in any usable form (written or printed matter, fixed or moving pictures, words, music, visible or audible signals, signals controlling the functioning of mechanisms, etc.) by means of any electromagnetic system (electrical transmission by wire, radio transmission, optical transmission, etc., or a combination of such systems).

01.01

0003 **network, telecommunication network**

F: réseau, réseau de télécommunications

S: red, red de telecomunicaciones

A set of nodes and links that provides connections between two or more defined points to accommodate telecommunication between them.

0004 **integrated digital network**

F: réseau numérique intégré

S: red digital integrada

A network in which connections established by digital switching are used for the transmission of digital signals.

0005 **integrated digital network, digital network**

F: réseau numérique intégré, réseau numérique

S: red digital integrada, red digital

A combination of digital switching nodes and digital links that uses integrated digital transmission, digital switching and common channel signalling to provide digital connections between two or more points to facilitate telecommunication and possibly other functions.

0008 **channel**

F: voie

S: canal de transmisión

A means of unidirectional communication.

Note — Several channels may share a common carrier as in frequency division and time division systems; in these cases, each channel is allotted a particular frequency band or a particular time slot which is reserved for it.

0009 **call (1)**

F: appel (1)

S: llamada (1)

In an automatic system, the action performed by a calling party in order to obtain communication with the wanted terminal equipment and by extension, the operations controlled by the action performed.

call (2)

F: communication (2)

S: comunicación (2)

The use, or the possible use, of a complete connection set up between a calling party and the called party or service (see Note 2 of 0001).

0010 (complete) connection in telecommunication

F: chaîne de connexion complète, (chemin de) communication

S: cadena de conexión completa, (camino de) comunicación

An association of transmission channels or circuits, switching and other functional units set up to provide means for a transfer of information between terminals in a telecommunication network.

Note 1 — A connection is the result of a switching operation.

Note 2 — A connection which allows an end-to-end communication, e.g. a conversation, may be called a “complete connection”.

Note 3 — The connection makes a communication possible but is not a communication.

0011 connection

F: chaîne de connexion

S: cadena de conexión

An association of transmission channels or circuits, switching and other functional units set up to provide a means for a transfer of information between two or more points in a telecommunication network.

0012 call attempt (1) (of a user)

F: (tentative d')appel (d'un usager)

S: tentativa de llamada (de un usuario) (1)

The sequence of operations made by a user of a telecommunication network to obtain another party or a service.

Note — Several call attempts may be required to establish a call.

0013 circuit, telecommunication circuit

F: circuit, circuit de télécommunications

S: circuito, circuito de telecomunicaciones

A combination of two transmission channels permitting bidirectional telecommunication between two points, to support a single call.

Note 1 — If the telecommunication is by nature unilateral, for example: long distance television transmission, the term “circuit” is sometimes used to designate the single channel providing the facility.

Note 2 — In telephony, use of the term “circuit” is generally limited to a telecommunication circuit with associated terminating equipment directly connecting two switching devices or exchanges.

Note 3 — A telecommunication circuit does not necessarily permit simultaneous transmission in both directions.

Note 4 — The “go” and “return” channels may be permanently associated together or may be selected from separate sets for association together throughout a call.

Note 5 — The term circuit may be preceded by other qualifiers than telecommunication e.g. telephone, digital, etc.

0015 telephone circuit

F: circuit téléphonique

S: circuito telefónico

A permanent electrical connection permitting the establishment of a telephone communication in both directions between two telephone exchanges.

02.06

0016 hypothetical reference circuit (nominal maximum circuit)

F: circuit fictif de référence

S: circuito ficticio de referencia

A hypothetical circuit having a defined length and a defined amount of terminal and intermediate equipment, these quantities being reasonably large but not extreme. Such a conception is of value in the study of certain characteristics (noise, for example) of long-distance circuits.

02.08

0019 (electric) circuit

F: circuit (électrique)

S: circuito (eléctrico)

A region of electrical action where such action takes place essentially along a path and can be uniquely specified in terms of time and a single dimension.

Note — In contradistinction, an “electric field” implies action which can only be specified uniquely in terms of time and two or three dimensions.

02.01 a)

0020 ... circuit (specific function)

F: circuit de ...

S: circuito de ...

Part of an installation forming (or able to form part of) an electric circuit traversed by a current having a definite function, specified in each case, (example: calling, speaking, feeding, etc. ...).

02.01 b)

0022 circuit group

F: faisceau de circuits

S: haz de circuitos

A group of circuits which are traffic-engineered as a unit.

0023 circuit sub-group

F: sous-faisceau de circuits

S: subhaz de circuitos

A number of circuits with similar characteristics (e.g. type of signalling, type of transmission path, etc.).

It is not engineered as a unit, but as a part of a circuit group. Circuit sub-groups are provided for reasons of service, protection, equipment limitation, maintenance, etc.

0026 path, telecommunication path

F: itinéraire, itinéraire de télécommunications

S: trayecto, trayecto de telecomunicación

The continuous course taken by a transmission signal between two points.

Note 1 — This may be a physical transmission medium, a frequency band in a frequency multiplex, a time slot in a time division multiplex, etc.

Note 2 — The path includes the transmission media and the means used for connecting them together.

0031 **link**

F: liaison

S: enlace

A telecommunication path with specified characteristics between two points.

0040 **signal** (general sense)

F: signal (sens général)

S: señal (sentido general)

Aggregate of waves propagated along a transmission channel and intended to act on a receiving unit.

Note — “General sense” applies only to the area of telecommunications. The ordinary dictionary sense is still wider, viz. “A preconcerted or intelligible sign conveying information or direction at a distance, a physical phenomenon or characteristic quantity of such a phenomenon whose time variations represent information, etc.

0041 **signal (in signalling applications)**

F: signal (applications concernant la signalisation)

S: señal (en aplicaciones de señalización)

A transferable element of information relating to a particular circuit, a particular transaction or to the network management.

Note 1 — A signal as defined above may be generated by a change of state.

Note 2 — A qualification may precede the term, e.g. “answer signal”. The qualification represents the name of the signal and generally refers to the kind of information the signal conveys or its main function. A great many of such qualifications are defined in standard signalling system’s specifications.

0042 **forward signal**

F: signal en avant

S: señal hacia adelante

A signal, used for the establishment, release or other control of a connection sent in the same direction as call set-up.

0046 **backward signal**

F: signal en arrière

S: señal hacia atrás

A signal, used for the establishment, release or other control of a connection, sent in the opposite direction to call set-up.

The marks in the margin indicate amendments agreed by the meeting.

0050 **subscriber’s line**

F: ligne d’abonné

S: línea de abonado

The telephone line connecting the exchange to the subscriber’s station.

13.24

0060 **process** (in a data processing system)

F: processus (dans un traitement de l’information)

S: proceso (en un sistema de proceso de datos)

A course of events occurring according to an intended purpose or effect.

(10.01.03 in ISO/TC97/SC1/515, Nov. 75)

0063 **bidirectional**

F: bidirectionnel

S: bidireccional

A qualification which implies that the transmission of information occurs in both directions.

0064 **unidirectional**

F: unidirectionnel

S: unidireccional

A qualification which implies that the transmission of information always occurs in one direction.

0066 **space division**

F: répartition dans l'espace, répartition spatiale

S: división en el espacio

The separation in the space domain of a plurality of transmission channels between two points.

0067 **time division**

F: répartition dans le temps, répartition temporelle

S: división en el tiempo

The separation in the time domain of a plurality of transmission channels between two points.

0068 **frequency division**

F: répartition en fréquence, répartition fréquentielle

S: división de frecuencia

The separation in the frequency domain of a plurality of transmission channels between two points.

0069 **code division**

F: répartition en code

S: división en código

The separation of a plurality of transmission channels by using specific values of codes belonging to the same set.

0075 **flag**

F: fanion

S: bandera

The unique pattern on the signalling data link used to delimit a signal unit.

0105 **functional unit**

F: unité fonctionnelle

S: unidad funcional

An entity of hardware or software, or both, capable of accomplishing a special purpose.

ISO 10.01.01

0108 **traffic-carrying device**

F: organe de trafic

S: dispositivo de transmisión de tráfico

Functional unit used directly or indirectly during the establishment and sustaining of a connection.

0112 **(network) resource(s)**

F: ressource(s) (du réseau)

S: recurso(s) (de la red) (órgano de la red)

Means of supplying a want or a stock that can be drawn on. In context with the telecommunication network, in particular devices for sending recorded announcements, traffic service positions, network integrated data banks, etc.

0115 **software**

F: logiciel

S: soporte lógico

Computer programs, procedures, rules and any associated documentation concerned with the operation of a system.

0120 **processor**

F: processeur

S: procesador (unidad de proceso)

A device capable of performing systematic execution of operations upon data.

0122 **administrative processor**

F: processeur de gestion

S: procesador de gestión

A centralized *processor* for administrative purposes, e.g. billing, which serves several switching centres.

0124 **operation and maintenance centre processor**

F: processeur de centre d'exploitation et de maintenance

S: procesador de centro de explotación y mantenimiento

A centralized *processor* for operation and maintenance purposes which serves one or more switching centres.

0150 **route**

F: route

S: ruta

- a) the means of transmission (paths, links via wire, cable, radio) used or to be used for the set-up of permanent or switched connections between two locations;
- b) the way within a network followed or to be followed for the transmission of a message or the set-up of a call between two locations.

Note — Two or more routes may be used in tandem. The whole way between the end points then again is called route.

0151 **routing**

F: acheminement

S: encaminamiento

- a) the process of determining and using, in accordance with a set of rules, the route for the transmission of a message or the set-up of a call. The process ends when the message or the call has reached the destination location;
- b) a qualification implying the above process, e.g.:
 - call routing;
 - message routing;
 - traffic routing.

0205 **seizure**

F: prise

S: toma

A successful bid.

With "bid": a single attempt to obtain the service of a resource.

0208 **busy**

F: occupation

S: ocupado

Condition of a resource which is in use, following its seizure.

0209 **engaged test (UK); busy test (USA)**

F: test d'occupation

S: prueba de ocupación

An engaged test is a test made to find out whether or not certain facilities which may be desired, such as a subscriber's line or trunk, are available for use.

17.66

busy test

F: test d'occupation

S: prueba de ocupación

A procedure for determining whether a traffic carrying device is free and available for use.

0212 **release**

F: libération

S: liberación

The sequence of events which brings about the end of a busy state.

0215 **one-way**

F: à sens unique

S: en un solo sentido

A qualification applying to traffic which implies that the call set-ups always occur in one direction.

0216 **both-way**

F: à double sens

S: en ambos sentidos

A qualification applying to traffic which implies that the call set-ups occur in both directions.

Note — The amount of traffic flowing in the two directions is not necessarily equal either in the short term or in the long term.

0221 **random errors**

F: erreurs aléatoires

S: errores aleatorios

Errors distributed over the digital signal so that they can be considered statistically independent from each other.

0222 **error burst**

F: paquet d'erreurs

S: ráfaga de errores

A group of bits in which two successive erroneous bits are always separated by less than a given number (x) of correct bits. The number x should be specified when describing an error burst.

Note — The last erroneous bit in a burst and the first erroneous bit in the following burst are accordingly separated by x correct bits or more.

0225 **long-term bit error rate**

F: taux d'erreur à long terme sur les bits

S: tasa de errores en los bits a largo plazo

Bit error rate measured over a sufficiently long time period, e.g. one month.

0226 **medium-term bit error rate**

F: taux d'erreur à moyen terme sur les bits

S: tasa de errores en los bits a plazo medio

Bit error rate that can be encountered for relatively short time periods, e.g. some minutes, due to temporary malfunctions of, for example, transmission equipment.

0231 **pilot**

F: onde pilote

S: piloto

Sinusoidal signal transmitted over analogue FDM links for regulation and supervision purposes.

1 Switching functions and techniques

1001 **exchange (switching exchange, switching centre)**

F: centre — central (centre ou central de commutation)

S: central (central de conmutación, centro de conmutación)

An aggregate of traffic carrying devices, switching stages, controlling and signalling means at a network node that enables subscriber lines and/or other telecommunication circuits to be interconnected as required by individual callers. (See Figure 1/Q.9.)

1002 **local exchange [local central office]**

F: central urbain

S: central local

An exchange in which subscribers' lines terminate. (See Figure 1/Q.9.)

15.02

1004 **transit exchange [tandem exchange, tandem central office, tandem office]**

F: centre de transit

S: central de tránsito

An exchange used primarily as a switching point for traffic between other exchanges. (See Figure 1/Q.9.)

15.04

1005 combined local/transit exchange

F: centre mixte urbain et de transit

S: central combinada local/de tránsito

An exchange in which subscribers' lines terminate that also is used as a switching point for traffic between other exchanges. (See Figure 1/Q.9.)

1007 geographically distributed exchange [geographically dispersed exchange]

F: centre géographiquement dispersé

S: central geográficamente distribuida

An exchange where not all sub-systems such as switching stages and control means are at the same location. (See Figure 1/Q.9.)

1008 remotely controlled exchange

F: centre télécommandé

S: central controlada a distancia (central telecontrolada)

An exchange whose switching functions are wholly or partially controlled by a control unit or a processor in another location. (See Figure 1/Q.9.)

1010 digital exchange

F: centre numérique

S: central digital

An exchange that switches information in digital form through its switching devices.

1011 integrated services exchange

F: central avec intégration des services

S: central de servicios integrados

An exchange arranged to handle multiple services such as telephone and data using all or part of the switching, signalling and control devices in common.

1013 satellite exchange

F: centre satellite

S: central satélite

A local exchange on a low level of the network hierarchy which is associated to another exchange and with no route switching functions except those towards the associated higher level local exchange. A satellite exchange has normally the capability to connect locally subscribers' lines terminating in it. (See Figure 1/Q.9.)

1015 switching stage

F: étage de commutation

S: etapa de conmutación

An aggregate of switching devices constituting a subset of the switching network in an exchange and designed to operate as a single unit from a traffic handling point of view. (See Figure 1/Q.9.)

1016 remote switching stage

F: étage de commutation distant

S: etapa de conmutación distante

A switching stage associated with and controlled by an exchange in a different location. (See Figure 1/Q.9.)

1018 **exchange concentrator**

F: concentrateur de central

S: concentrador de central

A switching stage wherein a number of subscriber lines or inter-exchange circuits carrying relatively low traffic volumes can be through-connected to a few number of circuits carrying higher traffic volumes. (See Figure 1/Q.9.)

1019 **co-located exchange concentrator**

F: concentrateur de central local

S: concentrador de central local

A concentrator in the same location as the exchange that controls it and to which its higher traffic volume circuits are connected. (See Figure 1/Q.9.)

1020 **remote exchange concentrator**

F: concentrateur de central distant

S: concentrador de central distante

A concentrator located remotely from the exchange that controls it and to which its higher traffic volume circuits are connected. The switching stages comprised normally have no capability to directly interconnect subscriber lines terminating in that concentrator. (See Figure 1/Q.9.)

1025 **line concentrator (stand alone concentrator)**

F: concentrateur de lignes (concentrateur autonome)

S: concentrador de lineas (concentrador independiente)

A switching device which concentrates traffic from a number of circuits or subscribers' lines onto a smaller number of circuits to a parent local exchange, where a similar switching device deconcentrates the traffic to the original number of lines. In the case of subscribers' lines, the correspondence of the lines before concentration and after deconcentration must be maintained. The system is both-way working, i.e., traffic from the exchange is concentrated onto the same circuits and deconcentrated to the subscribers as well. (See Figure 1/Q.9.)

1030 **semi-automatic system**

F: système semi-automatique

S: sistema semiautomático

A system in which the calling subscriber's order is given to an operator who completes the call through automatic switches.

16.19

1031 **automatic system**

F: système automatique

S: sistema automático

A system in which the *switching* operations are performed by electrically controlled devices without the intervention of operators.

16.20

1105 **inlet**

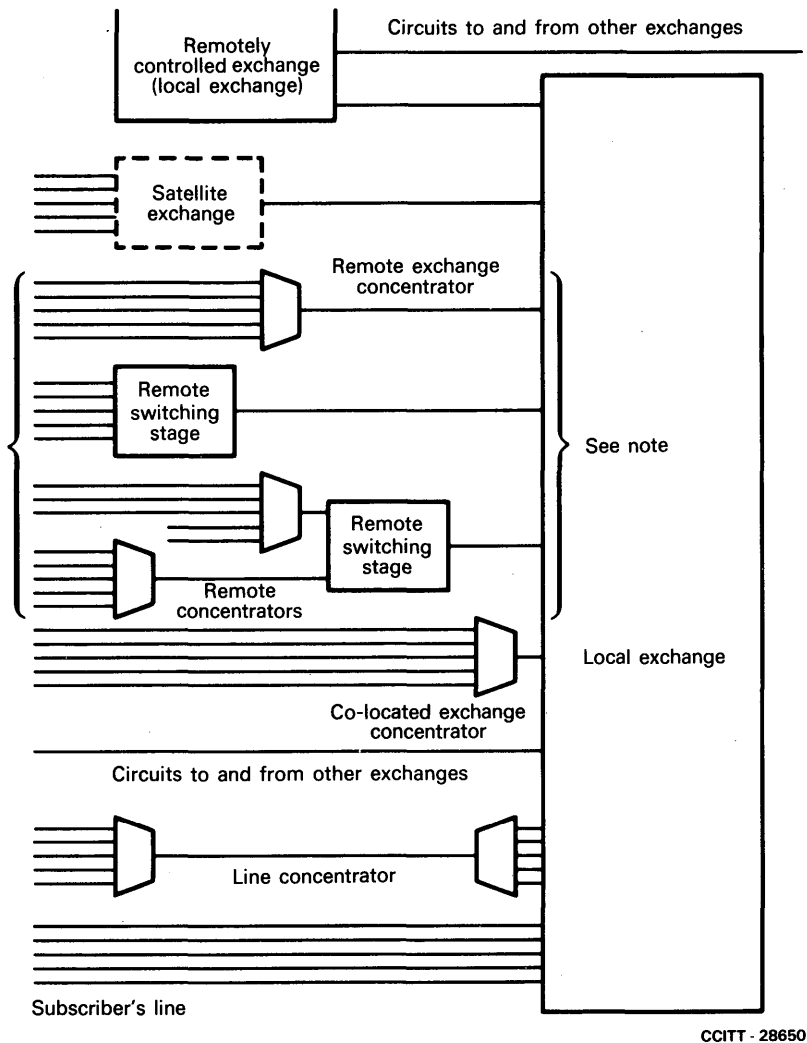
F: accès d'arrivée

S: entrada (en conmutación); acceso de entrada

Point through which the incoming traffic flow enters a switching stage.

F: accès de départ
S: salida (de conmutación); acceso de salida

Point through which the outgoing traffic flow leaves a switching stage.



Note – The brackets comprise the component parts of a geographically distributed exchange.

FIGURE 1/Q.9
Exchange and related terms

F: commutation
S: conmutación

- (1) The establishing, on demand, of an individual connection from a desired inlet to a desired outlet within a set of inlets and outlets for as long as is required for the transfer of information.
- (2) A qualification implying the action as defined above, e.g.:
- | | |
|---------------------|-------------------|
| switching centre | switching network |
| switching delay | switching node |
| switching device | switching point |
| switching equipment | switching system |
| switching exchange | switching unit |
| switching matrix | |

1111 switching node

F: nœud de commutation

S: nodo de conmutación

An interstitial point in a network where interconnection of required inlets and outlets may be undertaken.

1112 switching network

F: réseau de commutation

S: red de conexión

The switching stages of a telecommunication exchange taken collectively.

1113 switching matrix

F: matrice de commutation

S: matriz de conmutación

An array of crosspoints in a space division exchange which, from a traffic point of view, operates as a switch.

1115 selection stage

F: étage de sélection

S: etapa de selección

An aggregate of switches enabling an inlet to access one of a plurality of outlets and designed to operate as a single unit from a traffic handling point of view.

1117 concentration (in a switching stage)

F: concentration

S: concentración

A configuration wherein the number of inlets into the switching stage is larger than the number of outlets.

1118 expansion (in a switching stage)

F: expansion

S: expansión

A configuration wherein the number of inlets into the switching stage is smaller than the number of outlets.

1120 digital switching

F: commutation numérique

S: conmutación digital

A process in which connections are established by operations on digital signals without converting them to analogue signals.

1121 digital node, digital switching node

F: point nodal numérique, point nodal de commutation numérique

S: nodo digital, nodo de conmutación digital

A point at which digital switching occurs.

1122 digital circuit

F: circuit numérique

S: circuito digital

A circuit which transmits information signals in digital form between two exchanges. It includes termination equipment but not switching stages.

1125 circuit switching

F: commutation de circuits

S: conmutación de circuitos

The switching of circuits for the exclusive use of the connection for the duration of a call.

1126 space division switching

F: commutation par répartition dans l'espace (commutation spatiale)

S: conmutación por división en el espacio; conmutación espacial

The switching of inlets to outlets using space division techniques.

1127 time division switching

F: commutation par répartition dans le temps (commutation temporelle)

S: conmutación por división en el tiempo; conmutación temporal

The switching of inlets to outlets using time division (multiplexing) techniques.

1128 frequency division switching

F: commutation par répartition en fréquence

S: conmutación por división de frecuencia

The switching of inlets to outlets using frequency division (multiplexing) techniques.

1129 channel switching

F: commutation de voies

S: conmutación de canales

The switching of single channels for the exclusive use of the connection for the duration of a call.

1130 message switching

F: commutation de messages

S: conmutación de mensajes

The transfer of stored messages so as to minimize queue and idle times of traffic carrying devices.

1132 digital link

F: liaison numérique

S: enlace digital

A means of digital transmission with specified characteristics between two points.

1134 integrated digital transmission and switching

F: transmission et commutation numériques intégrées

S: transmisión y conmutación digitales integradas

The direct (digital) concatenation of digital transmission and digital switching, that maintains a continuous digital telecommunication path.

1135 digital connection

F: connexion numérique

S: conexión digital

An association of digital circuits, digital switches and other functional units providing means for the transfer of digitally encoded information signals between two terminal points.

1136 multislots connection

F: connexion à intervalles de temps multiples

S: conexión multiintervalo

Time slots associated with two or more digital circuits switched in parallel through a digital exchange for use on the same call to provide a wideband service.

1137 trombone (loop) connection

F: connexion en boucle

S: conexión en bucle

The use for a single call of two circuits in tandem between a remote switching stage and its controlling entity.

1138 semi-permanent connection

F: connexion semi-permanente

S: conexión semipermanente

A connection established part-time for the use of one user. At other times the connection may be released and available for use in handling traffic of the switched network.

1140 two-wire switching

F: commutation à deux fils

S: conmutación a dos hilos

Switching using the same path, frequency band or time interval for both directions of transmission.

1141 four-wire switching

F: commutation à quatre fils

S: conmutación a cuatro hilos

Switching using a separate path, frequency band or time interval for each direction of transmission.

1146 reentrant trunking

F: jonction réentrante

S: enlace reentrante

The routing of a circuit from outlet to inlet in a switching stage in order to access equipment associated with special services such as operators, auxiliary equipment, etc.

Note — Not to be confused with the action of mutual help where the purpose of re-entering the call is to attempt to reduce the probability of switching congestion on a given call by allowing a new possibility of choice of path from the new inlet to a trunk in the desired route.

1149 **multiple**

F: multiplage

S: múltiple

Interconnection of several inlets or outlets in a switching stage to the same traffic carrying device (e.g. other switching stage or circuit).

1205 **crossbar system**

F: système automatique "crossbar"

S: sistema de barras cruzadas

An automatic switching system in which the selecting mechanisms are *crossbar switches*.

16.26

1206 **junctor** (in the crossbar system)

F: joncteur

S: conector

In crossbar systems, a junctor is a circuit extending between frames of a switching unit and terminating in a switching device on each frame.

15.68

1207 **link** (in the crossbar system)

F: maillon

S: enlace; conexión interna

A link is a circuit extending between the primary and secondary selectors of a selection stage.

15.69

1210 **register**

F: enregistreur

S: registrador

The apparatus, in an automatic system, which receives the dialled impulses and controls the subsequent switching operations.

15.56

1212 **translation**

F: traduction

S: traducción

In automatic telephony: the retransmission of received trains of impulses after changing the number of impulses in each train and/or changing the number of trains.

15.58

1213 **translator**

F: traducteur

S: traductor

In automatic telephony: a device used for the *translation* of trains of impulses.

15.57

1305 (time division) highway (in switching); bus (USA)

F: canal (à multiplexage dans le temps)

S: canal principal (por división en el tiempo) (en conmutación)

A common path within an apparatus or station over which signals from a plurality of channels pass, separated by time division.

1310 character signal

F: signal de caractère

S: señal de carácter

A set of signal elements representing a character, or in PCM representing the quantized value of a sample.

Note — In PCM, the term “PCM word” may be used in this sense.

1315 cross-exchange check (cross-office)

F: vérification du trajet dans le central

S: verificación a través de la central

A check made across the exchange to verify that a speech path exists.

1318 in-call

F: communication en cours

S: en comunicación

A call in progress, initial switching at a given exchange having been completed.

1319 in-call rearrangement

F: remaniement des liaisons pendant la communication

S: reestructuración en comunicación

Reassignment of the switched path of an in-call during the call.

1330 channel gate

F: porte de voie

S: puerta de canal

A device for connecting a channel to a highway, or a highway to a channel, at specified times.

1331 primary block; digroup (USA)

F: bloc primaire

S: bloque primario

A basic group of PCM channels assembled by time division multiplexing.

Note — The following conventions could be useful:

Primary block μ — a basic group of PCM channels derived from 1544 kbit/s PCM multiplex equipment.

Primary block A — a basic group of PCM channels derived from 2048 kbit/s PCM multiplex equipment.

1332 frame

F: trame

S: trama

A set of consecutive digit time slots in which the position of each digit time slot can be identified by reference to a frame alignment signal.

The frame alignment signal does not necessarily occur, in whole or in part, in each frame.

1333 **multiframe**

F: multitrane

S: multitrana

A set of consecutive frames in which the position of each frame can be identified by reference to a multiframe alignment signal.

The multiframe alignment signal does not necessarily occur, in whole or in part, in each multiframe.

1334 **subframe**

F: secteur de trame — sous-trame

S: subtrama

A sequence of noncontiguous sets of digits assembled within a frame, each set occurring at n times the frame repetition rate where n is an integer > 1 .

1335 **parallel to serial converter; serializer (USA) [dynamicizer]**

F: convertisseur parallèle/série

S: convertidor paralelo/serie

A device that converts a group of digits, all of which are presented simultaneously, into a corresponding sequence of signal elements.

1336 **serial to parallel converter; deserializer (USA) [staticizer]**

F: convertisseur série/parallèle

S: convertidor serie/paralelo

A device which converts a sequence of signal elements into a corresponding group of digits, all of which are presented simultaneously.

1405 **frame alignment**

F: verrouillage de trame

S: alineación de trama

The state in which the frame of the receiving equipment is correctly phased with respect to that of the received signal.

1406 **frame alignment signal**

F: signal de verrouillage de trame

S: señal de alineación de trama

The distinctive signal used to secure frame alignment; this signal does not necessarily occur, in whole or in part, in each frame.

1407 **bunched frame alignment signal**

F: signal de verrouillage de trame concentré

S: señal de alineación de trama concentrada

A frame alignment signal in which the signal elements occupy consecutive digit time slots.

1408 **distributed frame alignment signal**

F: signal de verrouillage de trame réparti

S: señal de alineación de trama distribuida

A frame alignment signal in which the signal elements occupy non-consecutive digit time slots.

1409 frame alignment recovery time

F: temps de reprise du verrouillage de trame

S: tiempo de recuperación de la alineación de trama

The time that elapses between a valid frame alignment signal being available at the receive terminal equipment and frame alignment being established.

Note — The frame alignment recovery time includes the time required for replicated verification of the validity of the frame alignment signal.

1410 out-of-frame alignment time

F: durée de perte du verrouillage de trame

S: duración de la pérdida de alineación de trama

The time during which frame alignment is effectively lost. That time will include the time to detect loss of frame alignment and the alignment recovery time.

1414 time slot

F: intervalle de temps

S: intervalo de tiempo

Any cyclic time interval that can be recognized and defined uniquely.

1415 channel time slot

F: intervalle de temps de voie

S: intervalo de tiempo de canal

A time slot starting at a particular phase in a frame and allocated to a channel for transmitting a character signal and possibly in-slot signalling or other information.

Note — Where appropriate a description may be added, for example “telephone channel time slot”.

1416 signalling time slot

F: intervalle de temps de signalisation

S: intervalo de tiempo de señalización

A time slot starting at a particular phase in each frame and allocated to the transmission of signalling.

1417 frame alignment time slot

F: intervalle de temps de verrouillage de trame

S: intervalo de tiempo de alineación de trama

A time slot starting at a particular phase in each frame and allocated to the transmission of a frame alignment signal.

1418 digit time slot

F: intervalle de temps pour élément numérique

S: intervalo de tiempo de dígito

A time slot allocated to a single digit.

1420 time slot sequence integrity

F: intégrité de la séquence des intervalles de temps

S: integridad de la secuencia de intervalos de tiempo

The assurance that the digital information contained in the *n* time slots of a multislot connection arrives at the output (or terminal) in the same sequence as it was introduced.

1422 time slot interchange

F: échange entre intervalles de temps

S: intercambio de intervalos de tiempo

The transfer of information from one time slot to another between incoming and outgoing time division highways.

1425 retiming

F: réajustement du rythme

S: reajuste de la temporización

Adjustment of the intervals between corresponding significant instants of a digital signal, by reference to a timing signal.

1426 timing recovery (timing extraction)

F: récupération du rythme

S: recuperación de la temporización (extracción de la temporización)

The derivation of a timing signal from a received signal.

1428 isochronous

F: isochrone

S: isócrono

A signal¹⁾ is isochronous if the time interval separating any two significant instants is theoretically equal to the unit interval or to a multiple of the unit interval.

Note — In practice, variations in the time intervals are constrained within specified limits.

1429 anisochronous

F: anisochrone

S: anisócrono

A signal¹⁾ is anisochronous if the time interval separating any two significant instants is not necessarily related to the time interval separating any other two significant instants.

1430 synchronous

F: synchrone

S: sincrono

Signals¹⁾ are synchronous if their corresponding significant instants have a desired phase relationship with each other.

1431 synchronization

F: synchronisation

S: sincronización

The process of adjusting the corresponding significant instants of signals¹⁾ to make them synchronous.

¹⁾ In the definitions, "signal" is taken with the general meaning of Definition 02.27. For information, Definition 02.27 is reproduced below:

02.27 **signal** (general sense)

Aggregate of waves propagated along a transmission channel and intended to act on a receiving unit.

1432 **homochronous**

F: homochrone

S: homócrono

Signals²⁾ are homochronous if their corresponding significant instants have a constant, but uncontrolled, phase relationship with each other.

1433 **mesochronous**

F: mésochrone

S: mesócrono

Signals²⁾ are mesochronous if their corresponding significant instants occur at the same average rate.

Note — The phase relationship between corresponding significant instants usually varies between specified limits.

1434 **plesiochronous**

F: plésiochrone

S: plesiócrono

Signals²⁾ are plesiochronous if their corresponding significant instants occur at nominally the same rate, any variation in rate being constrained within specified limits.

Note 1 — Two signals having the same nominal digit rate, but not stemming from the same clock³⁾ or homochronous clocks, are usually plesiochronous.

Note 2 — There is no limit to the phase relationship between corresponding significant instants.

1435 **heterochronous**

F: hétérochrone

S: heterócrono

Signals²⁾ are heterochronous if their corresponding significant instants do not necessarily occur at the same rate.

Note 1 — Two signals having different nominal digit rates, and not stemming from the same clock or from homochronous clocks³⁾ are usually heterochronous.

Note 2 — Terms 1428 to 1435 are based on the following Greek roots:

iso = equal

syn = together

homo = same

meso = middle

plesio = near

hetero = different

²⁾ In the definitions, "signal" is taken with the general meaning of Definition 02.27. For information, Definition 02.27 is reproduced below:

02.27 **signal** (general sense)

Aggregate of waves propagated along a transmission channel and intended to act on a receiving unit.

³⁾ In these definitions "clock" is taken with the general meaning of Definition 51.10 and it is assumed that where replicated sources are used for security reasons, the assembly of these is regarded as being a single clock. For information, Definition 51.10 is reproduced below:

51.10 **clock**

Equipment providing a time base used in a transmission system to control the timing of certain functions such as the control of the duration of signal elements, the sampling, etc.

1438 unilateral control

F: commande unilatérale

S: control unilateral

Control between two synchronization nodes such that the frequency of the clock⁴⁾ of only one of these nodes is influenced by timing information derived from the clock of the other node.

1439 bilateral control

F: commande bilatérale

S: control bilateral

Control between two synchronization nodes such that the frequency of the clock⁴⁾ of each of these nodes is influenced by timing information derived from the clock of the other node.

1440 single-ended synchronization

F: synchronisation unilatérale

S: sincronización uniterminal

A method of synchronizing a specified synchronization node with respect to another synchronization node in which synchronization information at the specified node is derived from the phase difference between the local clock⁴⁾ and the incoming digital signal from the other node.

1441 double-ended synchronization

F: synchronisation bilatérale

S: sincronización bilateral

A method of synchronizing a specified synchronization node with respect to another synchronization node in which synchronization information at the specified node is derived by comparing the phase difference between the local clock⁴⁾ and the incoming digital signal from the other node, with the phase difference at the other node between its local clock and the digital signal incoming from the specified node.

1442 analogue control

F: mode analogique

S: control analógico

Synchronization control in which the relationship between the actual phase error between clocks⁴⁾ and the error signal device is a continuous function, at least over a limited range.

1443 amplitude quantized control

F: mode à quantification d'amplitude

S: control por cuantificación de amplitud

Synchronization control in which the functional relationship between actual phase error and derived error signal includes discontinuities.

Note — In practice this implies that the working range of phase errors is divided into a finite number of subranges and that a unique signal is derived for each subrange whenever the error falls within a subrange.

⁴⁾ In these definitions "clock" is taken with the general meaning of Definition 51.10 and it is assumed that where replicated sources are used for security reasons, the assembly of these is regarded as being a single clock.
For information, Definition 51.10 is reproduced below:

51.10 clock

Equipment providing a time base used in a transmission system to control the timing of certain functions such as the control of the duration of signal elements, the sampling, etc.

1444 time quantized control

F: mode à quantification temporelle

S: control por cuantificación temporal

Synchronization control in which the error signal is derived or utilized only at a number of discrete instants which may or may not be equally spaced in time.

1446 synchronized network [synchronous network]

F: réseau synchronisé [réseau synchrone]

S: red sincronizada [red síncrona]

A network in which the corresponding significant instants of nominated signals are adjusted to make them synchronous.

Note — Ideally the signals are synchronous, but they may be mesochronous in practice. By common usage such mesochronous networks are frequently described as synchronized.

1447 nonsynchronized network

F: réseau non synchronisé

S: red no sincronizada

A network in which the corresponding significant instants of signals need not be synchronized or mesochronous.

1448 mutually synchronized network

F: réseau à synchronisation mutuelle

S: red mutuamente sincronizada

A synchronized network in which each clock⁵⁾ exerts a degree of control on all others.

1449 democratic (mutually synchronized) network

F: réseau démocratique (à synchronisation mutuelle)

S: red democrática (mutuamente sincronizada)

A mutually synchronized network in which all clocks⁵⁾ in the network are of equal status and exert equal amounts of control on the others, the network operating frequency (digit rate) being the mean of the natural (uncontrolled) frequencies of the population of clocks.

1450 hierarchic (mutually synchronized) network

F: réseau hiérarchisé (à synchronisation mutuelle)

S: red jerárquica (mutuamente sincronizada)

A mutually synchronized system in which some clocks⁵⁾ exert more control than others, the network operating frequency being a weighted mean of the natural frequencies of the population of clocks.

1451 despotic (synchronized) network

F: réseau (à synchronisation) despotique

S: red despótica (sincronizada)

A synchronized network in which a unique master clock⁵⁾ exists with full power of control of all other clocks.

⁵⁾ In these definitions "clock" is taken with the general meaning of Definition 51.10 and it is assumed that where replicated sources are used for security reasons, the assembly of these is regarded as being a single clock.
For information, Definition 51.10 is reproduced below:

51.10 clock

Equipment providing a time base used in a transmission system to control the timing of certain functions such as the control of the duration of signal elements, the sampling, etc.

1452 oligarchic (synchronized) network

F: réseau (à synchronisation) oligarchique

S: red oligárquica (sincronizada)

A synchronized network in which control is exercised by a few selected clocks⁶⁾, the remainder being controlled by these.

1505 transmission delay (through a digital exchange)

F: temps de transmission (dans un central numérique)

S: tiempo de transmisión (a través de una central digital)

The sum of the times necessary for an octet to pass in both directions on a connection through a digital exchange due to buffering, frame alignment and time-slot interchange functions for digital-to-digital connections and in addition, for analogue-to-analogue connections, to the A/D conversions.

1506 switching delay (processing (handling) time)

F: temps de commutation (temps de traitement)

S: tiempo de conmutación (tiempo de proceso (tratamiento))

The interval of time attributable to the functions performed in a switching exchange in the process of setting up a call.

1507 incoming response delay

F: temps de réponse à la prise d'un circuit d'arrivée

S: duración de la preselección

A characteristic that is applicable where channel associated signalling is used. It is defined as the interval from the instant an incoming circuit seizure signal is recognized until a proceed-to-send signal is sent backwards by the exchange.

1508 exchange call set-up delay

F: temps d'établissement de la communication dans le central

S: tiempo de establecimiento de la comunicación por una central

The interval from the instant when the digits required for setting up a call are available in the exchange or the address information is received at the incoming signalling data transmission control of the exchange to the instant when the seizing signal is sent to the subsequent exchange or the corresponding address information is sent from the outgoing signalling data transmission control.

1510 through-connection delay

F: temps de transfert

S: tiempo de transferencia de la central

The interval from the instant at which the information required for setting up a through-connection in an exchange is available for processing in the exchange to the instant that the switching network through-connection is established and available for carrying traffic between the incoming and outgoing 64-kbit/s circuits.

⁶⁾ In these definitions "clock" is taken with the general meaning of Definition 51.10 and it is assumed that where replicated sources are used for security reasons, the assembly of these is regarded as being a single clock. For information, Definition 51.10 is reproduced below:

51.10 clock

Equipment providing a time base used in a transmission system to control the timing of certain functions such as the control of the duration of signal elements, the sampling, etc.

1512 exchange call-release delay

F: temps de libération de la communication par le central

S: tiempo de liberación de la comunicación por una central

Exchange call release delay is the interval from the instant at which the last information required for releasing a call in an exchange is available for processing in the exchange to the instant that the switching network through-connection is no longer available between the incoming and outgoing 64-kbit/s circuits and the disconnection signal is sent to the subsequent exchange. This interval does not include the time taken to detect the release signal, which might become significant during certain failure conditions, e.g. transmission system failures.

1514 post dialling delay

F: délai d'attente après numérotation

S: periodo de espera después de marcar

Time interval between the end of dialling by the subscriber and the reception by him of the appropriate tone or recorded announcement, or the abandon of the call without tone.

1801 digital section

F: section numérique

S: sección digital

The whole of the means of transmitting and receiving between two consecutive digital distribution frames (or equivalent) a digital signal of specified rate (see Figure 2/Q.9).

Note 1 – A digital section forms either a part or the whole of a digital path.

Note 2 – Where appropriate, the bit rate should qualify the title.

Note 3 – The description always applies to the combination of “go” and “return” directions of transmission, unless stated otherwise.

1802 digital path

F: conduit numérique

S: trayecto digital

The whole of the means of transmitting and receiving a digital signal of specified rate between those two digital distribution frames (or equivalent) at which terminal equipments or switches will be connected. Terminal equipments are those at which signals at the specified bit rate originate or terminate (see Figure 2/Q.9).

Note 1 – A digital path comprises one or more digital sections.

Note 2 – Where appropriate, the bit rate should qualify the title.

Note 3 – The description always applies to the combination of “go” and “return” directions of transmission, unless stated otherwise.

Note 4 – Digital paths interconnected by digital switches form a digital connection.

1803 digital line section

F: section de ligne numérique

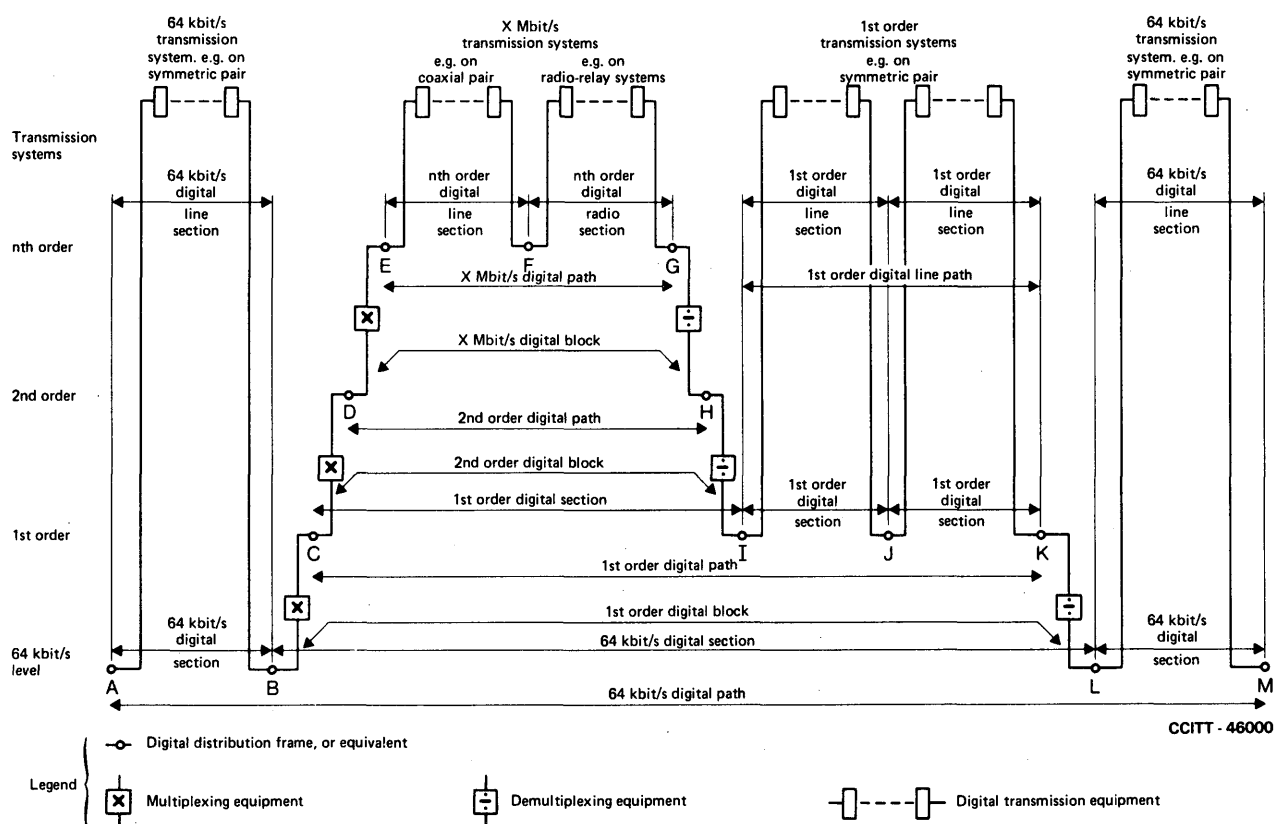
S: sección de línea digital

Two consecutive line terminal equipments, their interconnecting transmission medium and the in-station cabling between them and their adjacent digital distribution frames (or equivalents), which together provide the whole of the means of transmitting and receiving between two consecutive digital distribution frames (or equivalents) a digital signal of specified rate (see Figure 2/Q.9).

Note 1 – Line terminal equipments may include the following:

- regenerators
- code converters
- scramblers
- remote power feeding
- fault location
- supervision.

Note 2 – A digital line section is a particular case of a digital section.



Note 1 – Digital line and radio sections may be at digit rates which are either hierarchical or non-hierarchical.
 Note 2 – A-B is a 64 kbit/s digital line section, which is a particular case of a 64 kbit/s digital section.
 Note 3 – A-M is a 64 kbit/s digital path which comprises three 64 kbit/s digital sections, A-B, B-L and L-M.
 Note 4 – F-G is an X Mbit/s digital radio section which forms part of an X Mbit/s digital path E-G.
 Note 5 – C-I is a 1st order digital section which contains a 2nd order digital path D-H.
 Note 6 – I-K is an example of a digital line path.

FIGURE 2/Q.9
 Examples of digital path, digital section, digital line section, etc.

1804 digital block

F: bloc numérique

S: bloque digital

The combination of a digital path and associated digital multiplex equipments (see Figure 2/Q.9).

Note – The bit rate of the digital path should form part of the title.

2 Signalling functions and techniques

2001 signalling

F: signalisation

S: señalización

- The exchange of information (other than by speech) specifically concerned with the establishment, release and other control of calls, and network management, in automatic telecommunications operation.
- A qualification implying an action as defined above, e.g.:

signalling channel	signalling procedure
signalling equipment	signalling relation
signalling information	signalling route
signalling link	signalling system
signalling message	signalling time slot

2004 speech digit signalling

F: signalisation par éléments numériques vocaux

S: señalización por dígitos de conversación

A type of channel-associated signalling in which digit time slots primarily used for the transmission of encoded speech are periodically used for signalling.

2005 in-slot signalling

F: signalisation dans l'intervalle de temps

S: señalización dentro del intervalo

Signalling associated with a channel and transmitted in a digit time slot permanently (or periodically) allocated in the channel time slot.

2006 out-slot signalling

F: signalisation hors intervalle de temps

S: señalización fuera del intervalo

Signalling associated with a channel but transmitted in one or more separate digit time slots not within the channel time slot.

2008 common channel signalling

F: signalisation sur voie commune (signalisation par canal sémaphore)

S: señalización por canal común

A signalling technique in which signalling information relating to a multiplicity of circuits, and other information such as that used for network management, is conveyed over a single channel by addressed messages.

2009 channel associated signalling

F: signalisation voie par voie

S: señalización asociada al canal

A signalling method in which the signals necessary for the traffic carried by a single channel are transmitted in the channel itself or in a signalling channel permanently dedicated to it.

2011 in-band signalling

F: signalisation dans la bande

S: señalización dentro de banda

A signalling method in which signals are sent over the same transmission channel or circuit as the user's communication and in the same frequency band as that provided for the users.

2012 out-band signalling

F: signalisation hors bande

S: señalización fuera de banda

A signalling method in which signals are sent over the same transmission channel or circuit as the user's communication but in a different frequency band from that provided for the users.

2014 line signalling

F: signalisation de ligne

S: señalización de línea

A signalling method in which signals are transmitted between equipments which terminate and continuously monitor part or all of the traffic circuit.

2016 register signalling (signalling system R1)

F: signalisation entre enregistreurs

S: señalización entre registradores

Link-by-link multifrequency (MF) in-band pulse signalling is used for the transmission of address information. The signalling frequencies are 700 Hz to 1700 Hz, in 200 Hz steps, and combinations of two, and two only, determine the signal. The address information is preceded by a KP signal (start-of-pulsing) and terminated by an ST signal (end-of-pulsing). Either en bloc, or en bloc overlap, or overlap sending may apply. This register signalling arrangement is used extensively with other in-band and out-band line signalling systems.

2017 link-by-link signalling

F: signalisation section par section

S: señalización enlace por enlace

A signalling method in which signals are transmitted one link at a time in a multi-link connection and requiring processing at each intermediate switching point for subsequent transmission.

2018 end-to-end signalling

F: signalisation de bout en bout

S: señalización de extremo a extremo

A signalling method in which signals are transmitted from one end of a multi-link connection to the other end where processing of these signals is required.

2020 signalling system

F: système de signalisation

S: sistema de señalización

The procedures for the interpretation and use of a repertoire of signals together with the hardware and/or software needed for the generation, transmission, and reception of these signals.

2021 en-bloc signalling

F: signalisation "en bloc"

S: señalización en bloque

A signalling method in which the address digits are assembled into one block for onward transmission, the block containing all of the address information necessary to route the call to its destination.

2022 compelled signalling (general sense)

F: signalisation asservie (sens général)

S: señalización de secuencia obligada (sentido general)

A signalling method in which, after one signal (or message) has been sent, the sending of any further signals (or messages) in the same direction is inhibited until the signal sent has been acknowledged in the opposite direction by the receiving terminal and the acknowledgement has been received.

2023 compelled signalling (fully compelled; continuous compelled)

F: signalisation asservie (entièrement asservie; continuellement asservie)

S: señalización de secuencia obligada (totalmente obligada; continuamente obligada)

A signalling method in which the signal to be transmitted is applied continuously until acknowledged or until a timeout occurs. Upon recognition of the initial signal, the acknowledgement signal is applied continuously until the cessation of the initial signal or until a timeout occurs. The cessation of the acknowledgement signal may provoke the beginning of the next subsequent compelled cycle. In addition to the acknowledgement, the acknowledgement signal may carry other signalling information (e.g. concerning the next cycle).

2024 overlap address signalling

F: signalisation d'adresse à recouvrement

S: señalización de dirección con superposición

A signalling method in which the onward transmission of address signals from a switching centre may commence before the reception of all the address signals over the preceding link has been completed.

2025 overlap line signalling

F: signalisation de ligne à recouvrement

S: señalización de línea con superposición

A signalling method in which the onward transmission of a line signal from a switching centre may commence before the recognition time of the line signal being received expires.

2030 direct current signalling (d.c. signalling)

F: signalisation en courant continu

S: señalización en corriente continua (señalización en c.c.)

A signalling method in which the signalling information may be represented by controlling the direct current magnitude, polarity, and duration or a combination thereof.

2031 loop/disconnect signalling

F: signalisation par ouverture de boucle

S: señalización por interrupción del bucle

A direct current signalling method in which the signals are represented by the breaking of a loop circuit.

2032 alternating current signalling (a.c. signalling)

F: signalisation en courant alternatif

S: señalización en corriente alterna (señalización en c.a.)

A signalling method in which the signalling information is represented by means of pulsed alternating current having a frequency below the telephone speech band.

2033 voice-frequency signalling (VF signalling)

F: signalisation à fréquences vocales

S: señalización en frecuencia vocal (señalización FV)

A signalling method in which the signalling information is based on the use of currents which have frequencies within the telephone speech band.

2034 multi-frequency code signalling (MFC signalling)

F: signalisation multifréquences (signalisation MF)

S: señalización en código multifrecuencia (señalización CMF)

A voice-frequency signalling method in which the signalling information is represented by compound signals, each consisting of n frequencies from a set of m frequencies.

2038 dual seizure

F: prise simultanée

S: doble toma (toma simultánea)

The condition which occurs when in bothway operation two exchanges attempt to seize the same circuit at approximately the same time.

2039 **interruption control**

F: contrôle d'interruption

S: protección contra las interrupciones

A system which monitors a pilot for interruptions on FDM systems and which transmits an indication to the switching equipment.

2040 **signal spill-over** (in VF signalling)

F: partie débordante d'un signal (dans un système de signalisation à fréquences vocales)

S: rebasamiento de señal (en señalización FV)

That part of a VF signal which passes in band from one link to the other in a multi-link connection before the connection between the links has been split at the incoming end.

2041 **signal imitation** (in VF signalling)

F: imitation de signaux (dans un système de signalisation à fréquences vocales)

S: imitación de señal (en señalización FV)

An unwanted signal produced within the signalling band by speech or other currents which are not genuine signals causing the response of a signal receiver.

2042 **guarding** (in VF signalling)

F: protection (dans un système de signalisation à fréquences vocales)

S: guarda (en señalización FV)

Rendering ineffective the signal imitation by recognizing the simultaneous presence of frequencies outside the signalling band.

2043 **splitting** (in VF signalling)

F: coupure (dans un système de signalisation à fréquences vocales)

S: desprendimiento (en señalización FV)

A switching function which provides disconnection or isolation of that part of a channel which:

- precedes the point where the signalling frequency(ies) is(are) injected;
- succeeds the point where the signal receiver is connected.

Splitting when receiving a signal prevents false operation of signalling equipment by signal reflections and signal spill-over.

Splitting when sending a signal prevents interference from a preceding circuit or near-end equipment.

2050 **signalling information**

F: information de signalisation

S: información de señalización

The information content of a signal or a signalling message.

2060 **initial address message (IAM)**

F: message initial d'adresse (MIA)

S: mensaje inicial de dirección (MID)

A type of message sent in the forward direction at call set-up. It contains address information and other information relating to the routing and handling of the call.

2061 subsequent address message (SAM)

F: message subséquent d'adresse (MSA)

S: mensaje subsiguiente de dirección (MSD)

A type of message sent in the forward direction subsequent to the initial address message and containing further address information.

2070 message sequencing

F: mise en séquence des messages

S: secuenciación de mensajes

The procedures for ensuring that received messages are processed in the correct order.

2071 unreasonable message

F: message inattendu

S: mensaje irrazonable (o irracional)

A message with an inappropriate signal content, an incorrect signal direction, or an inappropriate place in the message sequence.

2072 reasonableness check

F: contrôle de vraisemblance

S: prueba de razonabilidad (o de racionabilidad)

A procedure for verifying whether the signalling information of a received signal message is reasonable in relation to the sequence of previously received signal messages for that circuit.

2073 call spill-over

F: empiètement de communications

S: rebasamiento de llamada

Receipt of an abnormally delayed signalling message from a previous call at a switching centre whilst a new call is being set up on that circuit.

2090 transaction (in signalling applications)

F: transaction (dans les applications de signalisation)

S: transacción (en aplicaciones de señalización)

An interchange of enquiry and response messages between signalling points that transfers information.

2091 enquiry (in a transaction)

F: demande (dans une transaction)

S: averiguación (en una transacción)

A signal or signals (possibly sent as a sequence of messages) requesting specific information.

2092 response (in a transaction)

F: réponse (dans une transaction)

S: respuesta (en una transacción)

A signal or signals (possibly sent as a sequence of messages) containing information requested by an enquiry.

2101 message transfer part

F: Sous-système Transport de Messages

S: parte de transferencia de mensajes

The functional part of a common channel signalling system which transfers signal messages as required by all the users, and which performs the necessary subsidiary functions, for example error control and signalling security.

2102 user part

F: Sous-système Utilisateur

S: parte de usuario

A functional part of the common channel signalling system which transfers signalling messages via the message transfer part. Different types of user parts exist (e.g. for telephone and data services), each of which is specific to a particular use of the signalling system.

2103 signalling network

F: réseau sémaphore

S: red de señalización

A network used for signalling and consisting of signalling points and connecting common channel signalling links.

2104 signalling network management functions

F: fonctions de gestion du réseau sémaphore

S: funciones de gestión de la red de señalización

Functions that, on the basis of predetermined data and information about the status of the signalling network, control the current message routing and configuration of signalling network facilities.

2105 (signalling) traffic flow control

F: contrôle de flux de trafic (sémaphore)

S: control de flujo del tráfico (de señalización)

Actions and procedures intended to limit signalling traffic at its source in the case when the signalling network is not capable of transferring all signalling traffic offered by the User Parts, because of network failures or overload situations.

2106 signalling point

F: point sémaphore

S: punto de señalización

A node in a signalling network which either originates and receives signal messages, or transfers signal messages from one signalling link to another, or both.

2107 (signalling) originating point

F: point sémaphore d'origine

S: punto de origen (de la señalización)

A signalling point in which a message is generated.

2108 signal transfer point

F: point de transfert sémaphore

S: punto de transferencia de la señalización

A signalling point with the function of transferring signalling messages from one signalling link to another.

2109 (signalling) destination point

F: point sémaphore de destination

S: punto de destino (de la señalización)

A signalling point to which a message is destined.

2110 adjacent signalling points

F: points sémaphores adjacents

S: puntos de señalización adyacentes

Two signalling points that are directly interconnected by a signalling link(s).

2111 signalling relation

F: relation sémaphore

S: relación de señalización

A relation formed by two signalling points involving the possibility of information interchange between corresponding user part functions.

2112 signalling route

F: route sémaphore

S: ruta de señalización

A predetermined path described by a succession of signalling points that may be transversed by signalling messages directed by a signalling point towards a specific destination point.

2113 signalling route set

F: faisceau de routes sémaphores

S: conjunto de rutas de señalización

The combination of all the permitted signalling routes that may be used to pass signalling messages from a signalling point to a specific destination.

2114 signalling routing

F: acheminement de la signalisation

S: encaminamiento de señalización

Procedures for directing the choice and allocation of signalling paths.

2115 signalling point code

F: code d'un point sémaphore

S: código de punto de señalización

A binary code uniquely identifying a signalling point in a signalling network. This code is used, according to its position in the label, either as destination point code or as originating point code.

2116 data channel

F: voie de données

S: canal de datos

A unidirectional transmission path for data, with transmission terminal equipment at both ends.

2117 data link

F: liaison de données

S: enlace de datos

This is an ensemble of terminal installations and the interconnecting network operating in a particular mode that permits information to be exchanged between terminal installations.

A bidirectional transmission path for data, comprising two data channels in opposite directions which operate together at the same data rate.

2118 signalling link

F: canal sémaphore (liaison de signalisation)

S: enlace de señalización

A transmission means which consists of a signalling data link and its transfer control functions, used for reliable transfer of signalling messages.

2119 signalling link set

F: faisceau de canaux sémaphores (faisceau de liaisons de signalisation)

S: conjunto de enlaces de señalización

A set of signalling link(s) directly connecting two signalling points.

2120 regular signalling link

F: canal sémaphore normal (liaison de signalisation régulière)

S: enlace de señalización regular

The signalling link which normally carries some particular parcel of signalling traffic.

2121 reserve signalling link

F: canal sémaphore de secours (liaison de signalisation de réserve)

S: enlace de señalización de reserva

The signalling link which can be used to carry all, or part of, the signalling traffic of a regular signalling link when the latter has failed or has been withdrawn from service.

2122 signalling channel (Signalling System No. 6)

F: voie de signalisation

S: canal de señalización

A data channel in combination with the associated signalling terminal equipment at each end.

2123 signalling data link

F: liaison sémaphore de données (liaison de données de signalisation)

S: enlace de datos de señalización

A combination of two data channels operating together in a single signalling system. The data channels operate in opposite directions and at the same data rate.

2125 changeover

F: passage sur canal sémaphore de secours (passage sur liaison de réserve)

S: paso a enlace de reserva

The procedure of transferring signalling traffic from one signalling link to one or more different signalling links, when the link in use fails or is required to be cleared of traffic.

2126 changeback

F: retour sur canal sémaphore normal (retour sur la liaison normale)

S: retorno al enlace de servicio

The procedure of transferring signalling traffic from one or more alternative signalling links to a signalling link which has become available.

2128 load-sharing (general)

F: partage de la charge

S: compartición de carga

A process by which signalling traffic is distributed over two or more signalling or message routes, in view of traffic equalization or security.

2130 **associated mode (of signalling)**

F: mode (de signalisation) associé

S: modo (de señalización) asociado

The mode where messages for a signalling relation involving two adjacent signalling points are conveyed over a directly interconnecting signalling link.

2131 **non-associated mode (of signalling)**

F: mode (de signalisation) non associé

S: modo (de señalización) no asociado

The mode where messages for a signalling relation involving two (non-adjacent) signalling points are conveyed, between those signalling points, over two or more signalling links in tandem passing through one or more signalling transfer points.

2133 **quasi-associated mode (of signalling)**

F: mode (de signalisation) quasi associé

S: modo (de señalización) cuasiasociado

A non-associated mode (of signalling) in which the (signalling) message route is determined basically, for each signalling message, by information contained in this message (namely in its routing label) and is fixed in normal operation.

2135 **block (data)**

F: bloc (de données)

S: bloque (de datos)

A group of bits, or *n*-ary digits, transmitted as a unit over which an encoding procedure is generally applied for error-control purposes.

2136 **block (Signalling System No. 6)**

F: bloc

S: bloque

A group of 12 signal units on the signalling channel.

2137 **signal units**

F: trame sémaphore

S: unidad de señalización

A group of bits forming a separately transferable entity used to convey information on a signalling link.

2138 **signalling message**

F: message (de signalisation)

S: mensaje de señalización

An assembly of signalling information pertaining to a call, management transaction, etc. comprising also elements for delimitation, sequencing and error control, that is transferred as an entity.

2139 **(signalling) message route**

F: route de message (de signalisation)

S: ruta de mensajes (de señalización)

The signalling link or consecutive links connected in tandem that are used to convey a signalling message from an originating point to its destination point.

2140 continuity check

F: contrôle de continuité

S: prueba de continuidad

A check made to a circuit or circuits in a connection to verify that an acceptable path (for transmission of data, speech, etc.) exists.

2141 check bit

F: bit de contrôle

S: bit de control

A bit associated with a character or block for the purpose of checking the absence of error within the character or block.

2142 check loop

F: boucle pour contrôle de continuité

S: bucle de pruebas de continuidad

A device which is attached to interconnect the Go and Return paths of a circuit at the incoming end of a circuit to permit the outgoing end to make a continuity check on a loop basis.

2202 service indicator

F: indicateur de service

S: indicador de servicio

Information within a signalling message identifying the user to which the message belongs.

2203 country-code indicator

F: indicateur d'indicatif de pays

S: indicador de indicativo de país

Information sent in the forward direction indicating whether or not the country code is included in the address information.

2204 calling party's category indicator

F: indicateur de catégorie du demandeur

S: indicador de la categoría del abonado que llama

Information sent in the forward direction denoting the category of the calling party which is used together with other call set-up information to select the appropriate call treatment.

2205 address separator

F: séparateur d'adresse

S: separador de dirección

The character which separates the different addresses in the selection signals.

2206 label

F: étiquette

S: etiqueta

Information within a signalling message used to identify typically the particular circuit, call or management transaction to which the message is related.

2207 **band number**

F: numéro de bande

S: número de banda

A subdivision of the address label, containing the most significant bits, used for routing the signal message and possibly for identifying the circuit group containing the traffic circuit concerned.

2301 **address signal**

F: signal d'adresse

S: señal de dirección

A signal containing one element of the part of the selection signals which indicate the destination of a call initiated by a customer, network facility, etc.

2302 **address signal complete**

F: signal d'adresse complet

S: señal de dirección completa

A signal sent in the backward direction indicating that signals required for routing the call to the called party have been received and that no called party's line condition signals will be sent.

2303 **address-incomplete signal**

F: signal d'adresse incomplet

S: señal de dirección incompleta

A signal sent in the backward direction indicating that the number of address signals received is not sufficient for setting up the call.

2304 **end-of-pulsing (ST) signal**

F: signal de fin de numérotation

S: señal de fin de numeración (SFN)

An address signal sent in the forward direction indicating that there are no more address signals to follow.

2306 **call-failure signal**

F: signal d'échec de l'appel

S: señal de llamada infructuosa

A signal sent in the backward direction indicating the failure of a call set-up attempt due to the lapse of a time-out or a fault not covered by specific signals.

2309 **ringing tone ; ringback tone (USA)**

F: tonalité de retour d'appel

S: tono de llamada

A tone which indicates that the ringing function is being applied at the called end.

2310 **release-guard signal**

F: signal de libération de garde

S: señal de liberación de guarda

A signal sent in the backward direction in response to the clear-forward signal when the circuit concerned is brought into the idle condition.

2311 **clear-forward signal**

F: signal de fin

S: señal de fin (desconexión)

A signal sent in the forward direction to terminate the call or call attempt and release the circuit concerned. This signal is normally sent when the calling party clears.

2312 **clear-back signal**

F: signal de raccrochage

S: señal de colgar

A signal sent in the backward direction indicating that the called party has cleared.

2313 **confusion signal**

F: signal de confusion

S: señal de confusión

A signal sent in the backward direction indicating that an exchange is unable to act upon a message received from the preceding exchange because the message is considered unreasonable.

3 **Control functions**

3001 **exchange control system**

F: système de commande du central

S: sistema de control de la central

The central control *system* of a stored program controlled switching *system*. It may consist of one or more *processors*.

3008 **register function**

F: fonction d'enregistreur

S: función de registrador

The functions of receiving, storing, analyzing and possibly translating and transmitting address and other information for the purpose of controlling the setting up of a call.

3012 **I/O devices**

F: dispositif d'entrée/sortie

S: dispositivos de entrada/salida

Memory and keyboard devices for entering or receiving data to or from the *system*. Can be controlled manually for entering or receiving data.

3101 **CCITT MML**

F: langage homme-machine du CCITT

S: LHM del CCITT

The man-machine language (MML) for stored program controlled switching systems developed by the International Telegraph and Telephone Consultative Committee (CCITT).

3103 **system (in MML)**

F: système

S: sistema

Refers to a stored program controlled switching *system* and also to its man-machine communication facility.

3105 **command (in MML)**

F: commande

S: instrucción; orden

A specification of an expected action or function by the system.

3110 control character (in MML)

F: caractère de commande

S: carácter de control

A character whose occurrence in a particular context initiates, modifies, or stops an action that affects the recording, processing or interpretation of data.

3115 function (in MML)

F: fonction

S: función

A function is an action which various groups of staff wish to carry out, e.g. add subscriber's line, initiate a testing routine, read a subscriber's class of service. To carry out one function, one or more *commands* may be necessary. The function is characterized by the *command code(s)*.

4 Interfaces and interface functions (machine-machine)

4001 interface

F: jonction, interface

S: interfaz

A shared boundary, for example, the boundary between two subsystems or two devices.

Note 1 — An interface is used to specify once the interconnection between the two sides of it. The specification includes the type, quantity and function of the interconnecting means and the type, form and sequencing order of the signals to be interchanged via those means.

Note 2 — Recommendation G.703, as an example, refers to physical, functional and electrical characteristics of interfaces that are necessary to interconnect digital network components to form a digital path or connection.

4002 physical interface

F: interface physique

S: interfaz físico

The interface between two equipments.

4003 interface specification

F: spécification d'interface

S: especificación de interfaz

A formal statement of the type, quantity, form and order of the interconnections and interactions between two associated systems, at their interface.

4004 physical interface specification (physical interface)

F: spécification d'interface physique

S: especificación de interfaz físico (interfaz físico)

A formal statement of the mechanical, electrical, electromagnetic and optical characteristics of the interconnections and interactions between two associated equipments, at their interface.

4006 codirectional interfaces

F: jonction codirectionnelle

S: interfaz codireccional

An interface across with the information and its associated timing signal are transmitted in the same direction (see Figure 3/Q.9).

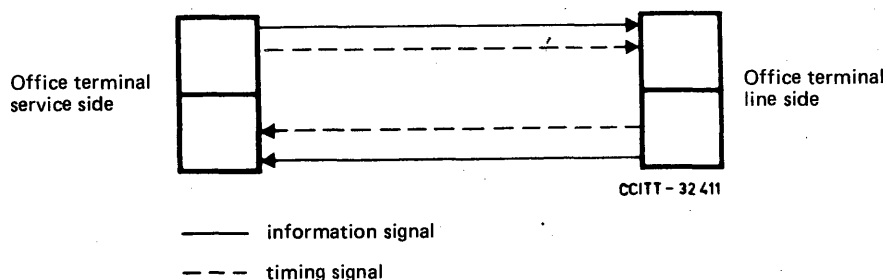


FIGURE 3/Q.9

Codirectional interface (G.703)

4007 centralized clock interface

F: jonction à horloge centrale

S: interfaz de reloj centralizado

An interface wherein for both directions of transmission of the information signal, the associated timing signals of both the exchange terminal on the line side and the exchange terminal on the service side are supplied from a centralized clock, which may be derived for example from certain incoming line signals (see Figure 4/Q.9).

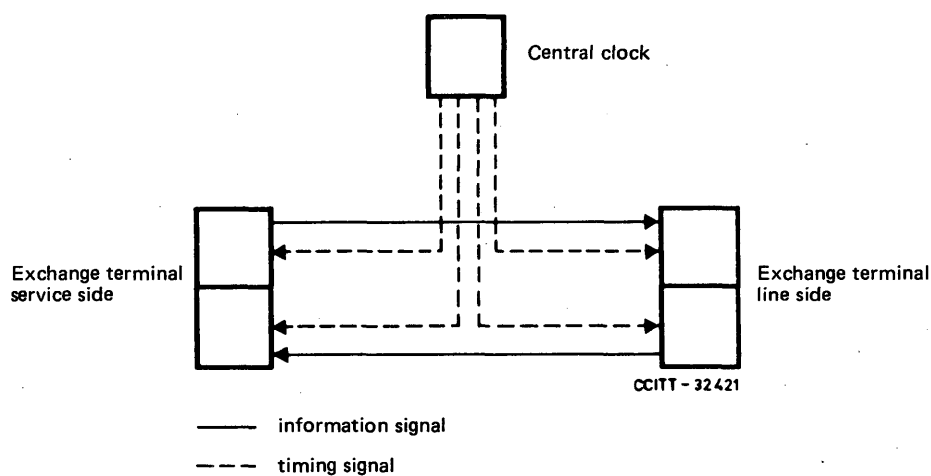


FIGURE 4/Q.9

Centralized clock interface (G.703)

4008 codirectional interface

F: jonction contradirectionnelle

S: interfaz contradireccional

An interface across which the timing signals associated with both directions of transmission are directed towards the service side (e.g. data or signalling) of the interface (see Figure 5/Q.9).

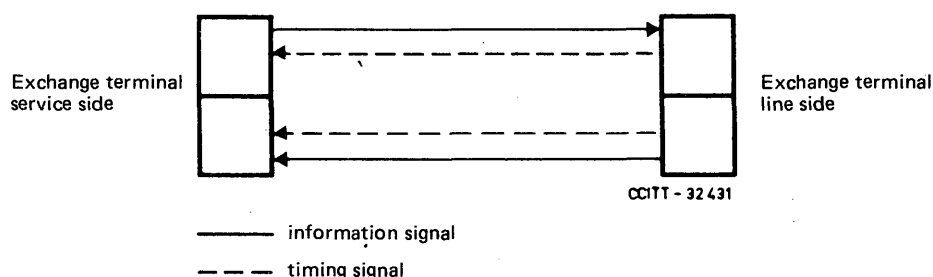


FIGURE 5/Q.9

Contradirectional interface (G.703)

4020 protocol

F: protocole

S: protocollo

A formal statement of the procedures that are adopted to accommodate communication between two or more functions within the same layer of a hierarchy of functions.

4022 access protocol

F: protocole d'accès

S: protocollo de acceso

A defined set of procedures that is adopted at an interface at a specified reference point between a user and a network to enable the user to employ the services and/or facilities of that network.

4025 user-user protocol

F: protocole usager-usager

S: protocolo usuario-usuario

A protocol that is adopted between two or more network users in order to accommodate communication between them.

5 Equipment and hardware

5001 automatic switching equipment

F: commutateur automatique

S: equipo de conmutación automática

Equipment in which *switching* operations are performed by electrically controlled apparatus without the intervention of operators.

15.12

5004 distribution frame

F: répartiteur

S: repartidor

A structure for terminating wires and connecting them together in any desired order.

15.20

5005 **main distribution frame**

F: répartiteur d'entrée

S: repartidor principal

A *distribution frame* to which are connected on one side the lines exterior to the exchange, and on the other side the internal cabling of the exchange.

15.21

5006 **intermediate distribution frame**

F: répartiteur intermédiaire

S: repartidor intermedio

A *distribution frame* intermediate between the main distribution frame and the switchboard, or the switching apparatus or intermediate between two ranks of switches in an automatic exchange.

15.22

5012 **crossbar switch**

F: commutateur crossbar

S: conmutador de barras cruzadas

A *switch* having a plurality of vertical paths, a plurality of horizontal paths, and electromagnetically-operated mechanical means for interconnecting any one of the vertical paths with any of the horizontal paths.

15.45

6 **Executive software**

6.1 *Basic software concepts*

6102 **algorithm**

F: algorithme

S: algoritmo

A prescribed finite set of well-defined rules or processes for the solution of a problem in a finite number of steps.

ISO 01.04.10

6103 **real time (adjective)**

F: en temps réel

S: en tiempo real

Pertaining to the processing of data by a computer in connection with another process outside the computer according to time requirements imposed by the outside process.

ISO 10.03.04

6104 **file**

F: fichier

S: fichero

A set of related records treated as a unit.

ISO 04.11.05

6105 **record**

F: enregistrement

S: registro

A set of related data or words treated as a unit.

ISO 04.11.03

6106 **field**

F: zone

S: campo

In a record, a specified area used for a particular category of data.

ISO 04.11.11

6107 **key (tag) (label)**

F: clé (étiquette) (label)

S: clave (etiqueta)

One or more characters within or attached to a set of data, that contains information about the set, including its identification.

ISO 04.12.04

6108 **identifier**

F: identificateur

S: identificador

A character, or group of characters, used to identify or name an item of data and possibly to indicate certain properties of that data.

ISO 07.04.01

6109 **parameter**

F: paramètre

S: parámetro

A variable that is given a constant value for a specified application and that may denote the application.

ISO 02.02.04

6110 **call (in software), procedure call**

F: appel

S: llamada

The use of a procedure name in an expression or statement which causes the execution of the procedure when encountered.

6111 **address**

F: adresse

S: dirección

A character or group of characters that identifies a storage or a device without the use of any intermediate reference.

ISO 07.01.11

6112 **absolute address**

F: adresse absolue

S: dirección absoluta

An address in a computer language that identifies a storage or a device without the use of any intermediate reference.

ISO 07.19.03

6113 indirect address

F: adresse indirecte

S: dirección indirecta

An address that designates the storage location of an item of data to be treated as the address of an operand but not necessarily as its direct address.

ISO 07.19.11

6114 direct address

F: adresse directe

S: dirección directa

An address that designates a storage location of an item of data to be treated as an operand.

ISO 07.19.10

6115 base address

F: adresse de base; adresse base

S: dirección de base

A numeric value that is used as a reference in the calculation of addresses in the execution of a computer program.

ISO 07.19.05

6116 relocatable address

F: adresse translatable

S: dirección reubicable

An address that is adjusted when the computer program containing it is relocated.

ISO 07.19.08

6117 monitor

F: moniteur

S: monitor

A functional unit that observes and records selected activities within a system for analysis.

ISO 11.03.02 mod

6118 direct access [random access]

F: accès sélectif

S: acceso directo

The facility to obtain data from a storage device or to enter data into a storage device in such a way that the process depends only on a reference to data previously accessed.

ISO 12.05.03

6.2 Software organization

6201 operating system

F: système d'exploitation

S: sistema operativo

Software that controls the management and the execution of programs.

ISO 01.04.07 mod

6202 conversational mode

F: mode dialogué

S: modo conversacional

A mode of operation of a data processing system in which a sequence of alternating entries and responses between a user and the system takes place in a manner similar to a dialogue between two persons.

ISO 10.03.03 mod

6203 time sharing [time slicing]

F: partage de temps

S: tiempo compartido

A mode of operation of a data processing system that provides for the interleaving in time of two or more processes in one processor.

ISO 10.04.05 mod

6204 time slicing [time sharing]

F: découpage de temps

S: segmentación de tiempo

A mode of operation in which two or more processes are assigned quanta of time on the same processor.

ISO 10.04.04

6205 to pack

F: condenser

S: compactar

To store data in a compact form in a storage medium by taking advantage of known characteristics of the data and of the storage medium, in such a way that the original form of the data can be recovered.

Example: To make use of bit or byte locations that would otherwise go unused.

ISO 06.03.12

6206 to map (over)

F: appliquer

S: aplicar (correlacionar)

To establish a set of values having a defined correspondence with the quantities or values of another set.

ISO 02.04.04

6207 to relocate

F: traducer

S: reubicar

To move a computer program or part of a computer program, and to adjust the necessary address references so that the computer program can be executed after being moved.

ISO 07.12.03

6208 chaining search

F: recherche en chaîne

S: búsqueda en cadena

A search in which each item contains means for locating the next item to be considered in the search.

ISO 06.04.08

6209 dichotomizing search

F: recherche dichotomique

S: búsqueda dicotómica

A search in which an ordered set of items is partitioned into two parts, which is rejected, the process being repeated on the accepted part until the search is completed.

ISO 06.04.04

6210 interrupt ; interruption

F: interruption

S: interrupción

A suspension of a process, such as the execution of a computer program, caused by an event external to that process and performed in such a way that the process can be resumed.

ISO 10.01.09

6211 to dump

F: vider

S: vaciar

To write the contents of a storage, or part of a storage, usually from an internal storage, on to an external medium for a specific purpose such as to allow other use of the storage, as a safeguard against faults or errors, or in connection with debugging.

ISO 07.14.01

6212 to patch

F: rapiécer

S: parchear

To make an improvized modification.

ISO 07.15.06

6.3 Programming

6301 to assemble

F: assembler

S: ensamblar

To translate a program expressed in an assembly language and perhaps to link subroutines.

ISO 07.03.04

6302 assembler ; assembly program

F: assembleur; programme d'assemblage

S: ensamblador; programa de ensamblaje

A program used to assemble.

ISO 07.03.05 mod

6303 to compile

F: compiler

S: compilar

To translate a program expressed in a high level language into a program expressed in a computer language.

ISO 07.03.06 mod

6304 **compiler ; compiling program**

F: compilateur

S: compilador; programa compilador

A program used to compile.

ISO 07.03.07 mod

6305 **link (in programming)**

F: lien

S: enlace

A part of a program that passes control and parameters between separate portions of the program.

ISO 07.09.09 mod

6306 **to link (in programming)**

F: relier

S: enlazar

To provide a link.

ISO 07.09.10

6307 **programming system**

F: système de programmation

S: sistema de programación

One or more programming languages and the necessary software for using these languages with particular automatic data processing equipment.

ISO 07.01.01

6308 **routine**

F: routine

S: rutina

An ordered set of instructions that may have some general or frequent use.

ISO 01.04.08 mod

6309 **subroutine**

F: sous-programme

S: subrutina

A sequence set of statements which taken as an entity may be used in one or more programs and at one or more points in a program, as required for repetitive occurrence of the same task.

ISO 07.08.01 mod

6310 **executive program ; supervisory program ; supervisor**

F: (programme) superviseur

S: programa ejecutivo; programa supervisor; supervisor

A program, usually part of an operating system, that controls the execution of other programs and regulates the flow of work in a data processing system.

ISO 07.06.01 mod

6311 reusable program (routine)

F: programme (routine) réutilisable

S: programa (rutina) reutilizable

A program (A routine) that may be loaded once and executed repeatedly subject to the requirements that any instructions that are modified during its execution are returned to their states and that its external program parameters are preserved unchanged.

ISO 07.08.05 mod

6312 reentrant program (routine) (subroutine); reenterable program (routine) (subroutine)

F: programme (routine); (sous-programme) reentrant

S: programa (rutina) (subrutina) reentrante; programa (rutina) (subrutina) reintroducible

A program (A routine) (A subroutine) that may be entered repeatedly and may be entered before prior executions of the same program (routine) (subroutine) have been completed, subject to the requirement that neither its external program parameters nor any instructions are modified during its execution.

Note — A reentrant program, routine or subroutine may be used by more than one computer program simultaneously.

ISO 07.08.06

6313 target program ; object program

F: programme résultant; programme-objet

S: programa resultante; programa objeto

A program in a target language that has been translated from a source language.

ISO 07.03.02 mod

6314 microinstruction

F: micro-instruction

S: microinstrucción

An instruction of a microprogram.

ISO 07.16.13

6315 microprogram

F: microprogramme

S: microprograma

A sequence of elementary instruction that corresponds to a specific computer operation, maintained in special storage, whose execution is initiated by the instruction register of a computer.

ISO 07.01.13

6316 to debug (in programming)

F: mettre au point

S: depurar

To detect, to trace, to eliminate mistakes in programs or in other software.

ISO 07.15.01

6.4 Languages

6401 computer language ; machine language

F: langage-machine

S: lenguaje de computador; lenguaje de máquina

A low level language whose instructions consist only of computer instructions.

ISO 07.02.15 mod

6402 macroinstruction ; macro (instruction)

F: macro-instruction

S: macroinstrucción

An instruction in a source language that is to be replaced by a defined sequence of instructions in the same source language.

Note — The macroinstruction may also specify values for parameters in the instructions that are to replace it.

ISO 07.16.05

6403 command language

F: langage de commande

S: lenguaje de instrucciones; lenguaje de órdenes

A source language consisting primarily of procedural operators that indicate the functions to be performed by an operating system.

ISO 10.02.09 mod

6404 assembly language

F: langage d'assemblage

S: lenguaje de ensamblaje

A low level language whose instructions are usually in one-to-one correspondence with computer instructions and that may provide facilities such as the use of macroinstructions.

ISO 07.02.16 mod

6405 syntax

F: syntaxe

S: sintaxis

The relationships among characters or groups of characters, independent of their meanings or the manner of their interpretation and use.

ISO 07.02.04

6406 object language ; target language

F: langage résultant; langage-objet

S: lenguaje objeto; lenguaje resultante

A language into which statements are translated.

ISO 07.02.11

6407 source language

F: langage d'origine; langage-source

S: lenguaje fuente

A language from which statements are translated.

ISO 07.02.10

6408 high level language (HLL)

F: langage évolué

S: lenguaje de alto nivel

A programming language that does not reflect the structure of any given computer or any given class of computers.

ISO 07.02.17

6409 low level language

F: langage lié au calculateur

S: lenguaje de bajo nivel

A programming language that reflects the structure of a computer or that of a given class of computers.

ISO 07.02.14

6410 man-machine language (MML)

F: langage homme-machine (LHM)

S: lenguaje hombre-máquina (LHM)

A language designed to facilitate direct user control of a computer.

6411 mnemonic (abbreviation)

F: (abréviation) mnémonique

S: nemotécnica (abreviatura)

A representation of an entity by one or more characters, so chosen that the character representation has a relationship to normal language usage such that the name of the entity serves as an aid to the memory of a human operator in remembering the appropriate coded representation used.

6501 CHILL

F: CHILL

S: CHILL

A high level programming language for programming SPC telephone exchanges, developed by CCITT and fully described in Recommendation Z.200 [4].

Note — For details of the individual terms and definitions used in CHILL see Appendix 6 to Recommendation Z.200 [4].

6901 comment (in MML)

F: commentaire

S: comentario

A character string enclosed between the separator strings/* (solidus asterisk) and */ (asterisk solidus). Has no MML syntactical or semantical meaning.

6902 format

F: format

S: formato

The arrangement or layout of data on a data medium.

6903 header

F: en-tête

S: encabezamiento

The header provides general information which could comprise identification information, date and time, etc.

6904 **identifier** (in MML)

F: identificateur

S: identificador

An identifier is a representation of an entity, typically consisting of one or more *characters*. It is used to identify or name a unique item of data. In the *man-machine language*, the first character is a letter.

6905 **mnemonic abbreviation**

F: abréviation mnémonique

S: abreviatura nemotécnica

A representation of an entity typically consisting of one or more *characters* chosen to assist the human memory.

6906 **arithmetic expression** (in MML)

F: expression arithmétique

S: expresión aritmética

A combination of *arithmetic delimiters*, *numerals* (*decimal*, *hexadecimal*, *octal* or *binary*) and *identifiers* enclosed by parentheses.

6907 **binary numeral**

F: nombre binaire

S: numeral binario

A *numeral* in the binary (base 2) *numbering system*, represented by the characters 0 (zero), 1 (one) and optionally preceded by B' (B apostrophe).

6908 **character**

F: caractère

S: carácter

A member of the *character set* which is used for the organization, control or representation of data.

6910 **character set** (in MML)

F: ensemble de caractères

S: juego de caracteres; conjunto de caracteres

The finite set of different characters used in *CCITT MML*.

6911 **decimal numeral**

F: nombre décimal

S: numeral decimal

A *numeral* in the decimal (base 10) *numbering system*, represented by the *characters* 0 (zero), 1, 2, 3, 4, 5, 6, 7, 8, 9 optionally preceded by D' (D apostrophe).

6912 **digit**

F: chiffre

S: cifra; dígito

A *character* of the *character set* representing an integer, listed in Table 1/Z.314 [5], column 3, positions 0 (zero) to 9.

6913 **flow liné** (in MML)

F: ligne de liaison

S: línea de flujo

A line representing a connection path between *symbols* in a *syntax diagram*.

6914 **graphic characters**

F: caractères graphiques

S: caracteres gráficos

Graphic characters are a collection of *characters* within the *character set* used to improve readability of *output*.

6915 **hexadecimal numeral**

F: nombre hexadécimal

S: numeral hexadecimal

A *numeral* in the hexadecimal (base 16) *numbering system*, represented by the *characters* 0 (zero), 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, optionally preceded by H' (H apostrophe).

6916 **input** (in MML)

F: entrée

S: entrada

The process that constitutes the introduction of data into a data processing system or any part of it.

6917 **letter**

F: lettre

S: letra

A *character* of the *character set* representing the alphabet, listed in Table 1/Z.314 [5], columns 4, 5, 6 and 7 excluding table positions 5/15 and 7/15.

6918 **meta-language** (in MML)

F: métalangage

S: metalenguaje

A symbolic method for defining *MML input* and *output syntax*.

6919 **octal numeral**

F: nombre octal

S: número octal

A *numeral* in the octal (base 8) *numbering system*, represented by the *characters* 0, 1, 2, 3, 4, 5, 6, 7, optionally preceded by O' (letter O apostrophe).

6920 **output** (in MML)

F: sortie

S: salida

The process that consists of the delivery of data from a data processing system or from any part of it.

6921 **parameter** (in MML)

F: paramètre

S: parámetro

A parameter identifies and contains a piece of necessary information to execute a *command*.

6922 **separator** (in MML)

F: séparateur

S: separador

A *character* used to delimit *syntax* elements.

6923 **symbol**

F: symbole

S: símbolo

A conventional representation of a concept or a representation of a concept upon which agreement has been reached.

6924 **syntax diagram**

F: diagramme syntaxique

S: diagrama sintáctico

The syntax diagrams are a method of defining the *syntax* of the *input* and *output* language by pictorial representation.

6925 **comment** (in SDL)

F: commentaire

S: comentario

Information which is in addition to or clarifies an SDL diagram. Comments may be attached by a single square bracket connected by a dashed line to a *symbol* or *flow line*. (Recommendation Z.102, §§ 2.6, 2.7.2 [6].)

6926 **connector** (in SDL)

F: connecteur

S: conector

A connector (○) is either an *in-connector* or an *out-connector*. A *flow line* may be broken by a pair of *associated connectors*, with the flow assumed to be from the *out-connector* to its associated *in-connector*. (Recommendation Z.102, §§ 2.4, 2.5.2 [6].)

6927 **decision** (in SDL)

F: décision

S: decisión

A decision is an *action* within a *transition* which asks a question to which the answer can be obtained at that instant and chooses one of several paths to continue the *transition*. (Recommendation Z.101, § 1.3.7 [7].)

6928 **description** (in SDL)

F: description

S: descripción

The implementation of the requirements of a system is described in a description of the system. Descriptions consist of *general parameters* of the system as implemented and the *functional description (FD)* of its actual behaviour. (Recommendation Z.101, §§ 1.2.2 a), 1.2.2 b) [7].)

6929 **flow line** (in SDL)

F: ligne de liaison

S: línea de flujo

A flow line (——— or ———>) connects every *symbol* to the symbol(s) it follows. (Recommendation Z.102, § 2.5.1 [6].)

6930 **functional block** (in SDL)

F: bloc fonctionnel

S: bloque funcional

A functional block is an object of manageable size and relevant internal relationship, containing one or more *processes*. (Recommendation Z.101, § 1.2.4 [7].)

6931 **functional description (FD)** (in SDL)

F: description fonctionnelle (DF)

S: descripción funcional (DF)

The functional description (FD) of a system describes the actual behaviour of the implementation of the functional requirements of the system in terms of the internal structure and logic processes within the system. (Recommendation Z.101, § 1.2.3 [7].)

6932 **functional specification (FS)** (in SDL)

S: spécification fonctionnelle (SF)

F: especificación funcional (EF)

The functional specification (FS) of a system is a specification of the total functional requirements of that system from all significant points of view. (Recommendation Z.101, § 1.2.3 [7].)

6933 **general parameters** (in SDL)

F: caractéristiques générales

S: parámetros generales

The general parameters in both a *specification* and a *description* of a system relate to such matters as temperature limits, construction, exchange capacity, grade of service, etc. (Recommendation Z.101, § 1.2.2. c) [7].)

6934 **input** (in SDL)

F: entrée

S: entrada

An input is an incoming *signal* which is *recognized* by a *process*. (Recommendation Z.101, § 1.3.2 [7].)

6935 **output** (in SDL)

F: sortie

S: salida

An output in an *action* within a *transition* which generates a *signal* which in turn acts as an *input* elsewhere. (Recommendation Z.101, § 1.3.6 [7].)

6936 **pictorial element (PE)**

F: élément graphique (EG)

S: elemento pictográfico (EP)

One of a number of standardized graphical entities used within *state pictures* to represent switching system concepts. (Annexes to Recommendation Z.103 [8].)

6937 **process** (in SDL)

F: processus

S: proceso

A process performs a logic function that requires a series of information items to proceed, where these items become available at different points in time. In the context of SDL, a process is an object that either is in a *state* awaiting an *input* or in a *transition*. (Recommendation Z.101, §§ 1.2.5, 1.3.9 [7].)

6938 **save** (in SDL)

F: mise en réserve

S: conservación

A save is the postponement of *recognition of a signal* when a *process* is in a *state* in which *recognition of that signal* does not occur. (Recommendation Z.101, § 1.3.4 [7].)

6939 **signal** (in SDL)

F: signal

S: señal

A signal is a flow of data conveying information to a *process*. (Recommendation Z.101, § 1.3.1 [7].)

6940 **specification** (in SDL)

F: spécification

S: especificación

The requirements of a system are defined in a specification of that system. A specification consists of *general parameters* required of the system and the *functional specification (FS)* of its required behaviour. (Recommendation Z.101, §§ 1.2.2 a), 1.2.2 b) [7].)

6941 **specification and description language (SDL)**

F: langage de spécification et de description (LDS)

S: lenguaje de especificación y descripción (LED)

The CCITT language used in the presentation of the *functional specification* and *functional description* of the internal logic processes in stored programmed control (SPC) switching systems.

6942 **state** (in SDL)

F: état

S: estado

A state is a condition in which the action of a *process* is *suspended* awaiting an *input*. (Recommendation Z.101, § 1.3.3 [7].)

6943 **symbol** (in SDL)

F: symbole

S: símbolo

In the context of SDL, a symbol is a representation of the concept of either a *state*, *input*, *task*, *output*, *decision* or *save*. (Recommendation Z.102, § 2.2 [6].)

6944 **task** (in SDL)

F: tâche

S: tarea

A task is any action within a *transition* which is neither a *decision* nor an *output*. (Recommendation Z.101, § 1.3.8 [7].)

6945 **transition** (in SDL)

F: transition

S: transición

A transition is a sequence of *actions* which occurs when a *process* changes from one *state* to another in response to an *input*. (Recommendation Z.101, § 1.3.5 [7].)

7 **(Spare)**

8 **Mobile station networks**

8.0 *Network structure*

8010 **base station** (in mobile station networks)

F: station de base (dans des réseaux de stations mobiles)

S: estación de base (en redes con estaciones móviles)

A fixed arrangement of radio emitters and receivers installed in a suitable site of a geographical area for the purpose of operating radio channels with mobile stations circulating in the geographical area concerned.

8011 **base station area**

F: zone de la station de base

S: zona de estación de base

The part of the network covered by a base station. Every mobile station in a base station area can be reached by the radio equipment of the base station.

8014 **mobile services switching centre (MSC)**

F: centre de commutation pour les services mobiles (CCM)

S: centro de conmutación de los servicios móviles (CCM)

In an automatic system, the interface between the radio mobile system and the public switched telephone network. The MSC performs all necessary signalling functions in order to establish calls to and from mobile stations. A mobile station is registered at one MSC which functions as its home centre for charging and billing purposes and for administering its subscriber parameters such as category.

In order to obtain radio coverage of a given geographical area a number of base stations are normally required; i.e. each MSC would thus have to interface several base stations. In addition several MSCs may be required in order to cover a country. "Land" or "maritime" may precede the term as qualifiers if that is more suitable in a specific application.

8015 **mobile service switching centre (MSC area)**

F: zone du centre de commutation pour les services mobiles (CCM)

S: centro de conmutación de servicio móvil (zona de CCM)

The part of the network covered by a mobile service switching centre. A MSC area may consist of several location areas.

8017 public land mobile network (PLMN)

F: réseau mobile terrestre public (RMTP)

S: red del servicio móvil terrestre público (RMTP)

A collection of mobile service switching centre areas within a common numbering plan (e.g. service access codes) and a common routing plan (e.g. definition of crossover point).

Functionally the PLMNs may be regarded as independent communications entities even though different PLMNs may be interconnected through the PSTN and PDNs for forwarding of calls or network information. A similar type of interconnection may exist for the interaction between the MSCs of one PLMN.

8018 service area

F: zone de service

S: zona de servicio

An area in which a mobile station is obtainable by a fixed telephone subscriber without the subscriber's knowledge of the actual location of the mobile station within the area. A service area may consist of several public land mobile networks. One service area may consist of one country, be part of a country or comprise several countries. The location registration system associated with each service area must thus contain a list of all mobile stations located within that service area.

See Figure 2/Q.70 for an example of the composition of a service area.

8020 system area

F: zone du système

S: zona de sistema

The group of public land mobile networks (or service areas) accessible by fully compatible mobile stations.

8025 location area

F: zone de localisation

S: zona de posición

An area in which a mobile station may move freely without updating the location register. A location area may comprise several base stations.

8030 home mobile service switching centre (MSC)

F: centre de commutation pour les services mobiles (CCM) de rattachement

S: centro de conmutación de servicio móvil (CCM) de domicilio

The MSC to which a mobile station is assigned for record purposes such as subscriber information.

8032 home public land mobile network (PLMN)

F: réseau mobile terrestre public (RMTP) de rattachement

S: red del servicio móvil terrestre público (RMTP) de domicilio

The PLMN in which a mobile station is permanently registered.

8035 visited mobile service switching centre (MSC)

F: centre de commutation pour les service mobiles (CCM) visité

S: centro de conmutación de los servicios móviles (CCM) visitado

The MSC, other than the home MSC, controlling the area in which a roaming subscriber is currently located.

8037 visited public land mobile network (PLMN)

F: réseau mobile terrestre public (RMTP) visité

S: red del servicio móvil terrestre público (RMTP) visitada

The PLMN, other than the home PLMN, in which a roaming subscriber is currently located.

8040 gateway mobile service switching centre (MSC)

F: centre de commutation pour les services mobiles (CCM) tête de ligne

S: centro de conmutación de los servicios móviles (CCM) de cabecera

The MSC which receives a call from a fixed subscriber, via a public switched network, for extension to a mobile station. The gateway MSC may vary for interconnection with different public networks.

The gateway MSC could be the home MSC or the visited MSC or any other.

8042 gateway public land mobile network (PLMN)

F: réseau mobile terrestre public (RMTP) tête de ligne

S: red del servicio móvil terrestre público (RMTP) de cabecera

The PLMN which receives a call from a fixed subscriber, via a public switched network, for extension to a mobile station. The gateway PLMN may vary for interconnection with different public networks.

The gateway PLMN could be the home PLMN or the visited PLMN or any other.

8.1 Identification and numbering

8111 national mobile station identity (NMSI)

F: identité nationale de la station mobile (INSM)

S: identidad de estación móvil nacional (IEMN)

The mobile station identification uniquely identifying the mobile station nationally.

The NMSI consists of the MNC followed by the MSIN.

8112 mobile network code (MNC)

F: code de réseau mobile (CRM)

S: indicativo de red para el servicio móvil (IRM)

A digit or a combination of digits in the national part of the mobile station identification uniquely identifying the home PLMN of the mobile station.

8113 mobile station identification number (MSIN)

F: numéro d'identification de la station mobile (NISM)

S: número de identificación de estación móvil (NIEM)

The part of the mobile station identification following the Mobile Network Code uniquely identifying the mobile station within a PLMN.

8114 mobile country code (MCC)

F: indicatif de pays de la station mobile (IPSM)

S: indicativo de país para el servicio móvil (IPM)

The part of the mobile station identification uniquely identifying the country of domicile of the mobile station.

8115 international mobile station identity (IMSI)

F: identité internationale de la station mobile (IISM)

S: identidad de estación móvil internacional (IEMI)

The mobile station identification uniquely identifying the mobile station internationally.

The IMSI consists of the MCC followed by the NMSI.

8120 international number of mobile station

F: numéro international de station mobile

S: número internacional de estación móvil

The number to be dialled following the international prefix to obtain a mobile station in another country. It consists of the country code of the country in which the mobile station is registered followed by the national (significant) mobile number of the called mobile station.

8125 national (significant) mobile number

F: numéro national (significatif) de la station mobile nationale (significative)

S: número móvil nacional (significativo)

The national (significant) mobile number could have the following form depending upon the way in which the land mobile numbering plan is integrated with the telephone numbering plan:

- i) The land mobile numbering plan could be fully integrated with the telephone numbering plan. In this case the mobile stations will be allocated a *subscriber number* as defined in Section 5 of Recommendation E.160. The *national (significant) mobile number* then consists of the *trunk code* allocated to the numbering area corresponding to the home area of the mobile station followed by the *subscriber number* allocated to it.
- ii) The public land mobile network could be regarded as a separate numbering area within the telephone network. In this case the national (significant) mobile number will consist of the *trunk code* allocated to the PLMN and the *subscriber number* within the PLMN.

8130 mobile station roaming number

F: numéro itinérant de station mobile

S: número itinerante de estación móvil

The number allocated to a land mobile station for the purpose of routing calls to that station when it has roamed out of the area covered by the public land mobile network in which the station is permanently registered.

8.2 Techniques and functions

8210 radio speech path

F: trajet radioélectrique de conversation

S: radiotrayecto de conversación

The radiocommunication facility between a mobile station and a base station intended to carry a call and uniquely assigned to the mobile station during the call.

8215 radio control path

F: trajet radioélectrique de commande

S: radiotrayecto de control

The radiocommunication facility between a mobile station and a base station intended to carry all the information transfer between the mobile station and the MSC, in which area the mobile station currently is located, during the time that no radio speech path between that base station and that mobile station is assigned.

8220 hand-off

F: passage sur une autre liaison

S: transferencia

The action of switching a call in progress from one base station to another base station. Hand-off is used to allow established calls to continue when mobile stations move from one base station area to another base station area.

8250 location information

F: information de position

S: información de posición

A minimum of information about a mobile station:

- international mobile station identity;
- actual location of the mobile station (e.g. public land mobile network, mobile service switching centre area, location area, as required).

8251 location register

F: enregistreur de position

S: registrador de posición

A function that stores the location information of the radio mobile system.

8270 designation method

F: methode avec désignation

S: método con designación

The calling subscriber must know the actual location area of the mobile station. The call is established according to the dialled information only, i.e. the call is not rerouted by the location register when the mobile station currently is in another location area.

8272 non-designation method

F: methode sans désignation

S: método sin designación

The calling subscriber is not required to know the actual location area of the mobile station. The call is routed according to the dialled information and, if required, rerouted on additional information given by a location register.

9 Telephone subscriber's equipment and local lines

(Still to be prepared.)

ANNEX A
(to Recommendation Q.9)

Alphabetical list of terms defined in this Recommendation

6112	absolute address	0022	circuit group
4022	access protocol	0020	... circuit (specific function)
6111	address	0023	circuit sub-group
2303	address-incomplete signal	1125	circuit-switching
2205	address separator	0013	circuit, telecommunication circuit
2301	address signal	2312	clear-back signal
2302	address signal complete	2311	clear-forward signal
2110	adjacent signalling points	0069	code division
0122	administrative processor	4008	codirectional interface
6102	algorithm	4006	codirectional interfaces
2032	alternating current signalling (a.c. signalling)	1019	co-located exchange concentrator
1443	amplitude quantized control	1005	combined local/transit exchange
1442	analogue control	3105	command (in MML)
1429	anisochronous	6403	command language
6906	arithmetic expression (in MML)	6901	comment (in MML)
6302	assembler; assembly program	6925	comment (in SDL)
6404	assembly language	2008	common channel signalling
2130	associated mode (of signalling)	0001	communication (1)
5001	automatic switching equipment	2023	compelled signalling (fully compelled; continuous compelled)
1031	automatic system	2022	compelled signalling (general sense)
0046	backward signal	6304	compiler; compiling program
2207	band number	0010	(complete) connection in telecommunication
6115	base address	6401	computer language; machine language
8011	base station area	1117	concentration (in a switching stage)
8010	base station (in mobile station networks)	2313	confusion signal
0063	bidirectional	0011	connection
1439	bilateral control	6926	connector (in SDL)
6907	binary numeral	2140	continuity check
2135	block (data)	3110	control character (in MML)
2136	block (Signalling System No. 6)	6202	conversational mode
0216	both-way	2203	country-code indicator
1407	bunched frame alignment signal	5012	crossbar switch
0208	busy	1205	crossbar system
0209	busy test (USA)	1315	cross-exchange check (cross-office)
0009	call (1)	2116	data channel
0012	call attempt (1) (of a user)	2117	data link
2306	call-failure signal	6911	decimal numeral
6110	call (in software), procedure call	6927	decision (in SDL)
2073	call spill-over	1449	democratic (mutually synchronized) network
2204	calling party's category indicator	6928	description (in SDL)
3101	CCITT MML	8270	designation method
4007	centralized clock interface	1451	despotic (synchronized) network
6208	chaining search	6209	dichotomizing search
2126	changeback	6912	digit
2125	changeover	1418	digit time slot
0008	channel	1804	digital block
2009	channel associated signalling	1122	digital circuit
1330	channel gate	1135	digital connection
1129	channel switching	1010	digital exchange
1415	channel time slot	1803	digital line section
6908	character	1132	digital link
6910	character set (in MML)	1121	digital node, digital switching node
1310	character signal	1802	digital path
2141	check bit	1801	digital section
2142	check loop	1120	digital switching
6501	CHILL		

6118	direct access [random access]	1318	in-call
6114	direct address	1319	in-call rearrangement
2030	direct current signalling (d.c. signalling)	1507	incoming response delay
1408	distributed frame alignment signal	6113	indirect address
5004	distribution frame	2060	initial address message (IAM)
1441	double-ended synchronization	1105	inlet
2033	dual seizure	2005	in-slot signalling
0019	(electric) circuit	6916	input (in MML)
2021	en-bloc signalling	6934	input (in SDL)
2304	end-of-pulsing (ST) signal	0004	integrated digital network
2018	end-to-end signalling	0005	integrated digital network, digital network
0209	engaged test (UK); busy test (USA)	1134	integrated digital transmission and switching
2091	enquiry (in a transaction)	1011	integrated services exchange
0222	error burst	4001	interface
1512	exchange call-release delay	4003	interface specification
1508	exchange call set-up delay	5006	intermediate distribution frame
1018	exchange concentrator	8115	international mobile station identity (IMSI)
3001	exchange control system	8120	international number of mobile station
1001	exchange (switching exchange, switching centre)	6210	interrupt; interruption
6310	executive program; supervisory program; supervisor	2039	interruption control
1118	expansion (in a switching stage)	3012	I/O devices
6106	field	1428	isochronous
6104	file	1206	juncor (in the crossbar system)
0075	flag	6107	key (tag) (label)
6913	flow line (in MML)	2206	label
6929	flow line (in SDL)	6917	letter
6902	format	1025	line concentrator (stand alone concentrator)
0042	forward signal	2014	line signalling
1141	four-wire switching	0031	link
1332	frame	2017	link-by-link signalling
1405	frame alignment	6305	link (in programming)
1409	frame alignment recovery time	1207	link (in the crossbar system)
1406	frame alignment signal	2128	load-sharing (general)
1417	frame alignment time slot	1002	local exchange [local central office]
0068	frequency division	8025	location area
1128	frequency division switching	8250	location information
3115	function (in MML)	8251	location register
6930	functional block (in SDL)	0225	long-term bit error rate
6931	functional description (FD) (in SDL)	2031	loop/disconnect signalling
6932	functional specification (FS) (in SDL)	6409	low level language
0105	functional unit	6402	macroinstruction; macro (instruction)
8042	gateway land mobile network (PLMN)	5005	main distribution frame
8040	gateway mobile service switching centre (MSC)	6410	man-machine language (MML)
6933	general parameters (in SDL)	0226	medium-term bit error rate
1007	geographically distributed exchange [geographically dispersed exchange]	1433	mesochronous
6914	graphic characters	2070	message sequencing
2042	guarding (in VF signalling)	1130	message switching
8220	hand-off	2101	message transfer part
6903	header	6918	meta-language (in MML)
1435	heterochronous	6314	microinstruction
6915	hexadecimal numeral	6315	microprogram
1450	hierarchic (mutually synchronized) network	6411	mnemonic (abbreviation)
6408	high level language (HLL)	6905	mnemonic abbreviation
8030	home mobile service switching centre (MSC)	8114	mobile country code (MCC)
8032	home public land mobile network (PLMN)	8112	mobile network code (MNC)
1432	homochronous	8015	mobile service switching centre (MSC area)
0016	hypothetical reference circuit (nominal maximum circuit)	8014	mobile services switching centre (MSC)
6108	identifier	8113	mobile station identification number (MSIN)
6904	identifier (in MML)	8130	mobile station roaming number
2011	in-band signalling	6117	monitor
		1333	multiframe

2034	multi-frequency code signalling (MFC signalling)	1008	remotely controlled exchange
1149	multiple	2121	reserve signalling link
1136	multislot connection	2092	response (in a transaction)
1448	mutually synchronized network	1425	retiming
8111	national mobile station identity (NMSI)	6311	reusable program (routine)
8125	national (significant) mobile number	2309	ringing tone ; ringback tone (USA)
0112	(network) resource(s)	0150	route
0003	network, telecommunication network	6308	routine
2131	non-associated mode (of signalling)	0151	routing
8272	non-designation method	1013	satellite exchange
1447	nonsynchronized network	6938	save (in SDL)
6406	object language ; target language	0205	seizure
6919	octal numeral	1115	selection stage
1452	oligarchic (synchronized) network	1030	semi-automatic system
0215	one-way	1138	semi-permanent connection
6201	operating system	6922	separator (in MML)
0124	operation and maintenance centre processor	1336	serial to parallel converter ; deserializer (USA) [staticizer]
2012	out-band signalling	8018	service area
1106	outlet	2202	service indicator
1410	out-of-frame alignment time	0040	signal (general sense)
6920	output (in MML)	2041	signal imitation (in VF signalling)
6935	output (in SDL)	6939	signal (in SDL)
2006	out-slot signalling	0041	signal (in signalling applications)
2024	overlap address signalling	2040	signal spill-over (in VF signalling)
2025	overlap line signalling	2108	signal transfer point
1335	parallel to serial converter ; serializer (USA) [dynamicizer]	2137	signal units
6109	parameter	2001	signalling
6921	parameter (in MML)	2122	signalling channel (Signalling System No. 6)
0026	path, telecommunication path	2123	signalling data link
4002	physical interface	2109	(signalling) destination point
4004	physical interface specification (physical interface)	2050	signalling information
6936	pictorial element (PE)	2118	signalling link
0231	pilot	2119	signalling link set
1434	plesiochronous	2138	signalling message
1514	post dialling delay	2139	(signalling) message route
1331	primary block ; digroup (USA)	2103	signalling network
0060	process (in a data processing system)	2104	signalling network management functions
6937	process (in SDL)	2107	(signalling) originating point
0120	processor	2106	signalling point
6307	programming system	2115	signalling point code
4020	protocol	2111	signalling relation
8017	public land mobile network (PLMN)	2112	signalling route
2133	quasi-associated mode (of signalling)	2113	signalling route set
8215	radio control path	2114	signalling routing
8210	radio speech path	2020	signalling system
0221	random errors	1416	signalling time slot
6103	real time (adjective)	2105	(signalling) traffic flow control
2072	reasonableness check	1440	single-ended synchronization
6105	record	0115	software
6312	reentrant program (routine) (subroutine) ; reenterable program (routine) (subroutine)	6407	source language
1146	reentrant trunking	0066	space division
1210	register	1126	space division switching
3008	register function	6941	specification and description language (SDL)
2016	register signalling (signalling system R1)	6940	specification (in SDL)
2120	regular signalling link	2004	speech digit signalling
0212	release	2043	splitting (in VF signalling)
2310	release-guard signal	6942	state (in SDL) subframe
6116	relocatable address	6309	subroutine
1020	remote exchange concentrator	0050	subscriber's line
1016	remote switching stage	2061	subsequent address message (SAM)
		1110	switching

1506	switching delay (processing (handling) time)	1426	timing recovery (timing extraction)
1113	switching matrix	6301	to assemble
1112	switching network	6303	to compile
1111	switching node	6316	to debug (in programming)
1015	switching stage	6211	to dump
6923	symbol	6306	to link (in programming)
6943	symbol (in SDL)	6206	to map (over)
1431	synchronization	6205	to pack
1446	synchronized network [synchronous network]	6212	to patch
1430	synchronous	6207	to relocate
6405	syntax	0108	traffic-carrying device
6924	syntax diagram	2090	transaction (in signalling applications)
8020	system area	1004	transit exchange [tandem exchange, tandem central office, tandem office]
3103	system (in MML)	6945	transition (in SDL)
6313	target program ; object program	1212	translation
6944	task (in SDL)	1213	translator
0002	telecommunication	1505	transmission delay (through a digital exchange)
0015	telephone circuit	1137	trombone (loop) connection
1510	through-connection delay	1140	two-wire switching
0067	time division	0064	unidirectional
1305	(time division) highway (in switching); bus (USA)	1438	unilateral control
1127	time division switching	2071	unreasonable message
1444	time quantized control	2102	user part
6203	time sharing [time slicing]	4025	user-user protocol
6204	time slicing [time sharing]	8035	visited mobile service switching centre (MSC)
1414	time slot	8037	visited public land mobile network (PLMN)
1422	time slot interchange	2033	voice-frequency signalling (VF signalling)
1420	time slot sequence integrity		

References

- [1] CCITT Recommendation *Vocabulary of pulse code modulation (PCM) and digital transmission terms*, Vol. III, Rec. G.702.
- [2] *List of definitions of essential telecommunication terms*, ITU, Geneva, 1961.
- [3] *List of terms and definitions of teletraffic*, Vol. II, Supplement No. 7.
- [4] CCITT Recommendation *CCITT high level language (CHILL)*, Vol. VI, Rec. Z.200.
- [5] CCITT Recommendation *The character set and basic elements*, Vol. VI, Rec. Z.314, Table 1/Z.314.
- [6] CCITT Recommendation *Symbols and rules*, Vol. VI, Rec. Z.102.
- [7] CCITT Recommendation *General explanation of the specification and description language (SDL)*, Vol. VI, Rec. Z.101.
- [8] CCITT Recommendation *Use of pictorial elements within state symbols*, Vol. VI, Rec. Z.103.
- [9] CCITT Recommendation *Definitions of essential technical terms in the field of telegraph transmission*, Vol. VII, Rec. R.140.

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SECTION 2

NUMBERING PLAN AND DIALLING PROCEDURES IN THE INTERNATIONAL SERVICE

Recommendation Q.10

DEFINITIONS RELATING TO NATIONAL AND INTERNATIONAL NUMBERING PLANS¹⁾

1 international prefix

F: préfixe international

S: prefijo internacional

The combination of digits to be dialled by a calling subscriber making a call to a subscriber in another country, to obtain access to the automatic outgoing international equipment.

2 country code

F: indicatif du pays

S: indicativo de país

The combination of one, two or three digits characterizing the called country.

3 trunk prefix

F: préfixe interurbain

S: prefijo interurbano

A digit or combination of digits to be dialled by a calling subscriber, making a call to a subscriber in his own country but outside his own numbering area. It provides access to the automatic outgoing trunk equipment.

4 trunk code

F: indicatif interurbain

S: indicativo interurbano

A digit or combination of digits (not including the trunk prefix) characterizing the called numbering area within a country (or group of countries, included in one integrated numbering plan).

The trunk code has to be dialled before the called subscriber's number where the calling and called subscribers are in different numbering areas.

¹⁾ This Recommendation is an extract of Recommendation E.160 [1]. For the examples relating to §§ 1 to 7, see Fascicle II.2.

5 subscriber number²⁾

F: numéro d'abonné

S: número de abonado

The number to be dialled or called to reach a subscriber in the same local network or numbering area.

This number is the one usually listed in the directory against the name of the subscriber.

6 national (significant) number

F: numéro national (significatif)

S: número nacional (significativo)

The number to be dialled following the trunk prefix to obtain a subscriber in the same country (or group of countries, included in one integrated numbering plan) but outside the same local network or numbering area.

The national (significant) number consists of the trunk code followed by the subscriber number.

It should be noted that, in some countries, it is customary to consider *for national purposes* that the trunk prefix is included in the national number [which is then not the national (significant) number]. A careful distinction must therefore be made between such national definition or practice and the CCITT definition, which is internationally valid. In order to avoid misunderstanding, the CCITT definition includes the word "significant" between brackets, reading as follows: "national (significant) number".

7 international number

F: numéro international

S: número internacional

The number to be dialled following the international prefix to obtain a subscriber in another country.

The international number consists of the country code of the required country followed by the national (significant) number of the called subscriber.

Reference

- [1] CCITT Recommendation *Definitions relating to national and international numbering plans*, Vol. II, Fascicle II.2, Rec. E.160.

Recommendation Q.11¹⁾

**ARRANGEMENT OF FIGURES, LETTERS AND SYMBOLS
ON ROTARY DIALS AND PUSHBUTTON TELEPHONE SETS**

1 Use of figures and letters in telephone numbers

1.1 For the automatic international service, it is preferable that the national numbering plan should not involve the use of letters (associated with figures). The use of letters in national numbering plans may, however, be necessary for national reasons. For example, countries using letters in their subscriber numbers will naturally use them in their national numbering.

²⁾ Care should be taken not to use the term "local number" instead of "subscriber number".

¹⁾ This Recommendation is also included in the Series E Recommendations under the number E.161.

- 1.2 For the automatic international service to countries using letters in telephone numbers, it would be helpful, in a country where letters are not used:
- a) to include in the directory a table for converting into figures the letter codes of exchanges in countries with which an automatic service is available;
 - b) to supply, at the time of opening this automatic service, a booklet of instructions containing the conversion table to the main subscribers to the international service.
- 1.3 It would also be desirable, in countries with letters in the telephone numbers, that subscribers with considerable international traffic should be asked to show on their letterheads, below their national telephone number, the international number with figures only. (See Recommendation E.123 [1].)

2 Rotary dials (see Figure 1/Q.11)

- 2.1 For countries which have not yet adopted any specific type of dial, the figures on the dial should be arranged in the following order: 1, 2, 3, ..., 0.
- 2.2 The dial shown in Figure 1/Q.11 uses the arrangement of letters and figures employed by some European Administrations. It may be convenient that the dials or pushbutton sets used by international operators for semiautomatic operating in Europe have this arrangement of letters and figures.
- Note* — On the North American dials and keysets, the digit 0 is not associated with letters O and Q but with the word *operator*, the letter O being associated with digit 6.

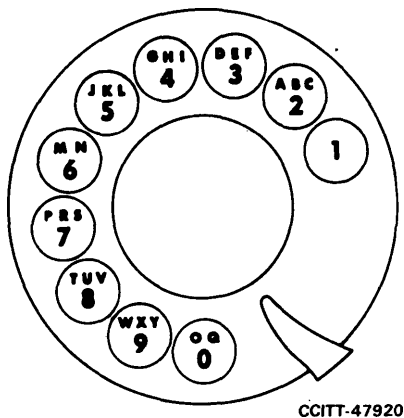


FIGURE 1/Q.11
Rotary dial

3 Pushbutton telephone sets

- 3.1 *10-pushbutton sets*
- 3.1.1 *Arrangement and numbering*

The standard arrangement and numbering for pushbuttons corresponding to the digits 1 to 0 is as shown below:

1	2	3
4	5	6
7	8	9
0		

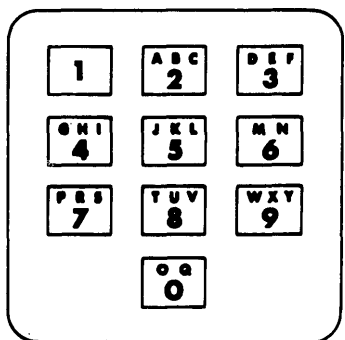
This arrangement, which corresponds to that already adopted in many countries — and on which some Administrations have based their standardization — is one found suitable for telephone users. This recommendation results from thorough studies made by several Administrations on subscriber reactions to various conceivable pushbutton patterns. Moreover, extensive research has shown that this arrangement leads to shorter entry times and lower error rates than other arrangements.²⁾

Where a need exists within an Administration for a 5×2 array for use on special telephone apparatus, the array should be as shown below:

1	2
3	4
5	6
7	8
9	0

Note — User dialling performance on this special array is slightly inferior to that on the standard array given above.

In view of the fact that purely numerical numbering plans are now recommended and that the association of letters to digits is not the same in different countries³⁾, it is undesirable to standardize letter symbols for the pushbuttons corresponding to each of the digits. In cases where a mixed letter-and-digit dialling system is still in use in a country, the letters associated with the figures in the dialling system of the country concerned may, of course, be included on the corresponding pushbuttons of their country's telephone sets (see Figure 2/Q.11).



CCITT-47930

FIGURE 2/Q.11

10-pushbutton set

3.1.2 Symbols

The symbols for these buttons are the digits 1 to 0 as indicated in the figures of § 3.1.1 above. These buttons are to be known as button 1, button 2, etc.

²⁾ An annotated list of literature references is available in an article from the periodical TELE No. 1, 1982, entitled "The layout of digits on push-button telephones — a review of the literature". Copies can be obtained from the author: Mr. G. Wikell, Swedish Telecommunication Headquarters, S-12386 FARSTA, Sweden.

³⁾ Thus, for example, on the North American dials and keysets, the digit 0 is not associated with letters O and Q but with the word *operator*, the letter O being associated with the digit 6.

3.2 12-pushbutton sets

3.2.1 Arrangement

In the 12-pushbutton set the standard arrangement shown in § 3.1.1 above is extended by two additional buttons, one to the left and the other to the right of the button 0, thus making a pattern of four horizontal rows of three buttons each forming a 4 × 3 array.

Two buttons may also be added to the 5 × 2 array shown in § 3.1.1 above. These should be located below and in line with buttons 9 and 0, thus making a 6 × 2 array.

3.2.2 Symbols

On the 4 × 3 array, the symbol on the button which is immediately to the left of the button 0 (on the 6 × 2 array, the corresponding button is located below button 9) and which, according to Recommendation Q.23, is used to transmit the frequency pair 941 Hz and 1209 Hz, should have a shape easily identified as the general shape shown in Figure 3/Q.11.



FIGURE 3/Q.11

The symbol will be known as the *star* as translated in the various languages.

On the 4 × 3 array, the symbol on the button which is immediately to the right of the button 0 (in the 6 × 2 array, the corresponding button is located below the button 0) and which, according to Recommendation Q.23, is used to transmit the frequency pair 941 Hz and 1477 Hz, should conform in shape to the specifications given in Figures 4/Q.11 or 5/Q.11. This symbol shall consist of four lines of equal length (*b*), forming two pairs of parallel lines. One pair is horizontal while the other is vertical or inclined to the right at an angle α of 80° as shown in Figure 5/Q.11. It will be seen that the two pairs of parallel lines overlap. The ratio a/b , where a is the overlap, shall be between 0.08 and 0.18.

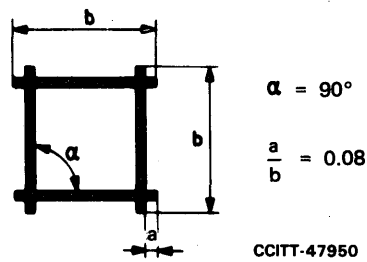


FIGURE 4/Q.11

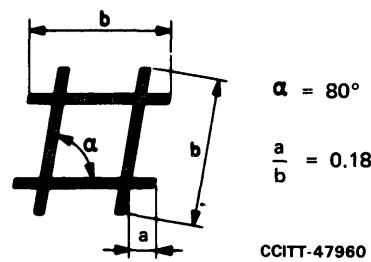


FIGURE 5/Q.11

The preferred values are:

- in Europe⁴⁾:
 $\alpha = 90^\circ$ with $a/b = 0.08$;
- in North America⁴⁾:
 $\alpha = 80^\circ$ with a/b close to the upper limit of 0.18.

⁴⁾ No information is available at the present time as to which of these values would be preferred in other continents.

The symbol will be known as the *square* or the most commonly used equivalent term in other languages⁵⁾.

The additional buttons with these symbols will be placed as shown below:

Standard 4 × 3 array

1	2	3
4	5	6
7	8	9
*	0	#

6 × 2 array

1	2
3	4
5	6
7	8
9	0
*	#

3.3 16-pushbutton sets

3.3.1 Arrangement

In the 16-pushbutton set, the 4 × 3 array shown in § 3.2.2 above is extended by four additional pushbuttons placed to the right in such a way as to form a 4 × 4 array.

3.3.2 Symbols

On the 4 × 4 array, the symbols on the additional buttons are A, B, C and D⁶⁾. (The reasons for the choice of these four symbols are explained in Annex A.)

- A is the symbol for the button to the right of pushbutton 3 and is used to transmit the frequency pair 697 Hz and 1633 Hz⁷⁾.
- B is the symbol for the button to the right of pushbutton 6 and is used to transmit the frequency pair 770 Hz and 1633 Hz⁷⁾.
- C is the symbol for the button to the right of pushbutton 9 and is used to transmit the frequency pair 852 Hz and 1633 Hz⁷⁾.
- D is the symbol for the button to the right of pushbutton # and is used to transmit the frequency pair 941 Hz and 1633 Hz⁷⁾.

In order to avoid any possibility of auditory confusion in transmitting these letters over international telephone lines the phonetic equivalents:

Amsterdam	or Alfred
Baltimore	Benjamin
Casablanca	Charles
Denmark	David

as already used in international telephone working, are recommended for identifying the letters A, B, C, D.

⁵⁾ In some countries an alternative term (e.g. "number sign"), may be necessary for this purpose, unless further investigation indicates that "square" is suitable for the customer.

⁶⁾ If letters still appear on buttons 1 to 0 of the pushbutton set when 16-pushbutton sets are introduced, Administrations may choose to use the lower case letters a, b, c, d rather than the upper case letters until such a time as it is possible to remove the alphabetic characters from buttons 1 to 0.

⁷⁾ These are the frequency pairs specified for the right-hand column as indicated in Recommendation Q.23.

The additional buttons with these symbols will be placed as shown below⁸⁾

1	2	3	A
4	5	6	B
7	8	9	C
*	0	#	D

3.4 *Design of symbols*

Symbol size and the line thickness should be appropriate to provide optimal recognition⁹⁾.

3.5 *Use of colours*

The question of standardization of pushbutton and symbol colour for international purposes is still not settled. In the meantime, colours different from the digit buttons and symbols should not be used^{9), 10)}.

4 **Additional pushbuttons for use on telephones**

4.1 *General*

For purposes other than dialling, additional pushbuttons may be required on a telephone. For example, a telephone may have a pushbutton to recall during an active call, control logic (e.g. a register) or an operator, or to effect the transfer of an active call to another station. To prevent subscriber confusion it may be desirable that the symbols used on those pushbuttons which have identical functions be standardized.

4.2 *Specific recommendations*

4.2.1 *Register recall pushbutton*

For the recall of a register during an active call the following methods are possible:

- a switchhook flash,
- a depression of one of the pushbuttons of the normal 10, 12 or 16 button array,
- a depression of another pushbutton specially provided for this purpose, the register recall pushbutton.

From the human factors viewpoint the depression of a pushbutton for register recall seems to be preferable to the use of a switchhook flash.

If a special register recall pushbutton is used, this pushbutton should be designated with the symbol R (capital) on or next to the pushbutton. The pushbutton should be clearly distinguishable and spatially separated from the standard 12 or 16-pushbutton array.

This symbol is recommended because:

- a) it symbolizes the term “Recall” in a number of languages;
- b) studies have shown that it is subject to minimal auditory and visual confusion;
- c) it avoids the difficulties inherent in specific technical terms for any lay subscribers.

The exact position, shape and colour of the button should not be standardized at the present time. Such standardization would inhibit design innovation and be unnecessarily restrictive.

⁸⁾ Some Administrations may wish to provide spatial separation for special reasons between buttons A, B, C, D and the other twelve buttons.

⁹⁾ Where exceptionally, for national purposes, Administrations use colours for the * and # symbols which are different from those used for the digit symbols, they should be red and blue respectively.

¹⁰⁾ Further study may show whether some form of perceptual separation, such as colour or size, is required between the pushbuttons A, B, C, D and the other twelve pushbuttons.

(to Recommendation Q.11)

**Method used in selecting the symbols for pushbuttons 13 to 16
of 16-pushbutton telephone sets**

During its Montreal meeting in June-July 1970, Study Group II agreed that a study had to be undertaken forthwith in order to choose suitable symbols for pushbuttons 13 to 16 of the 16-pushbutton set. The matter was considered urgent because at that time 16-pushbutton telephone sets were commercially available and various manufacturers had expressed an interest in their production. Standardization of the symbols was immediately needed to guide manufacturers before a large number of unstandardized sets was produced, that is, using different symbols or symbols that do not satisfy elementary human factor rules.

Pushbutton sets, it was noted, could be used not only for communications between subscribers but also for other purposes, e.g. for end-to-end data transmission. A large number of possible applications is envisaged. Many telephone and data applications, or functions, are not yet known but are likely to appear in the future when 16-pushbutton sets are introduced. These considerations led the CCITT to decide that the symbols for the pushbuttons 13 to 16 should not have any special meaning related to the functions of the pushbuttons.

A variety of symbols was considered during the studies made from 1970 to 1972. However, it appeared that only a set of four letters of the Latin alphabet satisfies most of the requirements mentioned in the Annex A to Recommendation E.123 [1], "Desirable properties of diallable symbols". In short, these desirable properties are:

- 1) distinct from other diallable symbols,
- 2) widely known by name,
- 3) reproducible,
- 4) CCITT-ISO compatible,
- 5) made up of a single character,
- 6) abstract,
- 7) immediately recognizable as a diallable character.

A test programme was designed in 1970 to find the most suitable set of four letters. This included a study of auditory and visual confusion between letters and the existing digits and symbols for the pushbuttons 1 to 12. Eight countries participated in the auditory tests and eight in the visual confusion tests. In addition, configuration (layout) tests were performed in seven countries.

The countries participating in the auditory confusion tests were: Australia, Denmark, Finland, Federal Republic of Germany, Japan, Sweden, United Kingdom (British Telecom), and United States of America (AT&T).

The countries participating in the visual confusion tests were: Canada, Denmark, Finland, Federal Republic of Germany, Italy, Sweden, United Kingdom (British Telecom), and United States of America (AT&T).

The countries participating in the configuration (layout) tests were: Canada, Japan, Federal Republic of Germany (Siemens), Netherlands (PTT/IPO), Sweden, United Kingdom (British Telecom), and United States of America (AT&T).

The results of the configuration tests showed a small decrement in the dialling performance with a 16-pushbutton set as compared to a standard 12-pushbutton set which, however, is not statistically significant. In these tests, pushbuttons 13 to 16 were labelled A, B, C, and D.

The results of the three types of tests were examined together with considerations of other desirable properties of the symbol set, e.g.:

- 1) simplicity for the user,
- 2) a logical sequence,
- 3) ease of recognition in as many countries as possible,
- 4) possibility of extending the set of symbols.

It was then agreed that the series of letters A, B, C, D was the most satisfactory from a general point of view.

Reference

- [1] CCITT Recommendation *The use and printing of symbols and separators in national and international telephone numbers*, Vol. II, Rec. E.123.

NUMBERING PLAN FOR THE INTERNATIONAL TELEPHONE SERVICE

Introduction

This Recommendation describes the numbering plan for the International Telephone Service. Recommendation E.164 describes the numbering plan for the ISDN era. It is for each Administration to choose the method of application from the two Recommendations which would provide the optimum approach to meeting their future national numbering plan needs. Evolution between the plans is for further study. However, for new equipment, it is recommended that E.164 be adopted.

1 National numbering plan

1.1 Each telephone Administration should give the most careful consideration to the preparation of a *national numbering plan*²⁾ for its own network. This plan should be designed so that a subscriber is always called by the same number in the trunk service. It should be applicable to all incoming international calls.

1.2 Number analysis

1.2.1 The national numbering plan of a country should be such that an analysis of a minimum number of digits of the national (significant) number (see definitions in Recommendation E.160 [2]):

- a) gives the most economical routing of incoming international traffic from various other countries;
- b) indicates the charging area in those countries where there are several.

1.2.2 In the case of a country with a two- or three-digit country code, not more than two digits of the national (significant) number should be analyzed for these purposes.

In the case of a country with a one-digit country code, not more than the three digits of the national (significant) number should be analyzed for these purposes.

1.2.3 In the case where an integrated numbering plan covers a group of countries, the digit analysis specified in § 1.2.2 should also determine the country of destination.

1.2.4 For the requirements relating to frontier traffic, see Recommendation D.390 R [4].

2 Limitation of the number of digits to be dialled by subscribers

2.1 International number

The CCITT recommended in 1964 that the number of digits to be dialled by subscribers in the automatic international service should not be more than 12 (excluding the international prefix). It is emphasized that this is the maximum number of digits and Administrations are invited to do their utmost to limit the digits to be dialled to the smallest possible number.

2.2 National (significant) number

Noting that:

- a) the international number (excluding the international prefix) consists of the country code followed by the national (significant) number;
- b) the smallest possible number of digits to be dialled in the automatic international service is achieved by limiting the number of digits of the country code and/or of the national (significant) number;

¹⁾ This Recommendation is also included in the Series E Recommendations under the number E.163.

²⁾ See the CCITT manual cited in [1] for a comprehensive study of national numbering plans from the national point of view.

- c) in some countries where telephony is already developed to an advanced stage, the national numbering plans in force enable the number of digits of the international number to be limited to less than 12;
- d) some other countries which drew up their national numbering plans some time before 1964 have taken steps to ensure that the number of digits of the international number will not exceed 12 and may even be less;

the CCITT recommends that the number of digits of the national (significant) number should be equal to a maximum of $12 - n$, where n is the number of digits of the country code.

3 Digit capacity of international registers

The CCITT considers it advisable to recommend that the digit capacity of registers dealing with international traffic should allow for future conditions that may arise, but not possible to specify at the present time. In this regard, registers dealing with international traffic should have a digit capacity, or a capacity that can be expanded, to cater for more than the maximum 12-digit international number envisaged at present. The increase in the number of digits above 12 is left as a matter of decision to be taken by individual Administrations. However, for new applications, a minimum digit capacity of 15 digits is recommended (see Recommendation E.164 [2]). Administrations are recommended, when making such a decision, to take account of the new applications likely to be introduced in the international service, and which are now being studied by the CCITT.

4 Prefixes and codes

4.1 International prefix ³⁾

It is recommended by the CCITT that the Administrations of countries that have not yet introduced automatic international operation, or Administrations that are, for various reasons, revising their numbering plans should adopt an international prefix (a code for access to the international automatic network) composed of the two digits 00.

The reasons for this recommendation are:

- to provide a maximum degree of standardization such that dialling is made as easy as possible for a person travelling in different countries (many countries already use the code 00),
- to minimize the number of digits to be dialled in automatic international operation,
- to simplify, for a future time when the use of the international prefix might have become a universal international standard, the format for writing an international telephone number.

4.2 Country code ^{3), 4)}

4.2.1 Country codes will be used:

- in semiautomatic operation, to route calls to the required country when the calls are transit calls or when, on the outgoing positions, there is common dialling access to all the outgoing routes;
- in automatic operation.

4.2.2 A list of country codes was prepared by the CCITT within the framework of a worldwide automatic telephone numbering plan.

This list was set up according to the following principles:

- a) The number of digits of the country code is one, two or three according to the foreseeable telephonic and demographic development of the country concerned.
- b) The nine digits from 1 to 9 have been allocated as the country code or as the first digit of the country code. These digits define *world numbering zones*.
- c) In the case of Europe, owing to the large number of countries requiring two-digit codes, the two digits 3 and 4 have been allocated as the first digit of the country codes.

4.2.3 The list of country codes already assigned is given in Annex A.

³⁾ See definitions in Recommendation E.160 [3].

⁴⁾ A "country code" may be assigned either to an individual country or to a geographical area.

4.3 *Assignment of country codes*

4.3.1 The existing world numbering plan should be maintained and codes presently assigned should not be changed, unless consolidation of an existing numbered area yields an advantage in terms of code usage.

4.3.2 All spare country codes will be assigned on a 3-digit basis, as detailed in Annex B. The list of spare country codes for the international semiautomatic and automatic service is given in Annex C.

4.3.3 In the case where all the country codes in a world numbering zone have been assigned and an additional code is required in that zone, a spare country code from another world numbering zone can be used in accordance with the following rules:

4.3.3.1 Preference should be given to the assignment of a spare country code from an adjacent world numbering zone.

4.3.3.2 If spare codes are not available from an adjacent world numbering zone, assignments will be made from the zones with the most spare codes.

4.4 *Codes for new international services*

The introduction of some international services requires the allocation of a country code. In such cases, the assignment of a country code will be determined by the rules detailed in Annex B.

4.5 *Trunk prefix*⁵⁾

4.5.1 The *national (significant) number* (see definition 6 of Recommendation E.160 [2]) does not include the trunk prefix. Accordingly, in the international service, the trunk prefix of the country of destination must not be dialled.

It should be noted that, in some countries, it is customary to consider *for national purposes* that the trunk prefix is included in the national number [which is then not the national (significant) number]. A careful distinction must therefore be made between such national definition or practice and the CCITT definition, which is internationally valid. In order to avoid misunderstanding, the CCITT definition includes the word “significant” between brackets, reading as follows: “national (significant) number”.

4.5.2 It is recommended by the CCITT that the Administrations of countries that have not yet adopted a trunk prefix for access to their national automatic trunk network should adopt a prefix composed of a single digit, preferably 0. Irrespective of what digit is adopted as a trunk prefix, this digit should be precluded from being used also as a first digit of the trunk codes.

The reasons for this recommendation are:

- to provide the maximum degree of standardization of the trunk prefixes used in different countries, so that dialling is made as easy as possible for a person travelling from one country to another,
- to minimize the number of digits to be dialled in the automatic national service,
- to reduce user problems which arise because of the requirement, in automatic international operation, that the trunk prefix of the country of destination must not be dialled.

4.5.3 In the automatic international service, following the international prefix and country code of the called country, the caller should dial the national (significant) number of the called subscriber (i.e. without dialling the trunk prefix).

4.5.4 The use and printing of symbols and separators in national and international telephone numbers is detailed in Recommendation E.123 [5].

⁵⁾ See definitions in Recommendation E.160 [3].

ANNEX A

(to Recommendation Q.11 bis)

List of country codes incorporating amendments proposed by the World Plan Committee, 1984

World numbering ZONE 1

Canada	1 ^{a)}	Bermuda	1 ^{a)}
United States of America, including Puerto Rico and the Virgin Islands	1 ^{a)}	Bahamas (Commonwealth of the)	1 ^{a)}
Jamaica	1 ^{a)}	Dominican Republic	1 ^{a)}
Barbados	1 ^{a)}	Grenada	1 ^{a)}
Antigua and Barbuda	1 ^{a)}	Montserrat	1 ^{a)}
Cayman Islands	1 ^{a)}	St. Kitts	1 ^{a)}
British Virgin Islands	1 ^{a)}	St. Lucia	1 ^{a)}
		Saint Vincent and the Grenadines	1 ^{a)}

^{a)} Integrated numbering area.

World numbering ZONE 2

Egypt (Arab Republic of)	20	Zaire (Republic of)	243
Morocco (Kingdom of)	21 ^{a)}	Angola (People's Republic of)	244
Algeria (People's Democratic Republic of)	21 ^{a)}	Guinea-Bissau (Republic of)	245
Tunisia	21 ^{a)}	Diego Garcia	246
Libya (Socialist People's Libyan Arab Jamahiriya)	21 ^{a)}	Seychelles (Republic of)	248
Gambia (Republic of the)	220	Sudan (Democratic Republic of the)	249
Senegal (Republic of)	221	Rwandese Republic	250
Mauritania (Islamic Republic of)	222	Ethiopia	251
Mali (Republic of)	223	Somali Democratic Republic	252
Guinea (Republic of)	224	Djibouti (Republic of)	253
Ivory Coast (Republic of the)	225	Kenya (Republic of)	254
Upper Volta (Republic of the)	226	Tanzania (United Republic of)	255
Niger (Republic of the)	227	Uganda (Republic of)	256
Togolese Republic	228	Burundi (Republic of)	257
Benin (People's Republic of)	229	Mozambique (People's Republic of)	258
Mauritius	230	Zanzibar (Tanzania)	259
Liberia (Republic of)	231	Zambia (Republic of)	260
Sierra Leone	232	Madagascar (Democratic Republic of)	261
Ghana	233	Reunion (French Department of)	262
Nigeria (Federal Republic of)	234	Zimbabwe (Republic of)	263
Chad (Republic of)	235	Namibia	264
Central African Republic	236	Malawi	265
Cameroon (Republic of)	237	Lesotho (Kingdom of)	266
Cape Verde (Republic of)	238	Botswana (Republic of)	267
Sao Tome and Principe		Swaziland (Kingdom of)	268
Democratic Republic of)	239	Comoros (Islamic Federal Republic of the)	269
Equatorial Guinea (Republic of)	240	South Africa (Republic of)	27
Gabonese Republic	241	Faroe Islands (Denmark)	298
Congo (People's Republic of the)	242	Greenland (Denmark)	299

Spare codes 247
280, 281, 282, 283, 284, 285, 286, 287, 288, 289
290, 291, 292, 293, 294, 295, 296, 297,

^{a)} *Integrated numbering area with subdivisions:*
— Morocco: 210, 211, 212 (212 in service);
— Algeria: 213, 214, 215;
— Tunisia: 216, 217;
— Libya: 218, 219.

World numbering ZONES 3 and 4

Greece	30	Denmark	45
Netherlands (Kingdom of the)	31	Sweden	46
Belgium	32	Norway	47
France	33 ^{a)}	Poland (People's Republic of)	48
Monaco	33 ^{a)}	Germany (Federal Republic of)	49
Spain	34	Gibraltar	350
Hungarian People's Republic	36	Portugal	351
German Democratic Republic	37	Luxembourg	352
Yugoslavia (Socialist Federal Republic of)	38	Ireland	353
Italy	39	Iceland	354
Romania (Socialist Republic of)	40	Albania (Socialist People's Republic of)	355
Switzerland (Confederation of)	41 ^{a)}	Malta (Republic of)	356
Liechtenstein (Principality of)	41 ^{a)}	Cyprus (Republic of)	357
Czechoslovak Socialist Republic	42	Finland	358
Austria	43	Bulgaria (People's Republic of)	359
United Kingdom of Great Britain and Northern Ireland	44		

^{a)} Integrated numbering plan.

World numbering ZONE 5

Falkland Islands (Malvinas)	500	Brazil (Federative Republic of)	55
Belize	501	Chile	56
Guatemala (Republic of)	502	Colombia (Republic of)	57
El Salvador (Republic of)	503	Venezuela (Republic of)	58
Honduras (Republic of)	504	Guadeloupe (French Department of)	590
Nicaragua	505	Bolivia (Republic of)	591
Costa Rica	506	Guyana	592
Panama (Republic of)	507	Ecuador	593
St. Pierre and Miquelon (French Department of)	508	Guiana (French Department of)	594
Haiti (Republic of)	509	Paraguay (Republic of)	595
Peru	51	Martinique (French Department of)	596
Mexico	52	Suriname (Republic of)	597
Cuba	53	Uruguay (Eastern Republic of)	598
Argentine Republic	54	Netherlands Antilles	599

World numbering ZONE 6

Malaysia	60	Vanuatu	678
Australia	61	Fiji	679
Indonesia (Republic of)	62	Palau	680
Philippines (Republic of the)	63	Wallis and Futuna	681
New Zealand	64	Cook Islands	682
Singapore (Republic of)	65	Niue Island	683
Thailand	66	American Samoa	684
Mariana Islands	670	Western Samoa	685
Guam	671	Kiribati Republic	686
Australian External Territories	672	New Caledonia and Dependencies	687
Brunei	673	Tuvalu	688
Nauru (Republic of)	674	French Polynesia	689
Papua New Guinea	675	Tokelan	690
Tonga (Kingdom of)	676	F.S. of Micronesia	691
Solomon Islands	677	Marshall Islands	692

Spare codes 693, 694, 695, 696, 697, 698, 699

World numbering ZONE 7

Union of Soviet Socialist Republics 7

World numbering ZONE 8

Japan	81	Democratic Kampuchea	855
Korea (Republic of)	82	Lao People's Democratic Republic	856
Viet Nam (Socialist Republic of)	84	China (People's Republic of)	86
Democratic People's Republic of Korea	850	Maritime Mobile Service	87 ^{a)}
Hong-Kong	852	Bangladesh (People's Republic of)	880 ^{b)}
Macao	853		
<i>Spare codes</i>	800, 801, 802, 803, 804, 805, 806, 807, 808, 809		
	830, 831, 832, 833, 834, 835, 836, 837, 838, 839		
	851, 854, 857, 858, 859		
	890, 891, 892, 893, 894, 895, 896, 897, 898, 899		

^{a)} The country code 87 is reserved for the Maritime Mobile Service. The following three digit country codes are assigned: 871 INMARSAT (Atlantic), 872 INMARSAT (Pacific), 873 INMARSAT (Indian Ocean).

^{b)} The remaining combinations in series 88 will not be allocated until the stock of spare 3-digit codes for the region is exhausted.

World numbering ZONE 9

Turkey	90	Kuwait (State of)	965
India (Republic of)	91	Saudi Arabia (Kingdom of)	966
Pakistan (Islamic Republic of)	92	Yemen Arab Republic	967
Afghanistan (Democratic Republic of)	93	Oman (Sultanate of)	968
Sri Lanka (Democratic Socialist Republic of)	94	Yemen (People's Democratic Republic of)	969
Burma (Socialist Republic of the Union of)	95	United Arab Emirates ^{a)}	971
Maldives (Republic of)	960	Israel (State of)	972
Lebanon	961	Bahrain (State of)	973
Jordan (Hashemite Kingdom of)	962	Qatar (State of)	974
Syrian Arab Republic	963	Mongolian People's Republic	976
Iraq (Republic of)	964	Nepal	977
		Iran	98
<i>Spare codes</i>	970, 975, 978, 979		
	990, 991, 992, 993, 994, 995, 996, 997, 998, 999		

^{a)} E.A.U: Abu Dhabi, Ajman, Dubai, Fujairah, Ras Al Khaimah, Sharjah, Umm Al Qiwain.

ANNEX B

(to Recommendation Q.11 *bis*)

Rules for the assignment of spare country codes

The rules listed in this annex are provided as a basis for the most effective utilization of the spare country codes.

B.1 Single isolated 3-digit codes should be assigned prior to the assignment of any 3-digit code which is part of a series of more than two consecutive 3-digit codes.

B.2 The assignment of spare codes of a zone, both within that zone and also to another zone, will take place as follows:

- a) When assigning a code to a country in the same zone:
start with the lowest numbered 3-digit codes in ascending order, e.g. 670, 680 ...
- b) When assigning a code to a country in another zone:
start with the highest numbered 3-digit codes in descending order, e.g. 688, 685 ...
- c) Within code 87 reserved for the Maritime Mobile Service a third digit will be assigned to codes used for maritime satellite ocean area systems, with the restriction that codes 878 and 879 may not be touched because they are reserved for national purposes.

B.3 Country codes for new international services or for the automation of some existing services should be taken from the world numbering zone with the most spare codes.

ANNEX C

(to Recommendation Q.11 *bis*)

List of spare country codes for the international semiautomatic and automatic service

Spare codes 247
280, 281, 282, 283, 284, 285, 286, 287, 288, 289
290, 291, 292, 293, 294, 295, 296, 297,
693, 694, 695, 696, 697, 698, 699
800, 801, 802, 803, 804, 805, 806, 807, 808, 809
830, 831, 832, 833, 834, 835, 836, 837, 838, 839
851, 854, 857, 858, 859
890, 891, 892, 893, 894, 895, 896, 897, 898, 899
970, 975, 978, 979
990, 991, 992, 993, 994, 995, 996, 997, 998, 999

References

- [1] CCITT manual *National telephone networks for the automatic service*, ITU, Geneva, 1964, 1968, 1978.
- [2] CCITT Recommendation *Numbering plan for the ISDN era*, Vol. II, Rec. E.164.
- [3] CCITT Recommendation *Definitions relating to national and international numbering plans*, Vol. II, Rec. E.160.
- [4] CCITT Recommendation *Accounting system in the international automatic telephone service*, Vol. II, Rec. D.390 R.
- [5] CCITT Recommendation *The use and printing of symbols and separators in national and international telephone numbers*, Vol. II, Rec. E.123.

SHIP STATION IDENTIFICATION FOR VHF/UHF AND MARITIME MOBILE-SATELLITE SERVICES

1 Introduction

1.1 The purpose of this Recommendation is to specify a method by which an internationally unique ship station identification may be assigned to all the ships participating in the Maritime Mobile Services, and to facilitate the introduction of international automatic VHF/UHF and Satellite Maritime Services.

1.2 Terminology

The following terms are used in this Recommendation:

1.2.1 Maritime Mobile (Terrestrial) Service

F: service mobile maritime (de Terre)

S: servicio móvil marítimo (terrenal)

Conventional Maritime Mobile Services such as the HF Maritime Service, the MF Maritime Service and the VHF Maritime Service (as defined in the *Radio Regulations* [1]).

Maritime Mobile-Satellite Service

F: service mobile maritime par satellite

S: servicio móvil marítimo por satélite

As defined in the *Radio Regulations* [1].

1.2.2 coast station

F: station côtière

S: estación costera

A land station in the Maritime Mobile Service.

coast earth station

F: station terrienne côtière

S: estación terrena costera

An earth station in the Fixed-Satellite Service or, in some cases, in the Maritime Mobile-Satellite Service, located at a specified fixed point on land to provide a feeder link for the Maritime Mobile-Satellite Service.

Note — In this Recommendation the term coast station is also intended to include, for simplicity, coast earth station.

1.2.3 ship station identity

F: identité de la station de navire

S: identidad de estación de barco

The ship's identification $X_1, X_2 \dots X_k$ transmitted on the radio path.

ship station number

F: numéro de station de navire

S: número de estación de barco

The number that identifies a ship for access from a public network and forms part of the international number to be dialled or keyed by a public network subscriber.

¹⁾ This Recommendation is also included in the Recommendations of the E and F Series under the numbers E.210 and F.120.

Note — In this Recommendation the term ship station is intended to also include, for simplicity, ship earth station.

1.2.4 coast station identity

F: identité de la station côtière

S: identidad de estación costera

The coast station identification $X_1, X_2 \dots X_k$ transmitted on the radio path.

Note — In this Recommendation the term coast station identity is intended to also include, for simplicity, coast earth station identity.

1.3 Basic considerations

The considerations that form the basis of this ship station identification system are:

- a) that every ship shall have a unique ship station identity;
- b) that the same unique ship station identity should be used in both VHF/UHF and Maritime Mobile-Satellite Systems;
- c) that the same unique ship station identity should be used for all telecommunication services;
- d) that it is desirable that the ship station number and the ship station identity be the same;
- e) that the capacity of the ship station identification system shall be sufficient to admit all ships wanting, or required, to participate in the various Maritime Mobile Services at present and in the foreseeable future;
- f) that access to Maritime Mobile Services via the existing international network in automatic operation should follow the relevant and appropriate CCITT Recommendations;
- g) that the ship identity system shall be a numerical system, and should use the full range of decimal digits;
- h) that two or three of the digits, $X_1X_2X_3$, of the ship station identity shall indicate the ship's nationality;
- i) that there are important differences in national networks that promote different approaches to automation of Maritime Mobile Services;
- j) that a numerical assignment plan should consider current telephone, data and telegraph network limitations while it permits change to support future requirements.

2 Ship station identification

2.1 Ship station identity ^{2), 3)}

Ship station identity is established as nine digits. It should be assigned to take into account the implications relating to it in the public switched networks.

$$X_1X_2X_3X_4X_5X_6X_7X_8X_9$$

The initial three digits define the nationality of the ship as indicated in the following sections.

2.2 Ship station number

The ship station number defines the ship station within the public switched network and this information is transmitted to a coast station or coast earth station. In the VHF/UHF Maritime Service the ship station number may be different from the ship station identity to relate to national network needs.

Note — For data transmission services the ship station number will always be identical to the ship station identity (see Recommendation X.121).

²⁾ A seven-digit ship station identity is used in the current generation of the Maritime Satellite System.

³⁾ Some international telex centres are limited to seven digits.

3 Assignment of ship station identification

3.1 Assignment of blocks of numbers

Blocks of numbers should be assigned to countries so that individual Administrations may systematically assign ship station identities within those blocks.

3.2 Identification of ship's geographical region

The first digit of each ship station identity is intended to identify the geographical region to which the nationality (registry) of the ship relates. Only the digits 2 through 7 are used for this purpose to identify easily the world's regions as follows:

- 2 – Europe
- 3 – North America
- 4 – Asia (except Southeast Asia)
- 5 – Oceania and Southeast Asia
- 6 – Africa
- 7 – South America.

Arrangements may therefore be made to systematically assign a ship station identity to each ship as soon as national blocks are allocated. The digits zero (0), one (1), eight (8) and nine (9) are allocated for other purposes as indicated below.

3.3 Identification of ship's nationality

Since blocks of the ship station identities would be systematically assigned by country, a ship's nationality can be determined by analysing the first three digits of its ship station identity.

The digits to be analysed are called Maritime Identification Digits (MID). Examples of the maritime identification digits for ships are given in Table 1/Q.11 *ter*.

4 Assignment of maritime identification digits

Each MID represents a discrete capacity assigned according to a plan that relates assigned capacity to ship population. A plan has been developed by the World Administrative Radio Conference for the Mobile Services (MOB-83) [2].

TABLE 1/Q.11 *ter*

Country	Maritime identification digits (MID)	Ship station identity
P	231	from 231000000 to 231999999
Q	233, 234	from 233000000 to 234999999
R	236, 237 238	from 236000000 to 238999999
S	240 to 249	from 240000000 to 249999999

5 **Group calls**

$X_1 = 0, X_2 = 1 \text{ to } 9$ and $X_1 = 0, X_2 = 0, X_3 = 0, X_4 = 0 \text{ to } 9$ are assigned to indicate a group call to a group of ships having a community of interest. Such calls may be barred in the public switched network and/or at the coast stations. Control of group calls may also be achieved by the use of special group service access to the coast stations. The group call numbering scheme used in the INMARSAT system is given in Annex B.

6 **Coast station identity**

$X_1 = 0, X_2 = 0, X_3 = 1 \text{ to } 9$ are assigned to indicate coast station identities. The use of such identities may be barred in the public switched network and/or the coast stations.

7 **Future expansion of the ship station identification system**

$X_1 = 1$ as in the format 1 XXXXXXXX has been reserved for future expansion.

8 **Evolutionary expansion of ship station identities as applied to Maritime Mobile (Terrestrial) Services**

Note – Public data networks would be capable of accommodating the full nine-digit ship station identity. Therefore, the evolutionary scheme outlined below may not be necessary in such networks (see Recommendation X.121).

8.1 The plan permits the identification of ships whose communications requirements are inter-regional, regional or national. The plan is intended to allow the automation of Maritime Mobile Services on public switched networks, where feasible, as the demand for ship station identities increases for the automatic service. This demand is considered in stages defined by the number of digits in ship station numbers required to satisfy automatic communication needs. A minimum number of digits is used for *ship station numbers* at any given time to permit countries with network restrictions to provide a maximum of automation. Trailing zeros are added to the ship station numbers (received from an automatic network) to form nine-digit ship station identities on the radio path. The $X_1X_2X_3$ digits are shown as maritime identification digits in Table 2/Q.11 *ter*.

8.2 In stage 1, those countries that would identify VHF/UHF calls and plan to automate VHF in a single stage of subscriber selection would have full access to all ships if they were able to assign six digits to ship station numbering in their networks. The plan contemplates mutual cooperation to extend this stage as long as possible by judicious ship station identity assignments to satisfy requirements for automatic VHF/UHF in the face of network limitations.

TABLE 2/Q.11 *ter*

Stage	Ship station number	Digits on the automatic network	Ship station identity	Digits on the radio path
1	MID $X_4X_5X_6$	6	MID $X_4X_5X_6 000$	9
2	MID $X_4X_5X_6X_7$	7 ^{a) b)}	MID $X_4X_5X_6X_7X 00$	9
3	MID $X_4X_5X_6X_7X_8$	8	MID $X_4X_5X_6X_7X_8 0$	9

^{a)} Due to network limitations, some countries may choose to withhold the first digit of the MID and insert it automatically at the coast station to retain automatic access to all ships whose MIDs have identical first digits (ships of the same geographical area). However, the application of this technique should be avoided if possible to minimize ambiguity.

^{b)} $X_2 = 8$ and 9 should only be assigned when requirements have made it absolutely necessary. This will permit those countries that cannot yet transmit a 7-digit ship station number in stage 2 to use the abbreviated regional and national numbers 8Y and 9 according to § 8.3 for as long as the digits $X_2 = 8$ and 9 have not been assigned in the area of their X_1 .

8.3 Additional ship station numbering techniques may be used to expand network access to more ship stations in stages 1 and 2. These techniques permit an extension of the time periods during which stages 1 and 2 apply. For example:

<i>Ship station number</i>	<i>Ship station identity</i>
8Y X ₄ X ₅ X ₆ X ₇	M _y I _y D _y X ₄ X ₅ X ₆ X ₇ 00
9 X ₄ X ₅ X ₆ X ₇ X ₈	M _n I _n D _n X ₄ X ₅ X ₆ X ₇ X ₈ 0

In this arrangement, the digits 8Y may be 80 to 89 to define as many as ten foreign MIDs (shown as M_yI_yD_y) to permit automatic calling of ships of particular nationalities. The coast station would be required to translate a given 8Y to a particular foreign MID. The digit 9 may be used to indicate the maritime identification digits for ships of the same nationality as the network and the coast station. The coast station would be required to translate 9 to one particular national MID (shown as M_nI_nD_n). National application of these techniques could be adopted to provide an efficient use of ship station numbers.

Note — See note to Recommendation Q.11 *quater*, § 2.2.1.

9 Ship station identity for the Maritime Mobile-Satellite Service

The international numbering plans would permit up to nine digits for ship station identity and ship station numbering to be used in association with country codes 87X for telephony, data network identification code 111X for data transmission and destination codes 58X for telex, where X may indicate ocean area or system.

10 Considerations related to ship station identity assignment

An efficient allocation of ship station identity will permit an extension of the time period in which stage 1 applies. The specific manner in which the optional techniques indicated in §§ 8.1 and 8.3 are applied depends on the needs of a given Administration to achieve an optimum result. Special consideration should be given to the assignment of ship station identities for ships engaged in regional and national traffic so that spare capacity remains available for inter-regional traffic when transition from stage 1 to stage 2 takes place.

ANNEX A

(to Recommendation Q.11 *ter*)

National network diversity and automation of VHF/UHF service

A.1 National network numbering and routing requirements provided to satisfy national subscriber population and service needs result in widely varying abilities to support automatic VHF/UHF service. The following diverse approaches have been recognized and should be expected.

A.1.1 The inability of some networks to carry as few as six digits for ship station number purposes will tend to defer automation indefinitely in some instances.

A.1.2 Some countries will find it practical to provide for automation on the basis of six digits for ship station numbering in accordance with the proposed plan in this Recommendation. When seven digits are required (in stage 2) the practice of not dialling the initial digit of the maritime identification digits may be adopted to maintain as much automation as feasible. Refer also to § 8.1.

A.1.3 Some countries may find it practical to use national network numbering to define ship station numbers that are translated to ship station identities at one or more coast stations and perhaps support this with locator services.

A.1.4 Some countries may find it practical to use two-stage selection, e.g. in the telephone service a second stage of subscriber dialling with multifrequency push-button equipment may be already available or provided specifically for subscribers particularly interested in maritime services.

A.1.5 Some countries may now, or later, provide for centralized maritime centres that may support automatic location and call routing facilities. The use of such maritime centres would enable the application of ship station numbers of up to nine digits between countries with such centres.

ANNEX B

(to Recommendation Q.11 *ter*)

Group call numbering scheme for the INMARSAT system

B.1 At present four different categories of group call service have been envisaged within the Maritime Mobile-Satellite Service.

B.1.1 *National group calls*

Category defined to address all ships of the same nationality.

B.1.2 *Fleet group calls*

Defined to address all ships within one fleet.

B.1.3 *Selected group calls*

Defined to address a number of ships having a community of interest, irrespective of nationalities or fleets, and forming a predefined group.

B.1.4 *Area group calls*

Defined to address all ships of any nationality located within a predetermined geographical area.

B.2 The group call numbering scheme for the Maritime Mobile-Satellite Service will use nine decimal digits allocated as follows:

$0_1M_2I_3D_40_50_60_70_80_9$ National group call

$0_1M_2I_3D_4F_5F_6F_7F_8F_9$ Fleet group call

$0_10_20_3S_4S_5S_6S_7S_8S_9$ Selected group call

$0_10_20_30_4A_5A_6A_7A_8A_9$ Area group call

where $M_2 \neq 0$ $M_2 \neq 1$ $F_5 \neq 0$ $S_4 \neq 0$.

B.2.1 The MIDs in national and fleet group numbers are those allocated in Table 1 of Appendix 43, Final Acts, World Administrative Radio Conference for the Mobile Services (WARC-MOB-83) [2].

B.2.2 Some coast earth stations may initially require 7 digit group numbers. Such cases will require bilateral agreement between the coast earth station Administration and a country wishing to use that coast earth station for group calls. When expanding from seven to nine digits, the general rules defined in Recommendations Q.11 *ter* and F.120 and in Appendix 43, Final Acts, WARC-MOB-83 are to be observed.

B.2.3 In accordance with Section 4 of Appendix 43, Final Acts, WARC-MOB-83, the particular MID reflects only the country allocating the group call identity and so does not prevent group calls to fleets containing more than one ship nationality. Allocation of selected group numbers should be avoided when the same group could equally well be assigned a fleet group number.

B.2.4 National group numbers and fleet group numbers would be allocated by countries. Selected group numbers and area group numbers as applicable to the INMARSAT System would be allocated by INMARSAT; allocation of such numbers may require cooperation with other organizations.

B.2.5 A country having assigned a national group or fleet group number should notify the Director General of INMARSAT, if those numbers are going to be used within the INMARSAT System.

Reference

- [1] *Radio Regulations*, ITU, Geneva, 1982.
- [2] *Final Acts of the World Administrative Radio Conference for the Mobile Services (MOB-83)*, ITU, Geneva, 1983.

Recommendation Q.11 quater ¹⁾

NUMBERING AND DIALLING PROCEDURES FOR VHF/UHF AND MARITIME MOBILE-SATELLITE TELEPHONE SERVICES

1 Introduction

1.1 Purpose

The purpose of this Recommendation is to standardize:

- a) the numbering and dialling procedures for subscribers in the public switched telephone network calling ship stations in the VHF/UHF and Maritime Mobile-Satellite Telephone Services, and
- b) the procedures for calling a subscriber, or an operator, in the public switched telephone network from ship stations. Adoption of such procedures will facilitate the introduction and development of automatic VHF/UHF and Maritime Mobile-Satellite Services.

1.2 Related CCITT Recommendations

F.120/E.210/Q.11 *ter* (Recommendation on ship station identification).

E.160/Q.11 <i>bis</i>	}	(Numbering plan).
E.163		

E.171/Q.13 (Routing plan).

Q.104 (Language or discriminating digit).

1.3 Basic considerations

The following basic considerations were taken into account when formulating the Recommendation:

- i) Each ship will be allocated a unique 9-digit ship station identity according to the numbering scheme in Recommendation Q.11 *ter*. The first generation in Maritime Mobile Satellite (INMARSAT) System also caters for 7-digit ship station identities beginning with digit 1.
- ii) It will be necessary to transmit the ship station identity, or part thereof (ship station number), through a diverse range of national and international telephone networks to facilitate automation of maritime mobile systems.
- iii) Any routing and numbering technique adopted should require as little change as possible to national and international public switched telephone networks.
- iv) It is desirable that a ship should possess one ship station identity for all telecommunications services (e.g. telephony, telex) and all maritime mobile systems (e.g. VHF/UHF and satellite).

¹⁾ This Recommendation is also included in the Series E Recommendations under the number E.211.

2 Maritime Mobile-Satellite Service

2.1 General

2.1.1 Maritime Mobile-Satellite Services are international in nature and international procedures will be adopted to provide access to these services. For some purposes, a maritime mobile-satellite system can be regarded as analogous to a national network and the ship earth stations as subscribers within that network.

For automatic shore-originated calls, international dialling procedures will be adopted using an international prefix number, the 87 "country code" and a ship station number.

2.1.2 For automatic ship-originated calls to terrestrial subscribers, international dialling procedures will be used, including a standardized prefix, i.e. all ships in all ocean areas will use the same prefix to identify an automatic international call.

In addition, prefixes will be adopted to identify other functions for the satellite system.

Annex A lists the allocation of the prefixes for use when automatic ship-to-shore telephone service is introduced. Additional prefixes may be required and these can be added, using the spare decimal numeric combinations.

It is desirable to have one set of prefixes for all services (telephone, telex and data). The prefixes listed in Annex A can be used where applicable for telex and data services and if necessary, additional prefixes for these services may be assigned by the competent Study Group. Close cooperation between the competent Study Groups will be necessary when assigning new prefixes.

The use of some prefixes could be barred to some customers.

2.1.3 The prefixes will be sent over the radio path to the coast earth station but would not be used outside the satellite system. Hence, a prefix sent to the coast earth station would not be used in the international network.

2.2 Procedures for shore-to-ship calls

2.2.1 A shore based subscriber calling a ship in a maritime mobile-satellite system will dial a numbering sequence as follows:

Pi	International prefix
87	Maritime international code
S	Ocean area and satellite system
MIDX ₄ -X _n	Ship station number.

Note — Since the ship station number, MIDX₄ . . X_n, only identifies the ship and not a service termination on the ship, information additional to the ship station number may be required in order to address a specific service termination on the ship, e.g. a facsimile equipment or a data terminal equipment (DTE). If signals for providing such information (e.g. calling party category indication) are available within the signalling systems used between the switching centre of call origin (i.e. the local national switching centre) and the coast earth station, they should be automatically inserted by that switching centre. In this case the numbering sequence would be as defined above, irrespective of the service termination on the ship. If some part of the connection does not have this capability, the required termination may be indicated by the following numbering sequence:

Pi	International prefix
87	Maritime international code
S	Ocean area and satellite system
8Y	Service termination
MIDX ₄ . . X _n	Ship station number.

- the value of the digit Y will take a different value for each service termination. Y = 1 is allocated to the facsimile service. As other service termination requirements are identified by INMARSAT, the CCITT will make additional allocations;

- it should be noted that the digits 8Y cannot be used for in-dialling for discrimination between several terminals of the same kind;
- it should be further noted that the digits 8Y should not be dialled for ordinary telephone calls;
- the digit “M” of MID cannot take the value 8 for ships participating in the Maritime Satellite Service so long as the digits 8Y are used for the purpose described above.

2.2.2 A discrimination digit will be inserted in the normal manner and will be regarded as following a 3-digit maritime country code (87S).

2.2.3 The numbering sequence requires the subscriber to know the satellite coverage area in which the ship is located.

2.2.4 The ship station number can be identical to the ship station identity.

2.3 Procedures for ship-to-shore calls

2.3.1 Calling a terrestrial subscriber

2.3.1.1 A shipboard subscriber will dial the prefix 00 followed by the full international telephone number required, whether or not the coast earth station is located in the called subscriber's country. Hence, the numbering sequence dialled by a ship board subscriber will be of the form:

00	Prefix for automatic call
I ₁ I ₂ I ₃	1, 2 or 3 digit country code
N ₁ -N _n ²⁾	National significant number.

2.3.1.2 The ship earth station will permit the choice of coast earth station identity through which the call is to be routed. Convenient land-line routings (e.g. use of the coast earth station nearest the destination country) could be encouraged by tariff considerations.

2.3.1.3 A discrimination digit will be inserted automatically at the coast earth station according to Recommendation Q.104.

2.3.2 Calling an operator (see Recommendation Q.102)

2.3.2.1 A shipboard subscriber will dial an operator prefix, the second digit identifying the type of operator required.

2.3.2.2 The table below illustrates the principle involved for two types of operator:

Prefix		Optional Digits	Type of Operator
Digit 1	Digit 2		
1	1	I ₁ I ₂ I ₃	International outgoing operator
1	2	I ₁ I ₂ I ₃	International information service.

Some Administrations may wish to operate a system whereby shipboard subscribers insert after the operator prefix a country code (I₁, I₂, I₃). The insertion of the country code will allow the call to be routed to a relevant operator. If an Administration operating such a system receives an operator prefix without the optional digits, then the call must still be connected to an appropriate operator. Similarly, if an Administration not operating such a system receives an operator prefix followed by optional digits, then the optional digits should be ignored and the call connected to the operator denoted by the prefix alone.

²⁾ The first generation Maritime Mobile Satellite (INMARSAT) System requires the use of an end-of-pulsing signal after the last digit of the national (significant) number.

2.3.2.3 Each Administration may decide which operators to provide, where they are to be located and how the call would be routed. If a request is received from a ship for a type of operator that the Administration does not provide, then the call will be routed to an operator convenient for that Administration.

2.3.3 *Other prefixes in Annex A*

Each Administration may decide which services to provide and how the call would be routed. If a request is received from a ship for a service that the Administration does not provide, then the call will be routed to a location convenient for that Administration.

The general dialling sequence could be:

Prefix		Optional country code	Other optional digits
<i>Digit 1</i>	<i>Digit 2</i>		
3	2	I ₁ I ₂ I ₃	—
3	8	—	—
2	3	—	X ₁ X ₂

The actual sequence may be decided by the Administration or the operating organization (e.g. INMARSAT).

2.4 *Procedures for ship-to-ship calls*

2.4.1 Dialling procedures for ship-to-ship calls will be similar to those for ship-to-shore calls, using the maritime country code 87S. The numbering sequence dialled by the shipboard subscriber will be of the form:

00	Prefix for automatic call
87	Maritime international code
S	Ocean area and satellite system
MIDX ₄ ... X _n	Ship station number

This format will be used whether or not the ships are in the same ocean area.

Note — The principles described in the note to § 2.2.1 may also apply for ship-to-ship calls.

2.4.2 Each Administration operating a coast earth station may decide whether to switch ship-to-ship traffic within an ocean area at the coast earth station or at an international switching centre.

3 **VHF/UHF Maritime Mobile Service**

3.1 *General*

VHF/UHF maritime mobile services are more localized than maritime mobile-satellite services. National procedures will be adopted to provide access to the VHF/UHF maritime mobile services.

3.2 *Procedures for shore-to-ship calls*

Individual Administrations will wish to automate their maritime services in their own timescales and to suit their own service requirements and network limitations. However, any scheme adopted by an Administration should be compatible with other schemes and should not inhibit progression towards a worldwide maritime service. In view of the restrictions imposed by national networks on shore originated calls, three levels of operation have been identified to ensure that future evolution of the service can take place.

3.2.1 *Level 1: Manual or single-operator service operation*

3.2.1.1 Some Administrations will operate the VHF/UHF service on a manual or single-operator basis (a single-operator service is one in which the coast station operator in one country corresponds with subscribers of another country or vice versa).

3.2.1.2 It will be necessary to ensure that the facilities are compatible with essential functions, e.g. distress, in any automatic scheme. Additional equipment could be required to cater for new ship calling arrangements and use of a worldwide numbering scheme.

3.2.2 *Level 2: Minimum automation*

3.2.2.1 The caller controls access to the relevant coast station and forwards the number of the required ship, i.e. there is no intelligent system in the network able to indicate the location of the ship. Hence, the customer is required to identify the location of the ship.

3.2.2.2 The level of automation requires a minimum of equipment, the required functions mainly consisting of interfacing with the network, call control, signalling over the radio channels and operational control of the radio channels. There would be a requirement to permit coexistence of the manual service and the automatic service.

3.2.2.3 An example of such a numbering sequence is given below. Access to coast stations is provided by dedicated number combinations taken from the national numbering plan.

Pi	International prefix
I ₁ I ₂	1 or 2 digit country code
N ₁ N ₂	Code to identify VHF/UHF service
S ₁ S ₂	Code to identify coast station
MIDXXX	Ship station number.

The number of digits in the code N₁ N₂ S₁ S₂ will vary from one country to another, but the maximum international significant number length of 12 digits must be taken into account. In the example given, a subscriber in one country is calling a ship off the coast of another country. If the ship was off the coast of the subscriber's own country, the national prefix would be dialled instead of the international prefix and country code.

3.2.3 *Level 3: Automatic national ship location*

3.2.3.1 The caller controls the access to a particular country (or part of a country or a group of countries) and dials the number of the required ship i.e. an intelligent system is contained in the network so that it can indicate the location of the ship. The network is then responsible for routing the call on the basis of a known ship's location. All ships participating within the relevant area must report their location to a coast station, preferably on an automatic basis.

3.2.3.2 Equipment additional to level 2 of operation would be necessary, particularly in relation to the network's responsibility for locating the ship.

3.2.3.3 A numbering sequence suitable for this level of operation is:

Pi	International prefix
I ₁ I ₂ I ₃	1, 2 or 3 digit country code
N ₁ N ₂ N ₃	Code(s) to identify VHF/UHF service
MIDXXX	Ship station number.

The code(s) N₁ N₂ N₃ will vary in length from one country to another. The example given concerns a subscriber in one country calling a ship off the coast of another country. If the ship was off the coast of the subscriber's own country, the national prefix would be dialled instead of the international prefix and country code.

3.3 *Implementation of automatic schemes in national networks – Shore-originated calls*

There are variations of the numbering schemes given in §§ 3.2.2 and 3.2.3. Some examples of these variations are given below.

3.3.1 *Two-stage selection*

3.3.1.1 Some countries may find it necessary to use a two-stage selection technique. A subscriber would dial a coast station or maritime centre and would be offered a second stage of dialling to facilitate the insertion of the ship station number. Numbering sequences for provision of access to the coast station or maritime centre would be the same as for an ordinary telephone call in that country. The second stage of dialling could be associated with multi-frequency push button equipment already available or specifically provided for subscribers requiring maritime service calls.

3.3.1.2 If the first stage of dialling is used to provide access to a particular coast station, the scheme would be associated with level 2 of operation. If the first stage of dialling is used to provide access to a maritime centre that is able to locate the ship, then levels 2 or 3 of operation would be appropriate.

3.3.2 *Digit insertion [(1 + 6) arrangement]*

3.3.2.1 When ship station numbers become seven digits in length (stage 2 of the numbering plan), some countries will be unable to transmit the full seven digits through their national networks. As the first digit of an MID (Maritime Identification Digits) indicates the zone (continent) in which a country is located, a technique may be adopted on a zonal (continental) basis in which the first digit of the MID is not dialled by the subscriber. The digit would then be inserted at the coast station (and/or maritime centre), on the assumption that the MID is allocated to a country in the same zone as the coast station (and/or maritime centre).

3.3.2.2 Access to ships registered in countries outside the zone in which the coast station is located would be given on a manual basis by countries operating the 1 + 6 system.

3.3.2.3 The digit insertion technique can be associated with levels 2 and 3 of operation.

3.3.3 *National numbering and conversion arrangement*

3.3.3.1 Some countries may find it necessary to temporarily allocate ship's numbers compatible with their national numbering plans. An example of such a technique is given below.

3.3.3.2 When a ship enters the service area of a VHF/UHF coast station, the ship station's identity would be forwarded by the coast station to its parent Maritime Centre. The Maritime Centre would then assign, temporarily, a national telephone number which would correspond to the ship station identity of the ship. This pair of numbers would be stored at the Maritime Centre and the coast station.

3.3.3.3 A shore-based subscriber calling this ship would access the Maritime Centre and use the ship station number to obtain the corresponding temporary national telephone number. Once this is available, the call could be completed automatically from the Maritime Centre. Alternatively, the call could be completed by the caller either on a manual, semiautomatic or automatic basis as appropriate.

3.3.3.4 The temporary national telephone number would be used for routing the call to the serving VHF/UHF coast station. At that point the corresponding ship station identity, which would be stored at the coast station, would be sent over the radio path to extend the connection to the ship.

3.3.4 *VHF/UHF system using 87S*

This scheme can be used in national networks where the subscriber does not need to know the location of the ship. The national subscriber would dial the international prefix of the country, the maritime international code (87), a digit to identify the VHF/UHF service and the ship station number (which in this case is the same as the ship station identity). This method can be used by the subscribers belonging to a national network to reach ships which are in the coverage area of the coast stations of that national network. As long as no internationally coordinated location registration of ships is implemented, a subscriber in another country would follow the procedure described in § 3.2.3.

3.4 *Procedures for ship-to-shore calls*

Ship-originated calls are less restricted than shore-originated call by national network limitations and no levels of operation are required. The prefixes defined in Annex A will be used. Table A-1/Q.11 *quater* is applicable to both the Maritime Mobile-Satellite Service and Maritime Mobile VHF/UHF Service. Application of the prefix scheme will be similar to the satellite service as shown in §§ 2.1.2 and 2.1.3.

To standardize dialling procedures for VHF/UHF ship-originated calls, international dialling procedures will be adopted and automatic coast stations throughout the world will act upon such numbering sequences. To allow for ships that rarely leave the coast of a particular country, another technique has been identified whereby national dialling procedures can also be used. Whether or not to adopt this technique would be decided by each Administration.

3.4.1 *Calling a terrestrial subscriber*

3.4.1.1 A shipboard subscriber will dial the prefix 00 followed by the required international number, whether or not the coast station is located in the required subscriber's country. Hence, the numbering sequence will be of the form:

00	Prefix for automatic call
I ₁ I ₂ I ₃	1, 2 or 3 digit country code
N ₁ -N _n	National (significant) number.

3.4.1.2 Where national procedures are used, a shipboard subscriber will dial the prefix 0 followed by the required number belonging to the country of the coast station through which the call is being connected. Hence, the numbering sequence would be of the form:

0	Prefix for automatic call of the coast station country
N ₁ -N _n	National (significant) number.

3.4.2 *Calling an operator*

3.4.2.1 A shipboard subscriber will dial an operator prefix, the second digit identifying the type of operator required.

3.4.2.2 The table below illustrates the principle involved:

Prefix		Optional Digits	Type of operator
Digit 1	Digit 2		
1	1	I ₁ I ₂ I ₃	International outgoing operator
1	2	I ₁ I ₂ I ₃	International information service
1	3		National operator
1	4		National information service

The use of the optional digits is the same as described in § 2.3.2.2.

3.4.2.3 Each Administration may decide which operators to provide, where they are to be located and how the call would be routed. If a request is received from a ship for a type of operator that the Administration does not provide, then the call will be routed to another operator convenient for that Administration.

3.5 *Procedures for ship-to-ship calls (via coast station)*

3.5.1 If the two ships are not off the coast of the same country, the shipboard subscriber will dial the prefix 00 and the appropriate procedure outlined in §§ 3.2 and 3.3 will be followed.

3.5.2 If the ships are off the coast of the same country, then the coast station would act upon the above procedure, but the national procedure of dialling the prefix 0 followed by the national number of the ship could be adopted.

4 **Instructions to telephone subscribers**

This subject requires further study.

ANNEX A

(to Recommendation Q.11 *quater*)

Allocation of telephone prefixes, telex access codes and data transmission prefixes

A.1 Administrations should make the application for the allocation of new prefixes and access codes to the CCITT Secretariat. The application should contain a definition for the service, termination or facility to be accessed.

The CCITT Secretariat would be responsible for coordinating the allocation of new prefixes and access codes with the competent Study Groups. The allocation of new prefixes and access codes should be done in such a way as to ensure that equivalent services carried by means of telephone, telex or data circuits are given the same prefix.

The prefixes and access codes to be used for automatic calling should be as follows:

Telephone — For international calls the prefix should be 00 followed by the international telephone number of the called subscriber. For national calls the prefix should be 0 followed by the national (significant) number of the called subscriber.

Note — In the Maritime Satellite Service only the international format should be used (see § 2.3.1.1).

Telex — For international calls the access code should be 00 followed by the international telex number of the called subscriber. For national calls the access code should be 0 followed by the national telex number of the called subscriber.

Note — In the Maritime Satellite Service only the international format should be used (see Recommendation F.121, § 2.3.2.1).

Data transmission — For data calls through a public data network the format should always consist of the prefix 0 followed by the international data number of the called subscriber (see Recommendation X.350, § 5.2.1).

A.2 Table A-1/Q.11 *quater* contains a list of prefixes and access codes allocated up to the present time for access to special destinations, services or facilities.

TABLE A-1/Q.11 *quater*

(Note 1)

Allocation of telephone prefixes, telex access codes and data transmission prefixes

Category	Prefix or access code		Applications (Notes 2 and 3)	Telephone	Telex	Data
	Digit 1	Digit 2				
Operator	1	0	Spare	—	—	—
	1	1	International outgoing operator	A	A	NA
	1	2	International information service	A	A	FS
	1	3	National operator	A	A	NA
	1	4	National information service	A	A	FS
	1	5	Radiotelegram service	FS	A	NA
	1	6	Spare	—	—	—
	1	7	Booking of telephone calls (Note 4)	A	A	NA
	1	8	Spare	—	—	—
	1	9	Spare	—	—	—
Automatic facilities	2	0	Access to maritime PAD (Note 5)	A	NA	NA
	2	1	Store-and-forward (international)	NA	A	NA
	2	2	Store-and-forward (national)	NA	A	NA
	2	3	Abbreviated dialling (short code selection)	A	A	NA
	2	4	Telex letter service	NA	A	NA
	2	5	Spare	—	—	—
	2	6		—	—	—
	2	7		—	—	—
	2	8		—	—	—
	2	9		—	—	—
Specialized assistance (Notes 6 and 7)	3	0	Spare	—	—	—
	3	1	Maritime enquiries	A	A	A
	3	2	Medical advice	A	A	A
	3	3	Technical assistance	A	A	A
	3	4	Person-to-person call	A	NA	NA
	3	5	Collect calls	A	NA	NA
	3	6	Credit card calls	A	A	NA
	3	7	Time and charges requested at end of call	A	A	NA
	3	8	Medical assistance	A	A	A
	3	9	Maritime assistance	A	A	A
Ship reporting (Note 6)	4	0	Spare	—	—	—
	4	1	Meteorological reports	A	A	A
	4	2	Navigational hazards and warnings	A	A	A
	4	3	Ship position reports	A	A	A
	4	4	Spare	—	—	—
	4	5		—	—	—
	4	6		—	—	—
	4	7		—	—	—
	4	8		—	—	—
	4	9		—	—	—

TABLE A-1/Q.11 *quater* (cont.)

Category	Prefix or access code		Applications (Notes 2 and 3)	Telephone	Telex	Data
	Digit 1	Digit 2				
Information retrieval	5	0	Spare	—	—	—
	5	1	Meteorological forecasts	FS	FS	FS
	5	2	Navigational warnings	FS	FS	FS
	5	3	Videotex (international)	FS	NA	FS
	5	4	Videotex (national)	FS	NA	FS
	5	5	News (international)	FS	FS	FS
	5	6	News (national)	FS	FS	FS
	5	7	Spare	—	—	—
	5	8		—	—	—
	5	9		—	—	—
Specialized use (Note 8)	6		Administration specialized use, e.g. leased lines	A	A	FS
	7		Spare	—	—	—
	8		Spare	—	—	—
Test (Note 6)	9	0	Spare	—	—	—
	9	1	Automatic test line	A	A	FS
	9	2	Commissioning tests	A	A	A
	9	3	Spare	—	—	—
	9	4	Spare	—	—	—
	9	5	Operational coordination	A	A	A
	9	6	Spare	—	—	—
	9	7		—	—	—
	9	8		—	—	—
	9	9		—	—	—

Note 1 — The same table is contained in Recommendations Q.11 *quater*, E.211, F.121 and X.350.

Note 2 — The entries in the columns under Telephone, Telex and Data have the following meanings:

A = Applicable for access by this service
 NA = Not applicable for access by this service
 FS = For further study.

Note 3 — The prefix or access code may be followed by an optional telephone country code, data country code (or data network identification code) or telex destination code, or other optional digits.

Note 4 — Via some coast earth stations it would be possible to book telephone calls using the telex service.

Note 5 — PAD = Packet Assembly/Disassembly facility. The prefix 20 should be followed by two digits indicating the required data rate (see Recommendation X.351).

Note 6 — Some of the facilities under this category are defined in Annex B.

Note 7 — The prefixes 34, 35, 36 and 37 may be followed by the international number of the called subscriber.

Note 8 — Digits following digit 6 will be allocated on a national basis.

ANNEX B

(to Recommendation Q.11 *quater*)

Application of telephone prefixes, data transmission prefixes and telex access codes – Definitions and descriptions

Services and facilities normally provided by the telephone data or telex networks are otherwise defined in CCITT Recommendations and do not require any further definitions. This annex provides definitions and descriptions of some of the special facilities of Annex A.

B.1 *Maritime enquiries (prefix 31)*

B.1.1 *Function*

Prefix 31 may be used for special enquiries such as ship location, authorization, all telegrams, etc.

B.2 *Medical advice (prefix 32)*

B.2.1 *Function*

Prefix 32 provides connection to national medical facilities (hospital, etc.) for obtaining medical advice or consultation.

B.3 *Technical assistance (prefix 33)*

B.3.1 *Function*

For the Maritime Satellite Service, prefix 33 provides connection to the technical personnel of the coast earth station in case difficulties are experienced in establishing communication.

For other maritime systems, further study is required.

B.4 *Collect calls (prefix 35)*

B.4.1 *Function*

Prefix 35 should be used for calls, charges for which will be billed to the called party. The telephone operator will intervene in the call and should be provided with the information pertinent to the call.

B.5 *Credit card calls (prefix 36)*

B.5.1 *Function*

Arrangements can be made with the Administration of certain coast stations or coast earth stations for payments for communications services to be made by a credit card. The arrangement is valid only for the services of the station with which it is made.

An operator will intervene in the call and should be provided with details of the credit card.

B.6 *Time and charges requested at end of call (prefix 37)*

B.6.1 *Function*

Prefix 37 provides, upon completion of the call, either automatic printout of charging information, or connection to an operator who will supply charging information on the call.

B.7 *Medical assistance (prefix 38)*

B.7.1 *Function*

If the condition of an ill or injured person aboard ship requires his urgent delivery ashore or the delivery of a doctor aboard ship, prefix 38 provides connection to the appropriate national authority responsible for this kind of activity.

B.8 *Maritime assistance (prefix 39)*

B.8.1 *Function*

Prefix 39 provides connection to the appropriate national authority in case maritime assistance is required (e.g. tow, oil pollution).

Note – This service is not clearly defined and may be interpreted differently by Administrations. Further study is required.

B.9 *Meteorological reports (prefix 41)*

B.9.1 *Function*

Prefix 41 provides connection to the meteorological office for transmission of ship weather reports.

B.10 *Navigational reports from ships (prefix 42)*

B.10.1 *Function*

Prefix 42 provides connection to a navigational office for transmission of information from ship on any hazards which could endanger safety of navigation (e.g. wrecks, derelicts, floating obstructions, defective radiobeacons or light vessels, icebergs, floating mines, etc.).

B.11 *Ship position reports (prefix 43)*

B.11.1 *Function*

Prefix 43 provides connection to an appropriate national or international centre collecting ship movement information for search and rescue (or other) purposes.

B.12 *Information retrieval services (prefixes 5x)*

Further study is required.

B.13 *Automatic test line (prefix 91)*

Prefix 91 provides automatic test of the ship earth station in telex and telephony mode. In the maritime satellite service the coast earth station will automatically transmit a "QUICK BROWN FOX" test message for telex and provide a loop-around test line connection in accordance with Recommendation O.11 for telephony. Test lines for data transmission are for further study.

B.14 *Commissioning tests (prefix 92)*

Prefix 92 is used in the Maritime Satellite Service for conducting commissioning tests of ship earth stations.

B.15 *Operational coordination (prefix 95)*

Prefix 95 is used in the Maritime Satellite Service for operational communications between management and maintenance elements of the system.

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SECTION 3

ROUTING PLAN FOR INTERNATIONAL SERVICE

Recommendation Q.12

OVERFLOW – ALTERNATIVE ROUTING – REROUTING – AUTOMATIC REPEAT ATTEMPT ¹⁾

1 When a call cannot find a free circuit in one group of circuits (first choice), technical arrangements can be made to route the call automatically via another group of circuits (second choice), at the same exchange; this process is called *overflow*. There may also be overflow, at the same exchange, from a second choice group of circuits to a third choice group of circuits, etc.

2 When the group of circuits over which the overflow traffic is routed involves at least one exchange not involved in the previous choice route, the process is called *alternative routing*.

3 It should be noted that overflow can occur without alternative routing for cases such as, when there are in one relation two groups of circuits, one group reserved for one-way operation and the other group used for both-way operation. In this case, when all one-way circuits are busy, the call can overflow to the both-way circuit group.

4 When congestion occurs at a transit exchange, arrangements can be made in some signalling systems, at the outgoing international exchange on receipt of a busy-flash signal or a congestion signal sent by the transit exchange, to reroute the call automatically from the outgoing international exchange over another route. This process is called *re-routing*. The use of rerouting is not envisaged in the International Routing Plan.

5 When a difficulty is encountered in the setting-up of a connection – such as double seizure on both-way circuits or error detection – arrangements can be provided to make another attempt to set up the connection for that call from the point where the first attempt took place. This process is called *automatic repeat attempt*.

An automatic repeat attempt may take place:

- on the same circuit; or
- on another circuit of the same group of circuits; or
- on a circuit in another group of circuits.

Reference

- [1] CCITT Recommendation *Overflow – Alternative routing – Rerouting – Automatic repeat attempt*, Vol. II, Rec. E.170.

¹⁾ This Recommendation is an extract of Recommendation E.170.

INTERNATIONAL TELEPHONE ROUTING PLAN

1 Introduction

1.1 This plan describes an international telephone routing plan designed to enable Administrations to select routings for their traffic which will result in a satisfactory connection between any two telephone stations in the world. The Plan relates to automatic and semi-automatic telephone traffic from fixed and mobile (both land and maritime) stations. The Plan is necessary to allow the objective to be achieved with maximum economy by the most efficient use of costly circuits and switching centres while safeguarding the grade of service and quality of transmission.

1.2 The Plan is one of the basic CCITT Recommendations which influence many other Recommendations, for example the transmission plan (Recommendation G.101).

1.3 In practice the large majority of international telephone traffic is routed on direct circuits (i.e. no intermediate switching point) between International Switching Centres (ISCs). It should be noted that it is the rules governing the routing of connections consisting of a number of circuits in tandem that this Recommendation primarily addresses. These connections have an importance in the network because:

- they are used as alternate routes to carry overflow traffic in busy periods to increase network efficiency,
- they can provide a degree of service protection in the event of failures of other routes,
- they can facilitate network management when associated with ISCs having temporary alternative routing capabilities.

1.4 This Plan replaces the previous one established in 1964 and it can be applied to all existing switching equipment and signalling systems and is intended to be flexible enough to incorporate new switching and signalling developments. Nevertheless, it is recognized that the Plan will have to be periodically reviewed and revised especially to take account of the evolution of ISDN.

1.5 The Plan accomplishes its basic purposes unconstrained by, and requiring no changes to, the numbering plan, the rules for charging the calling subscriber and the rules for the apportionment of charges (international accounting).

2 Principles

2.1 The Plan preserves the freedom of Administrations:

- a) to route their originating traffic directly or via any transit Administration they choose;
- b) to offer transit capabilities to as wide a range of destinations as possible in accordance with the guidelines which it provides.

2.2 The Plan provides guidance on possible international routings. Any routing chosen must be subject to agreements between the Administrations involved before implementation.

The freedom of Administrations to choose the routing of their terminal and transit traffic may be limited by technical, commercial and administrative considerations including:

- the capability of precisely measuring traffic volumes for accounting purposes,
- the need to maximize route profitability,
- the desirability of simplicity in international accounting.

2.3 The governing features of this Plan are:

- a) it is not hierarchical;
- b) Administrations are free to offer whatever transit capabilities they wish, providing they conform to this Recommendation;
- c) direct traffic should be routed over final (fully provided) or high usage circuit groups;

¹⁾ This Recommendation is also included in the E Series Recommendations under the number E.171

- d) no more than 4 international circuits in tandem should be involved between the originating and terminating ISCs;
- e) advantage should be taken of the non-coincidence of international traffic by the use of alternative routings to effect circuit economies and provide route diversity (Recommendation E.523);
- f) the routing of transit switched traffic should be planned to avoid the possibility of circular routings;
- g) when a circuit group has both terrestrial and satellite circuits the choice of routing should be governed by:
 - the guidance given in Recommendation G.114,
 - the number of satellite circuits likely to be utilized in the overall connection,
 - the circuit which provides the better transmission and overall service quality²⁾;
- h) the inclusion of two or more satellite circuits in the same connection should be avoided in all but exceptional cases. Annex A contains details on the effects of satellite communications.
Recommendation Q.14 defines the means to control the number of satellite links in an international telephone connection;
- i) both originating and transit traffic should be routed over the minimum number of international circuits in tandem unless this is in conflict with one of the above-mentioned features.

3 Number of circuits in tandem

3.1 International circuits

For reasons of transmission quality as well as the minimization of post-dialling and answer signal delays and the avoidance of signalling time-outs, it is desirable to limit the number of circuits in tandem in an overall connection (Recommendations G.101 and G.114, § 1). Recommendation Q.7 gives signalling considerations on tandem routings.

In this Plan the number of international circuits in a connection is limited to a maximum of 4. (See § 3.3.2 for a special case with multiple ISCs within the area of one Administration.)

3.2 National circuits

Limitations in the national section of the international connection are given in Recommendation G.101, § 3.1.

Many Administrations have fulfilled the requirements of Recommendation G.101, § 3.1 by establishing a national routing plan based on a theoretical final route structure with low-loss-probability circuit groups between switching centres of different categories.

The actual structure in many cases involves direct routes which bypass the theoretical final route or part of it, the structure being rather similar to the former international routing plan.

Note — The former international routing plan was last published in the Orange Book, Volume II.2, Recommendation E.171.

²⁾ When there are circuits between ISCs using different geographical routes with different transmission means, preference should be given to those circuits which provide better transmission quality as long as this is not conflicting with any other part of this Recommendation.

3.3 *Multiple ISCs in a country*

3.3.1 *In the originating or terminating country*

Administrations may find it advantageous for technical or economic reasons, for the protection of service, or to use multiple originating and/or terminating ISCs. In some cases this could result in the routing for a call involving a circuit between two ISCs in the originating or terminating country. Such circuits may be regarded as national circuits in applying this Plan.

3.3.2 *In a transit country*

Some Administrations may find it desirable to route transit traffic between two ISCs in their own country. In this case the allowable number of international circuits in tandem may be increased from 4 to 5 (this is the only exception to § 3.1 above).

4 **Basic routing rules**

4.1 *Originating traffic*

4.1.1 Originating traffic at an ISC may be offered to any route, taking into account all factors in this Plan, and the following guiding principles, to ensure good overall service quality for the call connection:

- a) an originating ISC should first select the direct route to the destination, if it is available;
- b) if the direct route is unavailable (because all circuits are busy or because no direct route is provided) then the originating ISC may select the route to any transit ISC which conforms to the principles in § 4.2 below. An agreement should first be reached between the originating, terminating and transit Administrations involved, for the use of this transit route.

4.1.2 A circuit group may be designed as a high usage circuit group (see Recommendation E.522) or as a final circuit group (see Recommendations E.520 or E.521).

4.1.3 Examples of some possible routings are given in Annex B.

4.2 *Transit traffic*

4.2.1 *Two and three international circuits in tandem*

An Administration offering transit capabilities may do so without special arrangements or restrictions to all destinations served by:

- a) direct circuit groups, or
- b) switching via an additional transit ISC that has a direct final circuit group to the destination, or
- c) a combination of a) and b).

Examples of two and three international circuits in tandem are given in b) to e) of Figure B-1/Q.13.

4.2.2 *Four international circuits in tandem*

If an Administration has provided a routing for its originating traffic that involves a maximum of 3 international circuits in tandem to a destination, it may offer this capability to other Administrations for transit traffic. In this case, these other Administrations must not themselves offer transit capabilities to the same destination as this would exceed 4 international circuits in tandem.

Examples of 4 international circuits in tandem are given in f) and g) of Figure B-1/Q.13.

4.2.3 A circuit group may be designed as a high usage circuit group (see Recommendation E.522) or as a final circuit group (see Recommendations E.520 or E.521).

4.2.4 *Special arrangements*

Some Administrations may route transit traffic differently from their own originating traffic to a given destination. These routings will in some cases involve offering transit traffic to direct routes, but not to overflow routes via alternative transit ISCs. On the other hand, originating traffic offered to the same direct routes is given access to overflow routes.

This arrangement may be used for:

- a) limiting the number of international circuits in tandem for transit calls, yet allowing originating calls up to the maximum of 4 international circuits in tandem.
- b) preventing transit traffic from overflowing from direct routes, to minimize subsequent transit charges.
- c) minimizing transmission propagation delay for transit calls.

In such cases, care must be exercised to avoid grade of service problems. Consideration should be given to:

- i) the analysis of 24-hour traffic profiles;
- ii) the exchange of network status information between Administrations.

In implementing such arrangements, Administrations offering transit capability should provide the necessary information on traffic profiles and network status capabilities. Originating Administrations should evaluate such information taking into account transmission costs, and call completion factors. (See Recommendations E.522 and E.523.)

Examples of some routings involving special arrangements are given in a) and b) of Figure B-2/Q.13.

5 **List of international transit capabilities**

5.1 To aid in the application of transit routings, a list of international transit capabilities via an Administration is desirable.

5.2 Each Administration that wishes to offer transit capabilities should develop and distribute its own list.

5.3 Annex C details the essential information that should be contained in a list of international transit capabilities plus additional information that might also be distributed by Administrations offering transit capabilities or might be requested by Administrations seeking transit routings.

ANNEX A

(to Recommendation Q.13)

The effects of satellite communication

A.1 The use of geostationary satellite circuits does not call for any alteration in the basic principles and rules of this Plan. However, because of the mean propagation time on satellite circuits, the precautions specified in Recommendation G.114 must be observed.

A.2 At originating ISCs, calls which are to be transit switched at another ISC and likely to use a satellite circuit elsewhere in the connection should be routed using terrestrial circuits from the originating ISC, if available.

A.3 At ISCs arrangements should be made to guard against the inclusion of two or more satellite circuits in the same connection in all but exceptional cases. (See § A.6 below.)

Avoidance of two or more satellite circuits is made more feasible when the signalling systems used have signals indicating whether the connection already includes a satellite circuit. (See Recommendation Q.7.)

In those cases when the signalling system does not provide the necessary information, bilateral agreement should be sought between the Administrations involved to establish a special circuit group on which traffic can be routed that has already one or more satellite circuits in the connections. (See Figure A-1/Q.13.)

A.4 The use of national satellite circuits for international originating and terminating connections should be avoided to the extent possible.

A.5 Connections (originating, terminating or transit) to and from the international maritime mobile satellite service should not, so far as possible, comprise other satellite circuits. In the shore-to-ship direction the country codes allocated to the maritime mobile satellite service should be analysed in order to apply this provision.

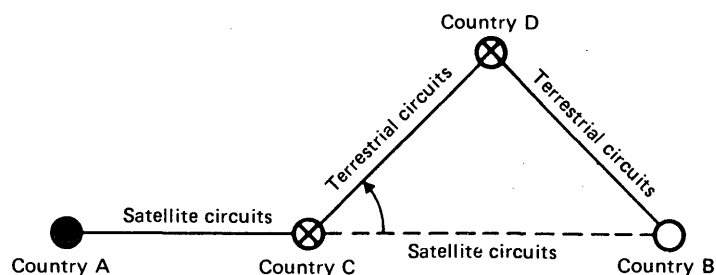
A.6 There will be cases when the above provisions cannot be fully applied. These are:

- routing to and from Administrations with exclusive or almost exclusive use of satellite circuits for international service;
- routings containing more than one international circuit in tandem in which the signalling systems used on one or more of the circuits in the connection does not provide nature of circuit indicators, or when no agreement can be reached with respect to the special circuit group;
- when no other reliable means of communication is available; then two or more satellite circuits in one connection may be used.

Note – When it is unavoidable to use more than one satellite circuit in an international connection, attention to echo control as indicated in Notes 2 and 3 of Recommendation G.114 should be exercised.

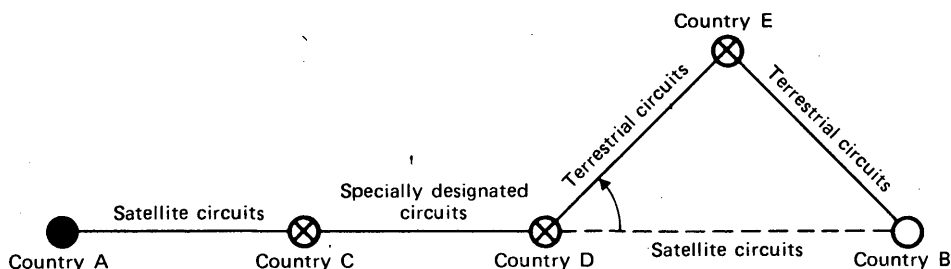
A.7 Control methods for echo suppressors³⁾ are given in Recommendation Q.115.

A.8 The use of demand assigned satellite systems in international telephony (e.g. SPADE) is governed by the same general and special considerations given above. The entirety of a demand assigned system and its access circuits may be regarded as a single international circuit for transmission purposes and as a transit ISC for routing purposes.



Note – Circuit group Country C to Country B is high usage for traffic originating at C but is not accessed for transit traffic from circuit group Country A to Country C in order to avoid two international satellite circuits in tandem.

a)



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Note – Circuit group Country C to Country D is specially designated by the Administration involved to be treated as if it comprised satellite circuits. Circuit group Country D to Country B is high usage for traffic originating at D but is not accessed for transit traffic from the specially designated circuit group Country C to Country D.

b)

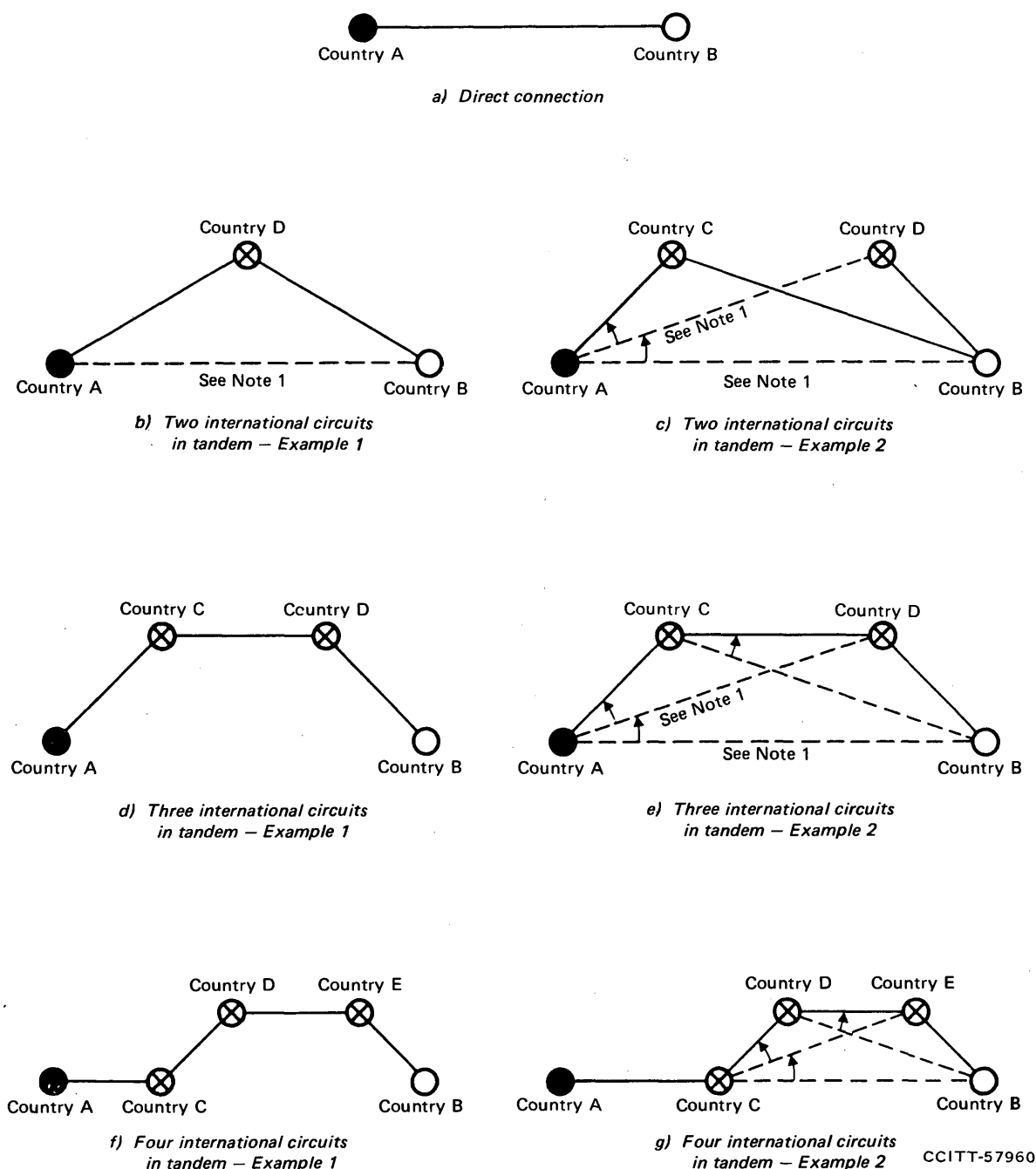
FIGURE A-1/Q.13

³⁾ Echo cancellers are also now in use.

ANNEX B

(to Recommendation Q.13)

Examples of possible routings and special arrangements



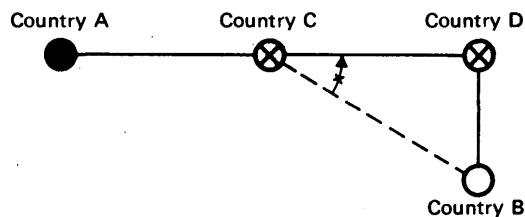
Note 1 – These circuit groups illustrate the choices available to the originating Administration under § 4.1.

Note 2 – For explanation of legends, see Figure B-2/Q.13.

Note 3 – For Figure a) see § 4.1.1 a); for Figures b), c), d), e) see §§ 4.1.1, 4.2.1 b) and 4.2.1 c); for Figures f), g) see §§ 4.1.1 and 4.2.2.

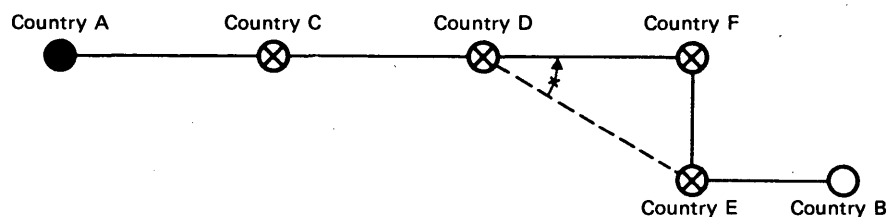
FIGURE B-1/Q.13

Example of some routings possible under the International Telephone Routing Plan



Note – Country C routes its originating traffic to Country B via a direct route with overflow to an alternative route via a transit ISC in Country D. In order to minimize transit charges Country C may bar overflow from the direct route for transit traffic. In establishing this arrangement for Country A, Countries C and A should review the traffic levels and 24 hour profiles to ensure that the transit traffic experiences adequate grade of service.

a/



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Note – This example uses the same principle as a/ for the purpose of limiting the number of circuits in tandem for transit traffic to 4. This arrangement may be applied at any of the transit ISCs.

b/

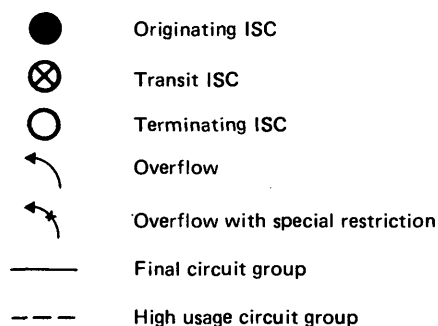


FIGURE B-2/Q.13

Examples of some special arrangements (see § 4.2.4)

ANNEX C
(to Recommendation Q.13)

List of international transit capabilities

C.1 Essential information on international transit capabilities

C.1.1 Use

Every Administration offering transit capabilities should compile and distribute a list including at least the information shown below in order to enable other Administrations to make a first choice of possible transit routings.

C.1.2 Suggested format

See Figure C-1/Q.13.

Administration _____ Date _____

Address for Inquiries _____

Destination	Transit ISC	Route type	Terrestrial possible	Special restrictions

FIGURE C-1/Q.13

C.1.3 *Instructions for completing the list*

Item A – Administration or RPOA

Enter the name of the Administration or recognized private operating agency responsible for preparing this list.

Item B – Date of Information

Enter the date for which the information below applies.

Item C – Address for Inquiries

Enter the name, address, telex and telephone number of the organizational unit or individual who will respond to enquiries concerning transit capabilities.

Column 1 – Destination country or Administration

Enter the name of the destination country or Administration. These destinations should be listed alphabetically within each World Zone grouping. Only those destinations for which this ISC can carry automatic transit traffic should be listed in this column. All destinations for which transit capabilities are being offered should be listed.

Column 2 – Transit ISCs

Enter the name or location that identifies the international switching centre(s) that has automatic transit access to the destinations in column 1. For multiple transit ISCs within the same Administration list each ISC in sequence.

Column 3 – Route Type

Enter whether the transit route to the destination is either:

DIR – If “direct” to the terminating ISC.

IND – If “indirectly” first routed via a further transit ISC. The name of the further transit ISC should also be entered.

ALT – If either the “DIR” or “IND” route automatically overflows to an “alternative” transit ISC. The name of the alternative transit ISC should also be entered.

Column 4 – Terrestrial possible

Enter YES if at least some transit calls to this destination can obtain an all terrestrial route beyond the transit ISC.

Enter NO if all transit calls to this destination will use a satellite circuit in the route beyond the transit ISC.

Column 5 – Special restrictions

Enter YES if the transit traffic is subject to overflow restrictions (see § 4.2.4) that might affect the grade of service achieved.

Enter NO if no such restrictions apply.

C.2 *Additional information on international transit capabilities*

C.2.1 *Use*

The information shown below is of value in comparing and selecting possible transit routes. Administrations offering transit capabilities might choose to compile and distribute some or all of these items with their basic list of international transit capabilities. Alternatively Administrations selecting a transit route may use the items shown below as a basis for enquiries.

C.2.2 *Format*

No particular format is suggested for this information. However, it is recommended that both transit and originating Administrations use the terminology and definitions given below.

If changes are planned in any of the items the change should be indicated together with the effective date.

C.2.3 *Details of additional items*

traffic profile

Under this item the busy hour traffic on the circuit group used beyond the transit ISC should be given together with an indication of the traffic variations during the day. Preferably the variations should be presented in the form of hourly traffic distributions as shown in Recommendation E.523.

Transit charges

Under this item details of the applicable transit charges should be given.

Grade of service

The grade of service normally experienced to the destination should be given. This may be supplemented by time of day variations. If overflow restrictions for transit traffic apply, the information must include at least the hours during which the grade of service is 1% or better.

Circuit quantities

The total circuit quantities available and subtotals for each type of transmission medium should be given.

If indirect routing is used this information should be given for the circuit groups to the next transit ISC.

Signalling

The signalling systems used for the onward routing from the transit ISC should be listed.

Restoration

This item should outline the restoration policy in the case of a major transmission facility outage in the onward routing.

Echo Control

This item should list the echo control capabilities at the transit ISC.

Prevention of two or more satellite circuits in tandem

This item should explain the capabilities at the transit ISC for preventing the connection of two satellite circuits in tandem.

Where indirect routing is used, this item should also identify whether a specially designated circuit group has been agreed to allow prevention of two satellite circuits in the same connection at a subsequent ISC.

**MEANS TO CONTROL THE NUMBER OF SATELLITE LINKS IN AN
INTERNATIONAL TELEPHONE CONNECTION**

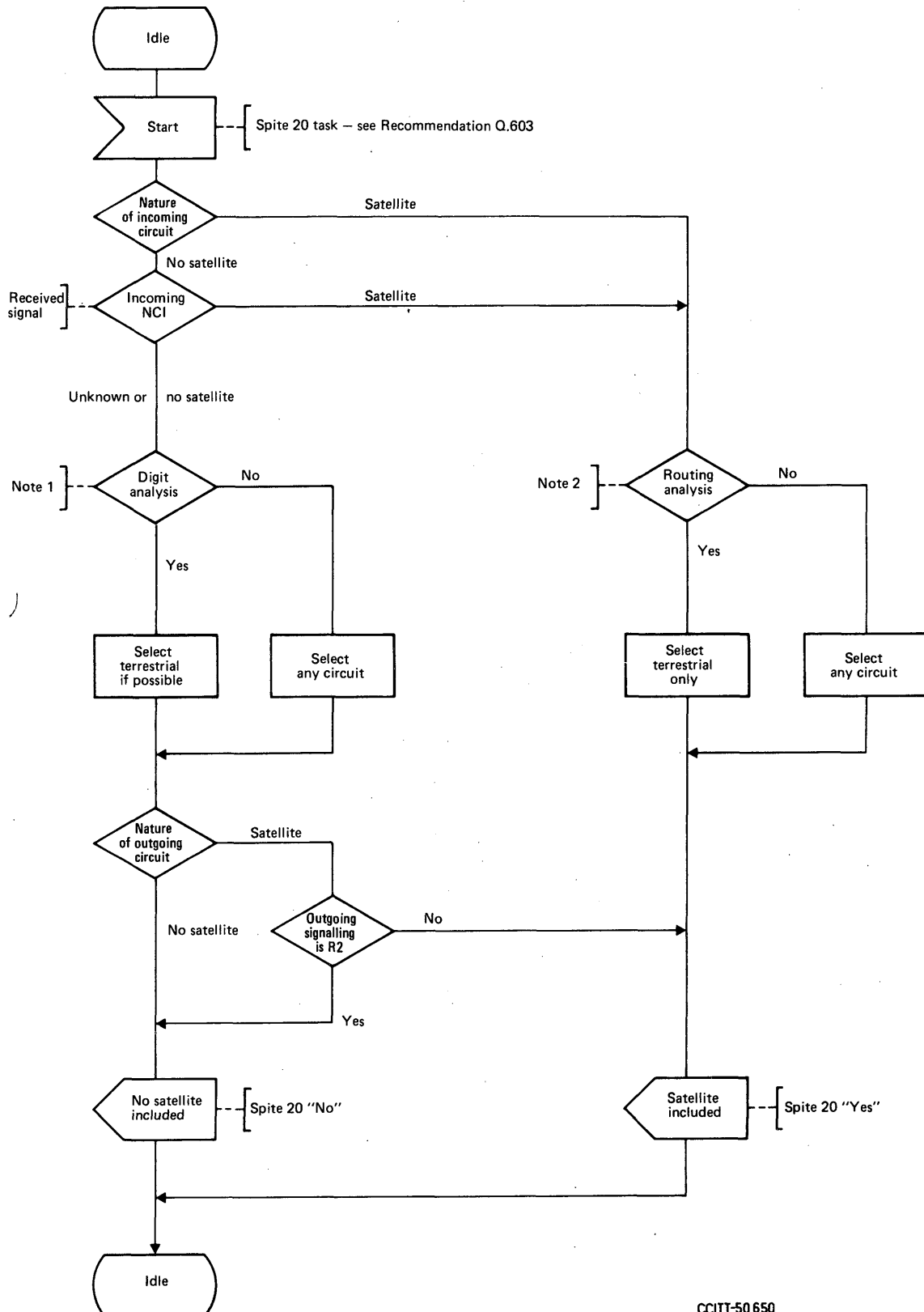
Recommendation Q.41 states that connections with a mean one-way propagation time in excess of 400 ms should be avoided apart from exceptional circumstances. Means should therefore be provided in international switching centres to prevent the multiple connection of satellite links whenever possible.

The following principles should apply in controlling such connections:

- a) If an exchange can determine the prior connection of a satellite link in a connection by:
 - information relating to the incoming circuit,
 - receipt of the Nature of Circuit Indicator: “satellite included”,the exchange should forward the call on a terrestrial circuit. A satellite circuit may be used in the following exceptional circumstances:
 - where no terrestrial circuits are provided to the required destination,
 - where only a few terrestrial circuits are provided on a final route and the loss of quality of service of a double satellite connection (echo problems and “double-talk”) is preferable to the degradation of grade of service that would be caused by the exclusion of the satellite circuits.A Nature of Circuit Indicator “satellite included” should be forwarded on the outgoing circuit where possible.
- b) If an exchange can determine by an analysis of the call destination that a satellite link will definitely or most probably be included at a later point in the call connection, it should give priority to terrestrial links in its outgoing circuit selection. Special attention is drawn to the analysis of country code 87S which may indicate that the call will include a maritime satellite link. (For the use of the S digit, see Recommendations Q.11 *bis* and Q.11 *quater*).

The above principles apply to all international exchanges and to all national exchanges which may connect to circuits via domestic satellite systems.

(to Recommendation Q.14)

Call processing logic – Nature of circuit indications

CCITT-50 650

Note 1 – Digit analysis indicates that satellite link will, or may be included at later point.

Note 2 – Are terrestrial circuit groups provided? The answer “no” should be given if the size of the terrestrial circuit group is very small in comparison with the satellite group(s). This can be achieved by giving the terrestrial circuit group the path of entry indication “satellite” for outgoing calls.

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SECTION 4

GENERAL RECOMMENDATIONS RELATIVE TO SIGNALLING AND SWITCHING SYSTEMS (NATIONAL OR INTERNATIONAL)

4.1 Power limits of signals of a signalling system

Recommendation Q.15

NOMINAL MEAN POWER DURING THE BUSY HOUR¹⁾

*(Remark of Recommendation G.222, Volume III of the Red Book,
amended at Geneva, 1964; further amended)*

Nominal mean power during the busy hour

To simplify calculations when designing carrier systems on cables or radio links, the CCITT has adopted a *conventional* value to represent the *mean absolute power level* (at a zero relative level point) of the speech plus signalling currents, etc., transmitted over a telephone channel in one direction of transmission during the busy hour.

The value adopted for this mean absolute power level corrected to a zero relative level point is -15 dBm0 (mean power = 31.6 microwatts); this is the mean with time and the mean for a large batch of circuits.

Note 1 — This conventional value was adopted by the CCIF in 1956 after a series of measurements and calculations had been carried out by various Administrations between 1953 and 1955. The documentation assembled at the time is indicated in [2]. The adopted value of about 32 microwatts was based on the following assumptions:

- i) mean power of 10 microwatts for all signalling and tones (Recommendation Q.15 [2], gives information concerning the apportionment on an energy basis of signals and tones);
- ii) mean power of 22 microwatts for other currents, namely:
 - speech currents, including echoes, assuming a mean activity factor of 0.25 for one telephone channel in one direction of transmission;
 - carrier leaks (see Recommendations G.232, § 5 [3]; G.233, § 11 [4]; G.235, § 5 [5]); and the Recommendations cited in [6] and [7];

¹⁾ This Recommendation is, basically, an extract of Recommendation G.223 [1].

- telegraph signals, assuming that few telephone channels are used for VF telegraphy systems (output signal power 135 microwatts (the Recommendation cited in [8])) or phototelegraphy (amplitude modulated signal with a maximum signal power of about 1 milliwatt (the Recommendation cited in [9])).

On the other hand, the power of pilots in the load of modern carrier systems has been treated as negligible.

The reference to “the busy hour” in § 1 is to indicate that the limit (of -15 dBm0) applies when transmission systems and telephone exchanges are at their busiest so that the various factors concerning occupancy and activity of the various services and signals are to be those appropriate to such busy conditions.

It is not intended to suggest that an integrating period of one hour may be used in the specification of the signals emitted by individual devices connected to transmission systems. This could lead to insupportably high short-term power levels being permitted which give rise to interference for durations of significance to telephony and other services.

Note 2 – The question of reconsidering the assumptions leading to this conventional value arose in 1968 for the following reasons:

- changes in the r.m.s. power of speech signals, due to the use of more modern telephone sets, to a different transmission plan, and perhaps also to some change in subscriber habits;
- change in the mean activity factor of a telephone channel due, *inter alia*, to different operating methods;
- increase in the number of VF telegraphy bearer circuits and sound-programme circuits;
- introduction of circuits used for data transmission, and rapid increase in their number.

During several Study Periods these points have been under study and various Administrations carried out measurements of speech signal power and loading of carrier systems. The results are shown in Supplement No. 5. These results indicate that there is no sufficiently firm information to justify an alteration to the conventional mean value of -15 dBm0 ($32 \mu\text{W}$) for the long-term mean power level per channel.

Indeed, the steps envisaged by Administrations to control and reduce the levels of non-speech signals indicate a tendency to limit the effect of the increase in the non-speech services.

As regards the subdivision of the $32 \mu\text{W}$ into $10 \mu\text{W}$ signalling and tones and $22 \mu\text{W}$ speech and echo, carrier leaks, and telegraphy, again there is no evidence which would justify proposals to alter this subdivision.

As a general principle, it should always be the objective of Administrations to ensure that the *actual* load carried by transmission systems does not significantly differ from the *conventional* value assumed in the design of such systems.

References

- [1] CCITT Recommendation *Assumptions for the calculation of noise on hypothetical reference circuits for telephony*, Vol. III, Rec. G.223.
- [2] *CCITT collected documents on the volume and power of speech currents transmitted over international telephone circuits*, Blue Book, Vol. III, Part 4, Annex 6, ITU, Geneva, 1965.
- [3] CCITT Recommendation *12-channel terminal equipments*, Vol. III, Rec. G.232, § 5.
- [4] CCITT Recommendation *Recommendations concerning translating equipments*, Vol. III, Rec. G.233, § 11.
- [5] CCITT Recommendation *16-channel terminal equipments*, Vol. III, Rec. G.235, § 5.
- [6] CCITT Recommendation *Characteristics of group links for the transmission of wide-spectrum signals*, Vol. III, Rec. H.14, § 2.3.
- [7] CCITT Recommendation *Characteristics of supergroup links for the transmission of wide-spectrum signals*, Vol. III, Rec. H.15, § 2.3.
- [8] CCITT Recommendation *Basic characteristics of telegraph equipments used in international voice-frequency telegraph systems*, Vol. III, Rec. H.23, § 1.2.
- [9] CCITT Recommendation *Phototelegraph transmission on telephone-type circuits*, Vol. III, Rec. H.41, § 2.3.

Recommendation Q.16

MAXIMUM PERMISSIBLE VALUE FOR THE ABSOLUTE POWER LEVEL
OF A SIGNALLING PULSE¹⁾

The CCITT recommends that, for crosstalk reasons, the absolute power level of each component of a short duration signal should not exceed the values given in Table 1/Q.16.

The values given in this table result from a compromise between the characteristics of various existing channel filters.

TABLE 1/Q.16
Maximum permissible value of power at a zero relative level point

Signalling frequency (Hz)	Maximum permissible power for a signal at a zero relative level point (microwatts)	Corresponding absolute power level. Decibels referred to 1 mW (dBm0)
800	750	-1
1200	500	-3
1600	400	-4
2000	300	-5
2400	250	-6
2800	150	-8
3200	150	-8

If the signals are made up of two different frequency components, transmitted simultaneously, the maximum permissible values for the absolute power levels are 3 decibels below the above figures.

Reference

[1] CCITT Recommendation *Maximum permissible value for the absolute power level (power referred to one milliwatt) of a signalling pulse*, Vol. III, Rec. G.224.

4.2 Signalling in the speech frequency band and outside the speech frequency band

Recommendation Q.20

COMPARATIVE ADVANTAGES OF “IN-BAND”
AND “OUT-BAND” SYSTEMS

Signalling over telephone circuits may be effected *in* the frequency band used for speech (“in-band” signalling), or *outside* it (“out-band” signalling). In the latter case, the same channel carries both the signalling and speech frequency bands, the signalling band being separate from the speech band, and signalling equipment is an integral part of the carrier system.

¹⁾ This Recommendation also appears as Recommendation G.224 [1].

In a further type of out-band signalling, a circuit, not used for speech, can be used to effect the signalling requirements of a number of speech circuits. This may be termed "separate channel signalling". The separate channel may be:

- a) a channel in a carrier system used to effect the signalling requirements of the remaining channels in the same carrier system which are used for speech, signalling equipment being an integral part of the carrier system: this may be termed "built-in separate channel signalling";
- b) completely separate, in which case signalling equipment is not an integral part of the carrier system; this may be termed "completely separate channel signalling".

1 Advantages of in-band signalling

1.1 In-band signalling can be applied to any type of line plant. The application of out-band signalling, and built-in separate channel signalling, is limited to carrier systems.

1.2 Through-signalling can be employed at transit points, and at carrier system terminals when a telephone circuit comprises two or more carrier links. No direct current repetition and thus no delay and no distortion of signals arises at such points. Out-band signalling and built-in separate channel signalling require a direct current repetition at such points.

1.3 Replacement of a faulty line section is easy. In the case of completely separate channel signalling, replacement of a faulty line section is based on security arrangements.

1.4 It is impossible to set up a connection on a faulty speech path. In the case of completely separate channel signalling, a continuity check of the speech path is required.

1.5 The full bandwidth of the speech channel is available for signalling. This facilitates the use of more than one signalling frequency. Normally the full bandwidth permits faster signalling than with a smaller signalling bandwidth. With in-band signalling, realization of this advantage is limited to those signals not required to be protected against signal imitation due to speech currents.

2 Advantages of out-band signalling

2.1 Relative freedom from disturbances due to speech currents; freedom from disturbances due to echo-suppressors; freedom from disturbances which might arise from connections to other signalling systems. With in-band signalling it is necessary to take steps to guard against such disturbances.

2.2 Possibility of signalling, during the setting-up of the call, by either discontinuous or continuous transmission, and the possibility of transmitting those signals during speech. Signalling during speech is not compatible with in-band signalling.

2.3 Simplicity of terminal equipment due to § 2.1 above and to the possibility of continuous signalling.

Out-band signalling (where the same channel carries both speech and signalling) also has the advantage of § 1.3 of in-band signalling.

Built-in separate channel signalling has the advantages of §§ 2.1, 2.2 and 2.3 of out-band, and the advantage of § 1.3 of in-band signalling.

Completely separate channel signalling has the advantages of §§ 2.1 and 2.2 of out-band signalling and, compared with out-band signalling and built-in separate channel signalling, has the additional advantages that no direct current repetition is necessary, and no distortion of signals arises, at carrier system terminals when a circuit comprises two or more carrier links.

SYSTEMS RECOMMENDED FOR OUT-BAND SIGNALLING

When Administrations wish to make mutual agreements to use out-band signalling systems, the CCITT considers it desirable, from the transmission viewpoint, for them to use one of the types of signalling systems (outside the speech band) defined in the following annexes:

Annex A: Normal carrier systems with 12 channels per group;

Annex B: Carrier systems with 8 channels per group.

ANNEX A

(to Recommendation Q.21)

**Out-band signalling systems for
carrier systems with 12 channels per group**

(The signal levels are quoted in terms of absolute power level at a zero relative level point in dBm0.)

A.1 *Type I* (discontinuous signals)

Frequency: virtual carrier (zero frequency).

Level: high,

for example -3 dBm0.

A.2 *Type II*

1) (discontinuous signals)

Frequency: 3825 Hz.

Level: high,

for example -5 dBm0.

2) (semi-continuous signals)

Frequency: 3825 Hz

Level: low,

for example -20 dBm0.

A.3 The *Type I* signalling system is compatible with only those group and supergroup reference pilots having a displacement from the virtual carrier frequency (zero frequency) of 140 Hz.

Types II-1 and II-2 are compatible with only those group and supergroup reference pilots having a displacement from the virtual carrier frequency (zero frequency) of 80 Hz.

ANNEX B

(to Recommendation Q.21)

**Out-band signalling systems for
carrier systems with 8 channels per group**

[The signal levels are quoted in terms of absolute power level (reference 1 mW) at a zero relative level point.]

Frequency: $4.3 \text{ kHz} \pm 10 \text{ Hz}$.

Level:

– discontinuous signals: -6 dBm0;

– semi-continuous signals: value between -20 dBm0 and -17.4 dBm0.

FREQUENCIES TO BE USED FOR IN-BAND SIGNALLING

To reduce the risk of signal imitation by speech currents, the frequencies for an in-band signalling system should be chosen from the frequencies in the band in which speech signal power is lowest, i.e. frequencies above 1500 Hz.

The desirability of this was confirmed by tests carried out in London, Paris and Zurich in 1946 and 1948 to choose the signalling frequencies of systems standardized by the CCITT. These tests led to the conclusion that, if relative freedom from false signals was to be obtained other than by undue increase in signal duration, frequencies of at least 2000 Hz would have to be used.

4.3 Signalling frequencies for push-button telephone sets and reception of those signals in exchanges

Recommendation Q.23

TECHNICAL FEATURES OF PUSH-BUTTON TELEPHONE SETS

1 The introduction of push-buttons on telephone sets may have an effect on the operation of international circuits:

- a) owing to the greater dialling speed, the post-dialling may be longer, since national and international networks will only be gradually adapted to allow for this greater speed;
- b) when pressing the buttons after an international call has been set up, the signalling frequencies for push-button sets may cause interference to foreign signalling systems on the connection. However, the subscriber can be warned of the possible disadvantages of touching the buttons in conditions different from those prescribed.

2 There can be no doubt that, owing to the high dialling speed which can be obtained with push-button sets, their use is bound to spread widely and rapidly and it is desirable for the signalling methods for such sets to be internationally standardized.

One factor in favour of such standardization is the advantage it offers for countries which have to import their equipments from various other countries. This argument, admittedly, applies to any type of telephone equipment.

Other advantages of standardization are:

- the possibility of using the push-button of such sets for signalling directly from one subscriber to another subscriber via a national and/or international connection;
- the standardized allocation of signalling frequencies for push-button sets facilitates the choice of signalling frequencies in the frequency band of a telephone circuit for any other use (data transmission, telephone signalling system, etc.) for which provision might have to be made. The risk of mutual interference among the signalling systems (see Recommendation Q.25) makes it necessary to have an orderly arrangement of the spectrum of frequencies used for signalling.

3 The general use of push-button sets for purposes other than telephone dialling is envisaged by some Administrations. However, some Administrations observe that it would seem advisable to reserve such uses for a network of relatively limited extent; in their view the reliability of standards for data transmission should not make any demands on the push-button set system other than those required for the transmission of telephone numerical information to the local exchange, if the design of push-button sets is to remain within economical limits compatible with their widespread use.

However, the CCITT considered, at Mar del Plata in 1968 that, even if the transmission of data from a push-button telephone set is at present to be envisaged in international traffic on a limited scale only, it would nonetheless be wise not to rule out the possibility of such transmission of data on a general scale.

4 In choosing a signalling system for push-button sets, Administrations may be guided by conditions which vary considerably from one country to another. Economic considerations may, for instance, lead them to prefer a direct current system which might be less expensive than a voice-frequency system. The numerical dialling information would then be transmitted only as far as the telephone exchange to which the subscriber is connected. There are no tones that could affect the connection after its establishment. Data would not be transmitted from the push-button sets unless a suitable converter were used in the exchange.

Standardization of a direct current system for signalling from push-button sets does not seem justified at the international level; it may depend on the conditions peculiar to the local networks of the country concerned.

5 The signalling system for push-button sets recommended by the CCITT applies solely to voice-frequency signals.

A multifrequency code for such signalling is recommended in which the dialling signal is composed of two frequencies emitted simultaneously when a button is pressed. It is planned to have 10 decimal digits and 6 reserve signals, making 16 signals in all. The two frequencies composing each signal are taken from two mutually exclusive frequency groups of four frequencies each, a code known as the "2 (1/4) code".

6 The low group frequencies of this 2 (1/4) code are:
697, 770, 852, 941 Hz.

The high group frequencies are:
1209, 1336, 1477 and 1633 Hz.

The allocation of frequencies to the various digits and symbols of a push-button set appears in Figure 1/Q.23.

7 The frequency variation tolerances and the permissible intermodulation products are defined as follows:
7.1 each transmitted frequency must be within $\pm 1.8\%$ of the nominal frequency;
7.2 the total distortion products (resulting from harmonics or intermodulation) must be at least 20 dB below the fundamental frequencies.

8 The CCITT determined, at Mar del Plata in 1968, that it was not practicable to specify a standardization of the levels for the frequencies transmitted when a push-button is pressed, as these level conditions depend essentially on national transmission plans which are not the same in all countries.

However, the sending level conditions must be such that on an international connection they do not exceed the values specified in Recommendation Q.16 (maximum permissible value for the absolute power level of a signalling pulse).

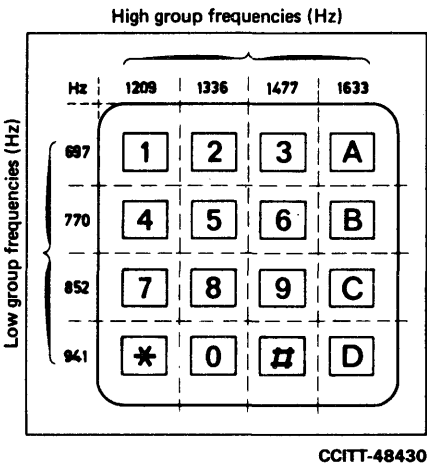


FIGURE 1/Q.23
Allocation of frequencies to the various digits and symbols of a push-button set

MULTIFREQUENCY PUSH-BUTTON SIGNAL RECEPTION

1 Introduction

Characteristics of multifrequency push-button (MFPB) telephone sets using voice frequency signals are included in Recommendation Q.23. This Recommendation Q.24, is intended primarily for application in local exchanges for the reception of MFPB signals. Other MFPB signal receiving applications, such as transit exchanges, would need to take into account the effects of transmission impairments, such as signal clipping, that could be introduced in long distance telephone networks. Since technical factors, such as transmission loss, vary among national networks, varying national standards exist. Varying standards may also exist, for example, to incorporate differences between local and transit exchange applications. This Recommendation is not intended to supersede existing national standards nor is it intended to imply that Administrations should modify those standards.

2 Technical parameters

2.1 General

The technical parameters identified herein are fundamental to the MFPB receiving function and reasons are given for the importance of each parameter. The parameters require operational values to be specified for compatibility with the MFPB sending equipment (Recommendation Q.23) and the network environment in which the receiving equipment must function. Annex A contains a Table showing values for some of these parameters that have been adopted by various Administrations and RPOAs. In addition to the fundamental parameters covered by this Recommendation, Administrations should consider whether other parameters need specification to account for operating conditions found in their networks.

2.2 Signal frequencies

Each signal consists of two frequencies taken from two mutually exclusive frequency groups (a high group and a low group) of four frequencies each, as specified in Recommendation Q.23. These frequencies and their allocation to form the various digits and symbols of the push-button signalling code are defined in Recommendation Q.23. The exchange shall provide a check for the simultaneous presence of one and only one frequency from the high group and one and only one from the low group.

2.3 Frequency tolerances

The exchange should respond to signals whose frequencies are within the tolerances for MFPB sending. Somewhat wider tolerances may be appropriate, for example to cater for transmission impairments encountered in subscriber cables or FDM transmission facilities. However, wider limits may increase susceptibility to noise and digit simulation by speech.

2.4 Power levels

The exchange should provide proper reception of signals whose power levels are determined by the amplitude of the sending equipment and loss that may be introduced by the subscriber cables or other network elements. The sending amplitude and transmission attenuation may be different for different frequencies. The reception characteristics may take advantage of a limitation, if specified, on the maximum difference in power level between the two received frequencies forming a valid signal to facilitate improved overall performance.

2.5 Signal reception timing

The exchange should recognize signals whose duration exceeds the minimum expected value from subscribers. To guard against false signal indications the exchange should not respond to signals whose duration is less than a specified maximum value. Similarly, pause intervals greater than a specified minimum value should be

recognized by the exchange. To minimize erroneous double-registration of a signal if reception is interrupted by a short break in transmission or by a noise pulse, interruptions shorter than a specified maximum value must not be recognized. The maximum rate at which signals can be received (signalling velocity) may be related to the above minimum values. All of these values may also be determined by subscriber feature requirements.

2.6 *Signal simulation by speech*

Because telephone set speech transmitters are normally connected in the circuit during the push-button dialling interval, it is necessary for the exchange to properly receive valid MFPB signals in the presence of voice or other disturbances. The nature of such disturbances may vary from one geographical area to another. The number of calls affected by signal simulation should not significantly degrade the overall telephone network performance experienced by subscribers.

Since actual immunity to digit simulation may be difficult to measure, a test environment using recorded speech, music, and other voice frequency sounds may be utilized to verify design performance.

2.7 *Interference by dial tone*

MFPB reception should not be adversely affected while dial tone is being applied. Characteristics of dial tone such as frequencies, power levels and spurious components are covered in Recommendation Q.35. These characteristics are specified to minimize the interference between the dial tone sending and the MFPB receiving functions. These functions are normally provided by closely related exchange equipment which must be designed to function properly over the entire range of signal characteristics and transmission impairments to be encountered.

2.8 *Interference by echos*

MFPB signal reception from extended subscriber lines having long 4-wire transmission sections must discriminate between a true signal condition and an echo condition which may persist for a number of milliseconds. Failure to provide such discrimination could result in signal reception errors, for example due to a reduction of the detected pause duration. Administrations having such extended subscriber lines with MFPB signalling should therefore specify the echo conditions under which the MFPB signalling function must operate.

2.9 *Noise immunity*

Noise sources such as power lines, electric railways and telecommunication circuits may induce electrical disturbances with various characteristics into MFPB signalling paths. These disturbances may cause MFPB signals to be missed, split (double signal registration) or cause signal simulation. The distortion products produced by the MFPB signalling source should also be included in the noise environment. A realistic noise environment specification and facilities for testing MFPB reception under the specified conditions, e.g., using recorded test tapes, are important to ensure that performance standards will be met under actual service conditions.

TABLE A-1/Q.24

Values of multi-frequency push-button receiving parameters adopted by various Administrations/RPOAs

Parameters			Values				
			NTT	AT&T	Danish Administration ^{a)}	Australian Administration	Brazilian Administration
Signal frequencies	Low group		697, 770, 852, 941 Hz	same as left column	same as left column	same as left column	same as left column
	High group		1209, 1336, 1477, 1633 Hz				
Frequency tolerance $ \Delta f $	Operation		$\leq 1.8\%$	$\leq 1.5\%$	$\leq (1.5\% + 2 \text{ Hz})$	$\leq (1.5\% + 4 \text{ Hz})$	$\leq 1.8\%$
	Non-operation		$\geq 3.0\%$	$\geq 3.5\%$		$\geq 7\%$	$\geq 3\%$
Power levels per frequency	Operation		–3 to –24 dBm	0 to –25 dBm	(A + 25) to A dBm	–5 to –27 dBm	–3 to –25 dBm
	Non-operation		Max. –29 dBm	Max. –55 dBm	Max. (A – 9) dBm (A = –27)	Max. –30 dBm	Max. –50 dBm
Power level difference between frequencies			Max. 5 dB	+4 dB to –8 dB ^{b)}	Max. 6 dB	Max. 10 dB	Max. 9 dB
Signal reception timing	Signal duration	Operation	Min. 40 ms	Min. 40 ms	Min. 40 ms	Min. 40 ms	Min. 40 ms
		Non-operation	Max. 24 ms	Max. 23 ms	Max. 20 ms	Max. 25 ms	Max. 20 ms
	Pause duration		Min. 30 ms	Min. 40 ms	Min. 40 ms	Min. 70 ms	Min. 30 ms
	Signal interruption		Max. 10 ms ^{c)}	Max. 10 ms	Max. 20 ms	Max. 12 ms	Max. 10 ms
	Signalling velocity		Min. 120 ms/digit	Min. 93 ms/digit	Min. 100 ms/digit	Min. 125 ms/digit	Min. 120 ms/digit
Signal simulation by speech			6 false/46 hours for speech with a mean level of –15 dBm	For the codes 0-9, 1 false/3000 calls For the codes 0-9, *, #, 1 false/2000 calls For the codes 0-9, *, # A-D, 1 false/1500 calls	46 false/100 hours for speech with a mean level of –12 dBm		5 false/50 hours for speech with a mean level of –13 dBm
Interference by echos				Should tolerate echos delayed up to 20 ms and at least 10 dB down			

^{a)} Same characteristics are used by several European Administrations; Values of A range from –22 to –30 to suit national conditions.

^{b)} The high group frequency power level may be up to 4 dB more or 8 dB less than the low group frequency power level.

^{c)} For analogue multifrequency push-button receivers only.

(to Recommendation Q.24)

ANNEX A

4.4 Protection of “in-band” signalling systems against each other

Recommendation Q.25

SPLITTING ARRANGEMENTS AND SIGNAL RECOGNITION TIMES IN “IN-BAND” SIGNALLING SYSTEMS

1 General

In each “in-band” signalling system precautions should be taken so that, when the signalling in that system is taking place:

- 1.1 no interference in the voice-frequency range from outside the system can pass into the system (i.e. into the transmission path between the sending end and the receiving end of the voice-frequency signals), and
- 1.2 as far as possible, no signalling current used in the system can pass into other systems, connected in tandem.

2 Sending-end splitting arrangements

2.1 In order to satisfy the condition in § 1.1 above, care should be taken that the correct operation of the signal receiver at the other end of the circuit is not disturbed by:

- surges (transient currents) caused by the opening or closing of direct current circuits connected to the speech wires of the switching equipment, whether these surges precede or follow the sending of a signal;
- noise, speech currents, etc., coming from tandem switched circuits, preceding or during the sending of a signal.

2.2 For this reason the following arrangements have been made in the Signalling Systems No. 4, and No. 5 for the transmission of voice-frequency signals on the international circuit:

- i) The exchange side of the circuit shall be disconnected 30 to 50 ms before a voice-frequency signal is sent over the circuit.
- ii) The exchange side of the circuit will not be reconnected for 30 to 50 ms following the end of the sending of a voice-frequency signal over the circuit.

2.3 Arrangements of the same type are required on System R1 and on national in-band systems [see § 3.4.1 b) below].

3 Receiving-end splitting arrangements

3.1 General

3.1.1 In order to satisfy the condition in § 1.2 above, the length of the part of a signal which passes into another system is limited by splitting the speech wires beyond the signal receiver when a signal is received and detected by this receiver.

The time during which the first part (sometimes called *spill-over*) of a received signal passes into another system, until the splitting becomes effective, is called “splitting time”.

Too long a splitting time may result in interference to signalling on a tandem system depending on the signal recognition time on the tandem system.

Too short a splitting time may result in an increase in the number of false operations of the splitting device by speech currents (*signal imitation*) and so impair speech transmission.

The splitting time must therefore be a compromise between the above two factors.

The splitting device also serves to limit the duration of signals on one path of the 4-wire circuit from returning over the other path by reflections at the termination; these reflections may give rise to faulty operation of signalling equipment on the other path.

3.1.2 The protection against mutual interference between in-band signalling systems in international service involves limitations of the length of any part of:

3.1.2.1 the *international* signal that may be able to pass:

- a) from the international signalling system into a national signalling system (protection of the national system);
- b) from one international signalling system into another international signalling system, when they are switched in tandem (protection of the international systems);
- c) from one international circuit into another international circuit of the same system when they are switched in tandem in the case of link-by-link signalling.

3.1.2.2 the *national* signal that may be able to pass:

- a) from the national signalling system into an international signalling system (protection of the international system);
- b) from one national signalling system into the national signalling system of another country via an international connection (protection of the national system).

3.2 *Protection of national and international systems against international systems*

Conditions in § 3.1.2.1 above are met because international signalling systems have a splitting device on each circuit. The splitting times of such systems are:

- 55 milliseconds for the compound signal element in System No. 4;
- 35 milliseconds for a signal in System No. 5;
- 20 milliseconds for a signal in System R1.

3.3 *Protection of the international system against national systems*

The condition in § 3.1.2.2 a) above is generally covered because:

- the values given in the specifications of the CCITT standard systems as the minimum recognition time of a line signal are in general greater than the splitting times of national systems (see the tables giving the basic characteristics of national signalling systems in Supplement No. 3 at the end of this fascicle);
- the signalling frequencies used in the international systems are, in the majority of countries, different from those used in national systems.

It may be necessary, if the splitting time of a national signalling system is greater than the minimum signal recognition time of an international system and the signalling frequencies used in the national system and international system are the same or nearly the same, to insert a device at the international exchange which will prevent a part of the national signal from passing into the international circuit for longer than this recognition time.

3.4 *Interference between national signalling systems when they are interconnected via an international circuit*

3.4.1 To ensure protection of national signalling systems one against the other [protection defined under § 3.1.2.2 b) above], it has been recommended by the CCITT since 1954 that new national in-band signalling systems should comply with the following two clauses:

- a) not more than 35 milliseconds of a national signal should be able to pass into another country;
- b) the connection between an international circuit and a national circuit should be split on the national circuit at the international exchange 30 to 50 milliseconds before that exchange sends any signal over the national signalling system.

Note – The object of these two clauses is to avoid interference, especially in conditions that may exist on international automatic connections.

3.4.2 The requirement of § 3.4.1 a) permits the signalling system used in country A to have a minimum signal recognition time based on this value of 35 milliseconds. It will then be possible to ensure, without taking any other precautions at the incoming end of an international circuit, that no fraction of a signal coming from country B, and being of the same, or nearly the same, frequency as that used in country A, will be wrongly recognized as a signal in country A.

One method of meeting the requirement of § 3.4.1 a) is to adopt a splitting time of less than 35 milliseconds for the national systems.

Another method exists which does not involve such a limitation in the splitting times of national systems, and which might be preferred when the design of the national signalling system is such that a short splitting time is not normally justified for that system alone. This second method involves the introduction, in the international exchange, of an arrangement for limiting the length of national signals which are liable to pass into the international circuit. Such an arrangement would be used only on circuits to those countries where there is a danger that interference might arise.

3.4.3 The requirement of § 3.4.1 b) avoids the false operation of the guard circuit of a signal receiver situated at the distant end of a national circuit.

4.5 Miscellaneous provisions

Recommendation Q.26

DIRECT ACCESS TO THE INTERNATIONAL NETWORK FROM THE NATIONAL NETWORK

The choice of the method of access to an outgoing international exchange from the national network is a purely national matter. Nevertheless, if an international connection is set up by automatic switching from an exchange other than the international exchange which is the outgoing point of the international circuit used, arrangements should be made in the national network to transmit over the international circuit at least the signals required to ensure the satisfactory setting-up, control and clearing-down of the international connection.

In addition, where a group of national circuits used in the above manner carries both semi-automatic and automatic traffic, means should be provided for distinguishing between these two classes of traffic for the purposes of international accounting [1].

Reference

- [1] CCITT Recommendation *Basic technical problems concerning the measurement and recording of call durations*, Vol. II, Rec. E.260, § 2.

Recommendation Q.27

TRANSMISSION OF THE ANSWER SIGNAL

It is essential for the answer signal to be transmitted with a minimum of interference to the transmission of speech currents, because the called subscriber may already be announcing his presence at this stage of the call.

On a connection which has been set up, the answer signal generally entails, at a certain number of points:

- a) repetitions and conversions, which delay transmission; and
- b) splitting of the speech path, where in-band signalling is used.

It is therefore desirable to minimize the delays and the duration of the interruption of the speech path. Minimization of the latter can be achieved by:

- short send line splitting;
- short duration of the signal; and
- fast termination of the sending and receiving splits on cessation of the signal.

Recommendation Q.28

DETERMINATION OF THE MOMENT OF THE CALLED SUBSCRIBER'S ANSWER IN THE AUTOMATIC SERVICE

1 Arrangements should be made in the national signalling system of the incoming country to determine (in the outgoing international exchange) the moment when the called subscriber replies; this information is necessary in the international service for the purposes of:

- charging the calling subscriber [1];
- measuring the call duration [2].

2 Where subscribers in an outgoing country have direct access to an operator's position (in a manual exchange, for instance) in a public exchange of an incoming country, arrangements should be made in the national network of the incoming country to ensure that – in the outgoing country – the calling subscriber is charged, and the call duration measured, only from the moment when the called subscriber replies. This means that an answer signal is not sent when the operator in a public exchange of the incoming country replies. These provisions are set out in detail for CCITT standardized systems (see Recommendation Q.102).

References

- [1] CCITT Recommendation *Chargeable duration of calls*, Vol. II, Rec. E.230.
- [2] CCITT Recommendation *Basic technical problems concerning the measurement and recording of call durations*, Vol. II, Rec. E.260.

Recommendation Q.29

CAUSES OF NOISE AND WAYS OF REDUCING NOISE IN TELEPHONE EXCHANGES

Circuit noise may be classified as follows:

- 1) power supply noise,
- 2) noise generated in the speech path circuit,
- 3) noise induced in the speech path circuit.

1 Power supply noise

1.1 Power sources

The interference resulting from the harmonics, ripple and current fluctuation of machines, rectifiers and batteries.

This noise may be reduced by d.c. generators with low harmonics and good regulation and rectifiers with good regulation, effective filters, and batteries with large capacity (i.e. with low internal impedance).

1.2 Supply leads

The interference in the speech circuits of an exchange due to power supply equipment originates mainly in the common impedances of the supply paths of speech and switching circuits, and is caused mainly by the sudden fluctuation of the current resulting from the sudden operation and release of the different relays, magnets and contacts.

These common impedances may be reduced by:

- a) the use of common power supply leads of sufficiently low resistance, the use of large capacitors fitted at apparatus ends of supply leads with minimum impedances, e.g. minimum distance between bus bars, or coaxial feeders. Another method employs close-spaced cables with alternate polarity;
- b) the use of a common battery with separate power supply leads for speech and switching circuits. Better results may be obtained at an increased cost by independent batteries adequately separated;
- c) the arrangement of the cells of the battery in a U formation.

1.3 *Earth returns*

Independent earth returns should be used for signalling-frequency supply circuits.

2 **Noise generated in the speech circuit**

2.1 *Contact noise caused by vibration*

This kind of noise is caused by contact resistance variations of the various commutator, switch and relay contacts due to mechanical vibration.

This contact noise may be reduced by:

- a) the use of damping devices to reduce the generation of vibration caused in particular by relay sets, mechanical and electromagnetic clutches;
- b) the use of multiple brushes, spring or resilient mountings to reduce the transmission of vibration;
- c) a suitable choice of contact materials;
- d) the use of the best contact shape and of twin contacts;
- e) maintaining atmospheric conditions at an appropriate relative humidity and the use of air filters; use of dust covers on equipment, arranging design of columns, window sills, radiators and floor to avoid harbouring dust;
- f) careful maintenance cleaning and lubrication in accordance with specifications.

2.2 *Frying noise*

In speech circuits some contact materials are liable to cause frying noise.

This noise may be reduced by the use of suitable contact materials and by keeping an appropriate relative humidity.

2.3 *Contact noise caused by wetting currents*

Speech circuits without d.c. currents are liable to fading due to contact resistance fluctuations. Fading may be reduced by wetting. However, wetting currents may introduce frying noise on the lines.

2.4 *Charge and discharge clicks*

Clicks may frequently be caused by the charging or discharging of capacities (cable capacity) by switches when rotating over occupied and non-occupied terminals.

Objectionable clicks are also likely to result from sudden battery reversals, dialling and other abrupt changes in the current flowing in the speech circuits.

These effects may be reduced:

- a) by disconnecting the speech circuits from the brushes during the hunting period of the switch;
- b) by the use of twisted pairs, by limiting the length of cabling and also by locating relays as close as possible to the selectors they control.

2.5 *Unsound contacts*

Objectionable noise may be due to unsound contacts on distribution frames, particularly when work is in progress such as adding or changing jumpers, etc. Such unsound contacts may be due to "dry" contacts inadequately soldered, poorly wrapped joints, or to the use of distribution frame equipment having inadequate contact pressure. It is suspected that this type of trouble is responsible for most of the "hits" and "misses" and usually for an increase in noise.

2.6 *Tapping losses*

When lines are tapped for service interception, observation, etc., the tapping circuit should be designed to give the minimum of unbalance to earth and the transmission loss introduced should be a minimum. Semi-permanent connections should be used in preference to base-metal sliding connections at the tapping point.

2.7 *Reduction of the number of switching contacts*

Circuits should be designed so that at each switching stage there is a minimum number of contacts in the speech circuit in order to reduce the risk of microphonic noise from "dry" contacts.

3 **Noise induced in the speech circuit**

3.1 *Noise induced in the speech circuit may be due to:*

- a) speech crosstalk;
- b) signalling frequency crosstalk;
- c) induction from tone supplies;
- d) direct current pulses;
- e) clicks caused by abrupt changes in inductive and capacitive circuits.

Clicks may be reduced at the source by the use of spark quench devices or other means to reduce the steepness of the interfering wave-front concerned. In addition, noise may be reduced by balancing, by using twisted pairs and/or by screening.

3.2 *Noises due to unbalanced transmission bridge circuits*

A well-balanced circuit is necessary for the transmission bridge to avoid noise interference. This can be achieved by:

- a) the use of balanced components;
- b) the separation of components used for speech from those used for control and switching;
- c) the separation of individual transmission bridges by screening or spacing;
- d) the addition of balancing components, e.g. balancing transformers or retardation coils;
- e) taking the precautions listed at the end of § 3.1 above.

3.3 *Low-level speech circuits*

Low-level electronic speech circuits are particularly susceptible to noise induction and should therefore be screened.

3.4 *Longitudinal interference*

Such noise may be induced into the speech circuit from the line by power distribution systems and traction circuits or by earth potential differences.

These may be reduced by balancing the line or by the addition of transformers.

Note — Interference which is sufficiently severe to cause unwanted operation of relays, etc., may be overcome by the use of loop circuits which should also reduce noise.

Recommendation Q.30

IMPROVING THE RELIABILITY OF CONTACTS IN SPEECH CIRCUITS

The following methods can be used for improving the reliability of contacts in speech circuits:

- a) use of precious metals such as platinum, palladium, gold, silver, or alloys of these metals. If, for one reason or another, it is not desired to "wet" the contacts, or if enough contact pressure cannot be provided, it is preferable to use the metals or alloys mentioned above, with the exception of pure silver;
- b) use of high contact pressure;
- c) double contacts;
- d) lubrication (with suitable oils) of certain non-precious metal contacts in the case of sliding contacts;
- e) direct current "wetting" of contacts, care being taken to avoid the introduction of noise due to transients when the contacts are made or broken;
- f) air filtration or other protective measures to avoid dust;
- g) the maintenance of suitable humidity;
- h) the use of protective covers;
- i) protection against fumes, vapours and gases;
- j) avoidance of the use, near contacts, of materials likely to be detrimental to the contacts.

When voice-frequency signals are sent over a transmission path, as it is not possible to use direct current wetting for the voice-frequency signal transmitting contacts due to the surges which occur on closing and opening the contact, it is preferable to use static modulators with rectifier elements.

Recommendation Q.31

NOISE IN A NATIONAL 4-WIRE AUTOMATIC EXCHANGE

It is desirable that the requirements concerning noise conditions for a national 4-wire automatic exchange be the same as for an international exchange (see Recommendation Q.45, § 5).

Recommendation Q.32

REDUCTION OF THE RISK OF INSTABILITY BY SWITCHING MEANS

Arrangements should be made in the incoming country to reduce the risk of instability:

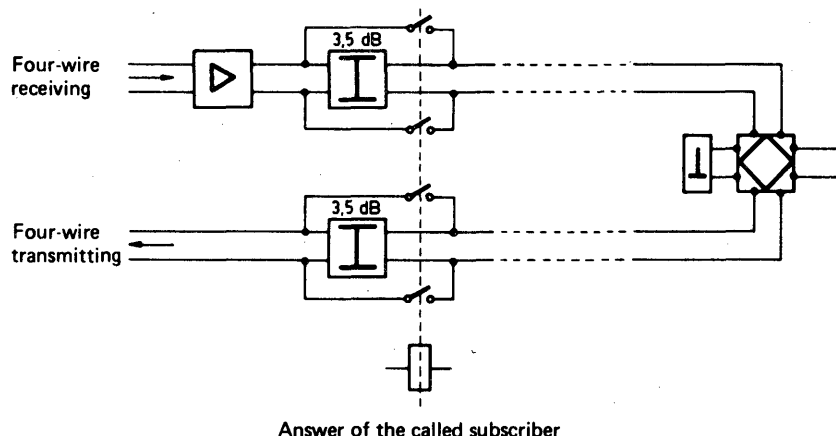
- during the period between the moment when the speech path is established and the moment when the called subscriber answers; and
- also the period between the moment when the called subscriber clears and the moment when the circuits are released.

This can be achieved in principle by any of the methods *a)*, *b)* or *c)* shown in Figure 1/Q.32.

It is recommended that, whatever method is used, the measures are taken in the incoming (in the traffic sense) country. Taking into account experience already acquired and also the stability calculations referred to in [1], it is considered sufficient to arrange for the stability¹⁾ of the 4-wire chain of circuits (made up of international circuits and national extension circuits, interconnected on a 4-wire basis) to be augmented by 3.5 dB.

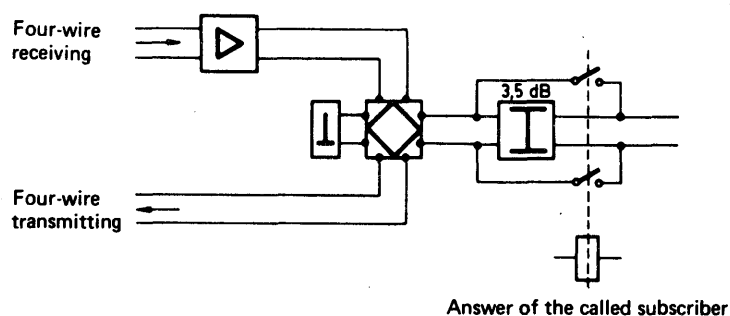
This recommendation applies to all signalling and switching (national or international) systems which could be used on international connections.

¹⁾ It should be noted that Recommendation Q.32 always refers to *stability* [2] and never to *singing margin* [3] which is approximately double the stability. The methods described in Figure 1/Q.32 are examples of possible means of increasing the stability of the 4-wire chain of circuits by 3.5 dB.

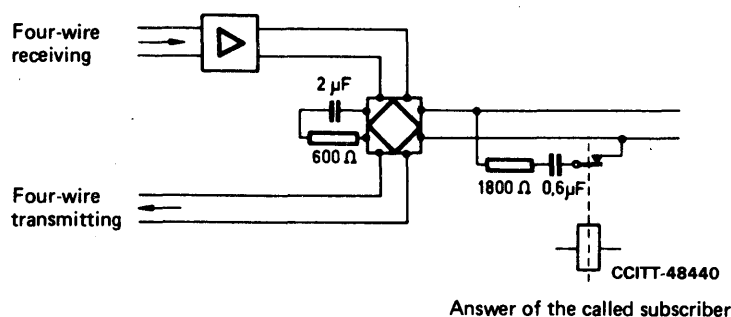


Note – In principle, the attenuators may be inserted in any of the exchanges, e.g. the incoming international centre.

Method a) Inserting an attenuator in each channel of the 4-wire chain of the connection



Method b) Inserting an attenuator in the 2-wire extension of the connection



Method c) Bridging a terminating impedance across the 2-wire extension of the connection

FIGURE 1/Q.32
Possible methods for reducing the risk of instability

References

- [1] CCITT Recommendation *Stability and echo*, Vol. III, Rec. G.131.
- [2] CCITT Definition: *Stability*, Vol. X, (Terms and Definitions).
- [3] CCITT Definition: *Singing margin*, Vol. X, (Terms and Definitions).

**PROTECTION AGAINST THE EFFECTS OF FAULTY
TRANSMISSION ON GROUPS OF CIRCUITS**

1 General

1.1 Although certain signalling systems may have the capability to provide an indication when an individual circuit is faulty, in order to maintain the required availability of the public network, it is considered necessary to provide alarm facilities to alert maintenance staff when a group of circuits provided by a multiplex transmission system is faulty.

1.2 An alarm indication can be initiated on failure of a FDM system by means of pilot supervision. On failure of a PCM system, an alarm indication is initiated at both ends by the loss of frame alignment (or multiframe alignment as appropriate) [1], [2].

These failure indicators provide the means whereby the faulty circuits can be removed from service automatically and, when the fault condition no longer exists, be restored automatically by the switching control of an international exchange.

Additionally, the existence of such failure indications allow an end-to-end indication of circuit availability which is a prerequisite to the operation of Signalling System No. 7 without a per call continuity check (see Recommendation Q.724).

1.3 Where transmission links comprise several transmission systems in tandem, the protection against the effects of faulty transmission on groups of circuits can only be maintained if the primary multiplex structure is maintained from end-to-end together with a transparency of alarm indications. In other cases the provisions of Sections 2 and 3 below apply.

2 Mixed transmission systems

2.1 Some transmission links comprise differing transmission systems which for maintenance purposes are treated separately (see Recommendation G.704). Examples of such transmission links are those with:

- analogue/digital conversion via transmultiplexers;
- conversion between 24 and 30 channel PCM systems;
- links via TDMA/DSI satellite systems.

In these cases, failure indications from the local multiplex equipment can be used, but alone these do not provide an end-to-end indication of circuit availability. Since the multiplex systems use different standards, it is usually impossible to provide a ready conversion of alarms from one system to another. In order to retain the benefits of the alarm indications for groups of circuits it is necessary to carry the fault indications on a circuit basis. This may be inherent in the normal circuit signalling (as in the case of the digital version of Signalling System R2) but in the general case some form of individual circuit supervision is required.

2.2 Circuit supervision for digital systems

2.2.1 2048 kbit/s systems (Recommendations G.732, G.734)

8448 kbit/s systems (Recommendation G.744)

In these systems there are two frame structure possibilities. One supports channel associated signalling, and the other is intended for common channel signalling which allows extra time-slots to be used for speech circuits. In order to provide circuit supervision it is necessary to use the frame structure for channel associated signalling, even in the case of voice frequency and common channel signalling systems. This implies a number of restrictions:

- in the 2048 kbit/s system time slot 16 is not available for speech. Additionally, the common channel signalling links of Systems No. 6 and No. 7 must use a time slot other than number 16;
- similarly, in the 8448 kbit/s system time slots 67–70 are required for the circuit supervision and cannot be used for speech.

Other systems of transmitting circuit supervision information (for example, using a common channel) are for further study.

2.2.2 1544 kbit/s systems (Recommendations G.733, G.735)

In this system the S bit is used for circuit supervision in a similar manner to its use for channel associated signalling.

2.2.3 Non-standard systems

In non-standard transmission systems it will often be necessary to provide a discrete signalling path for the transmission of circuit supervision indications. Annex A to this Recommendation describes the arrangements used for circuit supervision on TDMA/DSI satellite systems together with the interfacing with the terrestrial channels.

3 Signalling of circuit supervision indications

3.1 In integrated digital transmission systems interfacing directly with exchanges (e.g. Recommendations G.734, G.744) and where systems connect to other Administrations, it is recommended that a standard form of circuit supervision be used. This is detailed below for 2048 kbit/s PCM systems and 1544 kbit/s PCM systems.

3.2 2048 kbit/s PCM systems

Signalling bits "a" and "b" of time slot 16 are used. Under normal conditions bit b is set to 0 while bit a may be set to 1 or 0. Under abnormal (alarm) conditions both a and b bits are set to 1.

3.3 1544 kbit/s PCM systems

Under normal conditions the signalling bit is set to 0. Under abnormal (alarm) conditions the signalling bit is set to 1.

References

- [1] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s*, Vol. III, Rec. G.732.
- [2] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 1544 kbit/s*, Vol. III, Rec. G.733.

ANNEX A

(to Recommendation Q.33)

Circuit supervision via TDMA/DSI satellite systems

A.1 General

A.1.1 When satellite systems employ Time Division Multiple Access (TDMA) transmission techniques with Digital Speech Interpolation (DSI) equipment at an earth station, the integrity of multiplex transmission systems, FDM as well as PCM, used for terrestrial access to the satellite system cannot be maintained within the satellite system. For example, time slots 0 and 16 of a 2048 kbit/s PCM system of the group pilot of a FDM system may not be available between earth stations for the transfer of signalling or transmission alarm information. The provision of equivalent facilities over the satellite section therefore needs special consideration.

A.1.2 Although not necessarily a fault condition, an increase in circuit activity on a TDMA/DSI system may lead to an overload condition, e.g. "bit stealing" in the DSI equipment. Conveyance of overload indicators to the associated ISC may be used to initiate appropriate network management actions to reduce or eliminate the overload conditions on groups of circuits routed on the TDMA/DSI systems.

Implementation of this capability is at the discretion of individual Administrations.

A.1.3 In accordance with Recommendation Q.7, specified signalling systems considered to be suitable for international application via TDMA/DSI satellite systems are:

- System R2, provided that the satellite system is designed to be transparent to pulsed inter-register signals;
- System No. 5;
- Systems Nos. 6 and 7.

A.2 *Circuit supervision*

Possible methods of passing circuit supervision information for these signalling systems via a TDMA/DSI satellite system are as follows:

A.2.1 *Signalling System R2*

A.2.1.1 In the case of System R2, only the digital version of line signalling (Recommendations Q.421-Q.424) is specified for use on international digital links.

A.2.1.2 A satellite Line Signalling Channel (LSC) is required to convey the System R2 digital line signalling code. Two signalling bits, "a" and "b" are required in the LSC for each System R2 terrestrial circuit accessing the satellite section. Under transmission failure conditions, bits "a" and "b" are set to State 1, so that the line signalling protocols of digital R2 will eventually block the circuit.

Appendix I shows a typical format and organization of the LSC for System R2 line signalling.

A.2.1.3 Fault conditions detected at the earth station and the consequent actions to be taken are given: in Tables A-1/Q.33 and A-2/Q.33 when terrestrial access is via a 2048 kbit/s PCM system or via an FDM system with signalling conversion employed at the earth station, respectively.

The application of actions given in these tables enables appropriate end-to-end supervision to be provided on a per-circuit basis.

A.2.2 *Signalling System No. 5*

A.2.2.1 It should be noted that on circuits employing System No. 5 signalling, some administrations utilize a repeat forward clear procedure as a means of achieving clear down under failure conditions. This procedure, which may involve periodic sending of forward clear signals synchronously on a number of circuits, can result in severe periodic overloading of DSI channels. In order to avoid this possible overloading of DSI channels it is preferable to send the periodic forward clear signals cyclically on the circuits involved.

A.2.2.2 In order to convey circuit supervision information via the satellite system, it will be necessary to provide a satellite signalling channel.

The preferred method of conveying circuit supervision information by use of a satellite digital non-interpolated (DNI) channel is described in Section A.2.2.3.

If an LSC, as provided for in System R2, is available, then a second method of passing circuit supervision information is as described in Section A.2.2.4.

A.2.2.3 *Use of a DNI supervision channel*

When a DNI channel is utilized for circuit supervision purposes, detection by an earth station of circuit failures on its terrestrial sector will result in the setting of bits in the DNI channel to "1", in accordance with the information contained in Appendix II.

Thus, if the failed circuits are digital, the detection of failure conditions, such as loss of frame alignment, described in Table A-3/Q.33 will result in the setting to "1" of bits in the DNI channel associated with the affected circuits.

When the affected circuits are analogue, the failure will be detected at the earth station, e.g. by the loss of pilot, or if appropriate, by receipt of a pulsed backward pilot. Fault conditions and consequent actions when analogue access links are employed are given in Table A-4/Q.33.

The alarm information passed over the DNI channel can be forwarded by the receiving earth station to its associated ISC as described in Recommendation Q.33.

An Administration may utilize the alarm information at its ISC to block or busy affected circuits, or, for example, to inhibit the sending of repeat forward clear signals.

Appendix II shows the format and organization of the DNI supervisory channel.

A.2.2.4 Use of System R2 LSC

In this case the “a” and “b” signalling bits in the LSC corresponding to the Terrestrial Channels (TCs) for which supervision is applied shall assume the following meaning:

Under normal conditions:

$b = 0$ indicates that the relevant TC is in a normal condition. The $b = 0$ state may be established either within the TDMA terminal or at the ISC.

The “a” signalling bit contained in the same slot shall be set, as convenient, either to zero or “1”.

Under abnormal conditions:

$a = b = 1$ indicates that the relevant TC is in an abnormal condition.

Thus, for effective application, the failure of a distant terrestrial transmission system (FDM or PCM) in either direction between an earth station and its associated ISC should result in the sending of $a = b = 1$ for each affected circuit backward over the satellite section. The alarm information passed via the LSC is transferred from the receiving earth station to its associated ISC as follows:

- when digital access circuits are provided, bits a and b, in Time Slot 16 corresponding to the faulty circuits, are set to “1”;
- when analogue access circuits are employed receipt by the earth station of bits $a = b = 1$ for 6 or more circuits in an analogue group should result in the removal of the group pilot towards the ISC.

This method of using two signalling bits to convey circuit supervision information for System No. 5 circuits is inefficient in the utilization of satellite channel capacity. However, Administrations may need to take into account the possible advantages of such utilization, for example, a common terrestrial interface module for both System R2 and System No. 5 circuits may be employed at the earth station.

Appendix I shows the format and organization of the LSC for System R2 line signalling. Where appropriate to such use of circuits employing System No. 5 signalling, the fault conditions and consequent actions given in Tables A-1/Q.33 and A-2/Q.33 also apply.

A.2.3 Signalling System No. 6 and No. 7

A.2.3.1 These signalling systems employ a common signalling channel which may be conveyed via the satellite system (for example, via a 64 kbit/s signalling channel) or via a terrestrial transmission path.

A.2.3.2 The provision of transmission alarm information for circuit supervision purposes is necessary because:

- a) Although a speech path continuity check, where used, will remove faulty circuits from service, a faster method is required if severe operational problems at the ISC are to be avoided when a large number of circuits are affected by a transmission system failure.

- b) In the case of circuits employing System No. 7, end-to-end circuit supervision is required in accordance with Recommendation Q.724.
- c) It is not mandatory for an ISC recognizing a transmission system failure to send a blocking signal for each affected circuit.

A.2.3.3 If the common signalling channel and associated circuits are routed via the same satellite system, methods of conveying circuit supervision information are identical to those described for System No. 5. This will require a DNI satellite channel to carry circuit supervision information in addition to the common signalling channel. Digital terrestrial access systems will also require a time slot for circuit supervision purposes besides that required for common channel signalling.

A.2.3.4 Methods of utilizing the common signalling channel in lieu of the DNI channel for the purpose of conveying information on the status of the transmission path of the speech circuits require further study.

A.2.3.5 Fault conditions and consequent actions to be taken at earth stations when system No. 6 or No. 7 is employed, via digital and analogue access links, are given in Tables A-3/Q.33 and A-4/Q.33, respectively.

TABLE A-1/Q.33

Fault conditions and consequent actions at earth stations with 2048 kbit/s digital access links for System R2 circuits

Digital earth station equipment (digital access links)		Consequent actions	Terrestrial link to own CT				Prompt maintenance alarm	Satellite link					
			Backward alarm indication (bit 3, TS 0, even frames)	Backward alarm indication (bit 6, TS 16, frame 0)	a = b = 1 in TS 16 for all circuits concerned	AIS in non-interpolated channels		Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	a = b = 1 in satellite signalling channel for circuits concerned	Block switched circuits concerned
Fault conditions													
Transmitting part	Loss of frame alignment, BER exceeded or loss of incoming signal	Yes				Yes Note 1				Yes	Yes	Yes	
	Loss of multiframe alignment		Yes			Yes Note 1					Yes		
	Alarm indication from CT (bit 3 TS 0 even frame, bit 6 TS 16 frame 0)										Yes		
	Power supply failure – TDMA/DSI			Yes if possible		Yes				Yes if possible	Yes if possible	Yes if possible	
	Power supply failure – satellite signalling equipment			Yes if possible		Yes					Yes if possible		
Receiving part	Loss of reference timing			Yes	Yes	Yes	Yes						
	BER exceeded in satellite path			Yes	Yes	Yes		Yes					
	Backward alarm indication from remote ES concerning BER in satellite path			Yes		Yes Note 2							
	Loss of data unique word			Yes	Yes	Yes			Yes				

TABLE A-1/Q.33 (cont.)

Digital earth station equipment (digital access links)		Consequent actions	Terrestrial link to own CT				Prompt maintenance alarm	Satellite link					
			Backward alarm indication (bit 3, TS 0, even frames)	Backward alarm indication (bit 6, TS 16, frame 0)	a = b = 1 in TS 16 for all circuits concerned	AIS in non-interpolated channels		Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	a = b = 1 in satellite signalling channel for circuits concerned	Block switched circuits concerned
Fault conditions													
Receiving part	Backward alarm indication from remote ES concerning data unique word			Yes		Yes Note 2	Yes Note 3						
	Loss of alignment or BER exceeded in satellite signalling channel			Yes		Yes							Yes
	Backward alarm indication from remote ES concerning satellite signalling channel			Yes		Yes Note 2							
	Power supply failure – TDMA/DSI			Yes if possible	Yes if possible	Yes					Yes if possible		
	Power supply failure – satellite signalling equipment			Yes if possible		Yes					Yes if possible		

Note 1 – Prompt maintenance alarm is inhibited if AIS is present.

Note 2 – Prompt maintenance alarm shall be inhibited if the backward alarm is received from only one origin if the interface concerned is working to more than one destination. It is not inhibited when working to a single destination.

Note 3 – If prompt maintenance alarm according to Note 2 is not inhibited.

TABLE A-2/Q.33

**Fault conditions and consequent actions at earth stations with analogue access links for System R2 circuits
and signalling conversion at the earth station**

Digital earth station equipment (analogue access links)		Consequent actions	Terrestrial link to own CT		Prompt maintenance alarm	Satellite link					
			Relevant blocking signal (Note 1)	a = b = 1 at the input of the converter		Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	a = b = 1 in satellite signalling channel for circuits concerned	Block switched circuits concerned
Fault conditions											
Transmitting part	Loss of forward signal (Group pilot failure)	Yes		Yes				Yes	Note 4	Yes	
	Power supply failure from trans. equip.	Yes if possible		Yes				Yes if possible	Note 4	Yes if possible	
	Failure of line signal converter	Yes		Yes					Note 5		
	Power supply failure – TDMA/DSI	Note 6	Yes if possible	Yes				Yes if possible	Yes if possible	Yes if possible	
	Power supply failure – satellite signalling equipment		Yes if possible	Yes				Yes if possible			
Receiving part	Loss of reference timing	Note 6	Yes	Yes	Yes						
	BER exceeded in satellite path		Yes	Yes		Yes					
	Backward alarm indication from remote ES concerning BER in satellite path		Yes	Yes Note 2							
	Loss of data unique word		Yes	Yes			Yes				

TABLE A-2/Q.33 (cont.)

Digital earth station equipment (analogue access links)		Consequent actions	Terrestrial link to own CT		Prompt maintenance alarm	Satellite link					
			Relevant blocking signal (Note 1)	a = b = 1 at the input of the converter		Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	a = b = 1 in satellite signalling channel for circuits concerned	Block switched circuits concerned
Fault conditions											
Receiving part	Backward alarm indication from remote ES concerning data unique word	Note 6	Yes	Yes Note 2	Yes Note 3						
	Loss of alignment or BER exceeded in satellite signalling channel		Yes	Yes							Yes
	Backward alarm indication from remote es concerning satellite signalling channel		Yes	Yes Note 2							
	Power supply failure – TDMA/DSI		Yes if possible	Yes					Yes if possible		
	Power supply failure – satellite signalling equipment		Yes if possible	Yes					Yes if possible		

Note 1 – The “relevant blocking signal” is that signal which the Recommendation for analogue R.2 line signalling calls for in the event of interruption control or it may be the defined blocking condition resulting from busy equipment (Orange Book, Recommendation Q.416 and Q.424).

Note 2 – Prompt maintenance alarm shall be inhibited if the backward alarm is received from only one origin if the interface concerned is working to more than one destination. It is not inhibited when working to a single destination.

Note 3 – If prompt maintenance alarm according to Note 2 is not inhibited.

Note 4 – In this case the line signalling converter shall apply this condition. It is assumed that power supply failure on FDM transmission equipment will result in a group pilot failure.

Note 5 – The line signalling converter should comply with the principles described in Recommendation Q.422.

Note 6 – A relevant blocking signal will be generated by the converter in the analogue part.

TABLE A-3/Q.33

Fault conditions and consequent actions at earth stations using DNI supervision channel for circuits using in-band and common channel signalling with digital access links

Digital earth station equipment (digital access links)		Consequent actions	Terrestrial link to own CT				Prompt maintenance alarm	Satellite link					
			Backward alarm indication	Backward alarm indication	Circuit supervision signal for all circuits concerned	AIS in non-interpolated channels		Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	Indication of fault in affected channels via circuit supervision channel	Block switched circuits concerned
Fault conditions													
Transmitting part	Loss of frame alignment. BER exceeded or loss of incoming signal	Yes				Yes Note 1				Yes	Yes	Yes	
	Loss of multiframe alignment		Yes			Yes Note 1					Yes		
	Alarm indication from CT										Yes		
	Power supply failure – TDMA/DSI			Yes if possible		Yes				Yes if possible	Yes if possible	Yes if possible	
	Power supply failure – service supervision signalling equipment			Yes if possible		Yes					Yes if possible		
Receiving part	Loss of reference timing or burst			Yes	Yes	Yes	Yes						
	BER exceeded in satellite path			Yes	Yes	Yes		Yes					
	Backward alarm indication from remote ES concerning BER in satellite path			Yes		Yes Note 2							
	Loss of data unique word			Yes	Yes	Yes			Yes				

TABLE A-3/Q.33 (cont.)

Digital earth station equipment (digital access links)		Consequent actions	Terrestrial link to own CT				Prompt maintenance alarm	Satellite link					
			Backward alarm indication	Backward alarm indication	Circuit supervision signal for all circuits concerned	AIS in non-interpolated channels		Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	Indication of fault in affected channels via circuit supervision channel	Block switched circuits concerned
Fault conditions													
Receiving part	Backward alarm indication from remote ES concerning data unique word			Yes		Yes Note 2	Yes Note 3						
	Loss of TDMA frame alignment			Yes		Yes							
	Power supply failure – TDMA/DSI			Yes if possible	Yes if possible	Yes					Yes if possible		
	Power supply failure – service supervision signalling equipment			Yes if possible		Yes					Yes if possible		
	Indication of remote end transmission failure via circuit supervision channel			Yes									

Note 1 – Prompt maintenance alarm is inhibited if AIS is present.

Note 2 – Prompt maintenance alarm shall be inhibited if the backward alarm is received from only one origin. If the interface concerned is working to more than one destination. It is not inhibited when working to a single destination.

Note 3 – If prompt maintenance alarm according to Note 2 is not inhibited.

TABLE A-4/Q.33

Fault conditions and consequent actions at earth stations using DNI supervision channel for circuits using in-band and common channel signalling with analogue access links

Digital earth station equipment (analogue access links) Note 3 Fault conditions		Consequent actions	Terrestrial link to own CT		Prompt maintenance alarm	Satellite link					
			Removal of group pilot or supergroup pilot			Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	Indication of fault in affected channels via circuit supervision channel	Block switched circuits concerned
Transmitting part	Loss of forward signal (group pilot failure) or supergroup				Yes				Yes	Yes	Yes
	Power supply failure from trans. equip.				Yes				Yes if possible	Yes	Yes if possible
	Power supply failure – TDMA/DSI				Yes				Yes if possible	Yes if possible	Yes if possible
	Power supply failure – service supervision signalling equipment				Yes					Yes if possible	
Receiving part	Loss of reference timing or burst	Yes			Yes	Yes					
	BER exceeded in satellite path	Yes			Yes		Yes				
	Backward alarm indication from remote ES concerning BER in satellite path	Yes			Yes Note 1						
	Loss of data unique word	Yes			Yes			Yes			

TABLE A-4/Q.33 (cont.)

Digital earth station equipment (analogue access links) Note 3 Fault conditions		Consequent actions	Terrestrial link to own CT		Prompt maintenance alarm	Satellite link				
			Removal of group pilot or supergroup pilot			Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	Indication of fault in affected channels via circuit supervision channel
Receiving part	Backward alarm indication from remote ES concerning data unique word	Yes		Yes Note 1	Yes Note 2					
	Loss of TDMA frame alignment	Yes		Yes						
	Power supply failure – TDMA/DSI	Yes		Yes					Yes if possible	
	Power supply failure – service supervision signalling equipment	Yes		Yes					Yes if possible	
	Indication of remote end transmission failure via circuit supervision channel	Yes Note 4								

Note 1 – Prompt maintenance alarm shall be inhibited if the backward alarm is received from only one origin if the interface concerned is working to more than one destination. It is not inhibited when working to a single destination.

Note 2 – If prompt maintenance alarm according to Note 1 is not inhibited.

Note 3 – Apart from the requirements concerning the loss of group or supergroup pilots and indication of remote end transmission failure, all other fault conditions and subsequent actions are optional.

Note 4 – An Administration's decision to remove group or supergroup pilot is dependent on the number of failed circuits in the group or supergroup.

APPENDIX I

(to Annex A of Recommendation Q.33)

Format of each 64 kbit/s unit forming a satellite line signalling channel (LSC) for System R2 line signalling

Symbol N	1	2	3	4	5	6	7	63	64
P channel	0	1	Y_1	Y_3	a_{x+1}	a_{x+2}	a_{x+3}	a_{x+59}	a_{x+60}
Q channel	1	0	Y_2	Y_4	b_{x+1}	b_{x+2}	b_{x+3}	b_{x+59}	b_{x+60}

Symbols 1 and 2 carry the fixed pattern shown.

Symbols 3 and 4 carry Backward Alarm Indications related to the satellite system.

a_n and b_n are the signalling bits relating to the terrestrial channel connected to International Circuit (IC) number n.

Indicated by the subscript, where:

$x = 0$ in the first 64 kbit/s unit,

$x = 60$ in the second 64 kbit/s unit,

$x = 120$ in the third 64 kbit/s unit,

$x = 180$ in the fourth 64 kbit/s unit.

APPENDIX II

(to Annex A of Recommendation Q.33)

End-to-end circuit supervision for in-band and common channel signalling systems

End-to-end circuit supervision between corresponding Administrations may be provided using a pre-assigned digital non-interpolated (DNI) supervisory channel allocated for the purpose.

A recommended method of providing such supervision, which uses the binary information content of the DNI supervisory channel, is shown below. It should be noted that multi-destination operation requires a DNI supervisory channel from each destination.

Format of satellite circuit supervision channel (non-interpolated)

Symbol No.	1	2	3	4	5	6	7	—	63	64
P Channel	0	1	1	0	a_1	a_3	a_5	—	a_{117}	a_{119}
Q Channel	1	0	1	0	a_2	a_4	a_6	—	a_{118}	a_{120}

Symbols 1, 2, 3 and 4 are not used and carry the fixed sequence shown.

Symbols 5 to 64 represent supervision conditions, with bit a_n being used for supervision of the Terrestrial Channels (TCs) $2n$ and $(2n-1)$, connected to international circuits.

The meaning of each bit a_n is shown below:

$a_n = 0$ Indicates that both of the relevant TCs are in a normal condition.

$a_n = 1$ Indicates that either or both of the relevant TCs are in an abnormal or fault condition.

SECTION 5

TONES FOR USE IN NATIONAL SIGNALLING SYSTEMS

Recommendation Q.35¹⁾

TECHNICAL CHARACTERISTICS OF TONES²⁾ FOR THE TELEPHONE SERVICE

1 General

Administrations are reminded of the advantages of standardizing audible tones as far as possible so that subscribers and operators may quickly recognize any tone transmitted of whatever origin³⁾.

Guidance on the application of tones and recorded announcements in various situations is given in Recommendation E.182 [2].

In considering the degree of standardization, the CCITT took account of the nature of the various tones already in use. It was also considered that Administrations introducing new tones would find it helpful to know the preferred limits of cadence frequency and level.

Limits for tone cadences and frequencies are set forth below, all working tolerances being included in the limits.

Besides the limits applying to specifications, limits have been laid down for application to existing exchanges.

These latter limits are herein called *accepted* limits, while those for new equipment are called *recommended* limits.

The present Recommendation covers the case where audible tones are applied within the network. However, the same frequencies and cadences are to be applied if, in the ISDN, the audible tones are generated at the terminal equipment.

2 Electrical levels for tones

For international purposes, the levels of the ringing tone, the busy tone, the congestion tone, the special information tone and the warning tone have to be defined at a zero relative level point at the incoming (in the traffic direction) end of the international circuit.

The level of tones so defined must have a nominal value of -10 dBm0. The recommended limits should be not more than -5 dBm0 nor less than -15 dBm0 measured with continuous tone.

¹⁾ This Recommendation is also included in the Series E Recommendations under the number E.180 (Fascicle II.2)

²⁾ See [1] for particular values of tone cadences and frequencies in actual use.

³⁾ Recommendation E.181 [3] specifies the information which could be given to users to facilitate recognition of foreign tones.

For the special information tone, a difference in level of 3 dB is tolerable between any two of the three frequencies which make up the tone.

For the power level of the dial tone the point of reference is the local exchange, where the subscriber line is connected. In the existing networks the absolute power at the 2-wire access in the direction towards the subscriber station is normally in the range of $-10\text{ dBm} \pm 5\text{ dB}$. However, with respect to interference with multifrequency pushbutton (MFPB) receivers dial tone levels higher than -10 dBm should be avoided.

Note – The relative level of local exchanges in an analogue network is not fixed. For digital local exchanges the relative levels are given in Recommendation Q.517 [4]. A preferred level range of digital tone generators is -8 dBm0 to -3 dBm0 corresponding with the above level range at the output of local exchanges.

3 Acoustical levels for tones

When tones are generated by a source within a network, e.g. by a telephone exchange, the power level as perceived by the user will be influenced by the characteristics of the subscriber's line and the equipment between the source and the user's ear.

Furthermore, tones can be generated within the user's equipment, triggered by signals from the exchange. In these circumstances it is necessary to define the tone level in terms of the preferred range of sound pressure levels as heard by the listener.

Research has shown that the preferred listening level for information tones is substantially independent of room noise, circuit noise and tone cadence, but does vary over a range of tone frequencies. Figure 1/Q.35 shows the recommended sound pressure levels, with upper and lower limits of the recommended range, over a range of tone frequencies, based on these experiments.

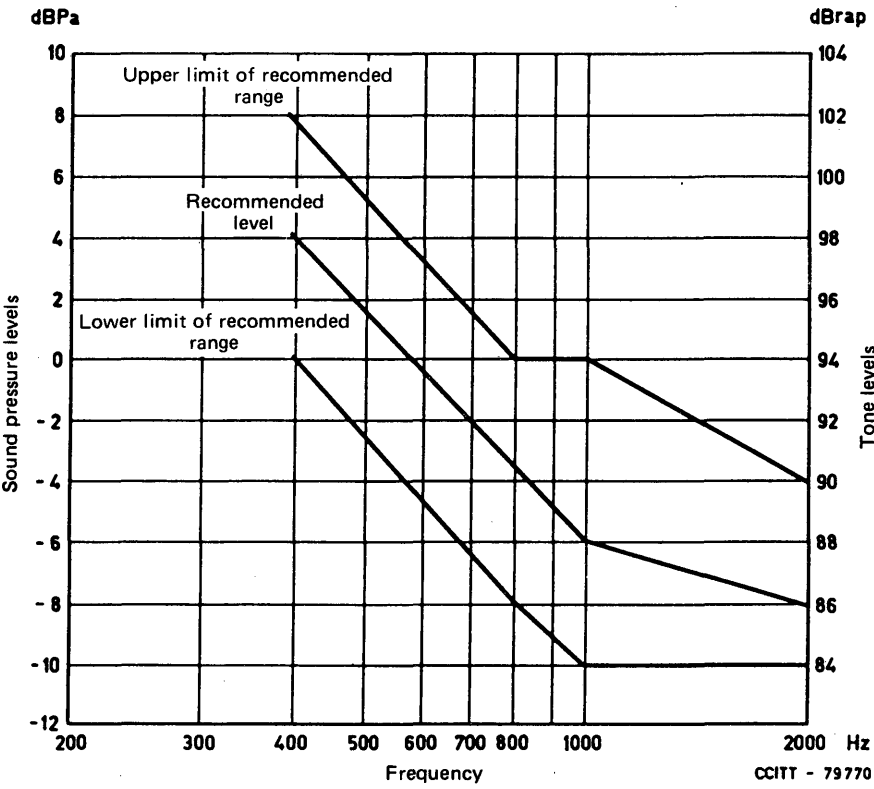


FIGURE 1/Q.35
Recommended listening level limits for tones

It is emphasized that there is no one-to-one relationship between electrical and acoustical power levels. What acoustic level will result from a given electrical level is dependent on various parameters such as the characteristics of the user's equipment.

It should be noted that the recommended sound pressure levels apply only to the most common situation of a user listening via a telephone handset, held reasonably close to the ear so that normal "ear coupling loss" values apply.

When using a loudspeaking telephone or a headset, the preferred sound pressure level is generally lower than the recommended levels.

4 Dial tone

4.1 It is recommended that dial tone should be a continuous tone.

4.2 It is recommended that dial tone should be:

- *either* a single frequency tone in the range 400-450 Hz,
- *or* a combined tone composed of up to three frequencies, with at least one frequency in each of the ranges 340-425 Hz and 400-450 Hz. The difference between any two frequencies should be at least 25 Hz.

4.3 Recognizing the local nature of "normal" use of dial tone, as well as the technical and economic consequences and consequences on customer habits of changes in dial tone, the full range of existing dial tones, including non-continuous tones as in Supplement No. 2 at the end of this fascicle, are considered acceptable. However, when adopting a new single frequency dial tone, Administrations are recommended to use 425 Hz.

4.4 Where digital tone generation is applied, the frequencies for dial tone should be the same as those recommended for analogue generated tones (see Annex A).

4.5 In order to prevent interference of harmonics or spurious components of the dial tone with the frequencies recommended for pushbutton telephone sets in Recommendation Q.23 and the MFPB signal reception specified in Recommendation Q.24, the maximum permissible power level of harmonics or quantizing noise of the dial tone has to be limited in a suitable way, depending on the specific characteristics of the implementations of the dial tone generator and the MFPB receivers within the same exchange. Examples of such limitations for the dial tone generator are given in Annex B.

Note — In cases of digital generation of the dial tone, the quantizing noise is composed of a number of spectral lines which depend on the number of samples in the generating pattern. In order to reduce the amplitude of the quantizing components, the number of samples should be chosen sufficiently high, thus spreading the quantizing distortion power more evenly over the whole spectrum.

5 Ringing tone

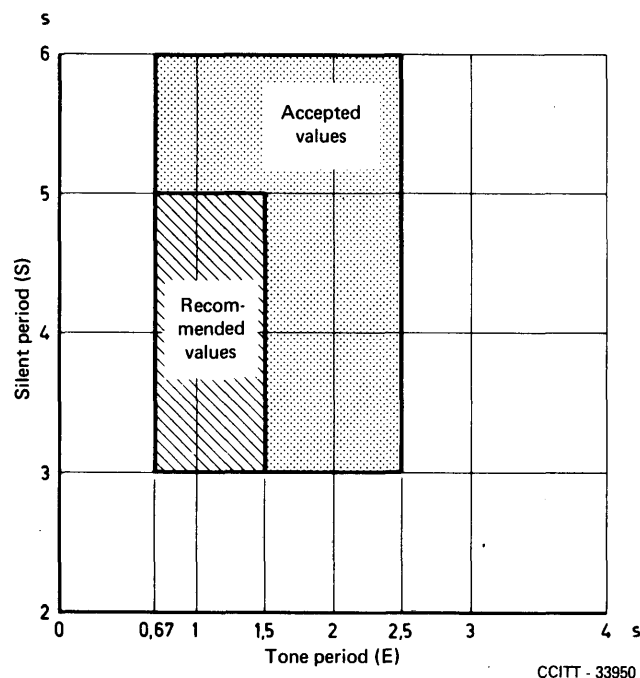
5.1 Ringing tone is a slow period tone, in which the tone period is shorter than the silent period.

The *recommended* limits for the tone period (including tolerances) are from 0.67 to 1.5 seconds. For existing exchanges, the *accepted* upper limit for the tone period is 2.5 seconds.

The *recommended* limits for the silent period separating two tone periods are 3 to 5 seconds. For existing exchanges, the *accepted* upper limit is 6 seconds.

The first tone period should start as soon as possible after the called subscriber's line has been found.

Figure 2/Q.35 shows the recommended and accepted limits for the ringing tone periods.



Frequency :

- recommended interval : 400-450 Hz
- accepted interval : 340-500 Hz

FIGURE 2/Q.35

Ringling tone

5.2 The ringing tone cadence should be similar to the cadence used for applying ringing current to the called subscriber's telephone set, but these two cadences need not be synchronized. The electrical parameters of the ringing current must be evaluated by the Administration concerned to prevent shock hazard.

5.3 The recommended frequency for the ringing tone is between 400 and 450 Hz. The accepted frequency should be not less than 340 Hz, nor more than 500 Hz. Frequencies between 450 and 500 Hz in the accepted frequency range should, however, be avoided. Administrations adopting a new single frequency ringing tone are recommended to use 425 Hz.

The ringing tone frequency may be modulated by a frequency between 16 and 100 Hz, but such modulation is not recommended for new equipment. If the accepted frequency is more than 475 Hz, no modulation by a lower frequency is allowed.

5.4 Where digital tone generation is applied, the frequency for ringing tone should be the same as that recommended for analogue generated tones (see Annex A).

6 Busy tone and congestion tone

6.1 The (subscriber) busy tone and the (equipment or circuit group) congestion tone are *quick* period tones in which the tone period is theoretically equal to the silent period. The total duration of a complete cycle (tone period E + silent period S) should be between 300 and 1100 milliseconds.

The ratio E/S of the tone period to the silent period should be between 0.67 and 1.5 (*recommended* values).

For existing exchanges, or for tones to be used in a special way, it is *accepted* that the tone period may be up to 500 milliseconds shorter than the silent period ($E \geq S - 500$ milliseconds). In no circumstances should the tone period be shorter than 100 milliseconds.

Figure 3/Q.35 shows the recommended and the accepted areas for the busy tone and the congestion tone periods.

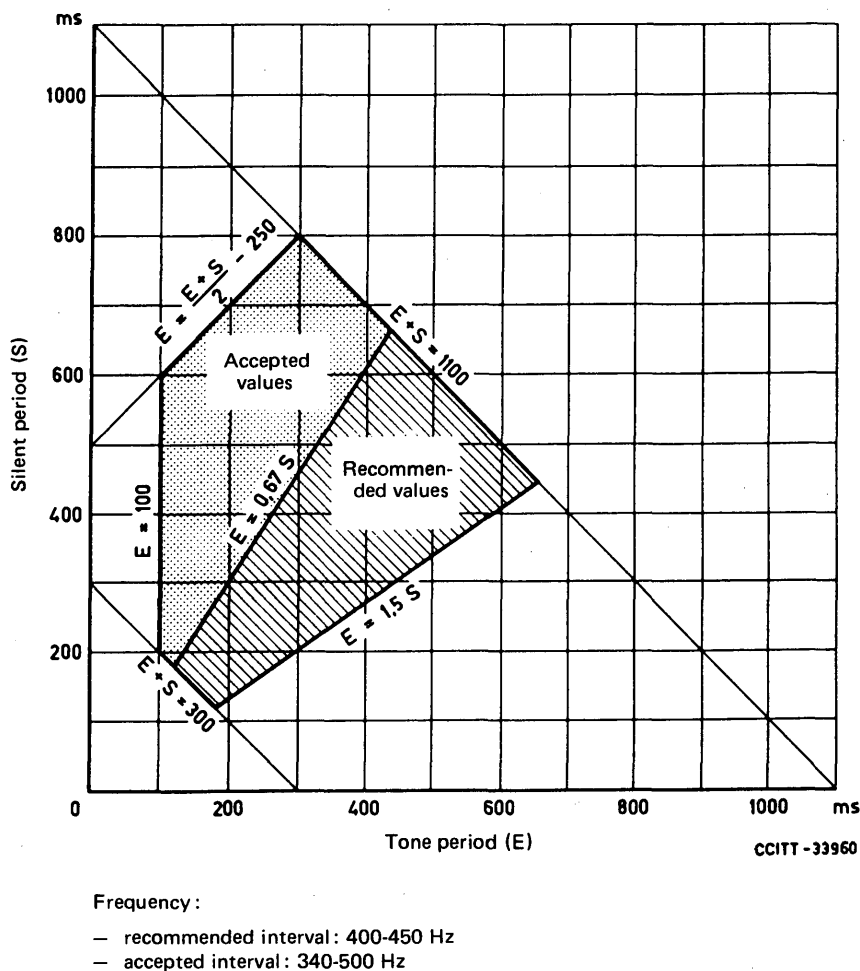


FIGURE 3/Q.35

(Subscriber) busy tone and (equipment or circuit group) congestion tone

6.2 The busy tone (of the called subscriber) and the congestion tone (of switching equipment or circuit groups) can be identical or almost identical, providing that this does not create any serious problems for the network and does not cause the subscriber to become confused. However, a distinction between these two tones is desirable:

- to allow Administrations to assess the quality of service,
- for the convenience of experienced subscribers.

6.3 Where a distinct congestion tone is used, it is recommended that:

- the same *frequency* should be used for the busy tone and the congestion tone;
- the busy tone should have a slower cadence than the congestion tone, but both cadences should be within the limits mentioned in § 5.1 above.

6.4 The *recommended* frequency for the busy tone and for the congestion tone must be between 400 and 450 Hz. The *accepted* frequency must not be less than 340 nor more than 500 Hz. Frequencies between 450 and 500 Hz in the accepted frequency range should, however, be avoided. Administrations adopting a new single frequency for busy and congestion tones are recommended to use 425 Hz.

6.5 Where digital tone generation is applied, the frequency for busy and congestion tones should be the same as that recommended for analogue generated tones (see Annex A).

7 Special information tone

7.1 The special information tone is provided for all cases in which neither the busy nor the congestion tone can give the required information to the calling subscriber in the case of call failure. There are three ways in which it may be used:

- a) when in special cases no provision is made for recourse either to a recorded announcement or to an operator, the equipment at the point which the calls have reached must:
 - 1) *either* connect the special information tone to the call,
 - 2) *or* preferably, if technically available, send an appropriate backward signal such that connection to the special information tone will be made by equipment which is nearer to the caller;
- b) when the call is connected to a recorded voice machine; the tone is then given during the silent intervals between transmissions of the announcement;
- c) under arrangements made at manual positions serving lines which have been abnormally routed so that by operating a key the operators may send the special information signal when, for example, the calling subscriber fails to understand the operator.

When the special information tone is applied with or without a recorded announcement, it should be recognized that customers may refer to an operator if they fail to understand the meaning of the recorded announcement and/or the special information tone.

7.2 The special information tone has a tone period theoretically equal in length to the silent period.

Tone period – The tone period consists of three successive tone signals, each lasting for 330 ± 70 milliseconds. Between these tone signals there may be a gap of up to 30 milliseconds.

Silent period – This lasts for 1000 ± 250 milliseconds.

7.3 The frequencies used for the three tone signals are: 950 ± 50 Hz; 1400 ± 50 Hz; 1800 ± 50 Hz, sent in that order.

8 Warning tone to indicate that a conversation is being recorded

Where a conversation is being recorded at a subscriber's station, it is recommended that the Administration require the use of a warning tone to indicate that the conversation is being recorded. When such a tone is applied, it is recommended that:

- a) it consists of a 350-500 ms pulse every 15 ± 3 seconds of recording time, and
- b) the frequency of the tone should be $1400 \text{ Hz} \pm 1.5\%$.

9 Payphone recognition tone

9.1 Where Administrations see the necessity of application of a payphone recognition tone in order to allow operators to recognise that a call originates at a payphone station or that the called number belongs to a payphone station it is recommended to use a payphone recognition tone.

The application of the tone will depend on the operational requirements of individual Administrations, e.g. in some cases the tone will only be required on an incoming call to the payphone, whilst in others there may be a requirement for the tone to be present on originating calls and throughout the period of the call.

9.2 The tone is a combination of two frequencies f_1 and f_2 in the range:

f_1 : 1100-1750 Hz

f_2 : 750-1450 Hz

with the ratio: $f_1/f_2 = 1.2$ to 1.5

and with a cadence (frequency sequence) as follows:

f_1 on 200 ms, silence 200 ms

f_2 on 200 ms, silence 2 s.

- 9.3 The level and the duration of the tone have to meet two contradictory requirements:
- the public exchange operator should be able to detect and recognise the tone in the presence of the highest expected levels of speech.
 - the tone should not interfere unduly with normal conversation.

Experience of customer reaction to the tone requires that the time during which the tone is applied should be as short as possible, subject to operational requirements. Similarly the level of the tone should be as low as possible and significantly lower than the recommended levels for other tones (e.g. –20 dBm at the payphone output). The duration of the tone and the level at which it is applied are interdependent factors, the shorter the duration the higher the level and vice versa. (Further studies on the recommended levels and duration will be carried out.)

10 Machine recognition of tones

The CCITT appreciates the value of machine recognition of tones for the purpose of service observations, maintenance, testing or for the collection of statistics where equivalent electrical signals do not exist. However, the CCITT considered, at Mar del Plata in 1968, that such machine recognition should not be a substitute for electrical signals. Where machine recognition of audible tones is to be introduced, the tone frequencies and cadences must be within close limits of precision.

For dial tone, ringing tone, busy and congestion tones a working frequency tolerance of $\pm 1\%$ should be met.

Note — The figure of 1% is taken as a compromise out of several national specifications which vary between $\pm 0.5\%$ and $\pm 1.5\%$. (See also Supplement No. 3 in Fascicle II.2.)

References

- [1] *Various tones used in national networks*, Vol. II, Supplement No. 2.
- [2] CCITT Recommendation *Application of tones and recorded announcements in telephone services*, Vol. VI, Rec. Q.36, Vol. II, Rec. E.182.
- [3] CCITT Recommendation *Customer recognition of foreign tones*, Vol. II, Rec. E.181.
- [4] CCITT Recommendation *Transmission Characteristics of Digital Local Exchanges*, Vol. VI, fascicle VI.5, Rec. Q.517.

ANNEX A

(to Recommendation Q.35)

Digital generation of tones

The practice of several Administrations and equipment designers for digital generation of tones is known to deviate largely:

- in the frequency chosen within the recommended range;
- in the power level which varies with the national application;
- in the mechanism of generation of tones and signal frequencies where, in part, the same equipment is used.

Therefore, it was found difficult to standardize on a fixed number of samples with a coded bit-stream, which represents one frequency with one distinct power level.

On the other hand there is no necessity for standardizing digital generated tones in a more stringent way than analogue generated tones for the following reasons:

- It is to the interest of Administrations that subscribers should not be confused by hearing different tones for the same purpose within their national networks. Consequently the practice already in use for analogue generated tones should be maintained for reasons associated with the human factor.
- The advantages that can be achieved by standardizing the code words for the tones in order to allow automatic recognition of tones by monitoring the bit stream seem to be so small that they do not justify a stringent restriction on all possible methods for digital generation of any frequency allocated with any level.
- For a long period of time a mixture of analogue and digital networks will exist. Thus, machine recognition of tones will have to be performed also with analogue receivers.

However, when Administrations have full freedom to make new decisions about tones in future networks, especially with respect to an all-digital network, they may consider a preferred solution for the digital generation of dial tone, busy tone, congestion tone and ringing tone having a uniform frequency of 425 Hz, as recommended by CCITT.

ANNEX B

(to Recommendation Q.35)

Examples for limitation of spurious components of the dial tone with respect to interference with the frequencies recommended for pushbutton telephone sets in Recommendation Q.23

B.1 *Method A* (used by ATT)

The total distortion power should be at least 33 dB less than the dial tone power, and the distortion power in any 100 Hz band above 500 Hz should be at least 40 dB less than the dial tone power.

B.2 *Method B* (used by the Federal Republic of Germany)

In the frequency range from 500 to 2000 Hz [i.e. the range of multifrequency pushbutton (MFPB) frequencies] the distortion power in any 100 Hz band should be at least 40 dB below the dial tone power. In addition, in the frequency range above 2000 Hz up to 4000 Hz the total distortion power should be at least 25 dB below the dial tone power.

Recommendation Q.36¹⁾

CUSTOMER RECOGNITION OF FOREIGN TONES

1 In order to facilitate recognition of foreign ringing and busy tones by a subscriber dialling an automatic international call, the information given to subscribers should:

- 1) emphasize that a slow repetition rate of the tone means "ringing" whereas a rapid repetition rate means "busy";
- 2) indicate that in some countries the ringing tone may be heard as a sequence of two short tones, pause, two more short tones, pause, and so on.

In addition, it may be useful for the purpose of educating subscribers:

- to provide auditory samples of such tones by tape recording or other means, or
- to include detailed descriptions of tones in directories.

2 Modern international signalling systems are capable of exchanging signals corresponding to indications normally given to subscribers by means of audible tones (busy, congestion, ringing, etc.). Administrations are encouraged to arrange their networks so that these information signals can be sent between countries in order that they can be recognized and converted into tones or announcements as near to the calling subscriber as practical. This procedure could significantly reduce the language problems arising from the growing use of recorded announcements.

Note — This Recommendation is complementary to Recommendation E.180 on the standardization of tones in the international telephone network. Whilst standardization is of primary importance, telephone users need information to assist them in recognizing foreign tones until such time as standardization is complete.

This is the purpose of § 1 of the present Recommendation which, as extensive human factor experiments show, should greatly reduce subscriber confusion.

The measure mentioned in § 2 does not eliminate the need for tone standardization as well, but can reduce customer difficulties in cases where standardization may be impractical for a long period but sophisticated exchanges arrangements are available.

¹⁾ This Recommendation is also included in the Series E Recommendations under the number E.181.

SECTION 6

GENERAL CHARACTERISTICS FOR INTERNATIONAL TELEPHONE CONNECTIONS AND INTERNATIONAL TELEPHONE CIRCUITS

6.0 General

Recommendation Q.40

THE TRANSMISSION PLAN¹⁾

1 Principles

The transmission plan of the CCITT established in 1964 was drawn up with the object of making use, in the international service, of the advantages offered by 4-wire switching. It is referred to in the Recommendations appearing in Part I, Section 1 of the Series G Recommendations. However, the recommendations in the plan are to be considered as met if the use of technical means other than those described below gives an equivalent performance at the international exchange.

Recommendations G.121 [1] and G.122 [2] describe the conditions to be fulfilled by a national network for this transmission plan to be put into effect.

Note 1 — From the point of view of the transmission plan, no distinction is made between intercontinental circuits and other international circuits.

Note 2 — Short trans-frontier circuits are not covered by this plan and should be the subject of agreement between the Administrations concerned.

.....

2 Definition of the constituent parts of a connection

2.1 *The international chain of circuits and the national systems*

A complete **international telephone connection** consists of three parts, as shown in Figure 1/Q.40. The division between these parts is determined by the *virtual analogue switching points* in the originating/terminating international switching centres (ISCs). These are theoretical points with specified relative levels (see Figure 2/Q.40 and §§ 5.1 and 5.2 of Recommendation G.101).

¹⁾ This Recommendation is an extract of Recommendation G.101 [3]. The suspensive points show where a passage in Recommendation G.101 has not been reproduced under Q.40.

The three parts of the connection are:

- Two national systems, one at each end. These may comprise one or more 4-wire national trunk circuits with 4-wire interconnection, as well as circuits with 2-wire connection up to the local exchanges and the subscribers sets with their subscriber lines.
- An international chain made up of one or more 4-wire international circuits. These are interconnected on a 4-wire basis in the international centres which provide for transit traffic and are also connected on a 4-wire basis to national systems in the international centres.
- An international 4-wire circuit is delimited by its virtual analogue switching points in an international switching centre.

Note 1 – In principle the choice of values of the relative levels at the virtual analogue switching points on the side of a national system is a national matter. In practice, several countries have chosen -3.5 dBr for receiving as well as for sending. These are theoretical values; they need not actually occur at any specific equipment item; however they serve to determine the relative levels at other points in the national network. If, for instance, the loss “ $t-b$ ” or “ $a-t$ ” is 3.5 dB (as is the case in several countries, see Table A-1/G.121), then it follows that the relative levels at point t are 0 dBr (input) and -7 dBr (output).

Note 2 – The virtual analogue switching points may not be the same as the points at which the circuit terminates physically in the switching equipment. These latter points are known as the *circuit terminals*; the exact position of these terminals is decided in each case by the Administration concerned.

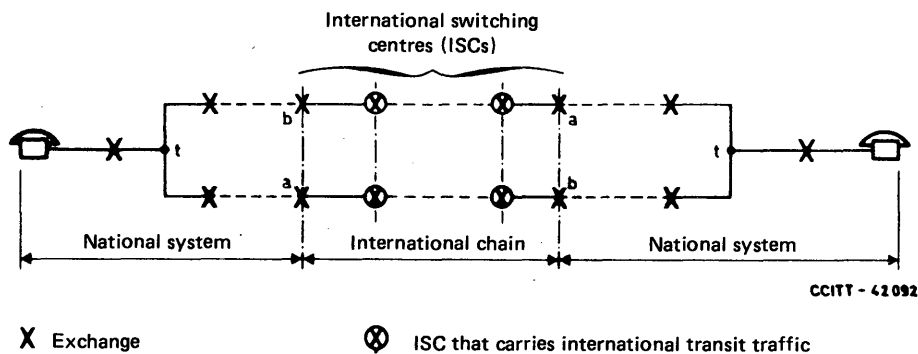


FIGURE 1/Q.40

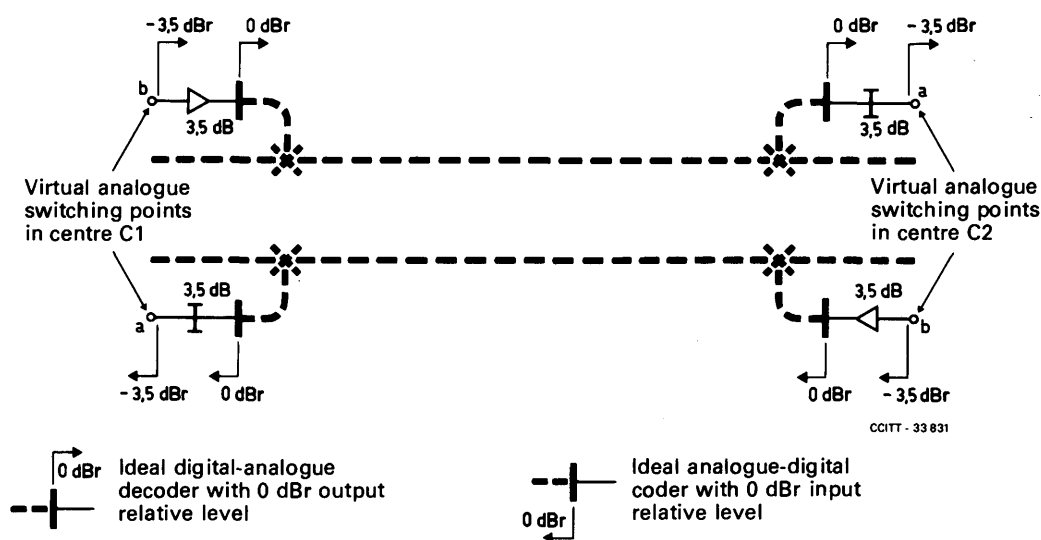
Definition of the constituent parts of an international connection

2.2 National extension circuits: 4-wire chain

When the maximum distance between an international exchange and a subscriber who can be reached from it does not exceed about 1000 km or, exceptionally, 1500 km, the country concerned is considered as of average size. In such countries, in most cases, not more than three national circuits are interconnected on a 4-wire basis between each other and to international circuits. These circuits should comply with the Recommendations of Subsection 1.2 [4] of Volume III, Fascicle III.1 (Recs. G.120, G.121, G.122, G.123 and G.125).

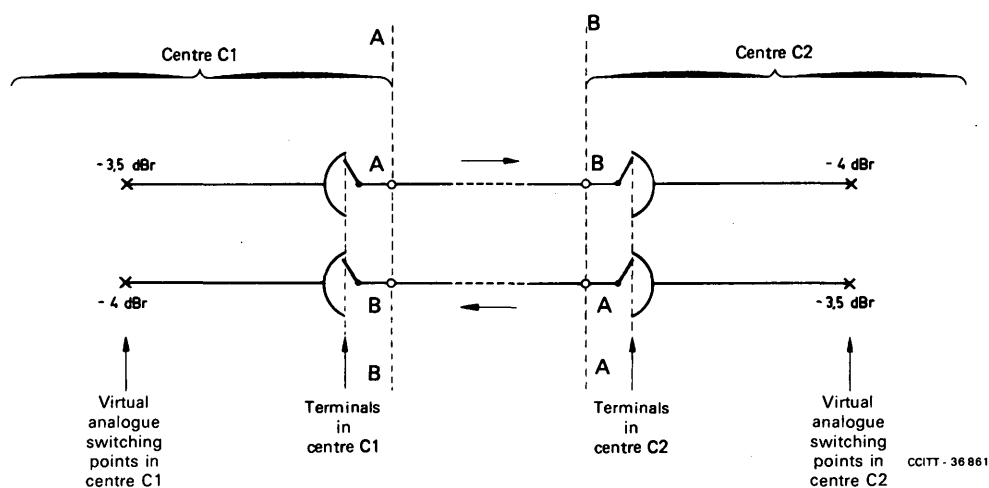
In a large country, a fourth and possibly a fifth national circuit may be included in the 4-wire chain, provided it has the nominal transmission loss and the characteristics recommended for international circuits used in a 4-wire chain (see Recommendation G.141, § 1, § 4 of this Recommendation and the Recommendations in Subsection 1.5 of Volume III, Fascicle III.1, Recs. G.151 [5], G.152 [6] and G.153 [7]).

Note – The abbreviation “a 4-wire chain” (see Figure 3/Q.40) signifies the chain composed of the international chain and the national extension circuits connected to it, either by 4-wire switching or by some equivalent procedure (as understood in § 1 above).



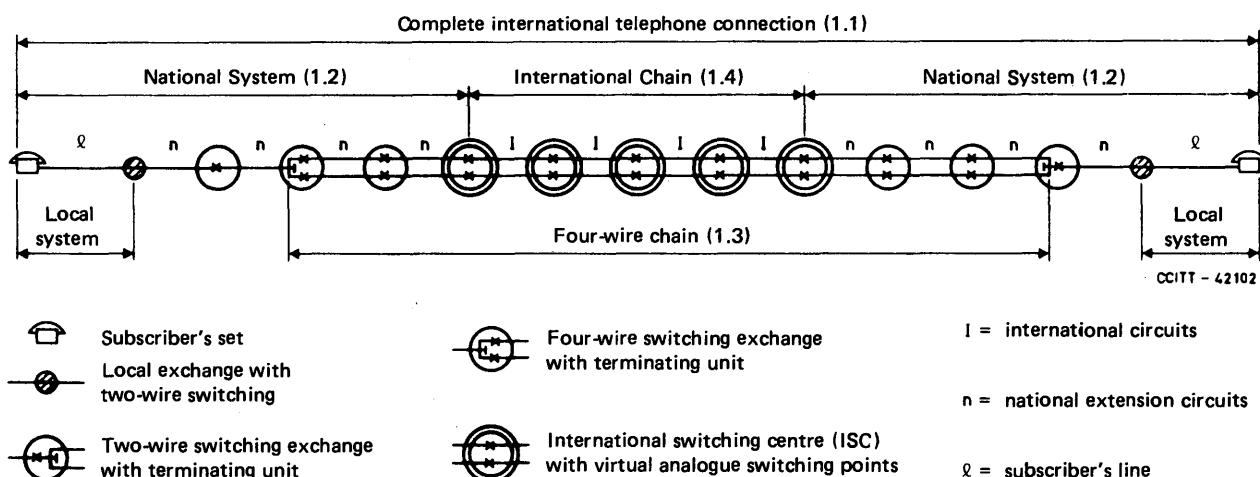
Note – Ideal coders and decoders are assumed to show a relation between analogue and digital signals and vice versa exactly in accordance with the appropriate tables for A-law or μ -law of Recommendation G.711 [8].

a) *Definition of virtual analogue switching points for a digital international circuit between digital international centres*



b) *Definition of virtual analogue switching points for an analogue international circuit between analogue international centres*

FIGURE 2/Q.40
Definitions for international circuits



Note – The arrangement shown for the national systems are examples only. The numbers given in brackets refer to the Subsections of Section 1 (Fascicle III.1) in which recommendations may be found relevant to that part of the connection. In addition, the circuits making up this chain must individually meet the requirements of Subsection 1.5.

FIGURE 3/Q.40

An international connection to illustrate the nomenclature adopted

3 Number of circuits in a connection

3.1 National circuits

It seems reasonable to assume that in most countries any *local exchange* can be connected to the international network by means of a chain of four (or less) national circuits. Five national circuits may be needed in some countries, but it is unlikely that any country may need to use more than five circuits. Hence the CCITT has reached the conclusion that four circuits is a representative figure to assume for the great majority of international connections.

In most modern national networks, the four circuits will probably include three 4-wire amplified circuits (usually set up on FDM carrier systems) and one 2-wire circuit, probably unamplified. However, cases in which local exchanges are reached by four amplified circuits, among them usually at least one PCM circuit, are becoming more and more frequent. All these circuits may be 4-wire circuits.

3.2 International circuits

According to the International Telephone Routing Plan (Recommendation E.171), the number of international circuits is restricted to four.

3.3 Hypothetical reference connections

(See Recommendations G.103 [9] and G.104 [10].)

References

- [1] CCITT Recommendation *Corrected reference equivalents (CREs) of national systems* Vol. III, Rec. G.121.
- [2] CCITT Recommendation *Influence of national networks on stability and echo losses in national systems*, Vol. III, Rec. G.122.

- [3] CCITT Recommendation *The transmission plan*, Vol. III, Rec. G.101.
- [4] CCITT Recommendations G.120, G.121, G.122, G.123 and G.124; Subsection 1.2: *General characteristics of national systems forming part of international connections* of Volume III.
- [5] CCITT Recommendation *General performance objectives applicable to all modern international circuits and national extension circuits*, Vol. III, Rec. G.151.
- [6] CCITT Recommendation *Characteristics appropriate to long-distance circuits of a length not exceeding 2500 km*, Vol. III, Rec. G.152.
- [7] CCITT Recommendation *Characteristics appropriate to international circuits more than 2500 km in length*, Vol. III, Rec. G.153.
- [8] CCITT Recommendation *Pulse code modulation (PCM) of voice frequencies*, Vol. III, Rec. G.711.
- [9] CCITT Recommendation *Hypothetical reference connections*, Vol. III, Rec. G.103.
- [10] CCITT Recommendation *Hypothetical reference connections (digital network)*, Vol. III, Rec. G.104.

6.1 General recommendations on the transmission quality for an entire international telephone connection

Recommendation Q.41

MEAN ONE-WAY PROPAGATION TIME¹⁾

The times in this Recommendation are the means of the propagation times in the two directions of transmission in a connection. When opposite directions of transmission are provided by different media (e.g. a satellite channel in one direction and a terrestrial channel in the other) the two times contributing to the mean may differ considerably.

1 Limits for a connection

It is necessary in an international telephone connection to limit the propagation time between two subscribers. As the propagation time is increased, subscriber difficulties increase, and the rate of increase of difficulty rises, see b) below. Relevant evidence is given in the bibliography of Recommendation G.114 [1].

As a network performance objective, CCITT therefore *recommends* the following limitations on mean one-way propagation times when echo sources exist and appropriate echo control devices, such as echo suppressors and echo cancellers, are used:

- a) 0 to 150 ms, acceptable.
Note – Echo suppressors specified in Reference [2] may be used for delays not exceeding 50 ms (see Reference [3]).
- b) 150 to 400 ms, acceptable, provided that increasing care is exercised on connections as the mean one-way propagation time exceeds about 300 ms, and provided that echo control devices, such as echo suppressors and echo cancellers, designed for long delay circuits are used.
- c) Above 400 ms, unacceptable. Connections with these delays should not be used except under the most exceptional circumstances.

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¹⁾ This Recommendation is an extract of Recommendation G.114 [1]. The suspensive points show where a passage in Recommendation G.114 has not been reproduced under Q.41.

2 Values for circuits

In the establishment of the general interconnection plan within the limits in § 1 the one-way propagation time of both the national extension circuits and the international circuits must be taken into account. The propagation time of circuits and connections is the aggregate of several components; e.g. group delay in cables and in filters encountered in FDM modems of different types. Digital transmission and switching also contribute delays. The conventional planning values given in § 2.1 may be used to estimate the total propagation time of specified assemblies which may form circuits or connections.

2.1 Conventional planning values of propagation time

Provisionally, the conventional planning values of propagation time in Table 1/Q.41 may be used.

2.2 National extension circuits

The main arteries of the national network should consist of high-velocity propagation lines. In these conditions, the propagation time between the international centre and the subscriber farthest away from it in the national network will probably not exceed:

- a) In purely analogue networks

$$12 + (0.004 \times \text{distance in kilometres}) \text{ ms.}$$

Here the factor 0.004 is based on the assumption that national trunk circuits will be routed over high-velocity plant (250 km/ms). The 12 ms constant term makes allowance for terminal equipment and for the probable presence in the national network of a certain quantity of loaded cables (e.g. three pairs of channel translating equipments plus about 160 km of H 88/36 loaded cables). For an average-sized country (see Figure 2/G.103) the one-way propagation time will be less than 18 ms.

- b) In mixed analogue/digital networks the propagation time can generally be estimated by the equation given for purely analogue networks. However, under certain unfavourable conditions increased delay may occur compared with the purely analogue case. This occurs in particular when digital exchanges are connected with analogue transmission systems through PCM/FDM equipments in tandem, or transmultiplexers. With the growing degree of digitisation the propagation time will gradually approach the condition of purely digital networks.
- c) In purely digital networks between exchanges (e.g. an IDN) the propagation time as defined above will probably not exceed:

$$3 + (0.004 \times \text{distance in kilometres}) \text{ ms.}$$

The 3 ms constant term makes allowance for one PCM coder or decoder and five digitally switched exchanges, see Figure 1/G.104.

Note – The value 0.004 is a mean value for coaxial cable systems and radio-relay systems; for optical fibre systems 0.005 is to be used.

- d) In purely digital networks between subscribers (e.g. an ISDN) the delay of c) above has to be increased by up to 3.6 ms if burst-mode (time compression multiplexing) transmission is used on 2-W local subscriber lines.

2.3 International circuits

International circuits²⁾ will use high-velocity transmission systems, e.g. terrestrial cable or radio-relay systems, submarine systems or satellite systems. The planning values of § 2.1 may be used.

The magnitude of the mean one-way propagation time for circuits on high altitude communication satellite systems makes it desirable to impose some routing restrictions on their use. Details of these restrictions are given in Recommendation Q.13. (See also Annex A to Recommendation G.114.)

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²⁾ For short nearby links, telecommunications cables operated at voice frequencies may also be used in the conditions set out in the introduction to Sub-section 5.4 of Fascicle III.2.

TABLE 1/Q.41

Transmission medium	Contribution to one-way propagation time	Remarks
Terrestrial coaxial cable or radio relay system; FDM and digital transmission	4 µs/km	Allows for delay in repeaters and regenerators
Optical fibre cable system; digital transmission	5 µs/km	Allows for delay in repeaters and regenerators
Submarine coaxial cable system	6 µs/km	
Satellite system – 14 000 km altitude – 36 000 km altitude	110 ms 260 ms	Between earth stations only
FDM channel modulator or demodulator	0.75 ms ^{a)}	Half the sum of propagation times in both directions of transmission
FDM companded channel modulator or demodulator	0.5 ms ^{b)}	
PCM coder or decoder	0.3 ms ^{a)}	
PCM/ADPCM/PCM transcoding	0.5 ms	
Transmultiplexer	1.5 ms ^{c)}	
Digital transit exchange, digital-digital	0.45 ms ^{d)}	
Digital local exchange, analogue-analogue	1.5 ms ^{d)}	
Echo cancellers	1 ms ^{e)}	

^{a)} These values allow for group-delay distortion around frequencies of peak speech energy and for delay of intermediate higher order multiplex and through-connecting equipment.

^{b)} This value refers to FDM equipments designed to be used with a compandor and special filters.

^{c)} For satellite digital communications where the transmultiplexer is located at the earth station, this value may be increased to 3.3 ms.

^{d)} These are mean values; depending on traffic loading, higher values can be encountered, e.g. 0.75 ms (1.925 ms) with 0.95 probability of not exceeding. (For details see Recommendations Q.507 and Q.517.)

^{e)} Echo cancellers, when placed in service, will add a one-way propagation time of up to 1 ms in the send path of each echo canceller. This delay excludes the delay through any codec in the echo canceller. No significant delay should be incurred in the receive path of the echo canceller.

References

- [1] CCITT Recommendation *Mean one-way propagation time*, Vol. III, Rec. G.114.
- [2] CCITT Recommendation *Definitions relating to echo suppressors and characteristics of a far-end operated, differential, half-echo suppressor*, Blue Book, Vol. III, Rec. G.161, ITU, Geneva, 1965.
- [3] CCITT Recommendation *Stability and echo*, Vol. III, Rec. G.131, § 2.2.

6.2 General characteristics of national systems forming part of international connections
(See Recommendations G.120 to G.125, Fascicle III.1.)

6.3 General characteristics of the “4-wire chain” formed by the international circuits and national extension circuits
(Overall characteristics for the 4-wire chain are defined in Recommendation Q.40, § 2.)

Recommendation Q.42

STABILITY AND ECHO (ECHO SUPPRESSORS)

(See Recommendation G.131 in Fascicle III.1 and Recommendation Q.115)

6.4 General characteristics of the 4-wire chain of international circuits; international transit

Recommendation Q.43

TRANSMISSION LOSSES, RELATIVE LEVELS¹⁾

.....

5.3 Definitions

5.3.1 transmission reference point

F: point de référence pour la transmission

S: punto de referencia para la transmisión

A hypothetical point used as the zero relative level point in the computation of nominal relative levels. At those points in a telephone circuit the nominal mean power level (–15 dBm) defined in the Recommendation G.223 [2] shall be applied when checking whether the transmission system conforms to the noise objectives defined in Recommendation G.222 [3].

Note – For certain systems, e.g. submarine cable systems (Recommendation G.371 [4]), other values apply.

Such a point exists at the sending end of each channel of a 4-wire switched circuit preceding the virtual switching point; on an international circuit it is defined as having a signal level of +3.5 dB above that of the virtual switching point.

In frequency division multiplex equipment, a hypothetical point of flat zero relative level (i.e. where all channels have the same relative level) is defined as a point where the multiplex signal, as far as the effect of intermodulation is concerned, can be represented by a uniform spectrum random noise signal with a mean power level as defined in the Recommendation cited in [5]. The nominal mean power level in each telephone channel is –15 dBm as defined in the Recommendation cited in [2].

¹⁾ This Recommendation is an extract of Recommendation G.101 [1]. The suspensive points show where a passage in Recommendation G.101 has not been reproduced under Q.43.

5.3.2 relative (power) level

F: niveau relatif de puissance

S: nivel relativo (de potencia)

5.3.2.1 Basic significance of relative level in FDM systems

The relative level at a point in a transmission system characterizes the signal power handling capacity at this point with respect to the conventional power level at a zero relative level point²⁾.

If, for example, at a particular point in an FDM system designed for a large number of channels the mean power handling capacity per telephone channel corresponds to an absolute power level of S dBm, the relative level associated with this point is $(S + 15)$ dBr. In particular, at a 0 dBr point, the conventional mean power level referred to one telephone channel is -15 dBm.

5.3.2.2 Definition of relative level, generally applicable to all systems

The relative level at a point on a circuit is given by the expression $10 \log_{10} (P/P_0)$ dBr, where P represents the power of a sinusoidal test signal at the point concerned and P_0 to the power of that signal at the transmission reference point. This is numerically equal to the composite gain (definition in *Yellow Book*, Fascicle X.1) between the transmission reference point and the point concerned, for a nominal frequency of 1000 Hz. For example, if a reference signal of 0 dBm at 1000 Hz is injected at the transmission reference point, the level at a point of x dBr will be x dBm (apparent power $P_x = 10^{x/10}$ mW). In addition, application of a digital reference sequence (DRS, § 5.3.3) will give a level of x dBm at a point of x dBr. The voltage of 0 dBm0 tone at any voiceband frequency at a point of x dBr is given by the expression:

$$V = \sqrt{10^{x/10} \times 1 \text{ W} \times 10^{-3} |Z_R|_{1000}} \text{ volts}$$

where $|Z_R|_{1000}$ is the modulus of the nominal impedance of the point at a nominal frequency of 1000 Hz.

Note 1 – The nominal reference frequency of 1000 Hz is in accordance with Recommendation G.712, § 16. For existing (analogue) transmission systems, one may continue to use a reference frequency of 800 Hz.

Note 2 – The relative levels at particular points in a transmission system (e.g. input and output of distribution frames or of equipment like channel translators) are fixed by convention, usually by agreement between manufacturers and users.

The recommendations of the CCITT are elaborated in such a way that the absolute power level of any testing signal to be applied at the input of a particular transmission system, to check whether it conforms to these recommendations, is clearly defined as soon as the relative level at this point is fixed.

Note 3 – The impedance Z_R may be resistive or complex; in the latter case the power P_x is an apparent power.

Note 4 – It is assumed that between the virtual analogue switching points of a circuit, established over international transmission systems, only points of equal relative level are interconnected in those systems, so that the transmission loss of the circuit will be equal to the difference in relative levels at the virtual analogue switching points (see § 5.2 of this Recommendation).

5.3.2.3 Relation between corrected send reference equivalents, loudness ratings and relative levels

The relationship between the 0 dBr point and the level of $T_{\max}$ in PCM encoding/decoding processes standardized by the CCITT is set forth in Recommendation G.711 [6]. In particular, if the minimum nominal corrected send reference equivalent (CSRE) of local systems referred to a point of 0 dBr of a PCM encoder is not less than 3.5 dB, or the minimum nominal send loudness rating (SLR) under the same conditions is not less than -1.5 dB, and the value of $T_{\max}$ of the process is set at $+3$ dBm0 (more accurately 3.14 dBm0 for A-law and 3.17 for μ -law), then in accordance with § 3 of Recommendation G.121 [7], the peak power of the speech will be suitably controlled.

²⁾ Taking into account such aspects as (basic) noise, intermodulation noise, peak power, etc. (see Recommendation G.223).

5.3.2.4 Compatibility of relative levels of analogue and digital systems

When the signal load is controlled as outlined in § 5.3.2.3, points of equal relative levels of FDM and PCM circuits may be directly connected together and each will respect the other's design criteria. This is of particular importance when points in the two multiplex hierarchies are connected together by means of transmultiplexers, codecs or modems.

5.3.2.5 Determination of relative level

Figure 1/Q.43 illustrates the principle of how the relative level at the input and output analogue points of a "real" codec can be determined.

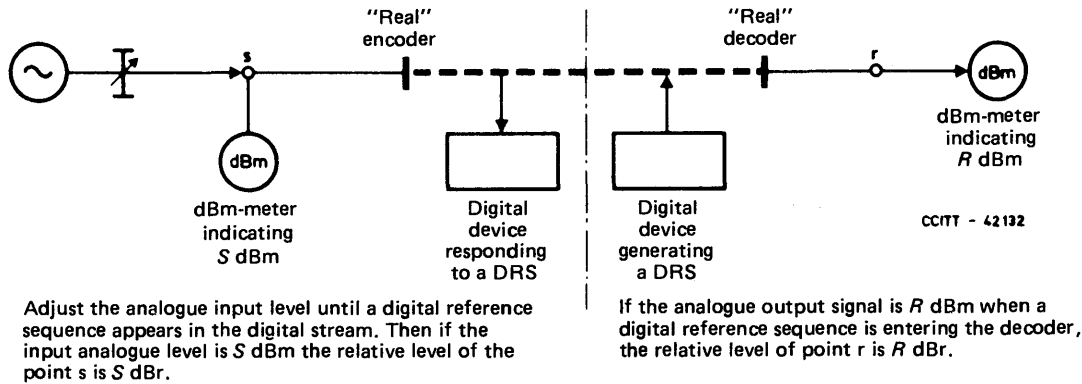


FIGURE 1/Q.43

Set-up for determining the relative level at the input and output analogue points of a "real" codec using digital reference sequences

When using Figure 1/Q.43 to determine the relative levels of a "real" codec with non-resistive impedances at the analogue input and output ports, the following precautions must be observed:

- i) the test frequency should be 1000 Hz with a suitable offset;
- ii) the power at points *s* and *r* is expressed as apparent power, i.e.:

$$\text{Apparent power level} = 10 \log_{10} \left[\frac{(\text{Voltage at point})^2 \times 10^3}{(\text{Modulus of nominal impedance at 1000 Hz}) (1 \text{ W})} \right] \text{ dBm}$$

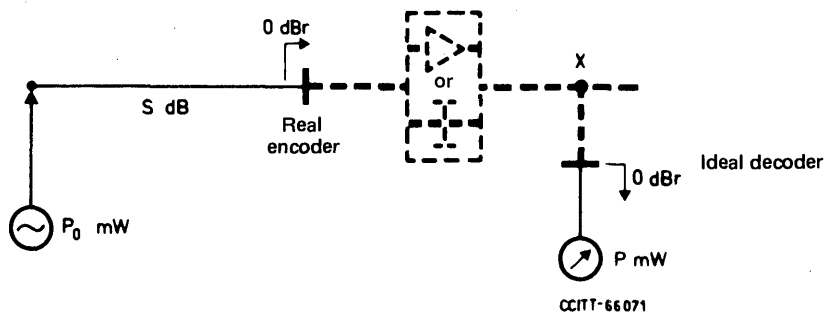
- iii) point *r* is terminated with the nominal design impedance of the decoder to avoid significant impedance mismatch errors.

Note – Precautions ii), iii) above are, of course equally applicable to the case of resistive input and output impedances and would generally be observed by conventional test procedures. Standardizing the reference frequency as in i) above is, however, essential for complex impedances because of the variation of nominal impedance with the test frequency.

5.3.2.6 Relative level of a point in a digital link

The relative level to be associated with a point in a digital path carrying a digital bit stream generated by a coder lined-up in accordance with the principles of § 5.3.2.3 above is determined by the value of the digital loss or gain between the output of the coder and the point considered. If there is no such loss or gain the relative level at the point considered is, by convention, said to be 0 dB.

The equivalent absolute power level of a digital link may be established as in Figure 2/Q.43 by using an ideal decoder. The relative level at a point *X* in the bit stream can then be assigned by comparing the power at the output of the ideal decoder with that at the analogue zero relative level point originating the digital signal.



Procedure

An analogue input signal is applied to the coder with a level of P_0 mW at the 0 dBr point. If this signal results in an analogue signal of P mW at the output of the ideal decoder then:

$$\text{Relative level at point X} = 10 \log_{10} \left(\frac{P}{P_0} \right) \text{ dBr}$$

Note — It is understood that the signal is always within the dynamic range of the conversion process.

FIGURE 2/Q.43

Procedure for determining the relative level of a point in a digital link

5.3.3 PCM digital reference sequence (DRS)

F: séquence numérique de référence MIC

S: secuencia de referencia digital MIC (SRD)

5.3.3.1 A PCM digital reference sequence is one of the set of possible PCM code sequences that, when decoded by an ideal decoder, produces an analogue sinusoidal signal at the agreed test reference frequency (i.e. a nominal 800 or 1000 Hz signal suitably offset) at a level of 0 dBm0.

Conversely an analogue sinusoidal signal at 0 dBm0 at the test reference frequency applied to the input of an ideal coder will generate a PCM digital reference sequence.

Some particular PCM digital reference sequences are defined in Recommendation G.711 [6] in respect to A-law and μ -law codecs.

5.3.3.2 In studying circuits and connections in mixed analogue/digital networks, use of the digital reference sequence can be helpful. For example, Figure 3/Q.43 shows the various level relationships that one obtains (conceptually) on a Type 2 international circuit where one end terminates at a digital exchange and the other end at an analogue exchange. In the example of Figure 3/Q.43, the analogue portion is assumed to require a loss of 0.5 dB and that provision for this loss is made by introducing a 1.0 dB pad (0.5 dB for each direction of transmission) in the receive direction at the analogue exchange. This has been deliberately chosen to illustrate the utility of the concept of a digital reference sequence.

Figure 3/Q.43 gives an example where all the analogue loss is introduced in the output direction at the analogue exchange. In this case the relative levels at the various codecs can be derived from either the DRS or the transmission reference point at the input of the international circuit with no ambiguity.

If, however, in Figure 3/Q.43 the analogue circuit section is lined up so as to give an overall loss in the direction b_1 - a_2 , care must be taken in the use of the DRS. In this case the 0 dBm0 sinusoidal reference signal and DRS may result in different levels at the point a_2 . Account should be taken of this effect when designing lining-up procedures for mixed analogue/digital circuits.

As a general principle, the relative levels on a mixed analogue/digital circuit should be referred to the transmission reference point at the input of the circuit.

5.3.4 circuit test access point

The CCITT has defined circuit test access points as being "4-wire test-access points so located that as much as possible of the international circuit is included between corresponding pairs of these access points at the two centres concerned". These points, and their relative level (with reference to the transmission reference point),

are determined in each case by the Administration concerned. They are used in practice as points of known relative level to which other transmission measurements will be related. In other words, for measurement and lining-up purposes, the relative level at the appropriate circuit test access point is the relative level with respect to which other levels are adjusted.

5.3.5 Measurement frequency

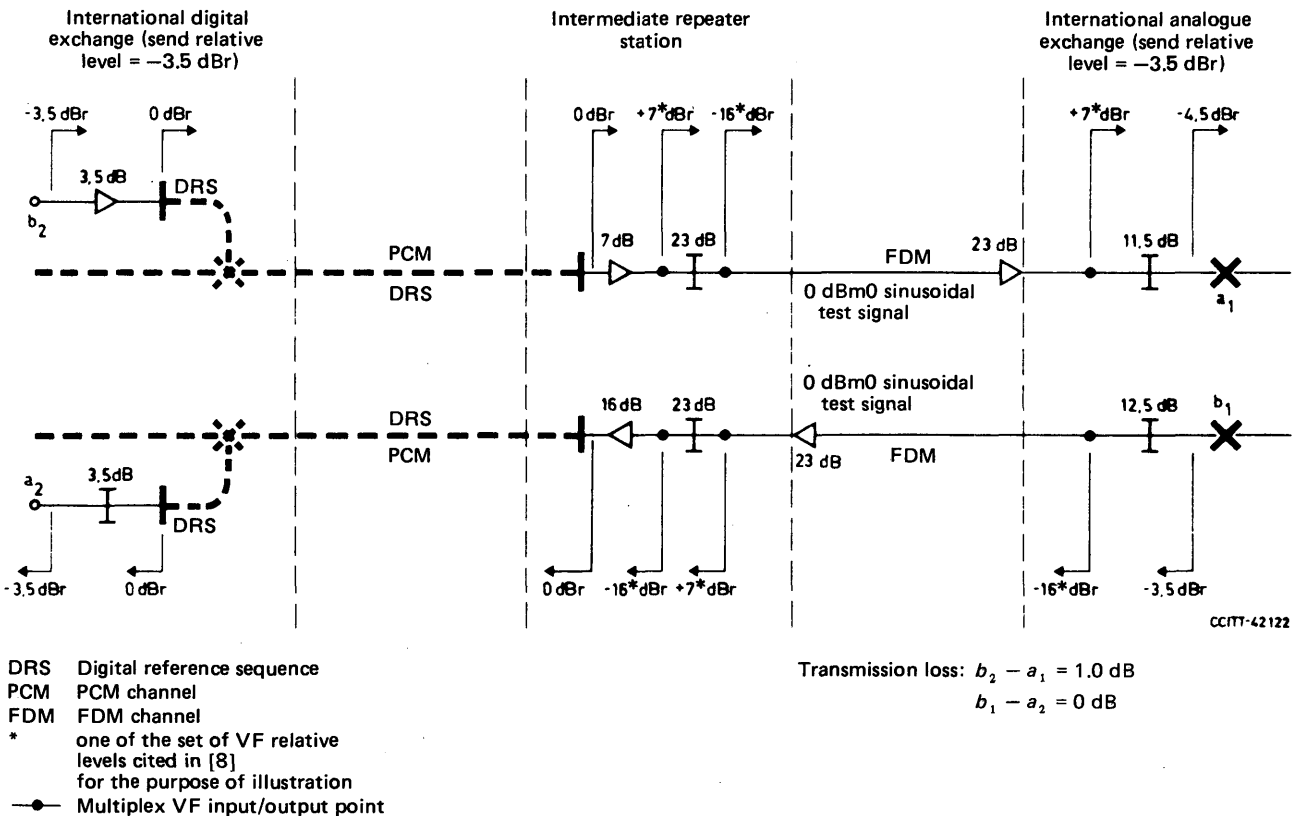
For all international circuits 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements.

A frequency of 1000 Hz is in fact now widely used for single-frequency measurements on some international circuits.

Multifrequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz and the frequency of the reference measurement signal for such characteristics can still be 800 Hz.

Note 1 – Definitions of §§ 5.3.1 and 5.3.2 are used in the work of Study Group XII. Definitions of §§ 5.3.4 and 5.3.5, taken from Recommendations M.640 [10] and M.580 [11], are included for information.

Note 2 – In order to take account of PCM circuits and circuit sections, the nominal frequencies 800 Hz and 1000 Hz are in fact offset by appropriate amounts to avoid interaction with the sampling frequency. Details can be found in Supplement No. 3.5 to Volume IV [12].



Note – For meaning of other symbols, see legend for Figure 5/G.101 [9].

FIGURE 3/Q.43

Use of a digital reference sequence in the design and line-up of a Type-2 international circuit

5.4 Interconnection of international circuits in a transit centre

In a transit centre, the virtual analogue switching points of the two international circuits to be interconnected are considered to be connected together directly without any additional loss or gain. In this way a chain of international circuits has a nominal transmission loss in transit equal to the sum of the individual circuit losses.

References

- [1] CCITT Recommendation *The transmission plan*, Vol. III, Rec. G.101.
- [2] CCITT Recommendation *Assumptions for the calculation of noise on hypothetical reference circuits for telephony*, Vol. III, Rec. G.223, § 1.
- [3] CCITT Recommendation *Noise objectives for design of carrier-transmission systems of 2500 km*, Vol. III, Rec. G.222.
- [4] CCITT Recommendation *FDM carrier systems for submarine cable*, Vol. III, Rec. G.371.
- [5] CCITT Recommendation *Assumptions for the calculation of noise on hypothetical reference circuits for telephony*, Vol. III, Rec. G.223, § 2.
- [6] CCITT Recommendation *Pulse code modulation (PCM) of voice frequencies*, Vol. III, Rec. G.711.
- [7] CCITT Recommendation *Corrected reference equivalents (CREs) of national systems*, Vol. III, Rec. G.121, § 3.
- [8] CCITT Recommendation *12-channel terminal equipments*, Vol. III, Rec. G.232, § 11.
- [9] CCITT Recommendation *The transmission plan*, Vol. III, Rec. G.101, Figure 5/G.101.
- [10] CCITT Recommendation *Four-wire switched connections and four-wire measurements on circuits*, Vol. IV, Rec. M.640.
- [11] CCITT Recommendation *Setting up and lining up an international circuit for public telephony*, Vol. IV, Rec. M.580.
- [12] *Test frequencies on circuit routed over PCM systems*, Vol. IV, Supplement No. 3.5.

Recommendation Q.44

ATTENUATION DISTORTION

1 Attenuation distortion

1.1 All-analogue conditions

The design objectives recommended for carrier terminal equipment by the Recommendation cited in [3] are such that for a chain of six circuits, each equipped with a single pair of channel translating equipments in accordance with that Recommendation, the network performance objective for the attenuation distortion given by Figure 1/G.132 [2] will in most cases be met. The distortion contributed by the seven international centres is thereby included.

Note – To assess the attenuation distortion of the international chain, the limits indicated for international circuits in Recommendation G.151, § 1 [4] must not be added to the limits for international centres mentioned in Recommendation Q.45. In fact, on the one hand, some exchange equipment would be counted twice if this addition were made; on the other, the specification limits of Recommendation Q.45 apply to the worst possible connection through an international exchange, while the maintenance limits of Recommendation G.151, § 1 apply to the poorest international circuit. The specifications of the various equipments are such that the mean performance will be appreciably better than could be estimated by the above-mentioned addition.

1.2 Mixed analogue/digital conditions

In the mixed analogue/digital period, it is expected that the attenuation/frequency characteristics of the analogue carrier terminal equipment that is to be used in international telephone connections will continue to be governed by existing Recommendations that are relevant to this type of circuit.

Where unintegrated PCM digital processes are to be included in international telephone connections, it is recommended that the attenuation/frequency characteristic of the bandpass filters associated with such processes should comply with the more stringent version of Figure 1/G.712 [5]. The latter Recommendation applies specifically to cases where integrated PCM digital processes are associated with trunk junctions (toll connecting trunks), trunk circuits (intertoll trunks), and international circuits.

With regard to the incorporation of unintegrated PCM digital processes in local telephone networks, the required attenuation/frequency characteristics of the bandpass filters involved are still under study.

2 The network performance objectives for the variation with frequency of transmission loss in terminal condition of a worldwide 4-wire chain of 12 circuits (international plus national extensions), each one routed over a single group link, are shown in Figure 1/Q.44 which assumes that no use is made of high-frequency radio circuits or 3-kHz channel equipment.

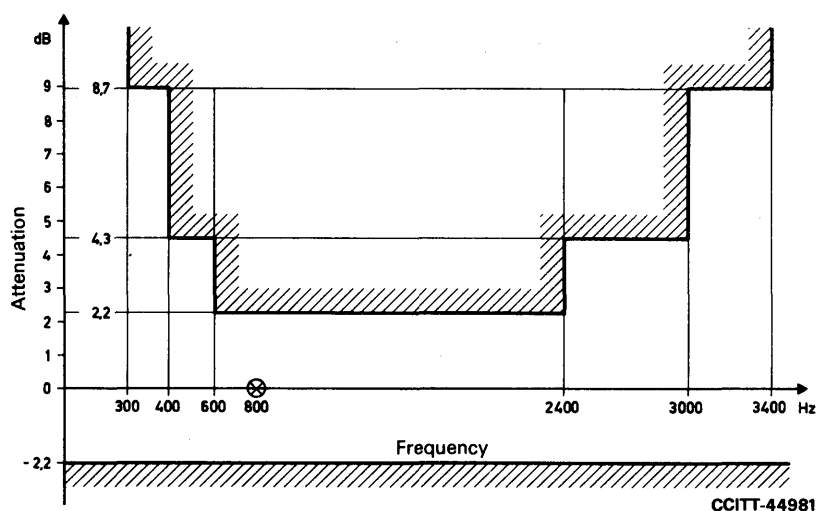


FIGURE 1/Q.44

Permissible attenuation variation with respect to its value measured at 800 Hz
(objective for worldwide 4-wire chain of 12 circuits in terminal service)

References

- [1] CCITT Recommendation *Transmission losses, relative levels and attenuation distortion*, Vol. III, Rec. G.141.
- [2] CCITT Recommendation *Attenuation distortion*, Vol. III, Rec. G.132.
- [3] CCITT Recommendation *12-channel terminal equipments*, Vol. III, Rec. G.232, § 1.
- [4] CCITT Recommendation *General performance objectives applicable to all modern international circuits and national extension circuits*, Vol. III, Rec. G.151, § 1.
- [5] CCITT Recommendation *Performance characteristics of the PCM multiplex at audio frequencies*, Vol. III, Rec. G.712.

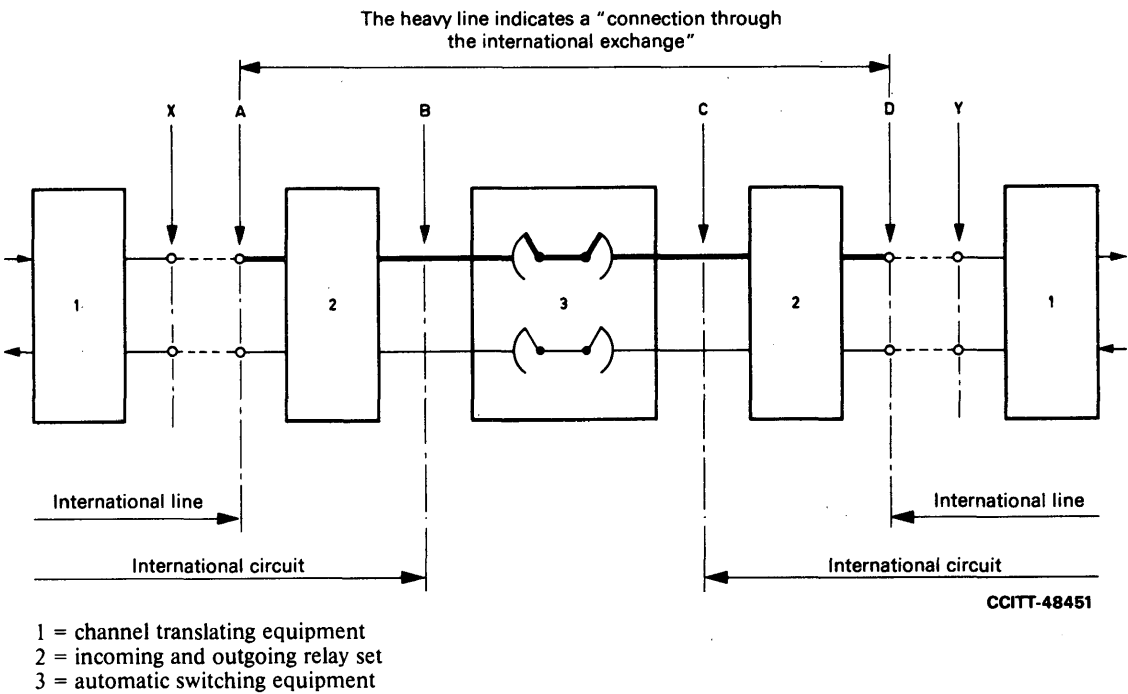
TRANSMISSION CHARACTERISTICS OF AN INTERNATIONAL ANALOGUE EXCHANGE¹⁾

1 Introduction

1.1 For the purposes of this Recommendation, an international exchange is a collection of equipment regarded as an entity by the Administration concerned. In the case of an international transit centre, it extends from the end of the incoming international line to the beginning of the outgoing international line (e.g. between such points as A and D in Figure 1/Q.45 or any other suitable pair of points).

In the absence of an international agreement on the choice of the points delimiting an international exchange, it has proved impossible to draw up model specifications showing the limits to be observed for quantities measured between these points. The CCITT recommendations given hereafter have been issued regardless of the actual arrangement.

Automatic international exchanges should be provided with circuit test access points (see Recommendation M.700 [1]) complying with the Recommendation cited in [2]. This Recommendation will ensure that circuit line-up and maintenance testing procedures are referred to points at or near the switchblock (Points B and C of Figure 1/Q.45).



Note – Between points X and A and points D and Y, there may be equipment such as echo suppressors, companders, equalizers, line signal receivers, etc., in addition to the cabling.

FIGURE 1/Q.45
International exchange

¹⁾ The transmission characteristics of a digital international exchange are specified in Recommendation Q.507.

- 1.2 The essential transmission requirements for an international exchange are:
- a) The *transmission loss* through the centre should be substantially constant with time and independent of the routing through the centre.
 - b) *Crosstalk and noise* should be negligible.
 - c) The *distortions* introduced should be small. These include attenuation distortion, non-linear distortion and intermodulation products.
 - d) *Impedance and balance with respect to earth* at the points in the international exchange to which the lines are connected should be closely controlled.

1.3 The following recommendations apply to new automatic 4-wire international exchanges of the electro-mechanical type. It is desirable that they should apply to new national 4-wire exchanges. They may also be applicable to electronic exchanges having metallic contact crosspoints.

These recommendations are intended to be used only as type tests, acceptance tests, or for special investigations. They do not constitute a complete specification. Generally the recommended tests should be conducted on a sampling basis.

2 Definitions

2.1 Definition of a "connection through an exchange"

Crosstalk and noise conditions for a 4-wire international exchange are defined by reference to a "connection through this exchange". By **connection through an exchange** is to be understood the pair of wires corresponding to one direction of transmission (GO direction or RETURN direction) and connecting the input point of one circuit incoming in the exchange and the output point of a different circuit outgoing from the exchange (these input or output points are often taken at the test-jack frame).

A connection through the international exchange is shown by a heavy line in Figure 1/Q.45.

2.2 Definition of switching equipment input and output points

Although the virtual switching points, which are points at which the two circuits are considered to be directly connected, are theoretical points, in practice it will always be possible to choose a point considered as the *switching equipment input* for the receive channel of a circuit and a point considered as the *switching equipment output* for the transmit channel of a circuit.

The exact position of each of these points depends on national practice and it is unnecessary for the CCITT to define it. Only the national authority responsible for each international transit centre can fix the position of these points in each case.

The switching equipment input point associated with a receive channel may be such that the nominal relative level is different from -4.0 dBr. Let this nominal relative level be $R^{2)}$.

The switching equipment output point associated with a transmit channel may be such that the nominal relative level is different from -3.5 dBr. Let this nominal relative level be $S^{2)}$.

Consider a circuit between the switching centre concerned and the adjacent centre. Let T be the nominal transmission loss between virtual switching points at the two ends of the channel of this circuit, which is the receive channel in the centre concerned.

When a transit connection is established through a centre by connecting the receive and transmit channels of one circuit to the transmit and receive channels respectively of another circuit, in order to ensure that the virtual switching points have been connected together with additional loss or gain, the *nominal* value of the attenuation (loss) to be introduced between the switching equipment input and the switching equipment output is $R - S + T$.

2.3 Definition of the net switching loss

Let the actual value of the attenuation introduced between the switching equipment input and output points be A . The net switching loss is defined to be equal to the difference between this *actual* value and the *nominal* value of the attenuation. Thus:

$$\begin{aligned}\text{Net switching loss} &= \text{actual loss} - \text{nominal loss} \\ &= A - (R - S + T).\end{aligned}$$

²⁾ If the value of R is chosen to be higher than the value of S , the level difference can be used to offset any inherent transmission loss in the switching equipment and the requirements of the transmission plan can be met without any need to install supplementary audio-frequency amplifiers.

3 Recommendations concerning transmission loss

3.1 Net switching loss

Ideally, the net switching loss of an international exchange would always be zero. That is, the *actual* loss (A) should equal the *nominal* loss ($R - S + T$).

Example – The relationship between the actual switching points and the virtual switching points in a practical international exchange is illustrated in Figure 2/Q.45. In this arrangement:

$$R = +7 \text{ dBr},$$

$$S = -16 \text{ dBr},$$

and T is assumed to be 0.5 dB

so that the nominal transmission loss needed between the +7 and -16 dBr points is:

$$(+7) - (-16) + (0.5) = 23.5 \text{ dB}.$$

In practice, different connections established by the switching equipment will introduce different values of net switching loss so that a distribution of net switching losses will arise. The mean value of this distribution should be very close to zero but does not need to be specified.

3.2 Loss dispersion

According to the Recommendation cited in [2], circuit test-access points are located at or near the switchblock (points B and C of Figure 1/Q.45). Moreover, the dispersion of loss is mainly due to the diversity of paths in the switchblock. It is therefore only necessary to consider the dispersion of loss between the points B and C.

The standard deviation of loss measured at 800 Hz of all possible paths between points B and C should be as small as possible. For purposes of calculation a value of 0.2 dB may be assumed.

In order to conform to this value, it is considered sufficient that, for purposes of design and acceptance testing, the difference between the losses at 800 Hz of the shortest and longest paths from point B to point C in no case exceeds 0.8 dB. For a practical assessment of the average value of net switching loss, the contribution from the switchblock can be taken as the mean of the maximum and minimum values of loss between points B and C.

These values apply for connections routed directly, and once only, through the switchblock. Due to the fact that the switchblock contains only switches and associated cabling, the actual loss between points B and C in any case can only have positive values.

If special re-entrant trunking arrangements are used, requiring the connection to pass through the switchblock twice (this may be a convenient way to extend the availability of the switching network or to introduce additional equipment, e.g. echo suppressors), the maximum loss and loss dispersion will be increased. In view of this, the re-entrant technique should not be used to such an extent as to increase significantly the mean net switching loss of the exchange.

3.3 Nonlinear distortion

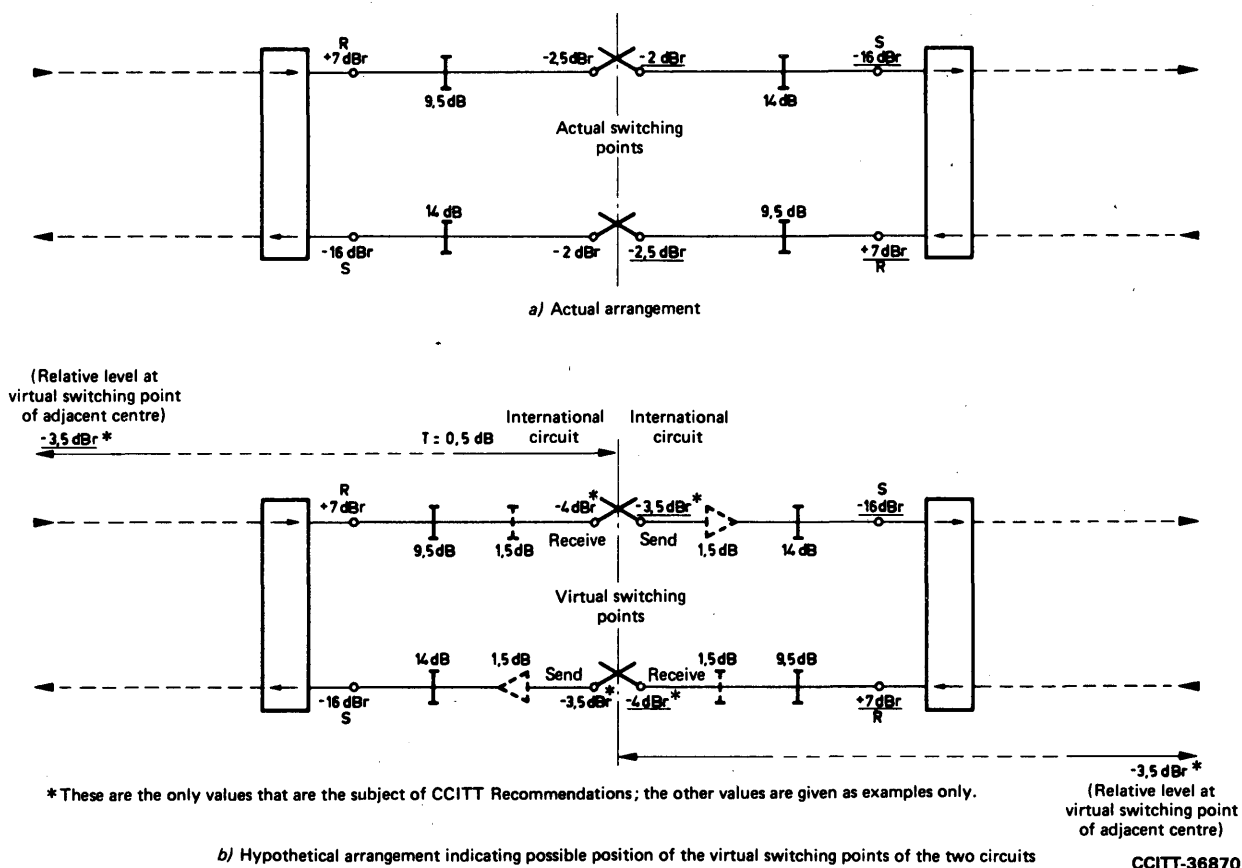
The transmission loss measured on any “connection through the international exchange” should not vary by more than 0.2 dB when the level of the test-tone is varied from -40 dBm0 to +3.5 dBm0.

3.4 Loss-frequency distortion referred to 800 Hz

The difference between the transmission loss measured on any “connection through the international exchange” over the frequency bands indicated below and that measured at 800 Hz³⁾, should lie within the following limits:

$$\begin{aligned} 300\text{-}400 \text{ Hz: } & -0.2 \text{ dB to } +0.5 \text{ dB}, \\ 400\text{-}2400 \text{ Hz: } & -0.2 \text{ dB to } +0.3 \text{ dB}, \\ 2400\text{-}3400 \text{ Hz: } & -0.2 \text{ dB to } +0.5 \text{ dB}. \end{aligned}$$

³⁾ 1000 Hz is an acceptable alternative frequency.



Note – Underlined values of relative level refer to the circuit on the right of the point concerned. Values of relative level not underlined refer to the circuit on the left of the point concerned. In an actual switching centre the virtual switching points would not physically exist.

FIGURE 2/Q.45
Example showing a simplified representation of a transit connection in an international exchange with actual arrangement and possible location of virtual switching points

4 Crosstalk recommendations

4.1 Crosstalk should be measured in exchanges at a frequency of 1100 Hz in accordance with Recommendation G.134 [3].

4.2 Crosstalk between connections established (between points A and D)

In an international 4-wire exchange the signal to crosstalk ratio measured at points A and D between any two "connections through the international exchange" (see definition in § 2.1 above) should be 70 dB or better.

This limit of 70 dB should normally apply to the most unfavourable case, in which two "connections" have parallel paths throughout the international exchange. It should be noted that this does not occur in practice, because normal cabling layout is such that when, at one switching stage, two "connections" use adjacent switches, in the following stage the two "connections" generally use switches which are not adjacent.

4.3 GO to RETURN crosstalk of the same path (between points A and D)

The signal-to-crosstalk ratio between the two "connections" which constitute the GO and RETURN channels of a 4-wire path established through the international exchange should be 60 dB or better.

5 Noise recommendations

For a 4-wire international exchange, noise measurements should be performed on a “connection through the exchange” during the busy-hour. (The *busy-hour* is defined in [4].) Each channel of the connection should be terminated at points A and D of Figure 1/Q.45, in 600 ohms. The noise should be measured at the downstream end of each channel and should be referred to a point zero relative level in that channel. Thus, in Figure 1/Q.45 the noise in the upper channel is measured at D and the noise in the lower channel is measured at A.

5.1 Mean noise power during the busy-hour

The mean of the noise over a long period during the busy-hour should not exceed the following values:

- Psophometrically weighted noise: -67 dBm0p (200 pW0p),
- Unweighted noise: -40 dBm0 ($100\,000\text{ pW0}$) measured with a device with a uniform response curve throughout the band 30-20 000 Hz.

Note – A sufficient variety of connections should be chosen to ensure that the measurements are representative of the various possible routes through the exchange.

5.2 Impulsive noise during the busy-hour

Noise counts should not exceed 5 counts in 5 minutes at a threshold level of -35 dBm0 (see Annex A to this Recommendation for measurement procedure).

Note – Figure 3/Q.45 shows the maximum number of impulsive noise counts acceptable on a 5-minute period.

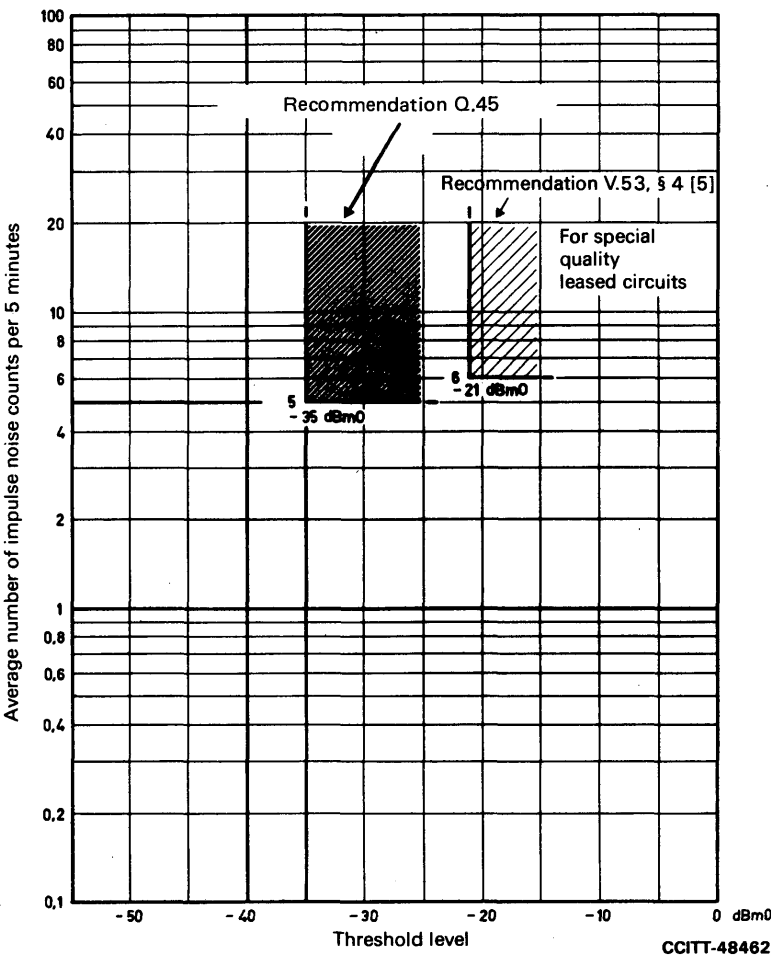


FIGURE 3/Q.45
Impulsive noise requirements for 4-wire exchanges

6 Other transmission recommendations

6.1 Intermodulation products (measured at A and D)

The intermodulation products to be taken into account for end-to-end multifrequency signalling and for data transmission are those of the third order, of type $(2f_1 - f_2)$ and $(2f_2 - f_1)$ where f_1 and f_2 are two signalling frequencies.

For a measurement of the intermodulation products, the two frequencies to be used are 900 Hz and 1020 Hz (see [6]). With each frequency f_1 and f_2 at a level of -6 dBm0, the difference between the level of either frequency f_1 or f_2 and the level of either of the intermodulation products at $(2f_1 - f_2)$ or $(2f_2 - f_1)$ should be at least 40 dB.

6.2 Group delay distortion (measured between A and D)

The group delay distortion measured on any "connection through the international exchange" over the band 600-3000 Hz should not exceed 100 microseconds.

6.3 Return loss (measured at A and D, from A towards D and from D towards A)

At any frequency from 300-600 Hz the return loss measured against 600 ohms should be not less than 15 dB. The corresponding value from 600-3400 Hz should be not less than 20 dB.

6.4 Impedance unbalance to earth

6.4.1 The impedance unbalance to earth measured, at points A and D, should not be worse than:

300- 600 Hz: 40 dB;
600-3400 Hz: 46 dB.

Note – Some Administrations guided by their knowledge of local conditions may feel a need to specify a figure for a lower frequency, for instance, 50 Hz.

6.4.2 The degree of unbalance to earth is defined as the ratio u/U measured as shown in a) and b) of Figure 4/Q.45 and is expressed in decibels as the reciprocal of this ratio in transmission units.

The diagrams of Figure 4/Q.45 used for measurement of unbalance differ only in respect of the presence or absence of an earth at the mid-point of the termination. Unbalance measurements according to a) and b) of Figure 4/Q.45 can give quite different results according to the nature of the unbalance.

6.4.3 The CCITT has recommended in 1968 that the set of limit values of § 6.4.1 above should be met for unbalance to earth measured with *both* measuring diagrams according to Figure 4/Q.45.

7 Use of cables specified by the IEC

The cables for telephone exchanges in accordance with the IEC (International Electrotechnical Commission) publication cited in [7] will meet the electrical characteristics required by the CCITT (especially as regards crosstalk) for ordinary exchanges, but this may no longer hold good for larger exchanges with considerable lengths of cable.

In accordance with Recommendation G.231 [8], it will be for the Administrations or the contractors to check whether standard cables will be satisfactory in equipping an exchange which requires telephone cables of exceptional length.

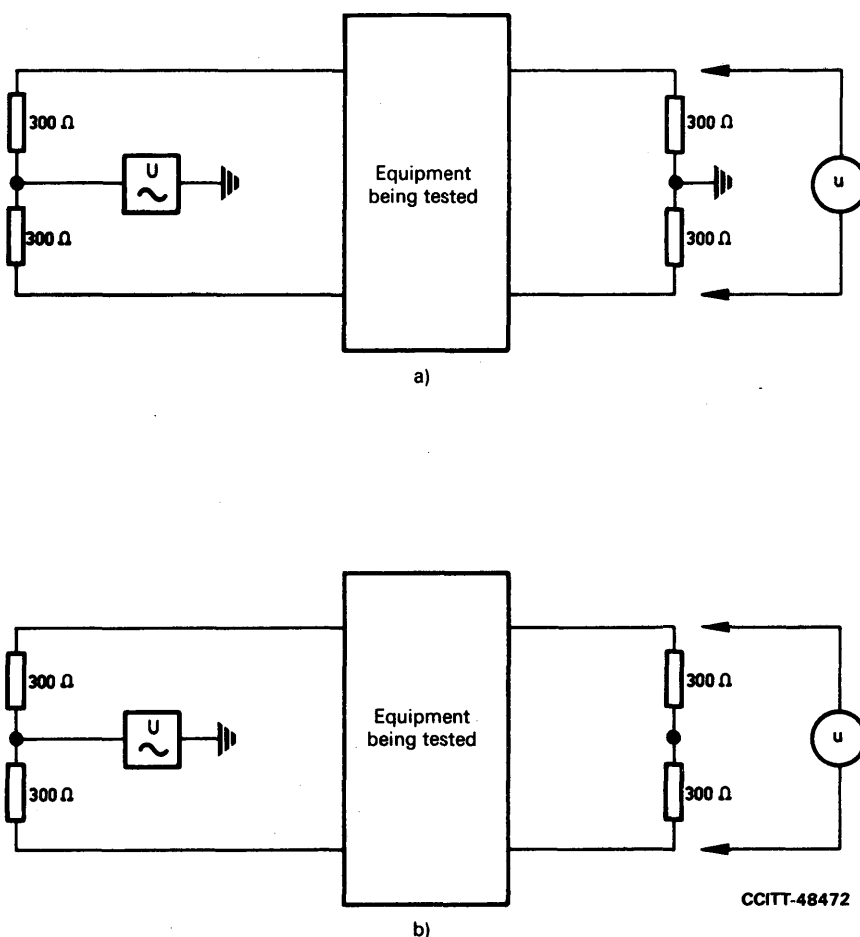


FIGURE 4/Q.45
Measurement of the degree of unbalance to Earth

ANNEX A

(to Recommendation Q.45, § 5.2)

Procedure for impulsive noise measurements

A.1 A test circuit should be formed by setting up a connection across the switching unit and terminating the connection on one side of the exchange by the appropriate closing impedance and on the other by the impulse measuring device in parallel to the closing impedance. Those terminating points should be points A and D in the diagram of Figure 1/Q.45 (or equivalent points) to include the switching equipment of the exchange. Where it is the desire of an Administration, measurements may be made at points X and Y if precautions are taken to ensure that the results apply only to the automatic switching equipment, signalling equipment, echo suppressors, relay sets, pads and cabling of the exchange.

A.2 The measurements should be made using the device specified in Recommendation O.71 [9]. The 600-3000 Hz filter network described in [10] should be in the circuit.

A.3 The measurements should be made at times when the probability of noise occurring is at its highest, that is normally during the busy-hour.

A.4 The time of observation for each test should be five minutes.

Note — The number of different test circuits set up across the exchange for measuring should take into account the size and complexity of the switching unit and should be a number sufficient to represent the various possible types of calls and routes through the exchange.

See also the document cited in [11].

References

- [1] CCITT Recommendation *Definitions for the maintenance organization*, Vol. IV, Rec. M.700.
- [2] CCITT Recommendation *Four-wire switched connections and four-wire measurements on circuits*, Vol. IV, Rec. M.640, § 2.
- [3] CCITT Recommendation *Linear crosstalk*, Vol. III, Rec. G.134.
- [4] CCITT Definitions: *Busy hour*, Vol. X, Fascicle X.1 (Terms and Definitions).
- [5] CCITT Recommendation *Limits for the maintenance of telephone-type circuits used for data transmission*, Vol. VIII, Rec. V.53, § 4.
- [6] CCITT Recommendation *Characteristics of compandors for telephony*, Vol. III, Rec. G.162, § 5.2.
- [7] Publication 189 of the I.E.C.
- [8] CCITT Recommendation *Arrangement of carrier equipment*, Vol. III, Rec. G.231.
- [9] CCITT Recommendation *Specification for an impulsive noise measuring instrument for telephone-type circuits*, Vol. IV, Rec. O.71.
- [10] *Ibid.*, § 3.5.
- [11] *Measurements of impulsive noise in a four-wire telephone exchange*, Green Book, Vol. VI-4, Supplement No. 7, ITU, Geneva, 1973.

SECTION 7

PCM MULTIPLEX EQUIPMENT AND UTILIZATION OF CCITT SIGNALLING SYSTEMS ON PCM LINKS

Recommendation Q.46

CHARACTERISTICS OF PRIMARY PCM MULTIPLEX EQUIPMENT OPERATING AT 2048 kbit/s

The primary PCM multiplex operating at 2048 kbit/s is described in Recommendation G.732, Volume III.

Recommendation Q.47

CHARACTERISTICS OF PRIMARY PCM MULTIPLEX EQUIPMENT OPERATING AT 1544 kbit/s

The primary PCM multiplex operating at 1544 kbit/s is described in Recommendation G.733, Volume III.

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SECTION 8

SIGNALLING FOR SATELLITE SYSTEMS

Recommendation Q.48

DEMAND ASSIGNMENT SIGNALLING SYSTEMS¹⁾

1 The term “demand assignment” (abbreviated as DA) should be taken as meaning that the assignment is on a per call basis.

Note – Satellite circuits with demand assigned multiple access are those circuits which may be set up by assignment of a satellite link to operate between specified earth stations when the actual demand arises.

The origin, destination, or both of the satellite link can be varied. The link is assigned to set up the required telephone circuit according to the call.

This defines the following concepts:

- 1) variable destination satellite link;
- 2) variable origin satellite link;
- 3) fully variable satellite link (the origin and destination of which may both be varied).

The Recommendation covers, when applicable, fully variable and variable destination types of DA systems.

2 The DA signalling system shall be capable of interworking with all currently standardized CCITT signalling systems and shall have the capacity to carry all the telephony signals currently provided by these CCITT signalling systems and shall in addition provide reserve capacity.

Any currently standardized CCITT signalling system shall be able to be applied to any access link. Different CCITT signalling systems may be applied to the various access links at the same time.

3 Account should be taken of the fact that particular earth stations may have special signalling requirements to suit the CTs using these earth stations (e.g. joint use of an earth station by a number of CTs, long distances between CT and earth station, CTs with access to more than one earth station).

4 The DA signalling system shall be an integrated signalling system used both for:

- a) signalling for setting up the DA speech circuit; and
- b) transfer of the information flow for telephony.

5 The DA signalling system shall be capable of transmitting address information in both the *en bloc* and the overlap mode of operation. The transmission of address information by the outgoing DA system terminal should be such as to result in minimum delay to these signals in the DA system.

The manner of transmitting signals over the DA signalling system shall be independent of the type of signalling system to be encountered in the access link at the far end.

¹⁾ See also the reference cited in [1].

Accordingly, the interworking arrangements described in Table 1/Q.48 are recommended. (For definitions of “*en bloc*” and “*en bloc overlap*” see the definitions in Recommendation Q.151.)

TABLE 1/Q.48
Interworking arrangements for DA signalling systems

En bloc – system No. 6	Case 1 En bloc	En bloc – system No. 5 En bloc – system No. 6
En bloc – system No. 6	Case 2 En bloc	Overlap – system R2
En bloc – system No. 5	Case 3 En bloc-overlap or en bloc	En bloc – system No. 5 En bloc – system No. 6
En bloc – system No. 5	Case 4 En bloc-overlap or en bloc	Overlap – system R2
Overlap – system No. 6 Overlap – system R2	Case 5 Overlap	En bloc – system No. 5
Overlap – system No. 6 Overlap – system R2	Case 6 Overlap	Overlap – system No. 6 Overlap – system R2

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6 The DA signalling system shall send out address digits from ES_B to CT_B in the correct order, that is, the order of dialling.

7 Means shall be provided for preventing spillover of signals between successive calls, which use the same satellite channel through the DA signalling system.

8 The DA signalling system should be capable, for the sequence *re-answer signal-clear back signal* of correctly extending to CT_A from ES_A, the last state representing the final position of the called party's switch hook.

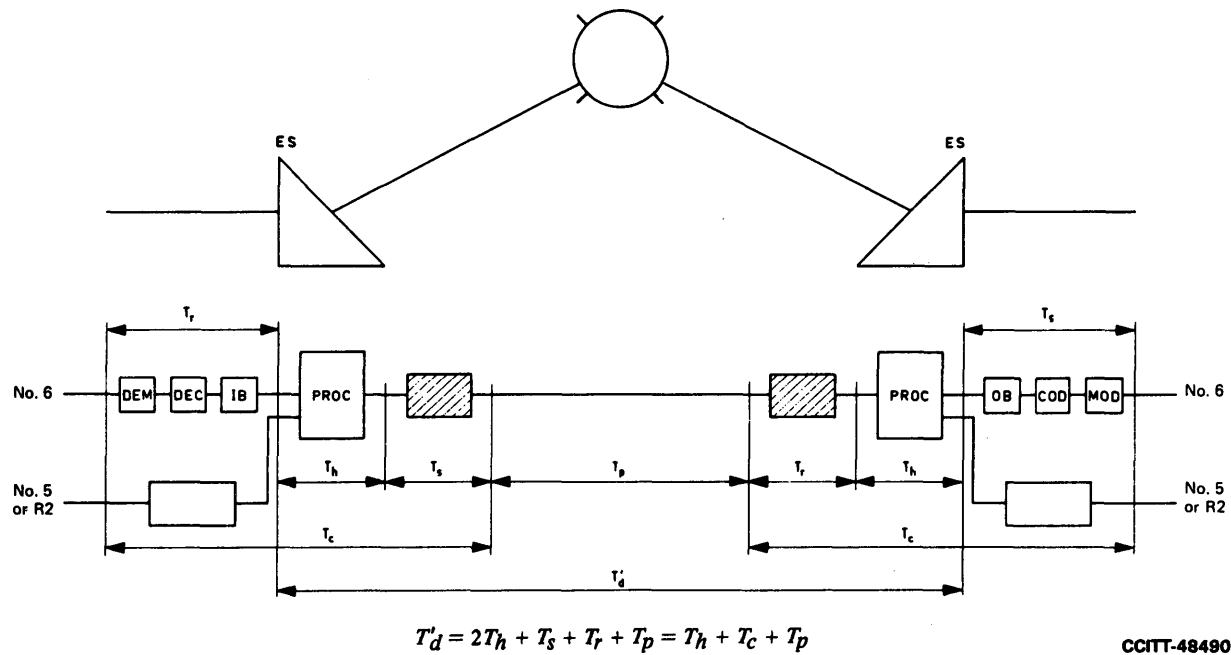
9 The message structure of the demand assignment signalling system should be such that one message will contain all the information necessary for one event (e.g. answer signal for one particular circuit). Single unit and multi-unit messages should be catered for. Each signal unit should contain both information and check bits.

10 All time-outs for both normal and abnormal conditions in the DA signalling system should be designed according to the recommendations concerning the relevant CCITT signalling systems.

11 Signal transfer time through the DA signalling system should be fast. While no firm time requirements in regard to the various components of signal transfer time have been established, design objectives in terms of average and 95% level values for the signal transfer time (T_d) for answer signals, other one-unit messages and the initial address message are given. These figures are to be viewed as reasonable objectives and not as firm requirements.

11.1 Signal transfer time in the DA signalling system

A signal transfer time in the DA signalling system is specified. This signal transfer time is called T'_d in the diagram of Figure 1/Q.48.



T'_d = Signal transfer time in DA signalling system.
(For other symbols, see Recommendation Q.252 [3].)

To facilitate the calculation of the total signal transfer time of the DA system, it is assumed that the time T_r as well as T_s respectively of the terrestrial and satellite transmission links are equal

FIGURE 1/Q.48
Functional signal transfer time diagram

The value $T_d = T'_d - T_p$ should be used as the design objective for the DA signalling system. The values of T_d calculated for the design of the system are shown in Table 2/Q.48.

Note – These figures have to be interpreted as reasonable estimates and not as firm requirements.

TABLE 2/Q.48
Values of signal transfer times for design of a DA signalling system
Design objectives for T_d

$T_d = T'_d - T_p$

T_d in ms	Type of message	Answer	Other one-unit message	IAM of 5 SU
	AV	52	85	145
	95% level	85	175	235

For calculation use the following relations:

$$T_d = 2 T_h + T_s + T_r = T_c + T_h \quad (11-1)$$

$$T_{d \text{ moy}} = T_{c \text{ moy}} + T_{h \text{ moy}} \quad (11-2)$$

$$T_{d 95\%} = T_{d \text{ moy}} + \sqrt{(\Delta T_c)^2 + (\Delta T_h)^2} \quad (11-3)$$

where

$$\Delta T_c = T_{c 95\%} - T_{c \text{ moy}} \quad (11-4)$$

$$\Delta T_h = T_{h 95\%} - T_{h \text{ moy}} \quad (11-5)$$

For basis of calculation, see [4].

12 Dependability requirements

The requirements specified for System No. 6 (see [5]) are recommended as the objectives for the DA signalling system.

12.1 Signal transfer dependability (see [6])

“b) Signal units of any type which give rise to wrongly accepted signals due to undetected errors and causing false operation (e.g. false clear-back signal):

not more than one error in 10^8 of all signal units transmitted, and

c) As in item b) but causing serious false operation (e.g., false metering or false clearing of a connection):

not more than one error in 10^{10} of all signal units transmitted.”

12.2 Error correction by retransmission (see [7])

Although the bit error rate in the DA signalling system has not been determined, the design of the system should be made such that a design objective “not more than one in 10^4 signal units carrying telephone information is allowed to be delayed as a consequence of error correction by retransmission.”

12.3 Interruption of the signalling service (see [8])

System No. 6 requirements are:

- interruption of duration between 2 seconds and 2 minutes: not more than once a year;
- interruption of duration exceeding 2 minutes: not more than once in 10 years.

Since the speech circuits and the signalling channel in the DA system normally will be interrupted simultaneously, it is understood that the above figures are related to the signalling equipment and not to the transmission media common to both the signalling channel and the speech circuits.

References

- [1] *Signalling for demand assignment satellite systems*, Green Book, Vol. VI-4, Supplement No. 8, ITU, Geneva, 1973.
- [2] CCITT Recommendation *Signal code for register signalling*, Vol. VI, Rec. Q.151.
- [3] CCITT Recommendation *Signal transfer time definitions*, Vol. VI, Rec. Q.252.
- [4] CCITT Recommendation *Signal transfer time requirements*, Vol. VI, Rec. Q.287, Annex A.
- [5] CCITT Recommendation *Service dependability*, Vol. VI, Rec. Q.276, § 6.6.1.
- [6] *Ibid.*, § 6.6.1, b) and c).
- [7] *Ibid.*, § 6.6.1, a).
- [8] *Ibid.*, § 6.6.1, d).

SECTION 9

AUTOMATIC TESTING EQUIPMENT

Recommendation Q.49

SPECIFICATION FOR THE CCITT AUTOMATIC TRANSMISSION MEASURING AND SIGNALLING TESTING EQUIPMENT ATME No. 2

(The specification for ATME No. 2, appears in Recommendation O.22, Fascicle IV.4.)

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PART III

Recommendations Q.60 to Q.62

INTERWORKING WITH THE MARITIME MOBILE-SATELLITE SERVICE

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**GENERAL REQUIREMENTS FOR THE INTERWORKING OF THE TERRESTRIAL
TELEPHONE NETWORK AND THE FIRST GENERATION INMARSAT SYSTEM**

1 Introduction

1.1 The purpose of this Recommendation is to define the general interworking requirements between the telephone network and the first generation INMARSAT system.

1.2 In order to support automatic working between subscribers in the public telephone service and telephone subscribers to the Maritime Mobile-Satellite Service, it is necessary that the interface between the terrestrial telephone network and the maritime satellite system be defined.

1.3 It should be possible to interface the maritime mobile satellite system with any signalling system standardized by the CCITT for automatic working. In order to facilitate the preparation of the interworking equipment, and also aiming at the international standardization of the service, this Recommendation lists several basic interworking requirements common to all signalling systems.

1.4 More specific interworking requirements applicable to System No. 5 are given in Recommendation Q.62 and System R2 are given in Recommendation Q.61. Interworking with other signalling systems including new signalling systems to be standardized in the future will also be developed by CCITT as separate Recommendations.

1.5 A brief description of the current INMARSAT system is given in Annex A. SDL descriptions of incoming and outgoing signalling procedures for the INMARSAT system are given in Annexes B and C respectively.

2 Maritime satellite switching centre

For the purpose of this Recommendation the term Maritime Satellite Switching Centre (MSSC) is used to indicate the interworking point between the terrestrial telephone network and the maritime satellite system. The maritime satellite switching centre (MSSC) may be located at the antenna site of the coast earth station [1] and operate as an independent international switching centre connected to one or more international switching centres (ISCs) or national switching centres, or it may be remote as a supplement to or as a part of an international switching centre.

3 List of general Series Q Recommendations

Due regard should be paid to the following general Series Q Recommendations:

- Q.11, Q.11 *bis*, Q.11 *ter*, Q.11 *quater* and Q.12, Q.13, numbering and routing plan
- Q.14, means of controlling the number of satellite links
- Q.15 through Q.22, general Recommendations
- Q.23, technical features of push-button telephone sets
- Q.25, splitting arrangement
- Q.26 through Q.33, miscellaneous provisions
- Q.35, tones for national signalling systems
- Q.40 through Q.45, transmission characteristics
- Q.102, facilities provided in international automatic working
- Q.103, numbering used
- Q.104, language digit or discriminating digit
- Q.105, national (significant) number
- Q.106, the sending-finished signal
- Q.107, sending sequence of forward-address information
- Q.107 *bis*, analysis of forward-address information for routing
- Q.109, transmission of the answer signal
- Q.112 through Q.114, transmission clauses
- Q.115, control of echo suppressors
- Q.116 through Q.118 *bis*, abnormal conditions.

4 Sending sequence of numerical (or address) signals

4.1 *Calls toward ship earth station [2] (shore-to-ship)*

In most cases the MSSC will not need the information contained in the S-digit of the country code 87S. In this situation the sequence of forward-address information sent to the MSSC should be as for a terminal international call.

Cases may arise where an MSSC requires the S-digit to distinguish between ocean areas, satellite systems or VHF/UHF vs. satellite. In this situation the sequence of forward-address information should be as for an international transit call, i.e. the sequence includes the country code 87S.

4.2 *S-digit*

It is a matter for the terrestrial subscriber to choose the proper S-digit and the MSSC to be used will be decided by the outgoing country. (For technical reasons accounting between Administrations should be performed on the basis of only 87S.)

4.3 *Calls from ship earth station (ship-to-shore)*

The desired MSSC is selected at the ship earth station by procedures within the maritime satellite system. After the dialling tone has been provided to the subscriber, he will dial a prefix followed by the full international telephone number required, whether or not the MSSC is located in the required subscriber's country (see also Recommendation Q.11 *quater*).

The prefix must be suppressed by the MSSC since it is only required for internal routing in the MSSC.

For calls to subscribers in the MSSC country, the country code should also be suppressed by the MSSC.

A discriminating digit must be inserted by the MSSC according to Recommendation Q.104.

4.4 *Operator services*

The desired MSSC is selected at the ship earth station by procedures within the maritime satellite system. After the dialling tone has been provided to the subscriber, he will dial a two digit prefix, possibly followed by a 1, 2 or 3 digit country code, to identify the type of operator required (see Recommendation Q.11 *quater*).

The MSSC could then convert the received dialling information as required for setting up the terrestrial connection to the operator.

4.5 *Special service terminations*

The desired MSSC is selected at the ship earth station by procedures within the maritime satellite system. After the dialling tone has been provided to the subscriber, he will dial a two digit prefix possibly followed by other digits to identify the type of special service termination required. (See Recommendation Q.11 *quater*). The MSSC should convert the received dialling information as required for setting up the terrestrial connection.

5 Special requirements related to setting-up and clearing of automatic calls

5.1 *Setting-up time for shore originated calls*

The setting-up time for shore originated calls should be as short as possible. If the MSSC has not been able to establish the connection within a period of 20 seconds after receipt of all address digits, a congestion indication should be returned.

Note — In maritime satellite systems the setting-up time is not controlled by each individual MSSC but may depend on the overall traffic load in the system and on the assignment procedure used. For several reasons the setting-up time of the radio path is likely to be longer than the setting-up time of the subscriber connection in terrestrial systems.

5.2 *Transmission of answer signal*

5.2.1 When the maritime satellite switching centre (MSSC) detects the answer signal from the maritime satellite system, the MSSC must remove the ringing tone, through-connect the circuit and return the answer signal as soon as possible to the terrestrial switching centre.

Precautions should be taken at the MSSC to avoid interpreting an interruption of the satellite link as an answer signal.

5.2.2 For ship originated calls the maritime satellite system should preferably include provisions for transferring the answer signal to the ship earth station.

5.3 *Seizure of a terrestrial circuit from the MSSC*

The maritime satellite switching centre should not seize a terrestrial circuit before each of the following conditions has been met:

- the satellite channel has been assigned;
- the continuity of the satellite channel has been verified;
- all digits necessary for routing decision by the maritime satellite switching centre have been received.

5.4 *Clear-back conditions*

5.4.1 The clear-back/re-answer sequence may not apply for shore originated calls, in which case the satellite link will be released when a clear-back signal is detected at the maritime satellite switching centre from the satellite link, without waiting for a clear-forward signal from the terrestrial network.

Precautions should be taken either at the MSSC or at the ship earth station in order to avoid unintentional clearing.

5.4.2 For ship originated calls the normal clear-back procedures should apply (see Recommendation Q.118).

5.5 *Clear-forward*

When detecting a clear-forward from the satellite link, the MSSC should immediately pass the clear-forward signal into the terrestrial network.

When detecting a clear-forward from the terrestrial network, the release guard (and clearing) sequence should follow the procedures defined for the signalling system used.

5.6 *Splitting arrangement*

When in-band signalling is used over the satellite link for setting-up and clearing of the link, a splitting arrangement shall be provided in order to avoid that signalling tones are passed into the terrestrial network. The splitting time shall be less than 20 ms.

In order to protect the maritime satellite system from line signals used on terrestrial signalling systems, it should be observed that such signalling tones passing through splitting arrangements in the terrestrial network may have a maximum duration of 50 ms.

6 *Audible tones sent by the MSSC*

Tones sent by the maritime satellite switching centre (MSSC) should have the following characteristics:

Dial tone:	425 Hz (1.5 seconds maximum, minimum is determined by receipt of first dial digit)
Ringing tone:	425 Hz (1 second on, 4 seconds off, immediate ringing)
Busy tone:	425 Hz (½ second on, ½ second off)
Congestion tone:	425 Hz (¼ second on, ¼ second off)
Special information tone:	as defined in Recommendation Q.35.

Note – The dial tone is given as a 1.5 seconds pulse in order to avoid subscribers' confusion due to the two-way transmission delay of 0.5 seconds. If the normal continuous tone with interruption after the receipt of the first digit was used, the delay would cause the tone to stay on after entry of the first digit.

7 Control of echo suppressors

Since all calls to and from a ship earth station will include a satellite link, appropriate actions must be taken to insert an incoming or outgoing half-echo suppressor at the MSSC or at an international exchange closer to the terrestrial subscriber. The ship earth station will connect to the satellite link on a 4-wire basis or will be provided with the equivalent of a half-echo suppressor. In order to reduce the analysis and control requirements at the MSSC it may prove convenient to carry out all echo suppressor control at one of the international exchanges rather than at the MSSC. This is most easily achieved by fitting permanent half-echo suppressors at the ISC end of each MSSC-ISC circuit. In any case the overall echo control requirements are the same as specified in Recommendation Q.115.

7.1 *Terrestrial signalling systems with signals for control of echo suppressors*

7.1.1 *Ship originated calls*

The MSSC should send an echo suppressor indicator informing transit centres or incoming centres whether or not an incoming half-echo suppressor should be included.

Insertion of an incoming half-echo suppressor will always be requested if the MSSC does not carry out echo suppressor control.

7.1.2 *Shore originated calls*

The MSSC will decide whether or not to insert an outgoing half-echo suppressor depending on the received echo suppressor indicator. If echo control is not performed at the MSSC, the echo suppressor indicator will always inform the MSSC that an outgoing half-echo suppressor has already been included.

7.2 *Terrestrial signalling systems without signals for control of echo suppressors*

When signals for the control of echo suppressors are not available on the particular terrestrial route, significant advantage is to be gained by carrying out the echo suppressor control at the international exchange. In any case the following rules should be observed:

7.2.1 *Ship originated calls*

- a) When the terrestrial connection between the outgoing ISC, (or MSSC) and the incoming ISC (or national incoming switching centre) does not normally require the use of echo suppressors, the outgoing ISC (or MSSC) should enable (or insert) an incoming half-echo suppressor associated with the satellite link.
- b) When the terrestrial connection between the outgoing ISC (or MSSC) and the incoming ISC (or national incoming switching centre) normally requires the use of echo suppressors, the outgoing ISC (or MSSC) should disable (or should not insert) any half-echo suppressors associated with either the satellite link or the terrestrial link.

7.2.2 *Shore originated calls*

- a) When the international connection between the outgoing ISC and the incoming ISC (or MSSC) does not normally require the use of echo suppressors, the incoming ISC (or MSSC) should enable (or insert) an outgoing half-echo suppressor associated with the satellite link.
- b) When the international connection between the outgoing ISC and the incoming ISC (or MSSC) normally requires the use of echo suppressors, the incoming ISC (or MSSC) should disable (or should not insert) any half-echo suppressors associated with either the satellite or terrestrial link.

8 Handling of group calls

8.1 *General*

A group call is a simultaneous call to a given group of ships. Such calls are identified by the following international number:

$$87S0X_2X_3 \dots X_k$$

where the first digit of the ship station number has the fixed value 0. The remaining digits determine which group of ships is being addressed.

Facilities for originating group calls from operators either in the MSSC country or another country may be readily made available by permitting such calls only when the Z digit is a language digit. Group calls originating from ordinary telephone subscribers should not be permitted so long as calling line identification is not available.

8.2 *Barring at the ISC of origin*

In order to avoid setting up of the international chain for unauthorized group calls from ordinary subscribers, barring of such calls should, as a general rule, be done at the ISC of origin.

8.3 *Barring at the MSSC*

Barring should also be provided at the MSSC in order to reject group call attempts from ships or from subscribers in countries where barring at the outgoing ISC is not possible.

9 *Avoiding two or more satellite links in tandem*

9.1 *Shore originated calls*

The country code 87S should be analysed at all transit centres where the call may either be routed on a circuit containing a satellite link or on a circuit not containing a satellite link. The latter circuit should always be chosen (see Recommendation Q.14).

9.2 *Ship originated calls*

If the signalling system provided between the MSSC and the terrestrial network contains signals which may be used to indicate that one satellite link is included, such signals should be used.

If the signalling system does not contain such signals, the outgoing ISC should avoid forwarding the call on an outgoing circuit which includes a satellite link. If, however, the signalling system employed between the outgoing ISC and the next ISC in the connection contains such signals, the outgoing ISC should insert the required information. The outgoing ISC could base its procedure upon incoming route identification.

10 *Operator assistance for semi-automatic shore originated calls*

If code 11/12 assistance facilities are not provided at the MSSC, then arrangements should be made to intercept such calls at the preceding ISC and route them to an appropriate operator.

It may be advantageous for Administrations to provide a publicized number (e.g. C12XXXX) for specialized assistance on calls to the maritime network.

References

- [1] Radio Regulations (Article 1, No. 71), ITU, Geneva, 1982.
- [2] *Ibid.*, (Article 1, No. 73).

ANNEX A

(to Recommendation Q.60)

Brief description of the first generation INMARSAT system

A.1 *Introduction*

This annex describes the signalling in the INMARSAT System in a multiple Maritime Satellite Switching Centre (MSSC) configuration, i.e., there is more than one MSSC serving an ocean region. Automatic call set-up and clearing are illustrated below. For calls which cannot be completed, the subscriber will receive from the MSSC or the terrestrial network the proper audible tone which describes the call status (i.e., busy tone, congestion tone).

A.2 System configuration

The INMARSAT system is composed as shown in Figure A-1/Q.60. Only the components required for interfacing the telephone network are shown. There are additional interfaces similar to the MSSC for interfacing the telex network and the international public data network.

The purpose of the MSSC is defined in § 2 of the Recommendation.

There is one operating Network Coordination Station (NCS) in each ocean area (there may in addition be one or more standby NCSs per ocean area). The main functions of the NCS are as follows.

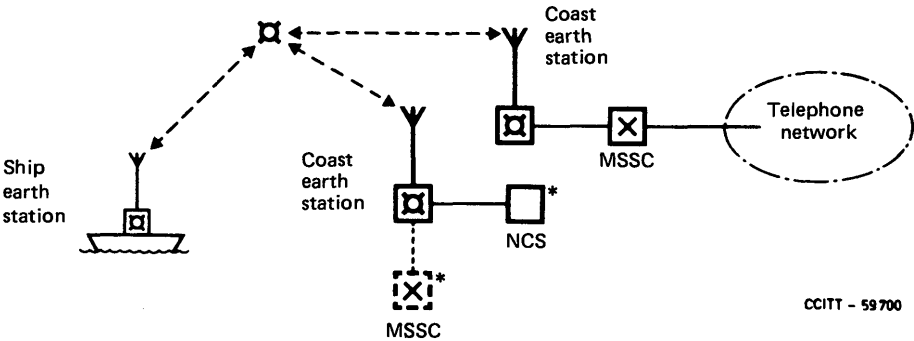
The ship earth stations can only monitor one calling channel in the shore-to-ship direction. This calling channel, denoted as the common assignment channel, is transmitted by the NCS. Each coast earth station transmits its own calling channel which is monitored by the NCS for relaying signalling messages from a coast earth station to a ship.

The NCS also performs all assignment of telephone channels on a call-by-call basis and monitors the actual use of the channels for maintenance purposes. The NCS keeps an up-dated list of all busy ships in the ocean area. If a coast earth station calls a busy ship, the NCS may thus return a ship busy indication to the calling coast earth station on the common assignment channel.

The procedures are further described below.

A.3 Ship earth station originated calls

The normal call set-up procedure for automatic call processing from a ship earth station is shown in Figure A-2/Q.60. The ship earth station transmits an out-of-band *request* message which includes the type of call desired, the identity of the MSSC through which the terminal wishes to communicate and the identification number of the ship earth station.



CCITT - 59 700

* The NCS of an ocean area will normally be co-located with an MSSC of that area.

FIGURE A-1/Q.60

Composition of the maritime satellite system
for interconnection with the telephone network

The MSSC upon reacting to the received *request* message, sends a *Request for Assignment* message to the Network Coordination Station (NCS). The NCS receiving the *request for assignment* message assigns a channel (frequency) and transmits this information in an *assignment* message to both the MSSC and the ship earth station. Both the MSSC and ship earth station receive the *assignment* message, automatically select the correct frequency, and initiate a continuity by transmitting a 2600 Hz tone.

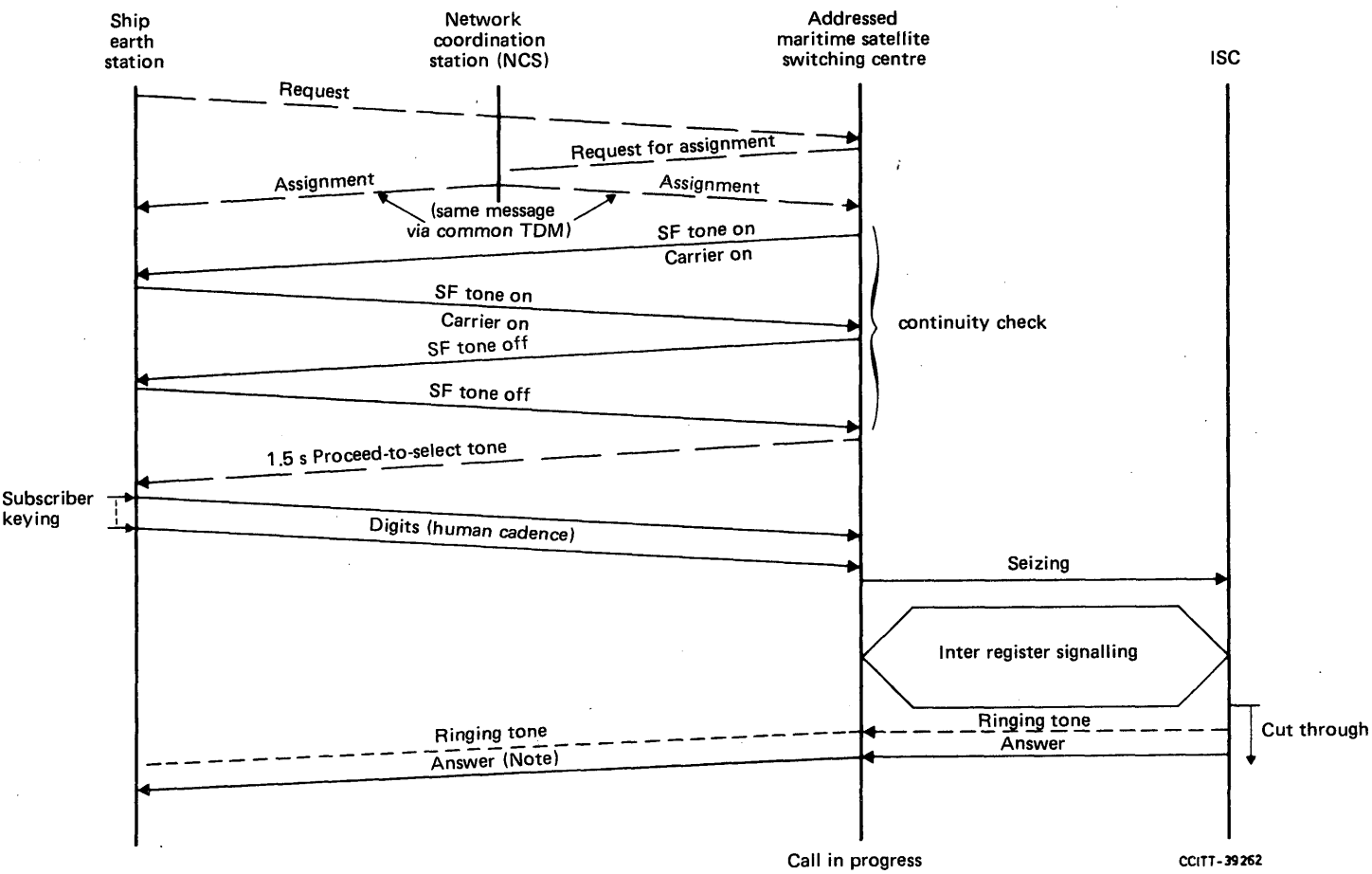
When continuity has been established, the MSSC sends a dial tone pulse to the ship earth station. The ship earth station subscriber then dials in the desired prefix, country code and national significant number followed by an end-of-selection signal. The signals are transferred as in band push button signals on the satellite link.

The MSSC proceeds to select a terrestrial trunk and follows the standard signalling sequences of the signalling system used towards the ISC (Figure A-2/Q.60). The ringing tone from the terrestrial network is allowed to pass directly to the ship earth station subscriber. When the terrestrial party answers the call, the ISC passes the answer signal to the MSSC and the international connection is established. The answer signal, if implemented, may then be passed to the ship earth station¹⁾.

A.4 Terrestrial originated calls

The normal call set-up procedure for automatic call processing from the terrestrial network to a ship earth station is shown in Figure A-3/Q.60. The ISC selects a circuit and sends the Seizing signal and the mobile terminal identification digits to the MSSC in accordance with the procedures used in the terrestrial signalling system. The MSSC then sends a *request-for-assignment* message to the NCS containing the ship earth station identity. The NCS responds by sending an *assignment* message to both the MSSC and the ship earth station. The MSSC and the ship earth station activate their carriers and send a 2600 Hz tone. Upon receipt of the 2600 Hz tone from the ship earth station the MSSC interprets this as an address complete condition, sends the ringing tone to the terrestrial network and stops sending 2600 Hz to the ship earth station. When the operator or subscriber at the ship earth station answers, the ship earth station discontinues sending its 2600 Hz tone.

The MSSC recognizes the cutting of the 2600 Hz tone as an answer signal from the ship earth station and begins the answer sequence toward the ISC as shown in Figure A-3/Q.60.



Note – If implemented.

FIGURE A-2/Q.60
Ship earth station originated calls

¹⁾ This is currently under study by INMARSAT.

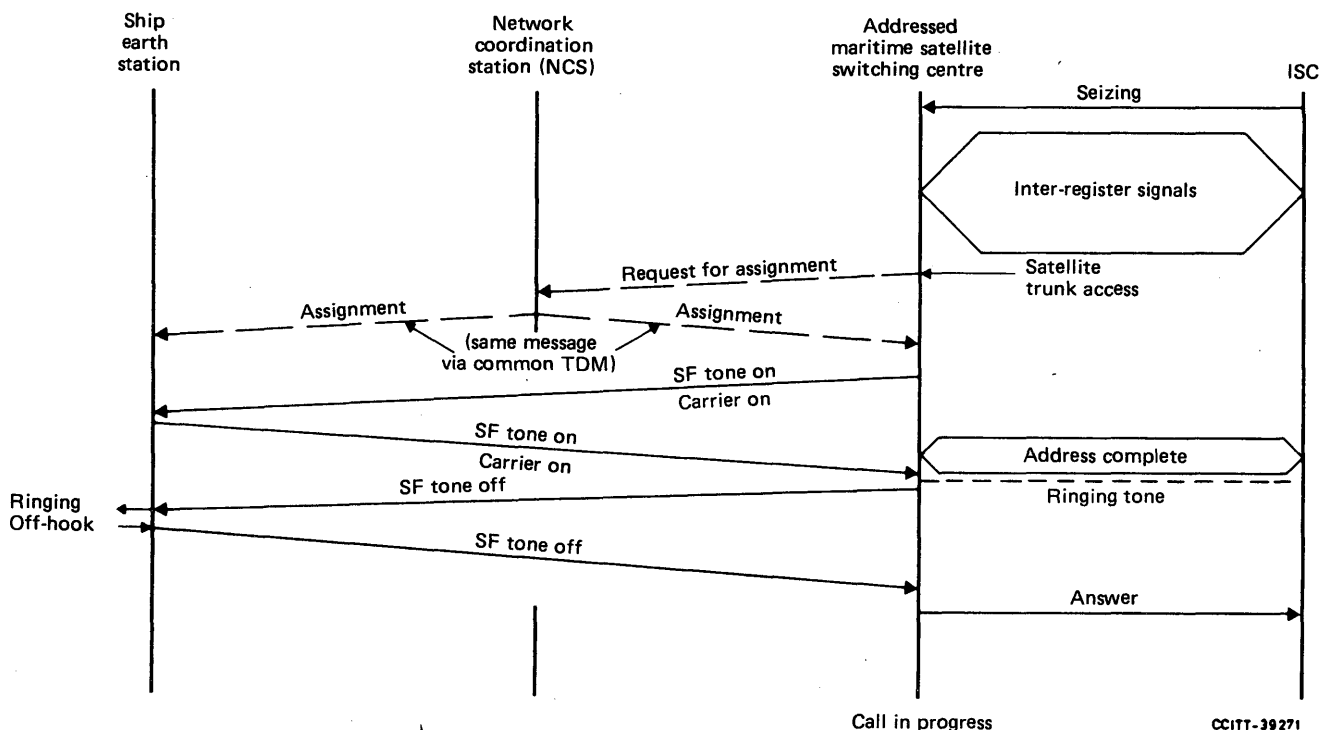


FIGURE A-3/Q.60

Terrestrial originated automatic call

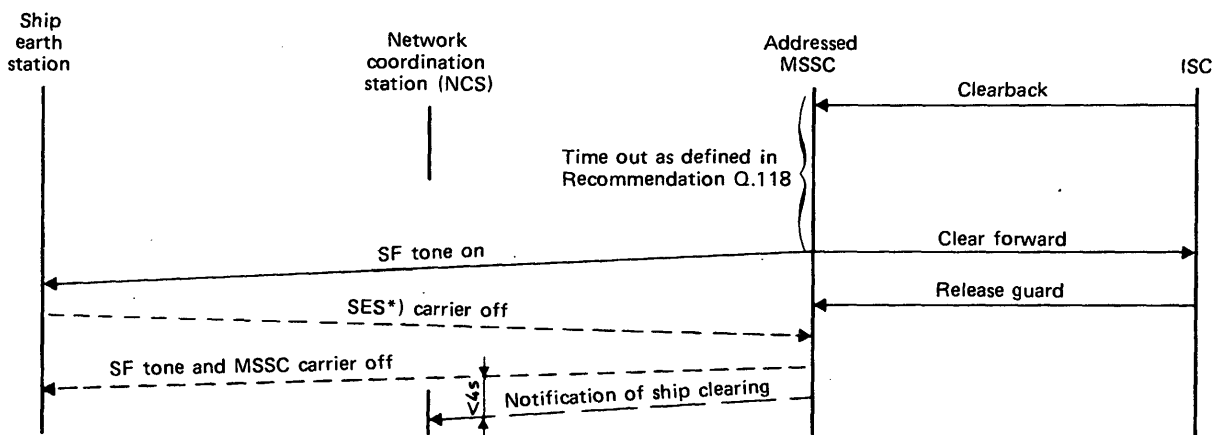
A.5 Automatic clearing of calls

Whether a telephone call originated from a ship earth station or from the terrestrial network, the MSSC, upon receiving a clear-forward signal, will begin to clear the call independently in each direction.

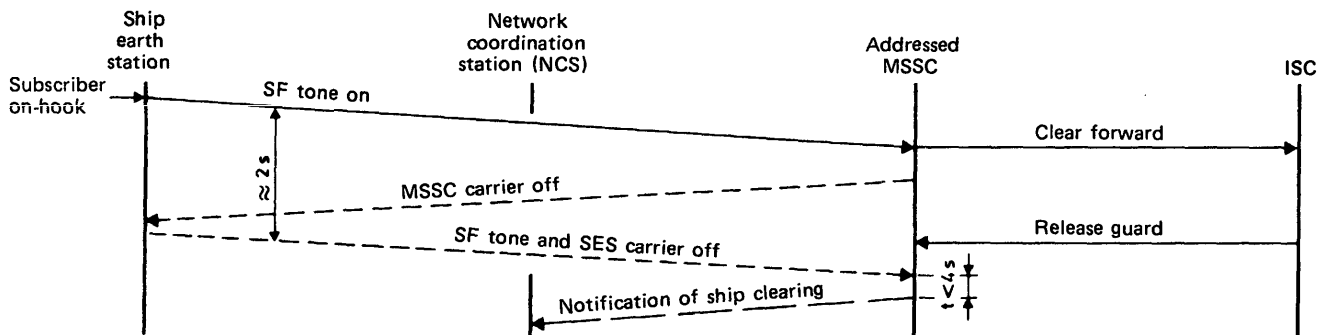
The MSSC, receiving a 2600 Hz clearing tone from a ship earth station will initiate clearing toward the terrestrial network in accordance with procedures defined for the signalling system used between the MSSC and the ISC. This applies to both clear-forward and clear-back from the ship earth station. Clearing will also be continued in the maritime satellite system independent of the terrestrial network.

Clearing initiated in the terrestrial network would be recognized by the MSSC receiving the appropriate clear-back or clear-forward signal. For clear-forward, the MSSC would continue clearing with normal terrestrial procedures and begin clearing the maritime satellite circuit. For clear-back from the terrestrial network, normal time-out supervision will take place and clear-forward will commence either after expiry of time-out or after receipt of a clear-forward from the ship, whichever happens first.

As examples of clearing sequences, Figure A-4/Q.60 illustrates the clearing of a ship earth station originated call and Figure A-5/Q.60 illustrates the clearing of a call originated in the terrestrial network. For a terrestrial originated call which has clearing initiated by the ship earth station, the satellite circuit is cleared after the MSSC recognizes the stopping of the ship earth station carrier. The terrestrial circuit is held until the end of release guard sequence as shown in Figure A-5/Q.60.



a) Clear-back from terrestrial network; clearing by MSSC on time-out



CCITT-39281

b) Clearing by ship earth station

* SES = Ship earth station

FIGURE A-4/Q.60
Clearing sequences for ship earth station
originated calls

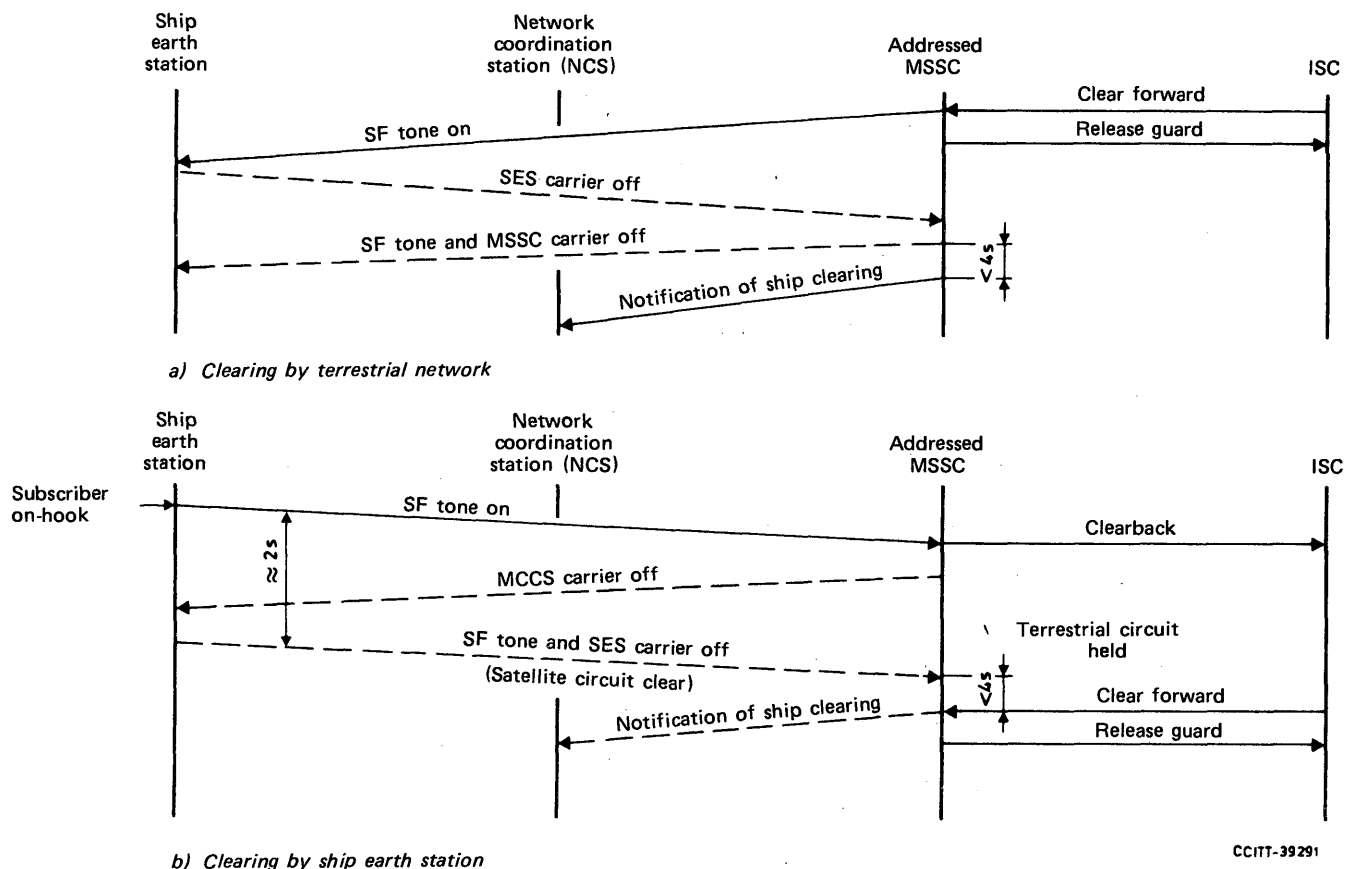


FIGURE A-5/Q.60

Clearing sequences for terrestrial originated calls

ANNEX B

(to Recommendation Q.60)

Logic procedures for incoming INMARSAT signalling system (ship originated call)

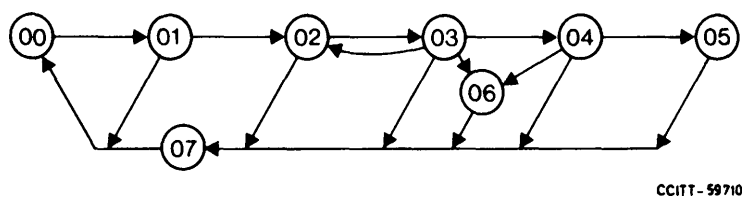
This Annex only includes those elements of the INMARSAT system which have to be implemented for interworking purposes.

Internal procedures such as those required for setting-up and clearing of the satellite link are not shown. They are only indicated by task symbols.

Other procedures not shown are:

- interruption control procedures related to the satellite link;
- pre-emption procedures for assigning channels to distress calls.

For more details on the first generation INMARSAT signalling system, see Annex A.



CCITT - 59710

State number	State description	Sheet reference	Timers running
00	Idle	1	
01	Wait for continuity	1	
02	Wait for digits	1	t_1
03	Wait for result of digit analysis	2	t_1
04	Wait for call set-up	2	t_1
05	Connected	2	
06	Wait for clear-forward	2	t_2
07	Wait for clearing	1	

FIGURE B-1/Q.60

State overview diagrams for incoming INMARSAT signalling system

Supervisory timers for incoming INMARSAT signalling system

t_1 = 15-20 seconds

t_2 = 20-30 seconds

FIGURE B-2/Q.60

Notes to incoming INMARSAT signalling system

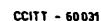


FIGURE B-3/Q.60
(sheet 1 of 2)

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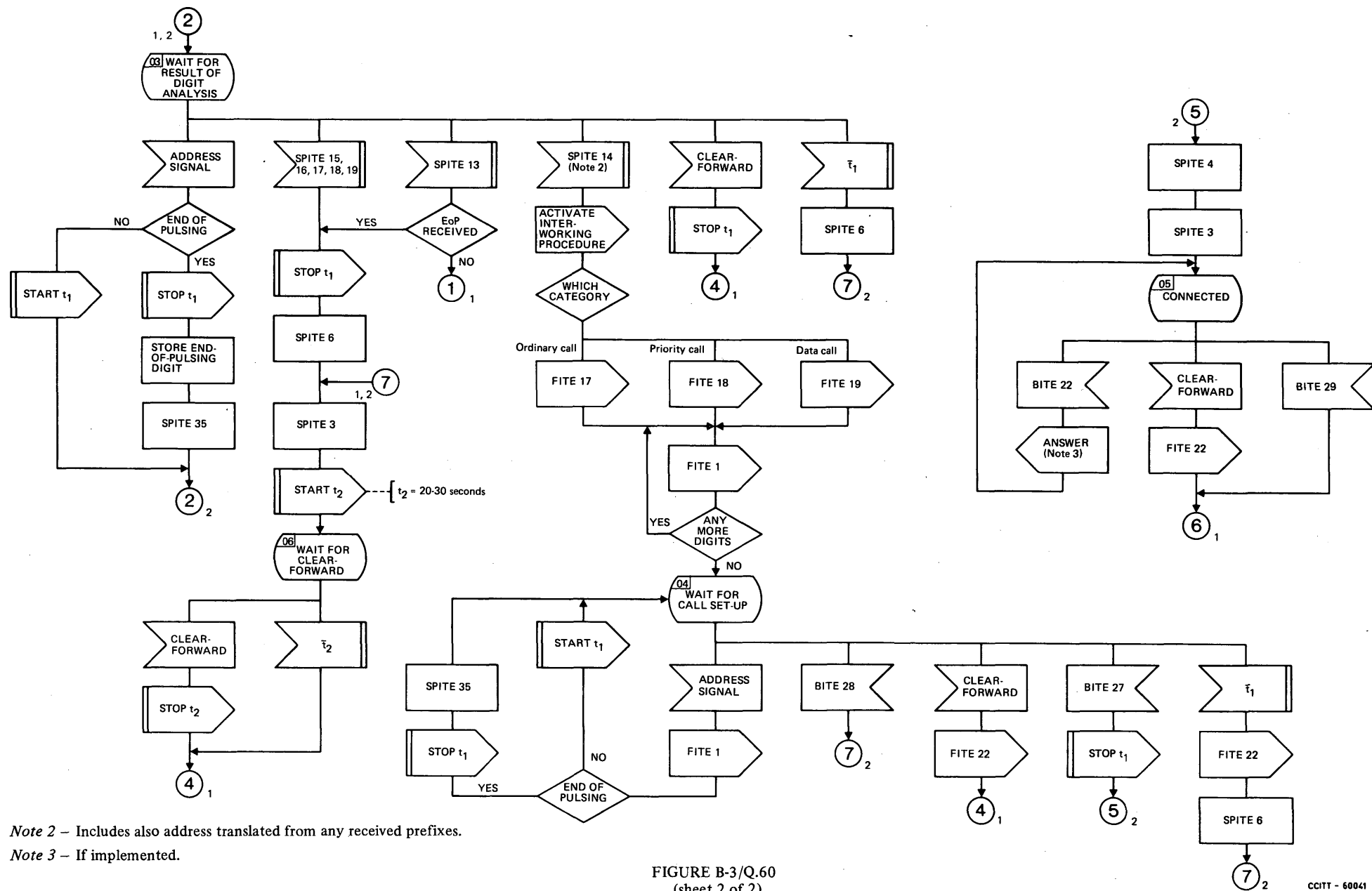


FIGURE B-3/Q.60
(sheet 2 of 2)

Incoming INMARSAT signalling system

(to Recommendation Q.60)

Logic procedures for outgoing INMARSAT signalling system (shore originated call)

This Annex only includes those elements of the INMARSAT system which have to be implemented for interworking purposes.

Internal procedures such as those required for setting-up and clearing of the satellite link are not shown. They are only indicated by task symbols.

Other procedures not shown are:

- interruption control procedures related to the satellite link;
- pre-emption procedures for assigning channels to distress calls.

For more details on the first generation INMARSAT signalling system, see Annex A.

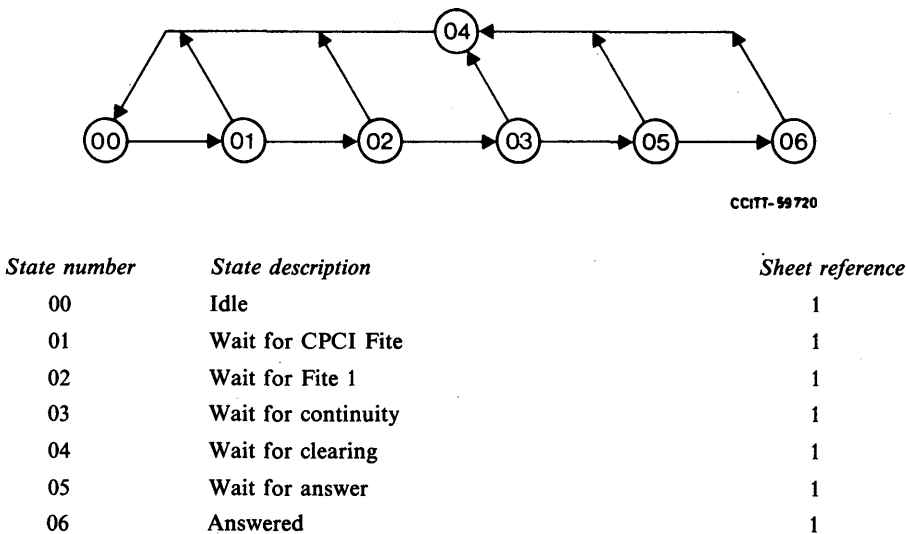
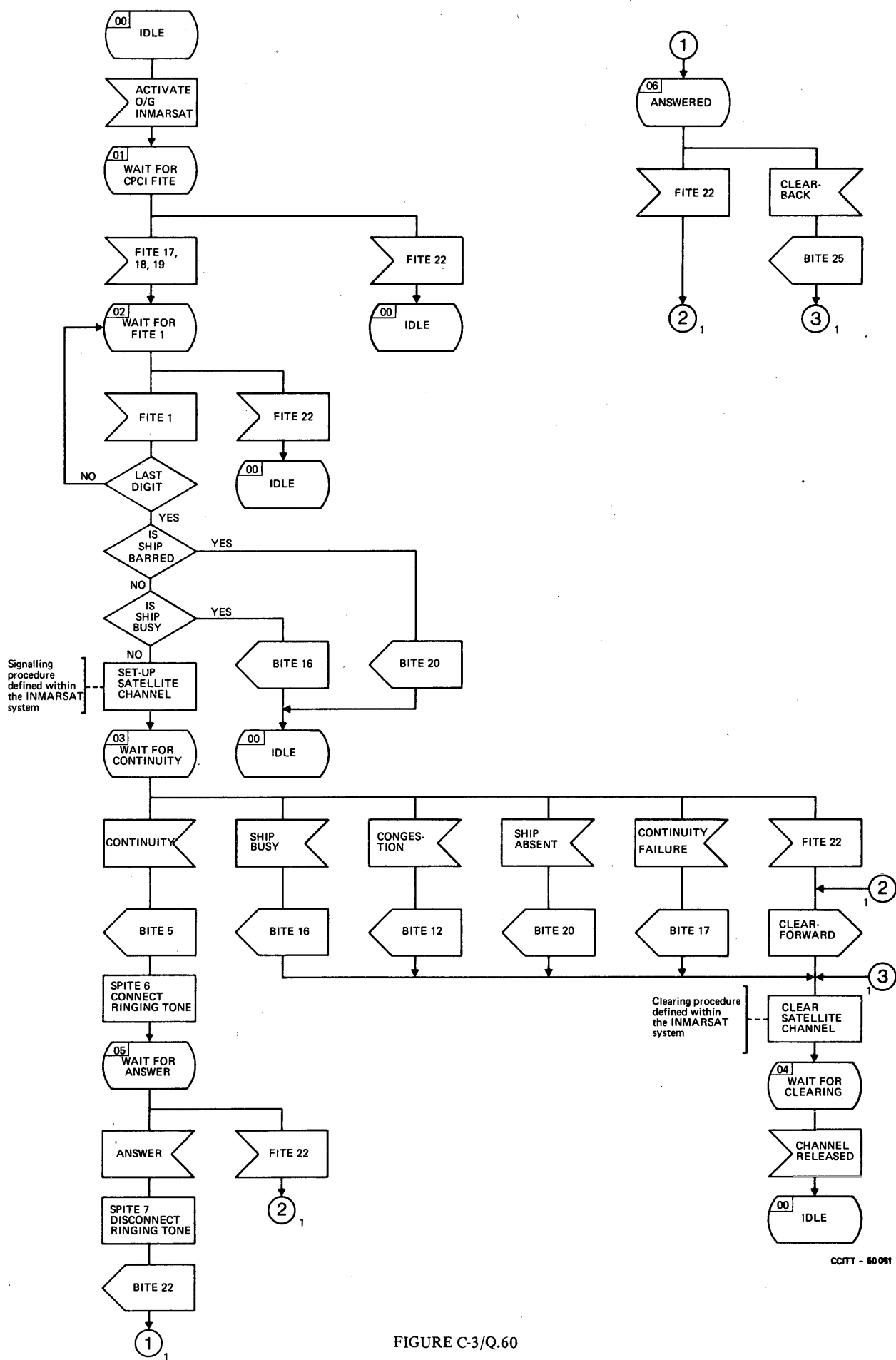


FIGURE C-1/Q.60

State overview diagram for outgoing INMARSAT signalling system

FIGURE C-2/Q.60

(Reserved for future notes)



CCITT - 60 051

FIGURE C-3/Q.60

Outgoing INMARSAT signalling system

INTERWORKING WITH SIGNALLING SYSTEM R2

1 Introduction

It is necessary to specify the interworking of Signalling System R2 and the signalling systems used in the first generation INMARSAT system. This is because:

- a) it may be desirable that a Maritime Satellite Switching Centre (MSSC)¹⁾ be connected to an international switching centre (ISC) by employing System R2 on the circuits between the MSSC and the ISC;
- b) the signalling systems used in the Maritime Mobile-Satellite Service will be different from System R2. Therefore it would be necessary to establish rules by which signalling events in one system may be related to corresponding events in the other system.

It is desirable that the interworking be such that the full capability of both System R2 and the maritime satellite signalling system be utilized.

This Recommendation considers only automatic interworking between the MSSC and an ISC utilizing either the analogue or digital versions of System R2 signalling.

For description of the INMARSAT signalling system, see Annex A to Recommendation Q.60.

2 Calls from Signalling System R2 to the maritime satellite system (see Figure 1/Q.61)

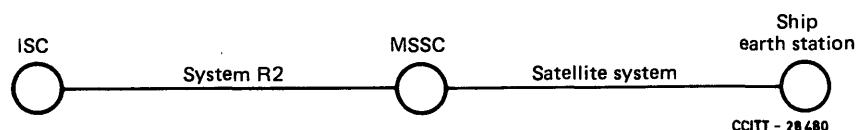


FIGURE 1/Q.61

2.1 The ISC sends the seizing signal followed by either of the following sequences of address signals:

2.1.1 Signal I-10 or a language digit when the country code 87S is not required for routing in the MSSC. At the MSSC this signal should be acknowledged by the signal A-5 in order to obtain the calling subscriber's category (Group II signal). The Group II signal is acknowledged at the MSSC by A-1. The ISC then continues to send further address signals which are acknowledged in compelled cycles with A-1 at the MSSC.

2.1.2 The country code indicator when the country code 87S is required for routing in the MSSC.

One of the following signals can be used as country code indicator:

- Signal I-11 when the MSSC has to insert an outgoing half-echo suppressor;
- Signal I-14 when an outgoing half-echo suppressor has been inserted.

At the MSSC this signal should be acknowledged by the signal A-5 in order to obtain the calling subscriber's category (Group II signal). The Group II signal is acknowledged at the MSSC by A-1. The ISC continues to send the country code digits and further address signals which are acknowledged in compelled cycles with A-1 at the MSSC.

¹⁾ For definition, see Recommendation Q.60.

2.1.3 Any numerical (or address) signal of the above sequences may be acknowledged by the signals A-3 or A-4:

- A-4 if congestion or abnormal release occurs in the MSSC;
- A-3 may, for example, be used in order to indicate to the ISC barring of unauthorized group calls. Such calls are identified from the first digit following the discriminating digit. The appropriate Group B signal would in this case be B-2.

This use of A-3 is only possible if analysis of the discriminating (or language) digit and the first digit of the subscriber number takes place before the whole number has been received by the MSSC. If this is not the case, the procedure of § 2.2 should be followed.

2.2 When the last address signal has been received at the MSSC, and number analysis has been completed, one of the following events leading to unsuccessful call completion may occur:

- The called ship earth station is excluded from participating in the system, the number of the called terminal has been changed or the received number is an unauthorized group call number (see also § 2.1.3 above). In these cases the MSSC shall send the A-3 signal followed by B-2 after the Group II signal has been received from the ISC.
- The NCS/MSSC is out of service. In this case the A-4 signal is sent, or the A-3 signal followed by B-4 after receipt of the Group II signal.
- The received number does not belong to any ship earth station. In this case the A-3 signal is sent followed by B-5 after receipt of the Group II signal.

2.3 If the received number is valid, the MSSC sends A-1 as an acknowledgement to the last digit (or the end-of-pulsing signal I-15) in order to suspend the compelled signalling.

2.4 The MSSC sends a *Request-for-Assignment* message to the Network Coordination Station (NCS) in order to obtain a satellite channel (see Annex A to Recommendation Q.60).

“If no reply to this request is received within 4 seconds (or 8 seconds if the request is repeated by the MSSC) or, if a congestion message is received from the NCS, the MSSC sends the pulsed A-4 signal or the A-3 signal followed by B-4 after receipt of the Group II signal.”

If a *Ship busy* message is received, the MSSC sends the pulsed A-3 signal followed by the B-3 signal after recognition of the forward Group II signal.

If an *Assignment* message is received from the NCS, the MSSC connects the continuity tone on the assigned satellite channel. If a continuity tone is received from the ship earth station within 10 seconds, the MSSC sends the pulsed A-3 signal followed by the B-6 signal after recognition of the forward Group II signal.

The continuity check may fail in two ways:

- no radio carrier is received from the ship earth station within 10 seconds (e.g. the ship is outside the satellite coverage area), or
- a radio carrier but no continuity tone is received from the ship earth station within 10 seconds.

The MSSC sends the pulsed A-3 signal followed by B-2 or B-8 respectively after recognition of the forward Group II signal.

2.5 When the MSSC detects the answer signal from the ship earth station, the MSSC must send the answer signal as soon as possible to the ISC.

2.6 When the MSSC detects the clear forward from the terrestrial network, the terrestrial circuit and the satellite link will clear down according to their respective specifications. If, however, switching at the MSSC is achieved by direct frequency selection then it will be necessary to delay the release-guard on the terrestrial link until the satellite link is idle.

2.7 The MSSC should send the clear-back signal into the terrestrial network when clear-back is detected on the satellite link. The satellite link will be released so that the provisions of Recommendation Q.118 do not apply for this part of the connection.

2.8 For the SDL description of incoming Signalling System R2, see Recommendation Q.616 [1].

2.9 For the SDL description of interworking between incoming Signalling System R2 and the outgoing INMARSAT signalling system see Annex A.

2.10 For SDL description of outgoing INMARSAT signalling system, see Annex C to Recommendation Q.60.

3 Calls from the maritime satellite system to Signalling System R2 (see Figure 2/Q.61)

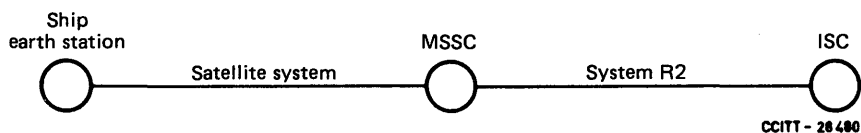


FIGURE 2/Q.61

3.1 The MSSC should not seize a terrestrial circuit before each of the following conditions have been met:

- the satellite channel has been assigned;
- the continuity of the satellite channel has been verified;
- all digits necessary for routing decisions by the MSSC have been received.

3.2 The first register signal to be sent by the MSSC is:

- the discriminating digit I-10 if the call is destined for a country whose ISC has direct connections to the MSSC;
- the country code indicator I-14 if the call is destined for another country and the incoming half-echo suppressor is to be inserted at a later ISC;
- the country code indicator I-12 if the call is destined for another country and the incoming half-echo suppressor can only be inserted at the MSSC.

3.3 The MSSC must respond to Group A or Group B signals in accordance with current Signalling System R2 specifications.

The following special requirements should however be taken into account:

- If the signal A-14 is received from the ISC, the MSSC must either forward I-14 in order to indicate that an incoming half-echo suppressor is required, or forward the next address signal where the MSSC has already inserted an incoming half-echo suppressor.
- If the signal A-3 or A-5 is received from the ISC, the MSSC should send the II-7 signal (for the time being no other category signal would be required).

The signals A-3, A-5 and A-14 may be received at any time during interregister signalling sequence.

If the signal A-11 is received from the ISC, the MSSC should send:

- I-14 to indicate that an incoming half-echo suppressor is required, or
- I-12 where the MSSC has already inserted an incoming half-echo suppressor.

If the signal A-12 is received, the next signal shall be the discriminating digit (I-10).

The MSSC should be capable of responding to signal A-13 with the signal I-14 in order to indicate that a satellite link is included (see Recommendation Q.480 [2]).

3.4 The end of pulsing signal I-15 should be sent by the MSSC, if required and requested, if the equivalent end-of-pulsing signal is received from the ship earth station.

3.5 The tones sent by the MSSC to the ship earth station in response to Group B signals received from the terrestrial network should comply with Recommendation Q.474 [3]. The characteristics of the tones are given in Recommendation Q.60.

3.6 Time-out supervision on the answer signal at the MSSC should comply with the provisions given in Recommendation Q.118, § 4.3.1.

3.7 If the MSSC receives a clear-back signal from the terrestrial network, the timeout of Recommendation Q.118, § 4.3.2 shall be started. The satellite and terrestrial links will be cleared either by the ship earth station or by expiry of the 1-2 minute time-out.

3.8 When the MSSC detects a release condition on the satellite link, the terrestrial connection should be cleared forward as soon as possible.

3.9 For the SDL description of outgoing System R2, see Recommendation Q.626 [4].

- 3.10 The SDL description of the interworking between incoming INMARSAT signalling system and outgoing System R2 is given in Annex B.
- 3.11 For the SDL description of incoming INMARSAT signalling system, see Annex B to Recommendation Q.60.

References

[1] CCITT Recommendation *Logic procedures for incoming Signalling System R2*, Vol. VI, Rec. Q.616.

[2] CCITT Recommendation *Miscellaneous procedures*, Vol. VI, Rec. Q.480.

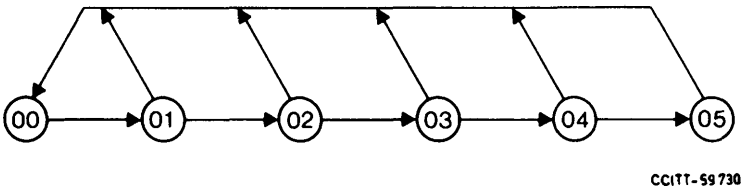
[3] CCITT Recommendation *Use of group B signals*, Vol. VI, Rec. Q.474.

[4] CCITT Recommendation *Logic procedures for outgoing Signalling System R2*, Vol. VI, Rec. Q.626.

ANNEX A

(to Recommendation Q.61)

Logic procedures for interworking of Signalling System R2 to the INMARSAT signalling system



State number	State description	Sheet reference
00	Idle	1
01	Wait for CPCI Fite	1
02	Wait for digits	1
03	Wait for Bite 5	1
04	Wait for answer	1
05	Answered	1

FIGURE A-1/Q.61

State overview diagram for interworking of Signalling System R2 to the INMARSAT signalling system

FIGURE A-2/Q.61

(Reserved for future notes)

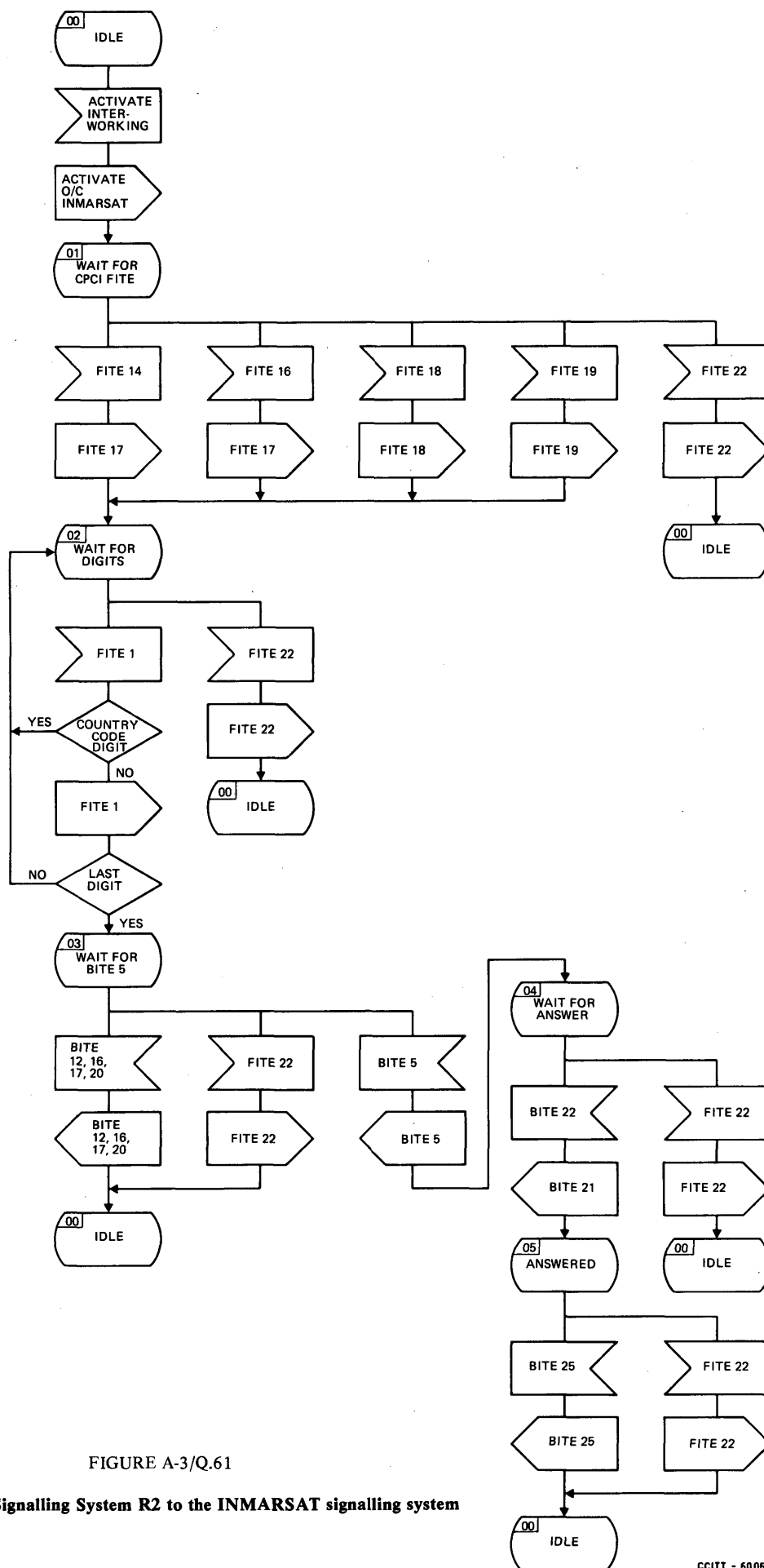


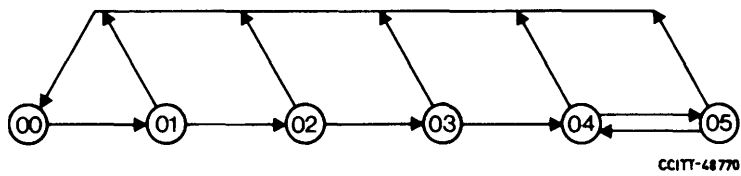
FIGURE A-3/Q.61

Interworking of Signalling System R2 to the INMARSAT signalling system

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(to Recommendation Q.61)

Logic procedures for interworking of the INMARSAT
signalling system to Signalling System R2



State number	State description	Sheet reference	Timers running
00	Idle	1, 2	
01	Wait for CPCI Fite	1	
02	Wait for address complete	2	
03	Wait for answer	2	t_1
04	Answered	2	
05	Clear-back	2	t_2

FIGURE B-1/Q.61

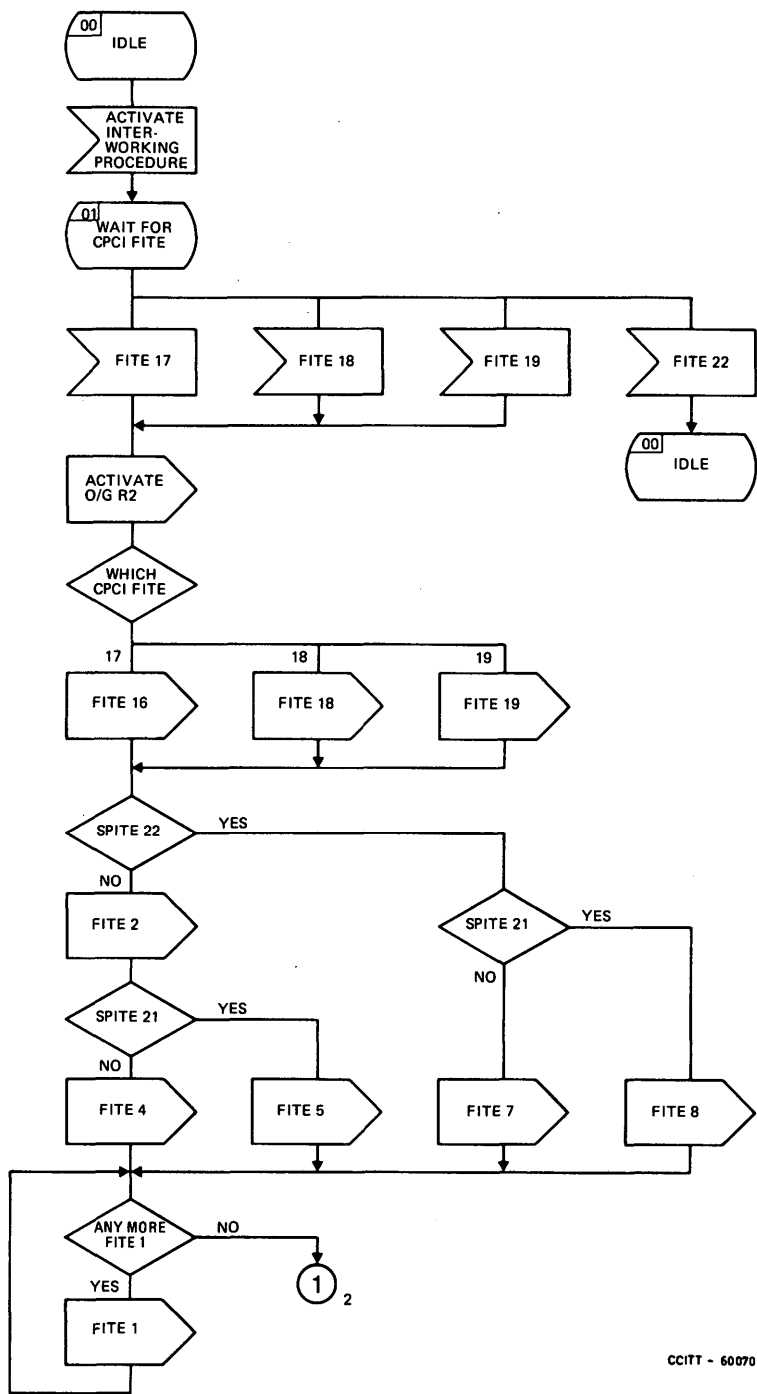
State overview diagram for interworking of the INMARSAT signalling system to Signalling System R2

Supervisory timers for interworking of the INMARSAT signalling system to Signalling System R2

t_1 = 2-4 minutes	Recommendation Q.118, § 4.3.1
t_2 = 1-2 minutes	Recommendation Q.118, § 4.3.2

FIGURE B-2/Q.61

Notes to interworking of the INMARSAT signalling system to Signalling System R2



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FIGURE B-3/Q.61
(sheet 1 of 2)

Interworking of the INMARSAT signalling system to Signalling System R2

INTERWORKING WITH SIGNALLING SYSTEM No. 5

1 Introduction

It is necessary to specify the interworking of Signalling System No. 5 and the signalling system used in the first generation INMARSAT system. This is because:

- a) it may be desirable that a Maritime Satellite Switching Centre (MSSC)¹⁾ be connected to an international switching centre (ISC) by employing System No. 5 on circuits between the MSSC and the ISC;
- b) the signalling systems used in the Maritime Mobile-Satellite Service will be different from System No. 5. Therefore it would be necessary to establish rules by which signalling events in one system may be related to corresponding events in the other system.

It is desirable that the interworking be such that the full capability of both System No. 5 and the maritime satellite signalling system can be utilized.

This Recommendation considers only automatic interworking between the MSSC and an ISC utilizing System No. 5.

For description of the INMARSAT signalling system, see Annex A to Recommendation Q.60.

2 Calls from Signalling System No. 5 to the maritime satellite system (see Figure 1/Q.62)

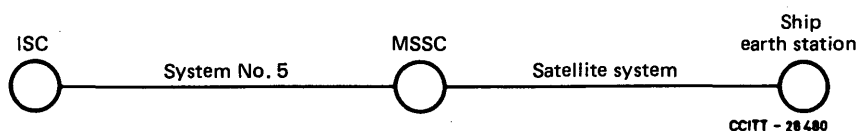


FIGURE 1/Q.62

2.1 The ISC sends the seizing signal followed by either of the following sequences of address signals:

2.1.1 Signal KP1 followed by the discriminating (or language) digit and the number of the wanted ship earth station when the country code 87S is not required for routing in the MSSC.

2.1.2 Signal KP2 followed by 87S, discriminating (or language) digit and the number of the wanted ship earth station when the country code is required for routing in the MSSC.

2.2 The MSSC register should ignore further digits when either:

- a) the ST signal has been received by the MSSC, or
- b) the busy-flash signal has been sent by the MSSC.

2.3 The answer signal should be sent in the backward direction as soon as the answer signal over the satellite link has been detected.

2.4 The busy-flash signal should be sent if the call cannot be completed for any of the following reasons:

- a) congestion at the MSSC or in the maritime satellite system;
- b) the satellite channel has not been assigned within 20 seconds of the receipt of the ST signal;
- c) the NCS/MSSC is out of service.

2.5 If the called ship earth station is busy, then the MSSC may either return the busy tone or the busy-flash signal.

¹⁾ For definition, see Recommendation Q.60.

2.6 The special information tone should be sent if the call cannot be completed for any of the following reasons:

- a) the ship earth station does not respond to the call;
- b) the called ship earth station is excluded from participating in the service;
- c) the received number does not belong to any ship earth station;
- d) the received number is an unauthorized group call;
- e) the called ship earth station is faulty;
- f) continuity of the satellite link is not established.

2.7 When a clear-back signal is detected on the satellite link, this signal shall result in sending of the clear-back signal on the terrestrial connection. The satellite link should be released so that the provisions of Recommendation Q.118 do not apply for this part of the connection.

2.8 When the MSSC detects the clear-forward from the terrestrial network, the terrestrial and satellite links will clear down according to their respective specification. If, however, switching at the MSSC is achieved by direct frequency selection, then it will be necessary to delay the release guard on the terrestrial link until the satellite link is idle.

2.9 For the SDL description of incoming System No. 5, see Recommendation Q.612 [1].

2.10 The SDL description of interworking between incoming System No. 5 and outgoing INMARSAT signalling system is given in Annex A.

2.11 For the SDL description of outgoing INMARSAT signalling system, see Annex C to Recommendation Q.60.

3 Calls from the maritime satellite system to Signalling System No. 5 (see Figure 2/Q.62)

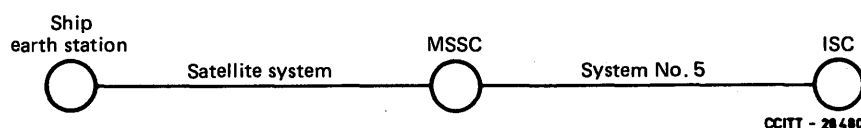


FIGURE 2/Q.62

3.1 The terrestrial circuit should not be seized before a satellite channel has been allocated, the continuity of the channel has been verified, and all digits have been received.

3.2 The KP signal should be used subject to the following conditions:

- a) KP1 if the call is terminated in the MSSC country (in this case the country code is suppressed) or in another country having direct connection to the MSSC;
- b) KP2 if the call is transit connected to another country.

3.3 The discriminating digit should be inserted according to [2].

3.4 The ST signal should be sent according to [3].

3.5 The congestion tone should be sent to the ship earth station when the busy-flash signal is received.

3.6 Time-out supervision of the answer signal at the MSSC should comply with the provisions of Recommendation Q.118, § 4.3.1.

3.7 If the MSSC receives a clear-back signal from the terrestrial network, the time-out of Recommendation Q.118, § 4.3.2 shall be started. The satellite and terrestrial links will be cleared either by the ship earth station or by expiry of the 1-2 minute time-out.

3.8 When the MSSC detects a release condition on the satellite link, the terrestrial connection should be cleared forward as soon as possible.

3.9 For the SDL description of outgoing System No. 5, see Recommendation Q.622 [4].

3.10 The SDL description of interworking between incoming INMARSAT signalling system and outgoing System No. 5 is given in Annex B.

3.11 For the SDL description of incoming INMARSAT signalling system, see Annex B to Recommendation Q.60.

References

[1] CCITT Recommendation *Logic procedures for incoming Signalling System No. 5*, Vol. VI, Rec. Q.612.

[2] CCITT Recommendation *Analysis of digital information for routing*, Vol. VI, Rec. Q.155, § 3.5.4.

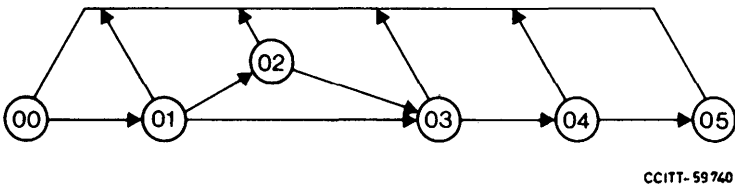
[3] CCITT Recommendation *End-of-pulsing conditions – Register arrangements concerning ST (end-of-pulsing) signal*, Rec. Q.152, § 3.2.1, b), (2).

[4] CCITT Recommendation *Logic procedures for outgoing Signalling System No. 5*, Vol. VI, Rec. Q.622.

ANNEX A

(to Recommendation Q.62)

Logic procedures for interworking of Signalling System No. 5 to the INMARSAT signalling system



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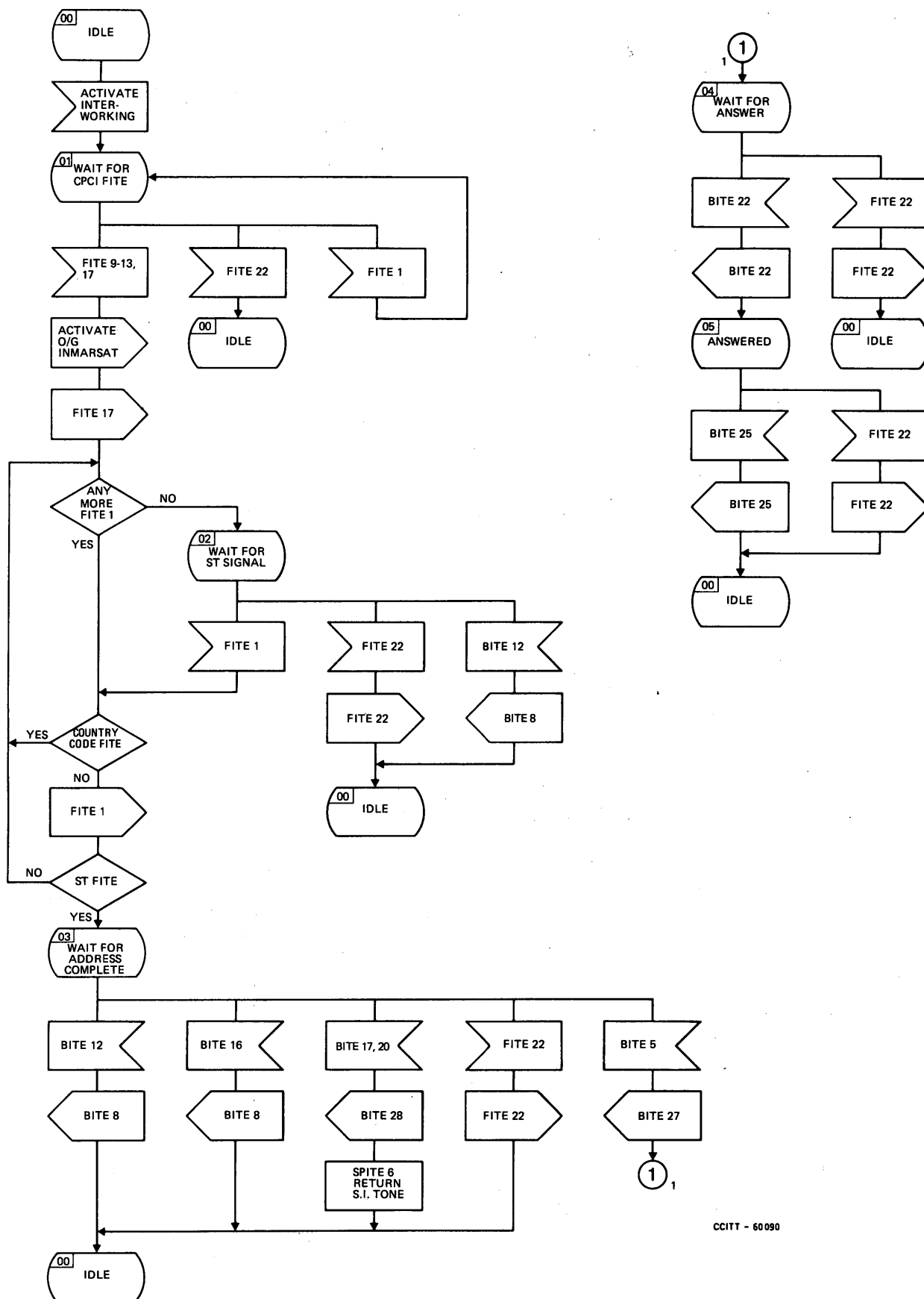
State number	State description	Sheet reference
00	Idle	1
01	Wait for CPCI Fite	1
02	Wait for ST signal	1
03	Wait for address complete	1
04	Wait for answer	1
05	Answered	1

FIGURE A-1/Q.62

State overview diagram for interworking of Signalling System No. 5 to the INMARSAT signalling system

FIGURE A-2/Q.62

(Reserved for future notes)



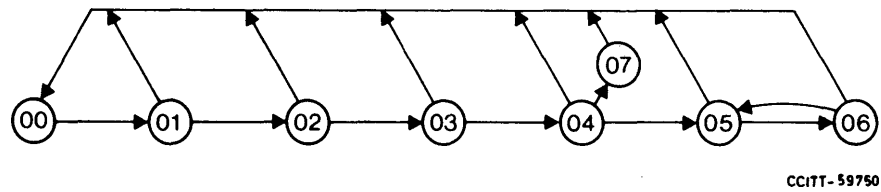
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FIGURE A-3/Q.62

Interworking of Signalling System No. 5 to the INMARSAT signalling system

(to Recommendation Q.62)

Logic procedures for interworking of the INMARSAT signalling system to Signalling System No. 5



State number	State description	Sheet reference	Timers running
00	Idle	1, 2	
01	Wait for CPC I Fite	1	
02	Wait for address complete	2	
03	Wait for register deactivation	2	
04	Wait for answer	2	t_1
05	Answered	2	
06	Clear-back	2	t_2
07	Wait for clear forward	2	t_3

FIGURE B-1/Q.62

State overview diagram for interworking of the INMERSAT signalling system to Signalling System No. 5

Supervisory timers for interworking of the INMARSAT signalling system to Signalling System No. 5

$t_1 = 2-4$ minutes **Recommendation Q.118, § 4.3.1**

$t_2 = 1-2$ minutes **Recommendation Q.118, § 4.3.2**

$$t_3 = 20 \text{ seconds}$$

FIGURE B-2/Q.62

Notes to interworking of the INMARSAT signalling system to Signalling System No. 5

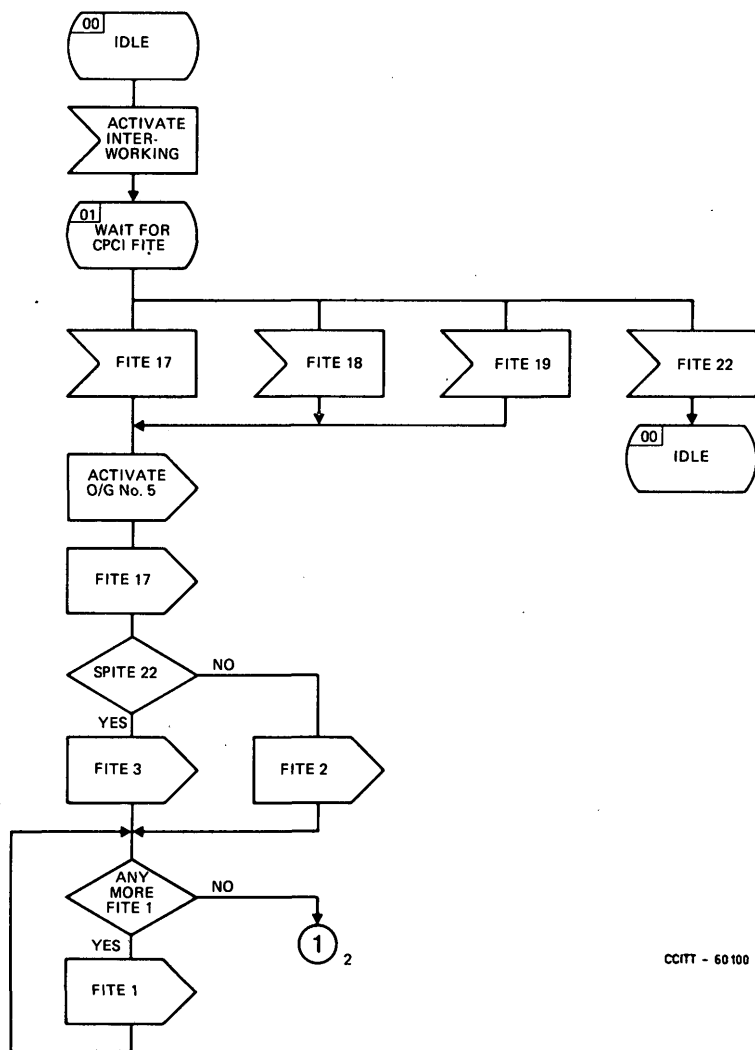


FIGURE B-3/Q.62
(sheet 1 of 2)

Interworking of the INMARSAT signalling system to Signalling System No. 5

PART IV

Recommendation Q.70

INTERWORKING WITH THE INTERNATIONAL AUTOMATIC LAND MOBILE SERVICE

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**INTERWORKING OF THE INTERNATIONAL AUTOMATIC
LAND MOBILE SERVICE AND THE PUBLIC SWITCHED TELEPHONE NETWORK**

1 Introduction

1.1 Public land mobile networks (PLMNs) may be regarded as extensions of national telephone networks with regard to interworking with the telephone network. However, in order to implement the desired functions of an advanced public land mobile service and to permit mobile subscribers to roam between various PLMNs, international standardization of signalling procedures on the radio path would be required.

1.2 In principle, a public land mobile network would be capable of interfacing any national signalling system. However, it is recommended that administrations interface the PLMNs with the telephone network by using Signalling System No. 7 if this system is available nationally.

1.3 The purpose of this Recommendation is to give guidance regarding the functions to be included in the signalling system to be used in the radio system.

It furthermore specifies general requirements for interworking with the telephone network using Signalling System No. 7. Interworking with other signalling systems used nationally will not be covered by this Recommendation. Interworking between PLMNs is for further study.

2 Definitions

The following are definitions of terms related to the public land mobile service.

2.1 Mobile Services Switching Centre (MSC)

In an automatic system the Mobile Services Switching Centre (MSC) constitutes the interface between the radio system and the public switched telephone network. The MSC performs all necessary signalling functions in order to establish calls to and from mobile stations. A mobile station is registered at one MSC which functions as its home centre for charging and billing purposes and for administering its subscriber parameters such as category.

In order to obtain radio coverage of a given geographical area a number of base stations (radio transmitters/receivers) are normally required; i.e. each MSC would thus have to interface several base stations. In addition several MSCs may be required in order to cover a country. The definition of the MSC may be prefixed by the terms "land" or "maritime" if that is more suitable in a specific application.

2.2 Public Land Mobile Network (PLMN)

A public land mobile network may be defined as a collection of MSC areas within a common numbering plan (e.g. service access codes) and a common routing plan (e.g. definition of crossover point). The MSCs are the functional interfaces between the fixed network and a PLMN.

Functionally the PLMNs may be regarded as independent communications entities even though different PLMNs may be interconnected through the PSTN and PDNs for forwarding of calls or network information. A similar type of interconnection may exist for the interaction between the MSCs of one PLMN.

The location register system of a PLMN may be centralized, distributed or segmented. So long as we are concerned with functions of a PLMN, such as routing and interworking, the configuration and operation of the location register system have no influence on external networks.

The use of the concept PLMN is illustrated in Figure 1/Q.70 where various PLMNs are shown with their interfaces to the fixed networks. It should be noted that a PLMN may have several interfaces with the fixed network (e.g. one for each MSC). Interworking between two PLMNs may be performed via an international gateway.

Figure 1/Q.70 also shows the information paths between a PSTN and a PLMN and between two different PLMNs. The solid lines indicate a possible physical path between the PLMNs through the PSTN. The dotted line indicates that, for some interactions, an end-to-end information path (established through the physical path) may exist between the two PLMNs.

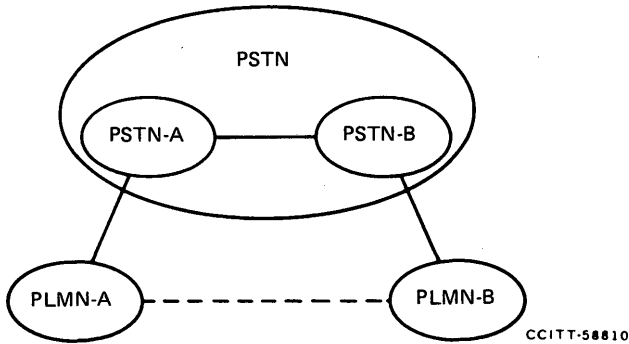


FIGURE 1/Q.70

The use of the concept PLMN for country A and country B

2.3 base station area

The part of the network covered by a base station. Every mobile station in a base station area can be reached by the radio equipment of the base station.

2.4 location area

The location area is defined as an area in which a mobile station may move freely without up-dating the location register. A location area may comprise several base stations.

2.5 MSC area

The part of the network covered by an MSC. An MSC area may consist of several location areas.

2.6 service area

The service area is defined as an area in which a mobile station is obtainable by a fixed telephone subscriber without the subscriber's knowledge of the actual location of the mobile station within the area. A service area may consist of several PLMNs. One service area may consist of one country, be a part of a country or comprise several countries. The location registration system associated with each service area must thus contain a list of all mobile stations located within that service area.

Figure 2/Q.70 shows an example of the composition of a service area.

Note — This definition does not take into account any constraints on routing imposed by the international telephone network.

2.7 system area

The system area is defined as the group of PLMNs (or service areas) accessible by fully compatible mobile stations.

Note — The location registers of the individual service areas remain autonomous; updating of the location information is not performed when a roaming mobile station moves from one service area to another. The overall composition of the international land mobile system is shown in Figure 3/Q.70.

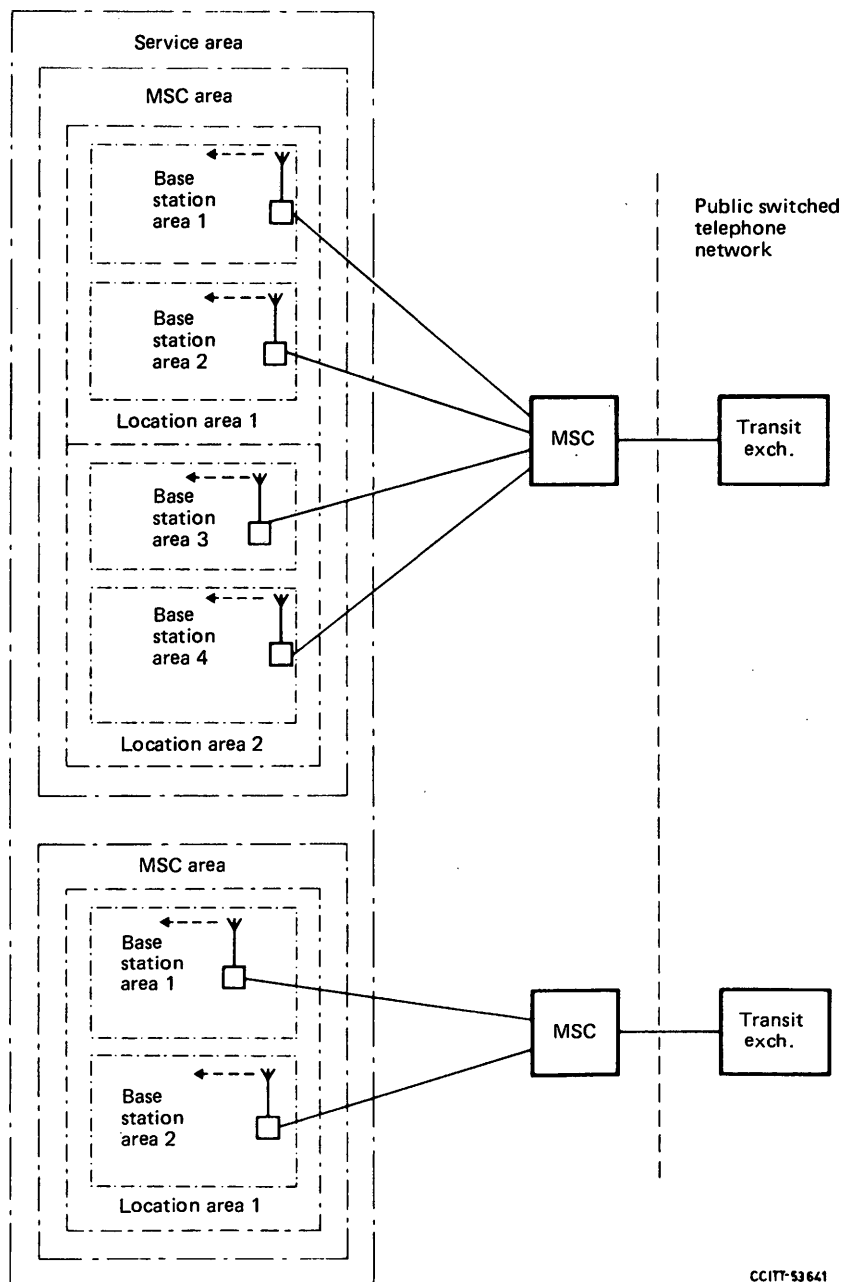


FIGURE 2/Q.70

Use of the definitions.
In this example the service area consists of one PLMN

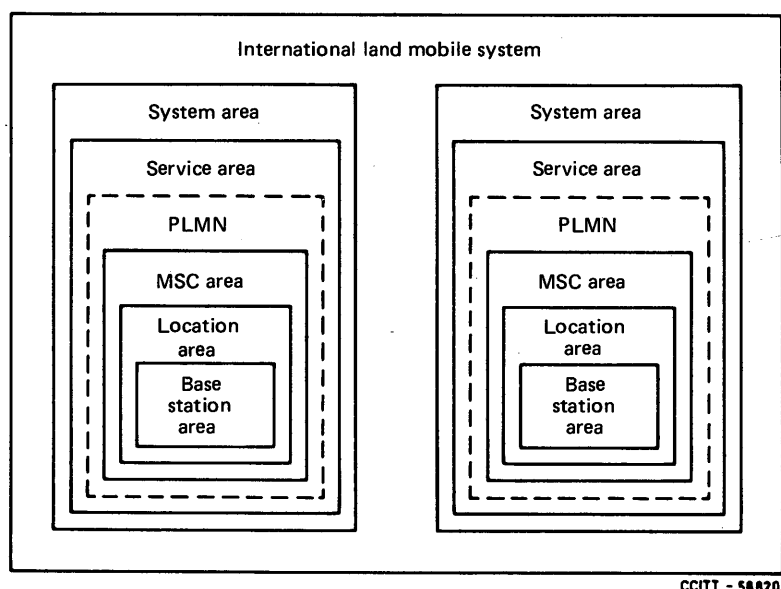


FIGURE 3/Q.70

Composition of the international land mobile system

2.8 home MSC

The MSC to which a mobile station is assigned for record purposes such as subscriber information.

2.9 home PLMN

The PLMN in which a mobile station is permanently registered.

2.10 visited MSC

The MSC, other than the home MSC, controlling the area in which a roaming subscriber is currently located.

2.11 visited PLMN

The PLMN, other than the home PLMN, in which a roaming subscriber is currently located.

2.12 gateway MSC

The MSC which receives a call from a fixed subscriber, via a public switched network, for extension to a mobile station. The gateway MSC may vary for interconnection with different public networks.

The gateway MSC could be the home MSC or the visited MSC or any other.

2.13 gateway PLMN

The PLMN which receives a call from a fixed subscriber, via a public switched network, for extension to a mobile station. The gateway PLMN may vary for interconnection with different public networks.

The gateway PLMN could be the home PLMN or the visited PLMN or any other.

2.14 location information

The location register should as a minimum contain the following information about a mobile station:

- international mobile station identity,
- actual location of the mobile station (e.g. PLMN, MSC area, location area, as required).

2.15 location register

To establish a call to a mobile station the network must know where this mobile station is located. This information is stored in a function named location register.

2.16 designation method

The calling subscriber must know the actual location area of the mobile station. The call is established according to the dialled information only, i.e. the call is not rerouted by the location register when the mobile station currently is in another location area.

2.17 non-designation method

The calling subscriber is not required to know the actual location area of the mobile station. The call is routed according to the dialled information and, if required, rerouted on additional information given by a location register.

2.18 directory number of a land mobile station

The international number of a mobile station is the number to be dialled following the international prefix to obtain a mobile station in another country. It consists of the country code of the country in which the mobile station is registered followed by the national (significant) mobile number of the called mobile station. The national (significant) mobile number is defined in Recommendation E.213.

2.19 international mobile station identity

The mobile station's identification $X_1X_2 \dots X_k$ uniquely identifying the station internationally. The identity is composed as defined in Recommendation E.212.

2.20 mobile station roaming number

The number allocated to a land mobile station for the purpose of routing calls to that station when it has roamed out of the area covered by the PLMN in which the station is permanently registered. See Recommendation E.213.

2.21 radio speech path

The radio communication facility between a mobile station and a base station intended to carry a call and uniquely assigned to the mobile station during that call.

2.22 radio control path

The radio communication facility between a mobile station and a base station intended to carry all the information transfer between the mobile station and the MSC, in which area the mobile station currently is located, during the time that no radio speech path between that base station and that mobile station is assigned.

2.23 hand-off

Hand-off is the action of switching a call in progress from one base station to another base station. Hand-off is used to allow established calls to continue when mobile stations move from one base station area to another base station area.

3 information needed in the mobile system

3.1 General

Below follows definitions of information that should be transferred on the radio path in public land mobile system in order to ensure proper interworking with the telephone network.

The definition of additional information required for other purposes than interworking (e.g. location registration) is not covered by this Recommendation.

All information needed in the mobile system for call handling, location registration and other functions is transferred on the radio control path until a radio speech path is assigned to a mobile station.

After a radio speech path assignment message has been sent via the radio control path, further signalling between the concerned mobile station and base station is performed on the radio speech path. After the release of the radio speech path (clear forward/release guard sequence or backward release message) the signalling information transfer facility is switched back to the radio control path.

When designing the radio path signalling, due regard should be paid to the specifications of the subscriber interface to the ISDN.

3.2 Mobile originating call

3.2.1 Forward information from the mobile station to the MSC

The following information should be included in this group:

a) Forward address message

The forward address message should at least include the following information:

- international mobile station identity;
- the address of the called subscriber including prefixes or a supplementary service request;
- mobile subscriber category (optional).

Note – More than one category indication may be required for one mobile station.

For a service integrated land mobile system it may also be necessary to indicate the required type of service (e.g. telephony).

b) Clear forward

3.2.2 Backward information from the MSC

The following information should be included in this group:

a) address complete and/or subscriber line free information

b) answer

c) charging information, if requested

Note – The following possibilities may be considered:

- charging rate indicated as part of the answer signal;
- call duration provided at the end of the call;
- charging rate and call duration provided at the end of the call;
- charges in monetary units provided at the end of the call;
- metering during speech.

d) unsuccessful call indication

The following possibilities should be considered:

- congestion (to indicate any congestion condition, e.g. radio path congestion, MSC congestion, national network congestion, etc.);
- supplementary service not available;
- address incomplete;
- calling procedure error (refers to calling procedure on radio path);
- call failure (failure to establish the connection through the PSTN without any specific reason given);

- supplementary service not subscribed;
 - subscriber busy;
 - access barred for this type of outgoing call;
 - unallocated number;
 - line-out-of-service;
 - call the information service;
 - access barred for calling mobile station.
- e) *backward release information* (used to clear the radio speech path in the backward direction)
- f) *release guard*

3.3 *Mobile terminating call*

3.3.1 *Forward information from the MSC to the mobile station*

The following information should be included in this group:

a) *selective calling signal*

The selective calling signal should at least include the following information:

- identity of the mobile station.

For a service integrated land mobile system it may also be necessary to indicate the required type of service of termination.

b) *clear forward information*

3.3.2 *Backward information from the mobile station*

The following information should be included in this group:

a) *address complete information* (acknowledgement to the selective call)

b) *answer*

c) *call rejected information* (to be used if the call, for some reason, is not accepted by the mobile station)

d) *clear back*

e) *release guard*

3.4 *Radio speech path assignment and continuity check*

A radio speech path assignment message is sent to the mobile station in order to assign a radio speech path for a call. The MSC shall ensure the continuity of this radio speech path by the continuity check procedure.

4 *Interworking with Signalling System No. 7*

4.1 *General*

A radio system conforming to § 3 would ensure a one-to-one correspondence to exist between the radio system and Signalling System No. 7.

The interworking recommended below is for that between the International TUP version of Signalling System No. 7 and a PLMN. In many cases the PLMN will interwork primarily with a national application of Signalling System No. 7 in which case other national signals will apply. However, it should be assumed that the defined international interworking is still obtained despite the interposed national application of Signalling System No. 7.

4.2 *Signals to be returned to Signalling System No. 7 for unsuccessful calls*

Table 1/Q.70 shows the correspondence which should exist between Unsuccessful Backward Set-up Information Messages (UBMs) and call events in the PLMN.

TABLE 1/Q.70

Unsuccessful Backward Set-up Information Messages (UBM)
and call events in the PLMN

Call event	UBM	Notes
Land mobile subscriber busy	SSB	1
Radio speech channel congestion	NNC	
No acknowledgement from the mobile station, call not being diverted	LOS	
Time-out on no answer from the mobile subscriber	CFL	
Continuity check failure	CFL	
Incoming calls barred, permanently	UNN	2
Incoming calls barred, temporarily	LOS	
Call rejected		

Note 1 – This time-out may be shorter than that recommended in Recommendation Q.118 or actually being used in a national network.

Note 2 – The call is rejected by the mobile station for several reasons, e.g. requested kind of terminal equipment not available (for further study in relation to interworking with the ISDN).

4.3 Information to be returned to the mobile subscriber for unsuccessful call set-up on Signalling System No. 7

When the MSC is receiving an Unsuccessful Backward Set-up Information Message (UBM) from Signalling System No. 7, the information to be returned to the mobile station on the radio path should be in accordance with Table 2/Q.70.

This information should also be treated as equivalent to a backward release signal in order to expedite the clearing of the radio path.

TABLE 2/Q.70

Correspondence between UBM received from PSTN
and information to be sent to the mobile station

UBM	Signal sent on radio path
SEC	Congestion
CGC	Congestion
NNC	Congestion
ADI	Address incomplete
CFL	Call failure
SSB	Subscriber busy
UNN	Unallocated number
LOS	Line-out-of-service
SST	Call the information service

4.4 Procedure for call set-up from the mobile station

The instant during call set-up at which the radio speech path is established, is determined by the MSC.

The following possibilities occur:

- i) After the MSC has received from the calling mobile station:
 - a call request message;
 - a forward address message.
- ii) After the MSC has received from the called side:
 - address complete and/or subscriber free information.

Note – Operational and technical problems involved in using this method require further study.

Radio speech path establishment at the answer instant is not recommended to be used for international calls. Its application for national calls is for further study.

The radio speech path assignment and continuity check sequence has to be inserted at the appropriate instant in the call set-up procedure outlined below.

The initial contact with the MSC is done by a *call request message* on the radio control path.

When the mobile station has received the *call accepted message*, it sends the *forward address message* to the MSC.

The *forward address message* (containing the address of the called subscriber) as received from the mobile station is converted into the appropriate Initial Address Message in Signalling System No. 7.

When address complete information is received from the PSTN, this information is sent to the mobile station and the speech path is through connected in the MSC when this has not yet been done.

The answer signal from the called side causes an *answer* to be passed to the mobile station. If a no charge condition is implied in the answer signal this is to be indicated.

In case of unsuccessful calls, information is provided to the mobile station in accordance with § 4.3.

4.5 Procedure for call set-up from the telephone network

The instant during call set-up at which the radio speech path is established is determined by the MSC.

This is recommended to occur immediately after the *selective calling signal* is sent to the mobile station.

Radio speech path establishment at the answer instant is not recommended to be used for international calls. Its application for national calls is for further study.

As soon as the MSC had received all digits of the mobile station number and the mobile station is free and available for the call and there is a free radio speech path available, the MSC sends the *selective calling signal* on the radio control path. When accepted the mobile station acknowledges this signal by the *address complete signal* which is converted into the Address Complete Message with subscriber free indication of Signalling System No. 7. The MSC sends the radio speech path assignment message to the mobile station and the continuity check is performed.

The off-hook condition shall cause the *answer* signal to be sent on the radio speech path from the mobile station. This signal is converted into the Answer Charge signal of Signalling System No. 7 and the connection is through connected in the MSC. In case of unsuccessful calls, information is provided to the PSTN in accordance with § 4.2.

4.6 Ordinary call set-up with request for supplementary information

If the called mobile subscriber is currently located in another PLMN (or in another MSC area) than his home PLMN (or home MSC area), the call may be set-up to the actual location of the subscriber. The procedure implemented is the same as for call diversion in the PSTN.

4.7 *Clearing conditions*

A *clear forward* received on the radio speech path should be converted into the CLF signal of Signalling System No. 7. Similarly the CLF signal received from Signalling System No. 7 should cause a clear forward to be sent on the radio speech path. Release guard should be applied independently on the two segments of the connection.

If CBK (clear back signal) is received from Signalling System No. 7, it should be suppressed by the MSC. So should also a following RAN signal. However, the MSC should start a time-out in accordance with Recommendation Q.118 for calls within a given network. On expiry of the time-out or by detecting a *clear forward* from the mobile station the telephone network should be cleared by a CLF signal. On expiry of the time-out the radio speech path should be cleared by a *backward release signal*.

If a clearback condition is detected on the radio speech path, a CBK signal should be provided on Signalling System No. 7. The re-answer sequence may not apply for the radio speech path.

4.8 *Hand-off*

When the mobile station moves to another base station area during a call the connection will be switched to the new area. This function is called hand-off.

When the base station belongs to a different MSC the PSTN may be involved in this operation.

The hand-off procedure between PLMN (MSC) is for further study.

4.9 *Diversion of calls*

PLMNs may offer, as a supplementary service to mobile subscribers, diversion of calls to a given subscriber. Immediate diversion or diversion on no reply may be possible as it is for fixed subscribers.

The procedure is the same as in the PSTN.

5 **Barring of incoming calls**

PLMN may offer, as a supplementary service to mobile subscribers, barring of incoming calls to the mobile station.

6 **Echo control**

Because of speech coding and/or other channel processing techniques, the end delay may have such magnitude that echo control devices may be required at both ends of the radio path.

Control of echo suppressors (or echo cancellers) should conform to Recommendation Q.115 so that the requirements of Recommendation G.131 can be met. This implies that care should be taken with regard to enabling and disabling of echo suppressors at MSCs for calls to and from the international telephone network.

PART V

Recommendations Q.101 to Q.118 *bis*

**CLAUSES APPLICABLE TO
CCITT STANDARD SYSTEMS**

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SECTION 1

GENERAL CLAUSES

Recommendation Q.101

1.1 FACILITIES PROVIDED IN INTERNATIONAL SEMI-AUTOMATIC WORKING

1.1.1 The operating methods used in the semi-automatic international service are described in the *Instructions for the International Telephone Service*. These operating methods assume the existence of equipment (operator's positions and automatic switching equipment) involving the following categories of operators:

- a) *outgoing* operators;
- b) *incoming* operators;
- c) *delay* operators;
- d) *assistance* operators;
- e) *information* or *special service* operators.

1.1.2 The *outgoing operator* controls the setting up of calls at the outgoing exchange. (From the operating point of view she is, in general, the controlling operator and is sometimes so referred to in the *Instructions*.)

She must be able to set up calls to any one of the following points in the called country:

- a) subscribers;
- b) incoming operators at the incoming international exchange;
- c) delay operators, especially a particular delay operator at the incoming international exchange;
- d) incoming operators at a local manual exchange in the called country;
- e) information or special service operators.

The outgoing operator should be able to recall incoming and delay operators on calls set up via these operators, by sending a forward-transfer signal as defined in the relevant system specifications.

1.1.3 The *incoming operator*¹⁾ at the incoming international exchange is obtained by using a special code 11 signal or a special number. The code 11 signal is a particular combination provided by the signal code. This operator performs the functions of an incoming operator in ordinary manual service for those calls which cannot be routed automatically at the incoming international exchange.

¹⁾ Called alternatively in French "opératrice translatrice", see *Instructions for the International Telephone Service* (art. 125).

1.1.4 The *delay operator* is obtained by using a special code 12 signal, or a special number. The code 12 signal is a particular combination provided by the signal code. The delay operator may be:

- any of the operators of this category;
- or a particular operator, or one of those operating a particular group of positions; her position or her group of positions is then indicated by a number which follows the code 12 signal or is indicated by the special number.

With respect to the direction in which a required call is set up, the delay operator may be at the outgoing international exchange and may be called by an operator at the incoming international exchange. From the technical point of view and as far as signalling is concerned, however, the delay operator at the outgoing international exchange called back by an operator at an incoming international exchange must be regarded as being at the incoming end of the international circuit over which she has been called back.

1.1.5 *Notes on incoming and delay operators*

a) Incoming and delay operators must be able to speak the *service language* used for the route concerned, and hence may have to belong to a particular language group. A *language (or information) digit*, from 1 to 8, sent on all semi-automatic calls, is used to obtain operators of a particular language group (see Recommendation Q.104)²⁾.

b) It may be the same operator who acts as an incoming and as a delay operator, and even as an assistance operator. She enters a circuit in any of these capacities in response to the appropriate signal.

c) While an incoming or delay operator is being called, the national ringing tone of the incoming country must be sent back over the international circuit.

1.1.6 The *assistance operator* at the incoming international exchange enters a semi-automatic circuit on a call already set up, when requested by the outgoing operator, because of language difficulties or, for instance, when she is required to interpret a national tone. Access to an assistance operator at an international transit exchange is not possible.

The assistance operator is called by a forward-transfer signal, sent by the outgoing operator when, for example, she operates a key on the outgoing position. An assistance operator in a required language group is obtained in conjunction with the forward-transfer signal by the language digit (or information) sent previously during the setting up of the call. Hence the incoming relay set must store the language digit (or information).

The outgoing operator receives no indication to show that the assistance operator is being called, or to show when she answers or withdraws from the circuit, but if necessary the outgoing operator can send the forward-transfer signal several times on the same call.

The assistance operator must be able:

- a) to break into the call as a third party (this she would do, for example, when the language spoken in the country of arrival is other than the service language used in that relation, and the operator intervenes as an interpreter);
- b) to enter a circuit on one side only after having isolated the other. She does this, in particular, when she translates a verbal announcement or interprets an audible tone returned from the incoming end.

In no circumstances will the assistance operator be able to block the international circuit.

Note — It should be noted that the term “assistance operator” has a very definite meaning in CCITT documents. It stands for an operator who breaks in, as required, as a third party in a circuit already set up. Hence this operator must not be confused with any other operator in the incoming country who may help to *set up* the call in conjunction with the international outgoing operator. Assistance operators may not be available on intraregional circuits.

1.1.7 The *information or special service operator* of the country of destination is obtained by using a special number. This operator is responsible for giving details concerning subscriber number and miscellaneous inquiries.

²⁾ The language digit may not be used on some intraregional circuits.

1.2 FACILITIES PROVIDED IN INTERNATIONAL AUTOMATIC WORKING

In international automatic working, the calling subscriber can obtain only such subscriber numbers as are made up of the numerical digits appearing on his dial or push-button set. Hence, he cannot obtain operators reached by code 11 or code 12 signal, or an assistance operator reached by a forward-transfer signal. In principle, he should not obtain access to incoming, delay or information operators¹⁾ reached by special numbers.

He can have direct dialling access to manual exchanges in the incoming country only subject to certain conditions (these conditions are defined in Recommendation Q.28, § 2, and in Recommendation Q.120, § 1.8, and are applicable to all CCITT standard systems).

It is pointless to send a language digit (or information) over an international circuit since the calling subscriber does not have to obtain operators speaking a particular language at the incoming international exchange. On automatic calls, a discriminating digit (or discriminating information) replaces the language digit (or information) sent on semi-automatic calls. This:

- enables the equipment in the outgoing international exchange to make a distinction between semi-automatic and automatic calls as is required when drawing up international accounts, as described in § 2 of Recommendation E.260;
- enables, therefore, incoming equipment to serve both automatic and semi-automatic service;
- in Systems No. 4, 6, 7 and R2 informs the equipment in the international incoming exchange that it has not to rely on an end-of-pulsing signal (see Recommendation Q.106);
- enables the equipment in the incoming international exchange to prevent automatic calls from having access to certain destinations (special services, for example).

Recommendation Q.103

1.3 NUMBERING USED

1.3.1 International prefix

The international prefix (see definition 1 in Recommendation Q.10) which gives subscribers access to the international automatic network is used only in automatic working and is not used in semi-automatic working.

The international prefix is not included in the numerical signals sent out from the international outgoing exchange.

1.3.2 Country code^{1)*}

Information about country codes will be found under § 8.2 in Recommendation Q.11. In the international outgoing exchange, the country code is used:

- a) in automatic working for the purpose of giving access to outgoing circuits;
- b) in semi-automatic working it is required to give outgoing operators in the outgoing international exchange access to the circuit by means of selectors.

The country code is sent on the international circuit or signalling channel:

- in the case of transit calls;
- in terminal and transit calls to a demand assignment system.

¹⁾ For information operators, see Recommendation E.115.

^{1)*} The country code may not be used on some intraregional calls.

1.4 LANGUAGE DIGIT OR DISCRIMINATING DIGIT

1.4.1 *Language digit (or language information)*

1.4.1.1 The language digit defined under 1.1.5 above indicates the *service language* to be used between operators in the international service, that is to say, the language to be spoken in the incoming international exchange by the incoming, delay and assistance operators when they come on the circuit. The language digit (or information) must be sent on *all* semi-automatic calls.

1.4.1.2 The digit (or indicator) to be used to select the appropriate language is as follows:

- 1 = French
- 2 = English
- 3 = German
- 4 = Russian
- 5 = Spanish
- 6 } available to Administrations for selecting a particular language
- 7 } provided by mutual agreement (in System No. 5,
- 8 } however, digit 7 is used on calls requiring access to test equipment)
- 9 = reserve (see § 1.4.2.2 below)

1.4.1.3 The language digit (or information) is either:

- sent by the operator to the outgoing equipment; in this case the operator must send it immediately before the national (significant) number¹⁾ of the called subscriber; or
- sent automatically by the outgoing equipment.

1.4.2 *Discriminating digit (or discriminating information)*

1.4.2.1 In all automatic calls, the position in the sequence of numerical signals occupied by the discriminating digit (or information) is that occupied by the language digit (or information) in semi-automatic calls (see Recommendations Q.102 and Q.107).

1.4.2.2 The digit 9 (or its equivalent) in the list of language digits (or calling party's categories) has been kept in reserve for use as extra discriminating information if required. Such use should be for a call with special characteristics, but the digit 9 (or the equivalent information) must not be used merely to take the place of the digit 0 (or its equivalent) in an automatic call²⁾.

1.4.2.3 Combination 13 in the signal code of System No. 4 and System R2 and its equivalent in Systems No. 6 and No. 7, as well as combination 7 in the signal code of System No. 5 serve as a discriminating digit (or information) on calls to automatic testing equipment.

¹⁾ See definition in Recommendation Q.10.

²⁾ For example, it might be thought useful to have an additional discriminating digit (or information) when a distinction has to be made between:

- a) automatic calls, and
- b) semi-automatic calls set up in the outgoing country directly by ordinary operators, in national exchanges and not by international operators in the international exchange, and arriving by the same group of national circuits as calls mentioned in a).

Such a distinction might be necessary because:

- in international accounts, calls mentioned in b) are dealt with as semi-automatic calls and are not to be metered by the international equipment.
- for signalling, calls mentioned in b) are not accompanied by an end-of-pulsing signal.

On signalling system No. 5 the discriminating digit 9 may be used to indicate a data call by bilateral agreement.

1.4.2.4 In Signalling Systems No. 6 and 7, the equivalent of the combinations 11 and 12 may be used as a discriminating digit (or calling party's indicator) on calls originated by a subscriber with priority (combination 11) or on data calls (combination 12).

1.4.2.5 On all automatic calls the discriminating digit must be sent over the international circuit or signalling channel by the country of origin of the call, and this country has to arrange for the automatic insertion of the discriminating digit (or information).

Recommendation Q.105

1.5 NATIONAL (SIGNIFICANT) NUMBER

1.5.1 In automatic working, the subscriber sends the called subscriber's national (significant) number¹⁾ by means of a dial, push-button set, or automatic dialling device.

1.5.2 In semi-automatic working, the operator sends the national (significant) number¹⁾ of the called subscriber by means of a keyset for example.

1.5.3 The outgoing equipment must be designed to cater for a sufficient number of digits in the national (significant) number¹⁾ as specified in Recommendation Q.11, §§ 2.2 and 3.

Recommendation Q.106

1.6 THE SENDING-FINISHED SIGNAL

In semi-automatic working, when the international outgoing operator has finished keying or dialling, she operates a special button on her keyboard or a key so that, after the number, a local signal which is called a *sending-finished* signal is sent to the outgoing equipment to show that there are no more digits to follow. In automatic working, subscribers cannot show when they have finished dialling the number, and so this signal does not apply.

Note — In semi-automatic working, local sending of the sending-finished signal will cause an *end-of-pulsing* signal to be sent on the international circuit^{1)*} or signalling channel. This has the same function and shows the incoming equipment that there are no more digits to be received. In some cases also in automatic working, when the outgoing equipment decides that there are no more digits to follow, an end-of-pulsing signal is sent on the international circuit or signalling channel, for example in the ST condition of System No. 5 (see Recommendation Q.152).

¹⁾ See definition in Recommendation Q.10.

^{1)*} In System R2 the sending of end-of-pulsing signal (code 15) may not occur if a *number-received* indication has already been received.

STANDARD SENDING SEQUENCE OF FORWARD ADDRESS INFORMATION

(Geneva, 1980)

A distinction is made in this Recommendation between the information to be sent by the telephone user for different types of calls and the corresponding information to be sent by the international signalling equipment.

With regard to the latter, the sequence of forward address information signals is dealt with in detail. The detailed exchange of other signalling information is covered by the procedures described in the specifications of the CCITT signalling systems concerned.

1 Information to be sent by the telephone user

The normal sequence of address information required for the set-up of an international call and to be sent by the user, i.e. the calling subscriber or operator, is as shown in Table 1/Q.107. This sequence does not depend on the CCITT signalling system used in the international network. Here five different types of call, from *a)* to *e)* are covered.

TABLE 1/Q.107
Standard sequence of the address information to be sent
by the telephone user

Type	Call to:	Address information sent by the user
<i>a)</i>	a subscriber (automatic)	1. International prefix ^{a)} 2. Country code ^{b)} 3. National (significant) number ^{c)}
<i>b)</i>	a subscriber (semi-automatic)	1. Country code ^{b) d)} 2. National (significant) number ^{c)} 3. Sending-finished
<i>c)</i>	any incoming or delay operator's position (semi-automatic)	1. Country code ^{b) d)} 2. Extra digit designating the incoming international exchange ^{e)} 3. Code 11 or code 12 ^{f)} 4. Sending-finished
<i>d)</i>	a particular delay operator, or one of those operating a particular group of delay operator's positions (semi-automatic)	1. Country code ^{b) d)} 2. Extra digit designating the incoming international exchange ^{e)} 3. Code 12 ^{f)} 4. Number of a particular position or a group of positions. 5. Sending-finished
<i>e)</i>	an information operator or a special service operator	1. Special numbers

^{a)} The recommended international prefix is 00, see Recommendation Q.11 *bis*, § 4.1.
^{b)} The country code consists of one of these digit combinations: I₁, I₁ I₂, I₁ I₂ I₃.
^{c)} The national (significant) number consists of the subscriber number and the trunk code: N₁, N₂, N₃ ... It does not contain the national (trunk) prefix (the preferred national prefix is 0 — see Recommendation Q.11 *bis*, § 4.5.2). The subscriber using the international automatic telephone network should be informed in an appropriate manner that the national prefix after the country code must not be sent.
^{d)} If, in the case of semi-automatic calls, the language digit L = 1, 2, 3, ... is not sent automatically by the outgoing signalling equipment, it has to be sent by the operator to the outgoing equipment. In this case, the operator must send the L digit immediately following the country code.
^{e)} The extra digit (N₁) designating the incoming international exchange is used in cases where more than one incoming international exchange can be reached in the country of destination. (It is recognized that the existing design of some equipment does not permit the insertion of the extra digit.)
^{f)} See Recommendation Q.101.

2 Sequence of forward address information to be sent by the outgoing international signalling equipment

The information to be sent in the forward direction by the outgoing international signalling equipment in order to set up telephone connections differs from the information to be sent by the telephone user. The content and the sequence of forward address information is furthermore dependent on the signalling systems used in the international network. In the following, a distinction is made between common channel and channel associated signalling systems.

2.1 Common channel signalling systems

In the case of common channel Signalling Systems No. 6 and No. 7, the first signal to be sent to an (international) signalling data link relating to the set up of a telephone connection is the initial address message. According to the definitions in Recommendations Q.254 [1] and Q.722 [2], the initial address message normally contains, among others, the following forward address information:

- a) nature-of-address indicator indicating that the
 - international number,
 - national (significant) number or
 - subscriber number is included;
- b) nature-of-circuit indicator indicating that
 - a satellite circuit is included
 - no satellite circuit is included;
- c) echo-suppressor indicator indicating that
 - an outgoing half-echo suppressor is included
 - no outgoing half-echo suppressor is included;
- d) calling-party's-category indicator including, among others,
 - a language digit, L
 - the discriminating digit D;
- e) address signals
 - country code
 - national (significant) numbers
 - code 11
 - code 12
 - end-of-pulsing (ST) signal or code 15.

As the initial address message of Signalling Systems No. 6 and No. 7 carries at least the information mentioned above, it is not necessary to describe here in detail the sequence of the forward address information to be sent by the outgoing international signalling equipment; reference is made to Recommendations Q.258 [3] and Q.722 [2], instead.

Nevertheless, the following additional comments are made:

- a) In cases where the international call is routed
 - from an originating international exchange (CT) to an international transit CT, or
 - from one international transit CT to another international transit CT(i.e. for international transit calls) the appropriate nature-of-address indicator (international number – Signalling System No. 7) or country code indicator (country code included – Signalling System No. 6) will be used together with the country code.
- b) If a terminal international link is selected; i.e. in cases where the call is routed
 - from an originating CT direct to a destination CT, or
 - from a transit CT to a destination CTthe nature-of-address indicator [national (significant) number: Signalling System No. 7] or the country code indicator (country code not included: Signalling System No. 6) will be used. In this case, no country code has to be sent.

In both cases a) and b) described above, further routing information will be included in the initial address message. For further details, see Recommendations Q.258 [3] and Q.722 [2].

2.2 Channel associated signalling systems

For channel associated signalling systems, it is important to determine the first interregister signal and the sequence of forward address information. This matter is dealt with in the following, taking into account various types of calls and Signalling Systems No. 4, No. 5, R1 and R2.

With the exception of the seizing signals in Signalling System No. 4, no line signals are dealt with.

2.2.1 The first signals to be sent on international links

Table 2/Q.107 shows the first type of signal to be sent on four different types of international links in the case where channel associated signalling systems are used.

TABLE 2/Q.107
First signal to be sent on international links

Type	International link		First signal sent on the international link
	from	to	
a)	Originating country	Destination country	Terminal-call indicator or discriminating or language digit
b)	Originating country	Transit country	Transit-call indicator
c)	Transit country	Transit country	Transit-call indicator
d)	Transit country	Destination country	Terminal-call indicator or discriminating or language digit

The terminal-call indicator is a type of signal indicating that an international terminal link *a)* or *d)* is involved and that no country code has to be sent to the incoming CT. In the case of Signalling System No. 4, the terminal-call indicator is represented by the terminal seizing signal – a forward line signal. For the other channel associated signalling systems, interregister signals are used. The discriminating digit D and the language digit L (both are also called the characteristic digit Z) must be in accordance with Recommendation Q.104.

The transit-call indicator is a type of signal indicating that an international transit link *b)* or *c)* is involved and that the country code will be included in the signalling sequence. In the case of Signalling System No. 4, the transit-call indicator is represented by the transit seizing signal – a forward line signal. For the other channel associated signalling systems, interregister signals are used.

2.2.2 Sequence of forward address information for automatic and semi-automatic calls to a subscriber

The forward address information to be sent by the outgoing international signalling equipment differs from the information sent by the telephone user as described in § 1.

Details covering the different channel associated CCITT signalling systems are shown in Table 3/Q.107.

2.2.3 Sequence of forward address information for calls to any incoming or delay operator's position

Table 4/Q.107 shows in detail the standard sequence of forward address information for calls to any incoming or delay operator's position to be sent by the outgoing international signalling equipment. A distinction is made between international transit and terminal calls as well as between different channel associated CCITT signalling systems.

TABLE 3/Q.107

Sequence of forward address information for automatic and semi-automatic calls to a subscriber to be sent by the outgoing international signalling equipment

Channel associated CCITT signalling system		No. 4	No. 5	R2	R1 ^{a)}
Sending sequence ↓ International transit call	Transit-call indicator	Transit seizing ^{b)}	KP 2	I-12 or I-14 or I-11 ^{c)}	—
	Echo-suppressor indicator	— ^{d)}	—		—
	Nature-of-circuit indicator	—	—	I-13 or I-14 ^{e)}	—
	Country code	I ₁ , I ₁ I ₂ , I ₁ I ₂ I ₃ ^{f)}			—
	Calling-party's-category indicator	D = 0 or L = 1, 2, 3, ...			—
	National (significant) number	N ₁ N ₂ N ₃ ...			—
	Sending-finished	Code 15	ST	Code 15	—
International terminal call	Terminal-call indicator	Terminal seizing ^{b)}	KP 1		KP ^{h)}
	Calling party's category indicator	D = 0 or L = 1, 2, 3, ... ^{g)}			—
	Echo-suppressor indicator	— ^{d)}	—	I-14 ^{e)}	—
	Nature-of-circuit indicator	—	—	I-13 or I-14 ^{e)}	—
	National (significant) number	N ₁ N ₂ N ₃ ...			—
	Sending-finished	Code 15	ST	Code 15	ST

a) Signalling System R1 is not used for international transit calls.

b) For Signalling System No. 4, the transit and the terminal-call indicators are represented by line signals. For the other signalling systems, no line signals are shown.

c) The use of signal I-11 in international working is subject to bilateral agreements.

d) Code 14 can be used for echo-suppressor control subject to bilateral or multilateral agreements.

e) These signals are sent on request.

f) See Recommendation Q.101.

g) For Signalling System R2, the L digit is also used as terminal-call indicator.

h) The KP signal is only used to prepare the incoming signalling equipment for the reception of the subsequent interregister signals; see also footnote a) above.

TABLE 4/Q.107
Sequence of forward address information for calls to any incoming or delay operators' position

Channel associated CCITT signalling system		No. 4	No. 5	R2	R1 ^{a)}
Sending sequence ↓	Transit-call indicator	Transit seizing ^{b)}	KP 2	I-12 or I-14 or I-11 ^{c)}	—
	Echo-suppressor indicator	— ^{d)}	—		—
	Nature-of-circuit indicator	—	—	I-13 or I-14 ^{e)}	—
	Country code	I ₁ , I ₁ I ₂ , I ₁ I ₂ I ₃			—
	Language digit	L = 1, 2, 3, ...			—
	Extra digit designating the incoming exchange	N ₁			—
	Access to operator's position	Code 11 or code 12 ^{f)}			—
	Sending-finished	Code 15	ST	Code 15	—
International terminal call	Terminal-call indicator	Terminal seizing ^{b)}	KP 1		KP ^{h)}
	Language digit	L = 1, 2, 3, ... ^{g)}			—
	Echo-suppressor indicator	— ^{d)}	—	I-14 ^{e)}	—
	Nature-of-circuit indicator	—	—	I-13 or I-14 ^{e)}	—
	Extra digit designating the incoming exchange	N ₁			—
	Access to operator's position	Code 11 or code 12 ^{f)}			e.g. 121 or 1150
	Sending-finished	Code 15	ST	Code 15	ST

^{a)} Signalling System R1 is not used for international transit calls.

^{b)} For Signalling System No. 4, the transit and the terminal-call indicators are represented by line signals. For the other signalling systems, no line signals are shown.

^{c)} The use of signal I-11 in international working is subject to bilateral agreements.

^{d)} Code 14 can be used for echo-suppressor control subject to bilateral or multilateral agreements.

^{e)} These signals are sent on request.

^{f)} See Recommendation Q. 101.

^{g)} For Signalling System R2, the L digit is also used as terminal-call indicator.

^{h)} The KP signal is only used to prepare the incoming signalling equipment for the reception of the subsequent interregister signals; see also Note ^{a)}.

2.2.4 *Sequence of forward address information for calls to a particular delay operator*

The standard sequence of forward address information for calls to a particular delay operator or one of those operating a particular group of delay operator's position is shown in detail in Table 5/Q.107. Again a distinction is made between international transit and terminal calls as well as between different channel associated CCITT signalling systems.

The footnotes relating to Table 4/Q.107 are also valid for Table 5/Q.107.

3 Standard sending sequence of forward address information in the case of calls to testing and measuring devices

International calls to testing and measuring devices are terminal calls. Therefore, the outgoing signalling equipment will not send the country code. In Signalling System No. 4, the terminal-call indicator is a line signal.

Table 6/Q.107 contains the standard sending sequence and forward address information in the case of calls to testing and measuring devices to be sent by the outgoing signalling equipment for Signalling Systems No. 4, No. 5, No. 6, No. 7, R1 and R2.

Recommendation O.11 [4] contains the detailed specifications for CCITT manual maintenance access lines. Recommendation O.22 [5] contains the detailed specifications for the CCITT ATME No. 2. Further information with regard to calls to testing and measuring devices can be found in the detailed specifications of the relevant CCITT signalling systems.

In the case of the common channel Signalling Systems No. 6 and No.7, all information will be carried by means of an initial address message in which the message indicators will be set to their appropriate values as specified in Recommendations Q.258 [3] and Q.722 [2].

In Table 7/Q.107 the access codes required to reach the testing and measuring devices in the exchange of destination are given for CCITT Signalling Systems No. 4, No. 5, No. 6, No. 7 and R2.

TABLE 5/Q.107
Sequence of forward address information for calls to a particular delay operator's position

Channel associated CCITT signalling system		No. 4	No. 5	R2	R1 ^{a)}
Sending sequence ↓ International transit call	Transit-call indicator	Transit seizing ^{b)}	KP 2	I-12 or I-14 or I-11 ^{c)}	—
	Echo-suppressor indicator	— ^{d)}	—		—
	Nature-of-circuit indicator	—	—	I-13 or I-14 ^{e)}	—
	Country code	I ₁ , I ₁ I ₂ , I ₁ I ₂ I ₃			—
	Language digit	L = 1, 2, 3, ...			—
	Extra digit designating the incoming CT	N ₁			—
	Access to operator's position	Code 12			—
	Number of a particular position	x ₁ (x ₂ x ₃ ...)			—
	Sending-finished	Code 15	ST	Code 15	—
International terminal call	Terminal-call indicator	Terminal seizing ^{b)}	KP 1		KP ^{g)}
	Language digit	L = 1, 2, 3, ... ^{f)}			—
	Echo-suppressor indicator	— ^{d)}	—	I-14 ^{e)}	—
	Nature-of-circuit indicator	—	—	I-13 or I-14 ^{e)}	—
	Extra digit designating the incoming CT	N ₁			—
	Access to operator's position	Code 12			e.g. 1150
	Number of a particular position	x ₁ (x ₂ x ₃ ...)			e.g. 11x ₁ x ₂
	Sending-finished	Code 15	ST	Code 15	ST

a) Signalling System R1 is not used for international transit calls.

b) For Signalling System No. 4, the transit and the terminal-call indicators are represented by line signals. For the other signalling systems, no line signals are shown.

c) The use of signal I-11 in international working is subject to bilateral agreements.

d) Code 14 can be used for echo-suppressor control subject to bilateral or multilateral agreements.

e) These signals are sent on request.

f) For Signalling System R2, the L digit is also used as terminal-call indicator.

g) The KP signal is only used to prepare the incoming signalling equipment for the reception of the subsequent interregister signals; see also Note^{a)}.

TABLE 6/Q.107

Sending sequence of forward address information in the case of calls to testing and measuring devices

Sending sequence ↓	CCITT signalling system	No. 4	No. 5	No. 6	No. 7	R2	R1
	Terminal-call indicator	Terminal seizing	KP 1	Together with other message indicators		D = code 13 ^{a)}	KP
	Calling party's category indicator	D = code 13	D = 7	Test call	Test call		—
	Test-call indicator	Code 12	Code 12	—	—	Code 13	—
	Access code for a particular testing or measuring device	Digit 0 plus 2 digits x, y	Digit 0 plus 2 digits x, y	16 combinations	16 combinations	2 digits x, y	Digits to be agreed upon (minimum three)
	Sending-finished	Code 15	ST	ST	ST	Code 15	ST

a) For signalling System R2, the D digit is also used as terminal-call indicator.

TABLE 7/Q.107

Access codes for a particular testing or measuring device

CCITT signalling system	Access codes				
	No. 4	No. 5	R2	No. 6	No. 7
Multiple address capability for transmission access test line.	21-29	21-29	21-29	6 7 8	21-29
ATME 2 Type a	61	61	61	1	61
ATME 2 Type b	62	62	62	2	62
ATME 2 Type c	63	63	—	—	63
Quiet termination	64	64	64	3	64
Echo suppressor test	65	65	65	4	65
Loop around	66	66	66	5	66
Echo canceller test	67	67	67	9	67
Simplified test	—	—	90	—	—
Good/no good transmission Test	00	—	00		
Continuity check	—	—	—	0	00

References

- [1] CCITT Recommendation *Telephone signals*, Vol. VI, Fascicle VI.3, Rec. Q.254.
- [2] CCITT Recommendation *General function of telephone messages and signals*, Vol. VI, Fascicle VI.6, Rec. Q.722.
- [3] CCITT Recommendation *Telephone signals*, Vol. VI, Fascicle VI.3, Rec. Q.258.
- [4] CCITT Recommendation *Specifications for manual maintenance access lines*, Vol. IV, Fascicle IV.4, Rec. O.11.
- [5] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Fascicle IV.4, Rec. O.22.

Recommendation Q.107 bis

ANALYSIS OF FORWARD ADDRESS INFORMATION FOR ROUTING

Geneva, 1980

1 General

This Recommendation covers the analysis of forward address information for the routing of circuits using Signalling Systems No. 4, No. 5, No. 6, No. 7 and R2.

For Signalling System R1, Recommendation Q.324 [1] indicates that in the application of Signalling System R1 to intra-regional networks, the routing plan of that network shall apply. The routing plan is such that analysis is limited to a maximum of six digits.

Signalling Systems No. 4, No. 5, No. 6, No. 7 and R2 as specified are suitable for international application (see also Recommendation Q.7) and Recommendations Q.12 and Q.13 on routing are applicable. Similarly, for international traffic the combinations of digits to be sent must be in accordance with Recommendations Q.10, Q.11 *bis* and Q.101 to Q.107.

Based on the forward address information received (see Recommendation Q.107), routing is performed at the outgoing international exchange and at the following (transit) exchanges. For this purpose, an analysis of some of the information received is required. Recommendation Q.107 specifies the standard sequences of forward address information for each of the signalling systems mentioned above.

2 Digit analysis at the outgoing international exchange

In general, the whole amount of forward address information relating to international calls is stored at the outgoing international exchange.

Some examples of the information required to determine the routing at an international exchange are given in the following:

$$\begin{aligned} & I_1 Z N_1 N_2 N_3^{1)} \\ & \text{or } I_1 I_2 Z N_1 N_2^{1)} \\ & \text{or } I_1 I_2 I_3 Z N_1 N_2^{1)} \end{aligned}$$

where

I_1, I_2, I_3 = digits of the country code

Z = characteristic digit, i.e. discriminating digit (D) or language digit (L), and

$N_1, \dots, N_n$ = digits of the national (significant) number.

¹⁾ In the cases of common channel Signalling Systems No. 6 and No. 7, the information content of the D or L digit will be conveyed by the calling-party's-category indicator.

The maximum number of digits which has to be analysed in the outgoing international exchange to determine the routing is 5, the language digit (L) or the discriminating digit (D) not being included. In cases where the country code is shared by different countries, up to 7 digits may have to be analysed for routing and accounting purposes. In the implementation of new international exchanges, this should be taken into account.

In semi-automatic working, in the case where the language digit is not sent by the operator, and in automatic working, it is necessary to determine (in the outgoing international exchange) the position where the language or discriminating digit must be inserted automatically (for channel associated signalling systems immediately after the country code). This position is determined by an analysis of the first or the first two digits of the country code. A three-digit country code can also be detected by an analysis of the first two digits.

In the case of countries with more than one incoming international exchange where semi-automatic calls to code 11 or code 12 operators require a digit analysis beyond the country code for routing in the outgoing international exchange, N_1 may be used as the extra digit designating the incoming international exchange. For direct relations between the outgoing exchange and the incoming exchanges, sending of the digit N_1 to the incoming international exchanges is not required²⁾.

3 Digit analysis at the international transit exchange

Signalling equipment for transit exchanges must be designed for the transfer of all information necessary for setting up calls including access to operators' positions.

In an international transit exchange, analysis of some of the digits is required to determine the routing to the desired international incoming exchange or to another international transit exchange. The maximum number of digits which has to be analysed at the international transit exchange to determine the routing is 5, the language (L) or the discriminating digit (D) not being included (see also § 2). In cases where the country code is shared by different countries, up to 7 digits may have to be analysed for routing and accounting purposes. In the implementation of new international exchanges, this should be taken into account.

The transit exchange decides how many of the received digits it needs for this analysis.

In an international transit exchange, an analysis, effective on the first or the first two digits of the country code, determines the number of digits in the country code. For channel associated signalling systems, the position of the language or the discriminating digit is therefore determined which, in the sequence of forward address information, follows immediately the country code.

Since in the case of common channel Signalling Systems No. 6 and No. 7 the initial address message contains all digits required for routing the call, selection of the outgoing circuit can start as soon as this message has been received. In addition to the digit information, other routing information is contained in the initial address message, e.g. country code or nature-of-address indicator, nature-of-circuit indicator, calling-party's-category indicator, and echo-suppressor indicator, some or all of which must be analysed as described in the detailed specifications.

Normally, it will not be necessary for a transit exchange using Signalling System No. 6 or No. 7 to analyse digits in more than the initial address message. Subsequent address messages can be forwarded to the next international exchange without analysis as soon as the outgoing circuit is determined.

In the case of Signalling System No. 6, however, a subsequent address message (SAM) must always be analysed for sequence reasonableness before being forwarded to the next international exchange.

In the case of incoming Signalling System No. 4, the transit exchange must ensure that it does not request signal code 15 in order to avoid premature release of the outgoing register, e.g. by evaluating the signal code 11 or code 12.

²⁾ It is recognized that the existing design of some equipment may not permit the reception of the extra digit N_1 . In this situation, agreement will be required between the relevant countries concerned that the extra digit N_1 would not be sent to a particular incoming international exchange.

4 **Examples of the digit analysis in an international transit exchange**

Possible cases for digit analysis by an international transit exchange are shown in the following examples (the letters given to the international exchanges correspond to Figure 1/Q.107 *bis* and the letters given to the digits correspond to the examples given in § 2 above). It should be noted that in some cases analysis of fewer digits than those indicated in the following examples may be sufficient.

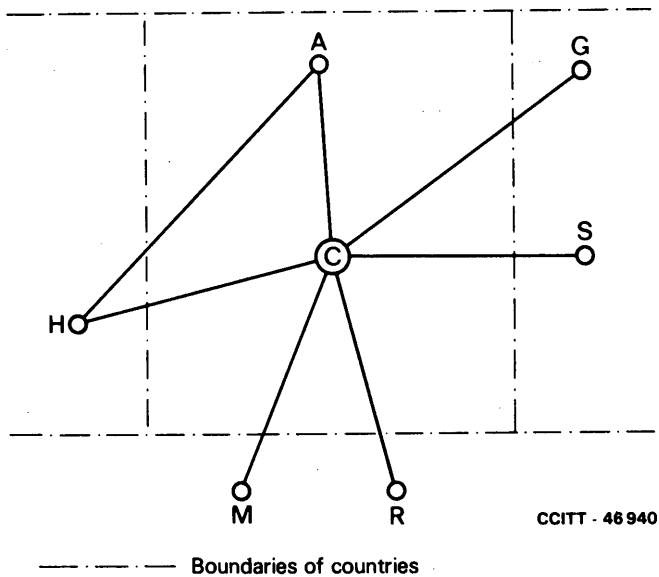


FIGURE 1/Q.107 *bis*
Examples of the digit analysis in an international transit exchange C

4.1 *Example 1*

In example 1, transit traffic via C in one country is routed to one of the two exchanges M or R in another country according to the first digit(s) of the national (significant) number.

- a) Automatic and semi-automatic calls with normal national numbers

Example: $I_1 I_2 Z N_1 N_2^{3)}$

- b) Semi-automatic calls to code 11 or code 12 operators in the case where only one incoming international exchange (M or R) is equipped to receive calls to operators' positions

Examples: $I_1 I_2 L C_{11}$ or $I_1 I_2 L C_{12}^{3)}$

In the case of countries with more than one incoming international exchange where code 11 or code 12 traffic requires for routing in the transit exchange a digit analysis beyond the country code, N_1 may be used as the extra digit designating the incoming international exchange⁴⁾.

Examples: $\underbrace{I_1 I_2 L N_1}_{\text{analysed}} C_{11}$ or $\underbrace{I_1 I_2 L N_1}_{\text{analysed}} C_{12}^{3)}$

³⁾ In the cases of common channel Signalling Systems No. 6 and No. 7, the information content of the D or L digit will be conveyed by the calling-party's-category indicator.

⁴⁾ It is recognized that the existing design of some equipment may not permit the reception of the extra digit N_1 . In this situation, agreement will be required between the relevant countries concerned that the extra digit N_1 would not be sent to a particular incoming international exchange.

4.2 Example 2

In example 2, transit traffic via C in one country is routed to G or S in another country. Automatic traffic with the presence of discriminating digit (D) is routed to G or S according to the first digit of the national significant number, while all semi-automatic traffic with the presence of language digit (L) is routed to S for assistance operator use regardless of digits following L.

Examples: $\underbrace{I_1 I_2 D}_{\text{analysed}}$ or $\underbrace{I_1 I_2 L^5)}_{\text{analysed}}$

5 Example of digit analysis for incoming terminal traffic

Terminal traffic incoming to an international exchange C in a country and which is to be routed to code 11 or code 12 operators in another international exchange A in the same country according to the extra digit N_1 ⁶⁾.

Examples: $\underbrace{L N_1 C_{11} C_{15}}_{\text{analysed}}$ or $\underbrace{L N_1 C_{12} X X C_{15}}_{\text{analysed}}^{7)}$

6 Cross-border traffic between adjacent countries

If for cross-border traffic between adjacent countries access to operators' positions is not provided, it may be decided by bilateral agreement to exclude the transfer of the language or the discriminating digit. In this case, the first digit sent will be the first of the national (significant) number. In addition, one or more of the first digits of the national (significant) number may be omitted, depending on the routing requirements at the incoming exchange.

For cross-border traffic between adjacent countries, the number of digits that must be analysed will be determined by bilateral agreement. This may involve more digits than for normal international traffic.

Reference

- [1] CCITT Recommendation *Analysis of address information for routing*, Vol. VI, Fascicle VI.4, Rec. Q.324.

Recommendation Q.108

1.8 ONE-WAY OR BOTH-WAY OPERATION OF INTERNATIONAL CIRCUITS

1.8.1 One-way operation

In order to have as simple as possible equipment in international exchanges and to avoid double seizures, System No. 4 has been designed in 1949-1954 for one-way operation of international circuits in semi-automatic and automatic working.

⁵⁾ In the cases of common channel Signalling Systems No. 6 and No. 7, the information content of the D or L digit will be conveyed by the calling-party's-category indicator.

⁶⁾ It is recognized that the existing design of some equipment may not permit the reception of the extra digit N_1 . In this situation, agreement will be required between the relevant countries concerned that the extra digit N_1 would not be sent to a particular incoming international exchange.

⁷⁾ In the cases of common channel Signalling Systems No. 6 and No. 7, the information content of the D or L digit will be conveyed by the calling-party's-category indicator. Code 15 may be considered as equivalent to ST in all CCITT signalling systems.

1.8.2 *Both-way operation*

1.8.2.1 These advantages of one-way operation naturally hold good in the case of long international (intercontinental) circuits. However, for these circuits the following considerations have been determining factors in providing both-way circuit operation:

- a) When a group of circuits is composed of a small number of circuits, the increase in efficiency due to both-way operation is obviously very important. Moreover, long international (intercontinental) circuits are very costly. Finally, the increase in the cost of terminal equipment which results from both-way operation is small compared with the considerable economic advantage derived from this mode of operation.
- b) The two ends of a long international (intercontinental) group of circuits may belong to two time zones which are very far apart and, depending on the difference in time, this is likely to result in important and variable differences between the traffic in the two directions.

1.8.2.2 All circuits in System No. 5 and the speech circuits in Systems No. 6 and 7 should be equipped to work in both-way operation. Nevertheless, the both-way method of operation would be applied only if it offered a considerable economic advantage. Hence in the case of large groups (for example, more than 40 circuits in each direction), the possibility of maintaining one-way operation might be considered, because of the extra reliability of this type of operation. If, in circumstances necessitating the use of large groups, there are great differences between the busy hours at each end, it would be advisable, if it were desired to maintain one-way operation, to arrange that the circuits be used successively in one or the other direction according to the time of day. This availability of the circuits for routing traffic from country A to country B or vice versa would be arranged by a convenient method.

In certain cases another solution is worthy of consideration. This consists of setting up three groups of circuits, two operated one-way and the third both-way, it being understood that the latter would be used as an overflow route for calls which could not be routed on the first two groups.

1.8.2.3 Attention is drawn to the conditions which should be introduced to avoid double seizing and false blocking on both-way international circuits. In addition, attention is drawn to the fact that in semi-automatic working, as in automatic working, access to the circuits at both ends should be automatic.

In semi-automatic operation, in the event of double seizing, automatic selection of a new circuit should be preferred to the operator's setting up the call again, so that the operator does not become aware of the double seizing. In automatic operation, automatic selection of a new circuit should naturally be the rule.

The necessary arrangements have been made in the specifications of the systems concerning simultaneous seizing in both-way operation.

1.8.2.4 The digital circuits in System R2 and the circuits in System R1 may be equipped to work in both-way operation.

Recommendation Q.109

1.9 TRANSMISSION OF THE ANSWER SIGNAL IN INTERNATIONAL EXCHANGES

For the reasons given in Recommendation Q.27, it is necessary to reduce to a minimum the delays resulting from:

- the conversion of the national answer signal into the international answer signal and vice versa; and
- the transmission of the international answer signal over the international part of the connection,

these delays being additional to any delays due to conversions and repetitions of the answer signal within the national systems of the incoming and outgoing countries.

SECTION 2

TRANSMISSION CLAUSES FOR SIGNALLING

A. Signalling on PCM links

Recommendation Q.110

2.0 GENERAL ASPECTS OF THE UTILIZATION OF STANDARDIZED CCITT SIGNALLING SYSTEMS ON PCM LINKS

2.0.1 *Signalling Systems No. 4, and No. 5*

Signalling Systems No. 4, and No. 5 are in-band signalling systems. It is not planned to specify modified versions of these systems for application to PCM transmission systems.

Should it be required to use one of these signalling systems on circuits routed partly or wholly via PCM transmission systems it is recommended that the standard in-band signalling arrangements for both line and interregister signals be used. The circuits should be connected on a 4-wire basis to appropriate analogue inputs and outputs of the PCM transmission system.

When used at analogue exchanges the circuits should be connected on a 4-wire basis to appropriate analogue inputs and outputs of a PCM transmission system conforming to Recommendations G.732 [1] or G.733 [2].

At digital exchanges, circuits should be connected to PCM interfaces conforming to Recommendation Q.503.

2.0.2 *Signalling System No. 6*

For the transmission of signalling information over digital systems a digital version of Signalling System No. 6 has been developed and is specified in Recommendations Q.251 and Q.295.

Alternatively, the analogue version of System No. 6, as also specified in Recommendations Q.251 to Q.295 may be used without modifications by replacing the analogue voice-frequency channel of the signalling data link by PCM voice-frequency channels. In this case, the connection of the modem to the PCM transmission channel should be made on a 4-wire basis to the analogue input and the analogue output.

2.0.3 *Signalling System No. 7*

Signalling System No. 7 has been developed for the use in integrated digital networks. It is optimized for 64 kbit/s PCM transmission channels.

In addition, it can be used on analogue transmission channels with lower bit rates.

2.0.4 *Signalling System R1*

Signalling System R1, as specified in Part I of Fascicle VI.4, may be used without modification on PCM voice-frequency channels by direct connection of the circuits to appropriate analogue inputs and outputs of the PCM transmission system.

An alternative method of transmitting the line signals via a PCM system as specified in Recommendation G.733 has been developed as the digital version of System R1. Details are given in Recommendations Q.314 to Q.316. The multifrequency interregister signals are applied in-band via the analogue input of the speech circuit.

At digital exchanges, circuits should be connected to PCM interfaces conforming to Recommendation Q.503.

2.0.5 Signalling System R2

The analogue version of System R2 line signalling cannot be transmitted via an analogue input of a PCM system since these line signals are sent out-band using a 3825 Hz signalling channel. The digital version of System R2 line signalling specified in Recommendations Q.421-Q.424 has been developed for use with PCM systems specified in Recommendation G.732 [1]. The multi-frequency inter-register signals are applied in-band via the input of the speech circuit. At digital exchanges, circuits should be connected to PCM interfaces conforming to Recommendation Q.503.

References

- [1] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s*, Vol. III, Fascicle III.3, Rec. G.732.
- [2] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 1544 kbit/s*, Vol. III, Fascicle III.3, Rec. G.733.

B. Clauses common to signal receivers (and senders) for Signalling Systems No. 4, No. 5, R1 and R2¹⁾

Recommendation Q.112

2.1 SIGNAL LEVELS AND SIGNAL RECEIVER SENSITIVITY

2.1.1 Standardized transmitted power

The values of the standardized transmitted power for the different line and interregister signals are defined in the relevant parts of the specifications for the CCITT Systems No. 4, No. 5, R1 and R2.

Note – The level of leak current which might be transmitted to line, for example when static modulators are used for signal transmission, should be considerably below signal level, as specified.

2.1.2 Variations of the absolute power level of received signals

The standardized absolute power level of the signalling current to be transmitted is fixed at the maximum value compatible with circuit transmission requirements and the extreme values of absolute power level, between which received signalling currents may lie, depend on three factors:

- 1) the overall loss and the variation with time of this loss of the international circuit (link-by-link signalling) or of the chain of international circuits (end-to-end signalling) at 800 Hz;
- 2) the variation with frequency of the overall loss of these circuits, in relation to the nominal value at 800 Hz;
- 3) the tolerance on the transmitted absolute power level in relation to the nominal value.

The operate level range of the signal receivers about a nominal value should take account of these three factors. In System No. 4, the operate range (± 9 dB) is appropriate for end-to-end signalling. The maximum number of circuits in the end-to-end signalling situation is normally three but more may be possible depending upon the actual conditions. In System No. 5 the operate range, (± 7 dB) for line signals and for register signals is appropriate for each circuit in link-by-link signalling. For the other CCITT systems see the relevant parts of their specifications.

¹⁾ For Signalling Systems No. 6 and No. 7, see Fascicles VI.3 and VI.7 respectively.

2.1.3 Maximum sensitivity of the signal receiver

It is desirable to limit the maximum sensitivity of the signal receiver, particularly on account of crosstalk between the GO and RETURN paths of a 4-wire circuit, leak currents, etc.

Recommendation Q.113

2.2 CONNECTION OF SIGNAL RECEIVERS IN THE CIRCUIT

2.2.1 The line signal receivers are permanently connected to the 4-wire side of the circuit. The register signal receivers in System No. 5 are connected to the 4-wire side of the circuit when the register is associated with the circuit for the setting up of the call; the same is valid (in the international exchanges) for the register signal receivers in Systems R1 and R2.

2.2.2 An in-band line signal receiver should be protected against disturbing currents (voice currents or possibly noise), coming from the near end of the circuit, by a buffer amplifier or other arrangement. The arrangement used should introduce an appropriate supplementary attenuation in such a manner that, at the point where the line signal receiver is connected, these disturbing currents are of such a level that they cannot:

- operate the line signal receiver;
- interfere with the reception of signals by operating the guard circuit of the line signal receiver.

The additional attenuation introduced should in consequence take account of:

- a) the relative level n at the point where the signal receiver is connected (this relative level is obtained by assuming a zero relative level at the distant origin of the circuit);
- b) the minimum permissible signal level at the input to the signal receiver, for example:
 - $-18 + n$ dBm in the case of System No. 4 (see Recommendation Q.123 § 3.2.1),
 - $-16 + n$ dBm in the case of System No. 5 (see Recommendation Q.144 § 2.4.1);
- c) the maximum permissible level for disturbing currents (voice currents and switching noise) coming from the near end of the circuit. The maximum level of voice current might be assumed to be, for example, $+10$ dBm0 in the direction *opposite* to that of the signals. The nature of the switching noises depends on the national systems used;
- d) any attenuation (terminating set and possibly pads) between the point where the signal receiver is connected and the point where the near-end disturbing currents are considered;
- e) a safety margin to give an appreciable reduction of the level of disturbing currents coming from the near end [as defined in c)] compared to the minimum level of the signal as defined in b).

2.2.3 When a register-signal receiver is connected to the circuit, the exchange side of the circuit is disconnected and hence the receiver is not subject to near-end disturbances.

2.2.4 The Recommendations of Volume III concerning international circuits must still be met after the connection of a signal sender and a signal receiver and of the switching equipment. In consequence, it is necessary to fix the limits of input and output impedance, insertion loss, attenuation distortion, non-linear distortion, balance, and crosstalk of line signal senders and receivers; an example of specification clauses concerning these conditions is given in Recommendation Q.114.

2.3 TYPICAL TRANSMISSION REQUIREMENTS FOR SIGNAL
SENDERS AND RECEIVERS

2.3.1 In-band line signal receivers (including the buffer amplifier or equivalent device), in §§ 2.3.2 to 2.3.7 below, apply only in the case where the signal receiver is a 4-terminal device ("quadripole") and where the nominal circuit impedance is 600 ohms.

2.3.2 *Input and output impedance*

The nominal value of the input and output impedances of the signal receiver is 600 ohms.

Z_E and Z_S , which are respectively the measured values of the input and output impedance of the signal receiver, should meet the following condition throughout the 300 to 3400 Hz frequency band:

$$\left| \frac{Z_E - 600}{Z_E + 600} \right| \leq 0.35 \text{ and } \left| \frac{Z_S - 600}{Z_S + 600} \right| \leq 0.35.$$

In making these measurements the free terminals should be looped by a resistance of 600 ohms and the voltage applied must not overload the equipment.

2.3.3 *Attenuation*

At 800 Hz, the insertion loss of the signal receiver, measured with a generator and a receiver of internal resistance of 600 ohms, must be between the limits:

$$A \pm 0.5 \text{ decibel.}$$

The value A is to be determined from the level diagram of the circuit according to the point of the circuit at which the signal receiver should be connected.

The measurement is made with a 1 mW generator having an internal impedance equal to a pure resistance of 600 ohms and having an e.m.f. of 2×0.775 volt (so-called "standard generator"). The e.m.f. of the generator will be adjusted to take into account the relative level of the point of the circuit at which the signal receiver is connected.

If n is the relative level at the signal receiver input, the e.m.f. of the generator will therefore be:

$$1.55 \cdot 10^{\frac{n}{20}} \text{ volts, if } n \text{ is expressed in d cibels.}$$

2.3.4 *Attenuation distortion*

The variation in insertion loss of the signal receiver in the 300-3400 Hz frequency band, measured under the conditions of § 2.3.3 above, should not exceed the limits shown in Figure 1/Q.114.

As in certain cases Systems No. 5, and R1 may be applied to circuits in transmission systems with a channel spacing of less than 4 kHz, the 300 Hz lower limit shown above may be replaced by 200 Hz for System No. 5.

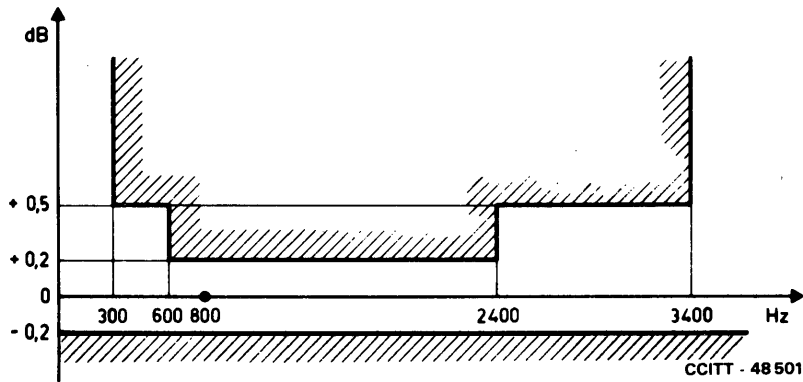


FIGURE 1/Q.114
Attenuation distortion of the signal receiver

2.3.5 Nonlinear distortion

The curve representing the variation (as a function of power) of the output level of the signal receiver, with reference to the nominal value of the output level, should be within the limits shown in Figure 2/Q.114 over the relevant frequency range.

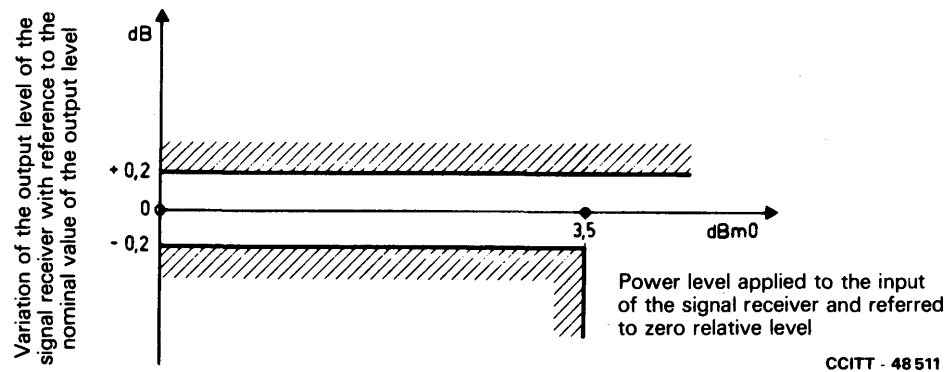


FIGURE 2/Q.114
Limits for nonlinear distortion due to the insertion of the signal receiver

2.3.6 Balance

The input and output of the signal receiver should have a high degree of balance to earth, the admittance of each terminal to earth being very low.

The same clause should apply to the signal sender.

2.3.7 Crosstalk between adjacent signal receivers

The crosstalk ratio between two adjacent signal receivers should not be less than 74 dB in the relevant frequency band.

2.3.8 During the register signalling period no speech transmission takes place. It is not essential therefore for the register signalling equipment of systems having separate equipment for that purpose to take account of §§ 2.3.2 to 2.3.7 above but it is desirable to adopt appropriate clauses for efficient signalling performance.

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SECTION 3

CONTROL OF ECHO SUPPRESSORS

Recommendation Q.115

3. CONTROL OF ECHO SUPPRESSORS

3.1 *General*

In order to achieve transmission objectives on long automatic and semi-automatic telephone connections, it is necessary to take into account the effects of echo. A general discussion of echo considerations is given in Recommendation Q.42 which is an extract of Recommendation G.131. Included there are rules governing the use of echo suppressors. Both ideal rules and practical rules are listed. The characteristics of terminal half-echo suppressors are given in Recommendations G.161 [1] and G.164 [2].

The various rules mentioned above can be carried out at switching centres only if sufficient information is available to coordinate an overall control action. Logical means to obtain pertinent information and the switching considerations governing its practicable use are detailed below. Control based on the transfer of signals between switching centres is given particular attention. Self-contained control action such as tone disablement of echo suppressors for data transmission is not within the scope of this Section.

In the cases to be discussed, control methods will be applied at international exchanges (CTs), but it is recognized that in some countries covering large geographic areas it may be appropriate to extend the control methods into national networks.

The actions described in §§ 3.5 to 3.8 about the analysis of information and the decision to be taken in an outgoing transit or incoming international exchange are summarized in the SDL flowchart of the Annex A.

The control of echo cancellers requires further studies. Provisionally, the use of the term of echo suppressor covers both echo suppressor and echo canceller devices.

3.2 *Compatibility of echo suppressors and signalling equipment*

a) Arrangements should be incorporated in the switching equipment to prevent echo suppressor action from disturbing simultaneous forward and backward signalling via the speech paths. For this case typical arrangements are:

- i) locating the echo suppressors on the switching side of the signalling equipment;
- ii) inhibiting the action of echo suppressors located on the line side of the signalling equipment by means of an appropriate condition extended from the signalling equipment to the echo suppressor while signalling is in progress.

Note – The standard half-echo suppressor (Recommendations G.161 [1] and G.164 [2]) if located on the line side of line signalling equipment may adversely affect signalling. This difficulty is possible because with the new standard half-echo suppressor normal operation will at times cause 6 dB additional loss to appear in the path to a line signalling receiver. Operating margins are correspondingly reduced. For example, with signalling receivers for System No. 5 as specified in Recommendation Q.112, signalling reliability could be impaired. Accordingly, adequate operating margins should be assured or the echo suppressor should not be located on the line side of line signalling receivers. With regard to interregister signalling which requires simultaneous transmission in both directions, similar considerations call for disabling the echo suppressors while interregister signalling is in progress in order to prevent the 6 dB loss.

b) Arrangements should be incorporated in the Systems No. 6 and No. 7 equipment to prevent echo suppressor action from disturbing the procedure for making the continuity check of the speech path.

3.3 Terminology

a) Subsequent discussion of control measures will refer only to the standard terminal half-echo suppressor specified in Recommendation G.161 [1]. The term *echo suppressor* will be used to denote this device.

b) Two means for introducing echo suppressors are considered as acceptable, these are, the use of permanently associated echo suppressors and the use of echo suppressors inserted from a common pool of echo suppressors.

c) With respect to d.c. control of permanently associated echo suppressors, control actions are said to *enable* or *disable*.

d) With respect to echo suppressors provided from pools, control actions are concerned with *inserting* or *not inserting*.

e) The signals assigned in Systems R2, No. 6 and No. 7 (and reserved in System No. 4) for echo suppressor control are in most cases a means to guide subsequent exchanges in taking necessary action with respect to possible introduction of an incoming echo suppressor. Thus the descriptive phrases associated with the various signalling systems, as given below, convey comparable meaning in the control plan.

Systems No. 4 and R2: incoming half-echo suppressor required,

Systems No. 6 and No. 7: outgoing half-echo suppressor included.

f) A secondary signalling function related to echo suppressor control provides for the possibility that echo suppressors may not be available at an originating CT. In this case responsibility for both outgoing and incoming echo suppressors may be delegated by signal.

g) A *long* circuit is considered as one which, if used by itself, would require echo suppression.

h) A *short* circuit is considered as one which, if used by itself, would not require echo suppression.

3.4 Operation without signals

In Signalling Systems No. 5 and R1, signals are not available for echo suppressor information. In System No. 4 a signal may be applied only if multilateral or bilateral agreements authorize its use. Accordingly, the recommended control plan relies on means other than signals in cases where it has not been found practicable to provide signals. In the case of System No. 5, the normal field of application to long circuits typically indicates the presence of echo suppressors. In the case of System R1, regional control procedures not requiring signals are applicable.

3.5 Analysis of information at an outgoing international exchange

The outgoing international exchange, hereafter designated "A", must make a decision with respect to its echo suppressor requirements at the time an outgoing circuit is selected. Unless echo suppressors are not available, one or more of the following items of information should influence this decision:

- i) country code of destination and possibly some additional address digits;
- ii) information about the actual routing of the call;
- iii) nature of outgoing international circuit at A (e.g. satellite circuit);
- iv) nature of incoming national circuit at A;
- v) signals received over the incoming national circuit at A.

With respect to iii) and iv), the characteristic of primary interest is propagation time. Two general categories, *long* and *short*, are the basis of control action. See §§ 3.3 g) and h) above, for definition of terminology.

3.6 Decision to be taken at the outgoing international exchange

If the factors i) to v) in § 3.5 above indicate that there is no need to provide echo suppressors on a particular connection, the outgoing exchange should act accordingly and advise subsequent exchanges by signal or other appropriate means, of its decision.

If the information available indicates that the connection to be established will require echo suppression and if it is known that an outgoing echo suppressor is not already provided in the national network, then the outgoing exchange should provide for the outgoing echo suppressor. The outgoing exchange should also, if signals are available, indicate by signal to subsequent exchanges as appropriate what action it has taken.

In the event that an outgoing exchange is unable to provide an outgoing echo suppressor when a need is known, it may call for cooperative action. (Signal I-11 in System R2 is specifically assigned to make possible a cooperative transfer of responsibility for echo suppressor control from an originating CT to a transit CT. The signal *outgoing half-echo suppressor not included* could be used with Systems No. 6 and No. 7, but such an application would in effect assume that a modern exchange found sufficient reason to displace an outgoing echo suppressor from its preferred location.)

3.7 *Decision to be taken at an international transit exchange*

The decision at an international transit exchange depends on an assessment of switching and signalling information available after the transit CT has selected an outgoing circuit. Information similar to that listed in 3.5 i) to v) above is of interest.

a) When the first transit CT knows that an outgoing echo suppressor has not yet been provided closer to the call source by a signal of CCITT Systems No. 6, 7 and R2, or by bilateral agreements for specific exceptions, the transit CT should consider the outgoing circuit selected, the ultimate call destination and such other information as indicated above. If a connection requiring echo suppression may result, an outgoing echo suppressor should be enabled or inserted at the first transit CT.

b) When the transit CT concerned knows that an outgoing echo suppressor is located closer to the call source, the question to be decided is the location of the incoming echo suppressor. The incoming echo suppressor is located at the transit CT only when a location nearer to the called party is not practicable. Specifically, an exception may result when the transit CT selects a *short* terminal circuit equipped with CCITT Signalling Systems No. 4, 5, or R1. In this case, an incoming echo suppressor should be enabled or inserted at the transit CT.

c) It follows from the above that in every case where an international transit centre interconnects two circuits and knows that echo suppressors will be provided at a preceding location and also at a more distant location, the transit centre should disable or not insert its own echo suppressors. (Full echo suppressors are not covered in the control plan and should not be affected by the procedures described in this Section.)

d) It is, of course, commonly the case that an outgoing echo suppressor has not been introduced at the outgoing exchange because none is required. When the transit exchange has reason to know of such a situation, it should not introduce echo suppressors and should advise the subsequent exchange when possible that an incoming echo suppressor is not required (or equivalently, that an outgoing echo suppressor has not been introduced).

e) In the case of a routing where both an incoming and outgoing half echo suppressor have already been inserted at earlier points, the transit exchange should advise the subsequent exchange, where possible, that an incoming half echo suppressor is not required.

3.8 *Decision to be taken at the incoming international exchange*

Short circuits equipped with CCITT Systems No. 5, R1 and 4 (unless bilateral agreements are reached), provide no signals at the incoming CT for selective use of echo suppressors. As a result, in the absence of separate circuit groups on the same route or other alternatives, the economic choice is to omit echo suppressors. In the case of a call that has passed through a transit exchange en route to the incoming exchange, the requirement for an incoming echo suppressor should then be met at the preceding CT as covered in § 3.7 b) above.

With CCITT Systems No. 6, 7, R2 and 4 (assuming multilateral or bilateral agreement) selective use of echo suppressors on *short* terminal links is a basic option. Therefore, the terminal CT acts in accordance with the control signal received. When an outgoing echo suppressor has been included at a preceding CT, the incoming CT should enable or insert an incoming echo suppressor.

When no echo suppressor has yet appeared elsewhere in the connection, none should be enabled or inserted at the incoming CT.

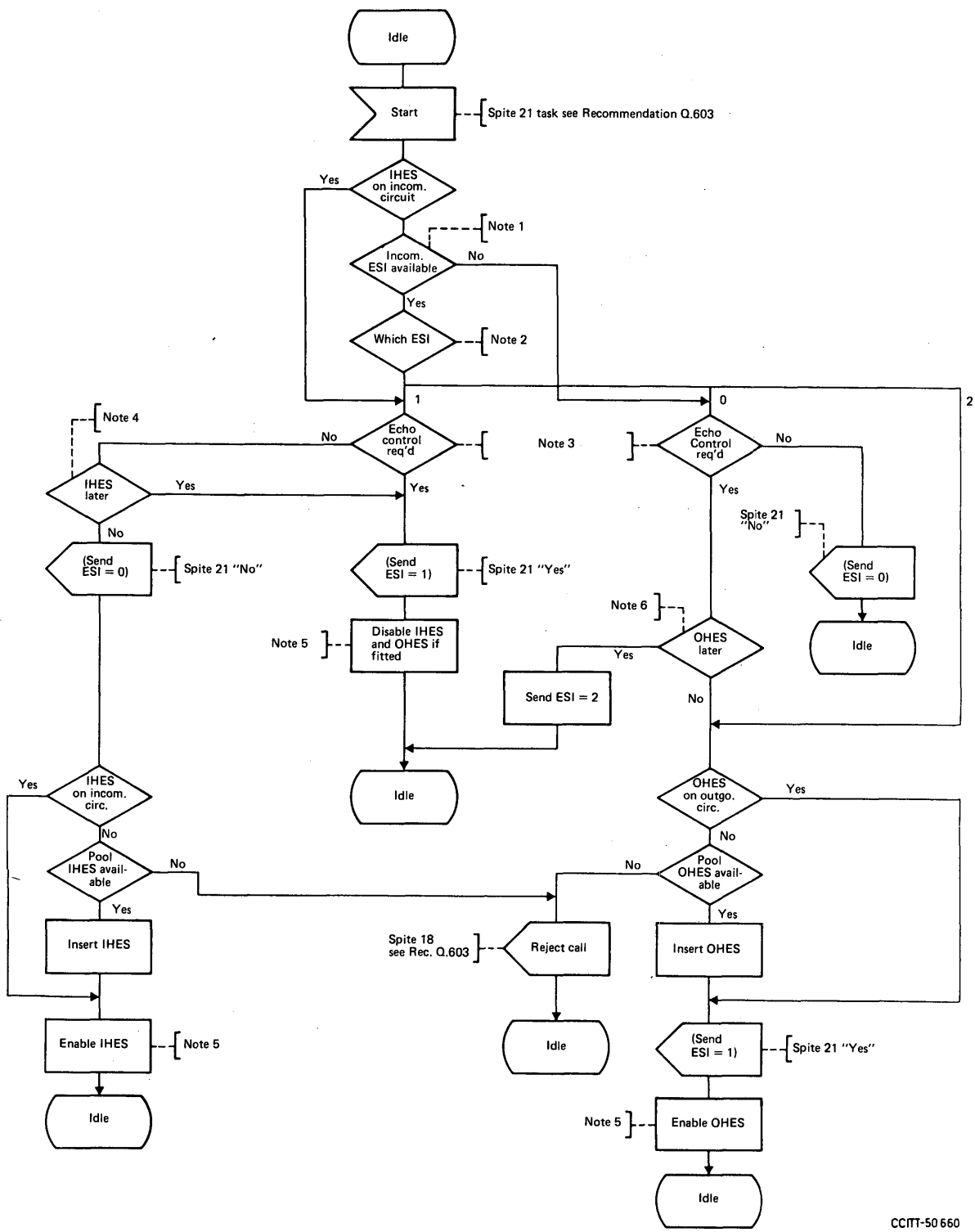
3.9 *Other considerations*

It is recognized that when echo suppressors are inserted from pools, there is a small probability that no echo suppressor will be available when needed. In this case an (equipment) congestion signal should be given to the calling subscriber.

Nothing in this Recommendation should be construed as discouraging control measures which may supplement the plan described and lead to improved results in specific situations. For example, regional procedures which introduce loss to control echo may be arranged to satisfy both regional and international needs on a selective basis. In addition for multiple ISC in one country the procedure of Annex B may be applied. It is recognized that possibilities for echo control have not been exhausted. If switching and signalling equipment have a changed role in the application of future procedures, this Recommendation will be subject to revision.

(to Recommendation Q.115)

Call processing logic – Echo suppressor control



CCITT-50 660

Call processing logic – Echo suppressor control diagram notes.

Note 1 – “Yes” where incoming signalling system provides echo suppressor indicators (ESI). For terminal R2 calls ESI is only available on request using signal A14. Signal A14 should only be returned where an IHES can be inserted.

Note 2 – ESI = 0, OHES not included, IHES not required.

ESI = 1, OHES included, IHES required.

ESI = 2, OHES not included, OHES required.

Note 3 – Analysis of digits indicates a long connection which requires or already has echo suppressors; or route analysis indicates that permanent echo suppressors are fitted.

Note 4 – IHES should be connected as close to called subscriber as possible. This decision relates to the capability of the next or a later exchange to connect echo suppressors from a pool.

Note 5 – During the “register activated” phase all echo suppressors should be disabled. Enable or disable actions refer to the period after register deactivation, except for System R2 where it refers to the period after the reception of the answer signal.

Note 6 – This exchange cannot connect OHES, but by bilateral agreement is to be connected at next exchange. The indicator ESI = 2 is only used in Signalling System R2 and can only be used between the outgoing R2 international exchange and the first transit exchange.

ESI	Echo suppressor indicator.
IHES	Incoming half echo suppressor.
OHES	Outgoing half echo suppressor.
SPITE 21	Incoming half echo suppressor to be included at distant end? See Recommendation Q.603.

Note 7 – On R2 to R2 transit calls where I – 12 is received and half echo suppressors are fitted to an outgoing satellite link, end-to-end operation is allowed and I – 12 will therefore be sent (see Recommendation Q.479).

ANNEX B

(to Recommendation Q.115)

Echo suppressor control on inter-ISC circuits within a single country

In the case where an international transit call is connected through multiple ISCs in a single country in tandem, the following problem may arise with the control of echo suppressors.

Referring to Figure B-1/Q.115, which shows such a connection with two possible outgoing international circuits, one echo suppressed (Exchange B), and one unsuppressed (Exchange C). Exchange E does not have echo suppressors in a pool. Exchange D does not know whether or not the outgoing circuit from Exchange E is provided with echo suppressors. It is not therefore able to control the half echo suppressor HESd, since there may be an incoming half echo suppressor later in the connection.

In order to overcome this problem, a backward signal can be used from Exchange E, which informs Exchange D of the provision of echo suppressors on the outgoing international circuit.

Two methods are currently proposed by Administrations to provide these backward indications, these are detailed below:

- i) A backward signal to Exchange D indicating the presence or absence of echo suppressors on the outgoing international circuit is generated by Exchange E as soon as the outgoing circuit has been selected. If a call failure situation subsequently arises and a repeat attempt is made then a new outgoing international circuit is chosen, and a further signal is passed back to Exchange D indicating the presence or absence of echo suppressors on this new circuit. HESd is then enabled, or disabled according to the last backward echo suppressor indicator received from Exchange E.
- ii) In this case HESd is initially disabled, and remains so unless a signal is received from Exchange E indicating the absence of echo suppressor on the outgoing circuit. Exchange E only transmits such a signal if the outgoing international circuit has no echo suppressor provided, and will delay transmission of the signal until the address complete signal (or equivalent) is ready to be sent.

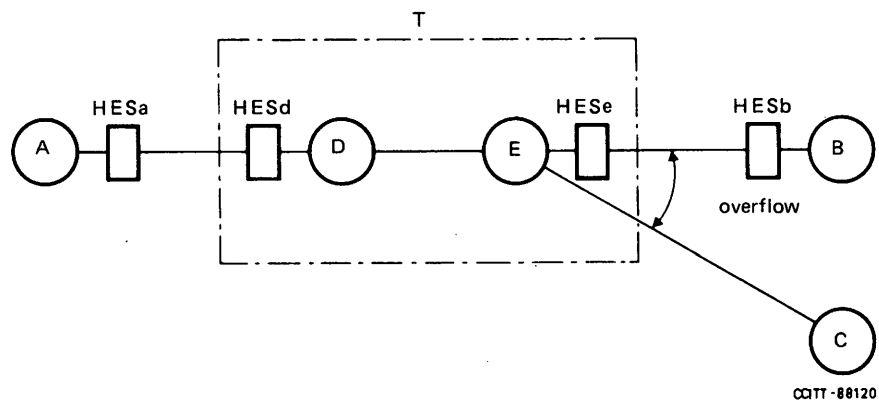


FIGURE B-1/Q.115

ES control on multiple ISCs in a country

References

- [1] CCITT Recommendation *Echo suppressors suitable for circuits having either short or long propagation times*, Vol. III of Orange Book, Rec. G.161.
- [2] CCITT Recommendation *Echo Suppressors*, Vol. III, Rec. G.164.

SECTION 4

ABNORMAL CONDITIONS

Recommendation Q.116

4.1 INDICATION GIVEN TO THE OUTGOING OPERATOR OR CALLING SUBSCRIBER IN CASE OF AN ABNORMAL CONDITION

In general, when an abnormal condition occurs in the setting up of a call, the outgoing operator in semi-automatic operation and the calling subscriber in automatic operation should receive an indication to show that it is necessary to make a new attempt to set up the call or to take other appropriate action.

The tables in the specifications of the signalling systems give details of the signals that are received at the outgoing exchange when abnormal conditions occur in setting up a call. Each Administration will decide how these signals are to be translated into appropriate indications for outgoing operators or calling subscribers.

Recommendation Q.117

4.2 ALARMS FOR TECHNICAL STAFF AND ARRANGEMENTS IN CASE OF FAULTS

4.2.1 In general, when an abnormal condition is recognized as being possibly due to a fault, an alarm must be given to indicate this condition and, if possible, any other necessary operation must be carried out to avoid circuits being put out of service unnecessarily and to facilitate fault tracing.

4.2.2 There will be the usual alarm and fault indication arrangements for such items as blown fuses, disconnected heat coils, faulty signalling equipment, failures of power supplies, failures of common control equipment, etc., as provided under the specifications of each Administration.

4.2.3 The occupation of each item of equipment such as line circuit equipment, link circuit, operators' calling equipment, selectors, registers, etc., can be indicated by the lighting of a lamp near to the equipment concerned, or by other suitable means, as may be available, e.g. in exchanges with stored-programme control.

4.2.4 It can be arranged for the progress of a call to be followed, in particular the sending or reception of digits or successive numerical signals. In this respect, each Administration will decide the arrangements it desires to install, taking account of the practice which it normally follows in this matter.

4.3 SPECIAL RELEASE ARRANGEMENTS

- 4.3.1 *Answer signal not received by an outgoing exchange after receiving a number-received signal or number-received information (Systems No. 4 and R2) or after receiving an address complete signal (Systems No. 6 and No. 7) or after transmitting the ST signal (System No. 5)*

It is recommended that arrangements should be made either in the national network of the outgoing country or at the outgoing international exchange, for the connection to be released if an answer signal is not received within a delay period of 2 to 4 minutes as soon as it is known, or can be assumed, that the called subscriber's line has been reached.

If an Administration adopts a shorter delay period for this forced release condition, there will be a risk that the international connection will be released prematurely on calls not returning an answer signal. If the maximum delay of 4 minutes is exceeded, it will of course involve an unnecessary occupation of international circuits.

- 4.3.2 *Delay in clearing by the calling subscriber in automatic service (arrangements made in the outgoing country)*

In automatic working, arrangements must be made to clear the international connection and stop the charging if, between 1 and 2 minutes after receipt of the clear-back signal¹⁾, the calling subscriber has not cleared. Clearing of the international connection should preferably be controlled from the point where the charging of the calling subscriber is carried out.

Such timed supervision may also be applied in semi-automatic service.

During the establishment of the connection to the requested extension, PBXs should not return clear-back condition, because this would unintentionally clear the connection especially on calls from networks with shorter time-outs.

- 4.3.3 *Clear-forward signal not received by the incoming exchange after sending a clear-back signal²⁾*

The incoming circuits at the incoming international exchange should include an arrangement for releasing the national part of the connection if, after sending a clear-back signal, a clear-forward signal is not received within 2 to 3 minutes (provided that a similar arrangement is not already made in the national network of the incoming country). This arrangement avoids indefinite blocking of the national circuits of the country of destination or of the subscriber's line in the case of interruptions of the line or equipment faults.

Since the call may be a semi-automatic call not including the time-out of 4.3.2 at the outgoing end, the expiry of the 2 to 3 minute time-out should not cause any alarm or blocking actions on the international circuit.

Recommendation Q.118 bis

4.4 INDICATION OF CONGESTION CONDITIONS AT TRANSIT EXCHANGES

In the case of congestion at a transit exchange, the following conditions apply:

- 4.4.1 The busy-flash signal or an equivalent signal shall be returned to indicate that there is equipment congestion in the exchange or that no free outgoing circuit is available. This signal shall be returned within the periods specified.

In semi-automatic and in automatic working, the receipt of this signal by the international exchange will cause the clear-forward signal to be sent so as to release the international connection and will give a suitable indication to the calling subscriber or operator, unless an automatic repeat attempt is made.

¹⁾ In the North American network the corresponding time-out is 10 to 32 seconds.

²⁾ These release arrangements may not be used within some regional networks.

PART VI

SUPPLEMENTS TO THE SERIES Q RECOMMENDATIONS

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REPORT ON THE ENERGY TRANSMITTED
BY CONTROL SIGNALS AND TONES

(For this Supplement, see Supplement No. 1 in Volume VI-4 of the *Green Book*)

Supplement No. 2

CHARACTERISTICS OF SPEECH INTERPOLATION SYSTEMS
AFFECTING SIGNALLING

1 Celtic system

1.1 General

The first generation CELTIC system (concentrator exploiting the idle time of circuits) has been in operation since 1977. A second generation system, to come into operation in 1983, is now being developed (1980).

CELTIC is a fully digital system (see Figure 1).

Connection and service messages can be routed on a CELTIC signalling circuit between terminals A and B.

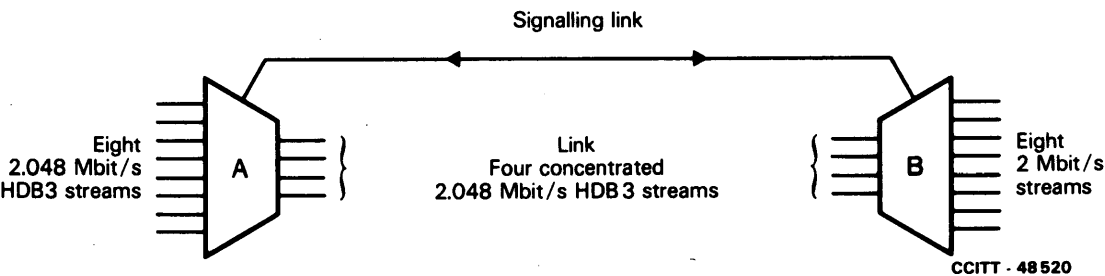


FIGURE 1

1.2 Summary description of CELTIC

The incoming PCM streams are synchronized and then multiplexed (possibly with a jump or doubling of the PCM frame, if the clocks of the incoming PCM streams are not synchronous).

The signal is then sent to a speech detector unit and to a delay line (see Figure 2).

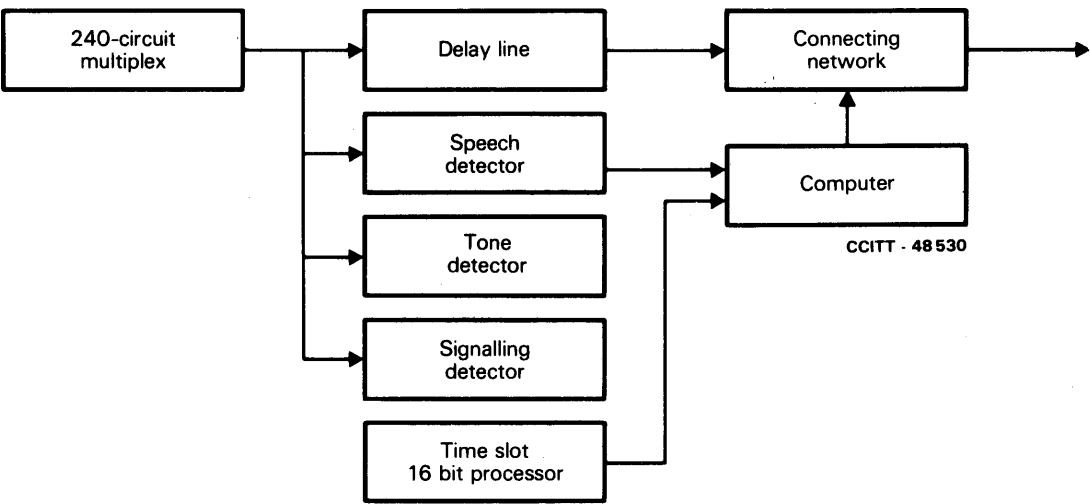


FIGURE 2

1.2.1 Delay line

The delay line is used to offset delay due to the decision time of the speech detector, the answering time of the computer (search for an available channel and its assignment to an active circuit) and the processing time taken by the CELTIC signalling unit to set up the connecting message. The delay line is the same for all circuits (adjustable from 0 to 32 ms). Its nominal value is 32 ms.

This delay line may be cancelled circuit by circuit.

1.2.2 Speech detector

- In the CELTIC 1G system, the speech detector has two hangover times:
Short hangover: 50 ms (speech duration less than 50 ms)
Long hangover: 180 ms (speech duration more than 50 ms)
- In the CELTIC 2G system, there will be only one hangover of 120 ms. The speech detector will be adapted to noise in a range between –40 and –55 dBm0.

The decision time of the speech detector varies according to the nature of the signal (between approximately 2 and 12 ms). The decision criteria are constituted mainly by the amplitude of the signal, but also by the presence of sibilants in the speech.

The speech detector takes into account the speech level in the receiving channel: a positive decision is given only if the level of the sample of transmitted speech is higher than the level in the receiving channel.

In the CELTIC 2G system, the speech detector is backed up by a *signalling detector*: when a signalling frequency is recognized, this detector suppresses the return channel protection and where necessary the delay line and disables the echo suppressors which may be integrated in CELTIC. This signalling detector reacts quickly and is adapted to the signalling pulses in the band (signal shape criterion).

The speech detector is associated with a 2100 Hz tone detector (data transmission).

Tone detection suppresses *return channel protection*, effects *circuit-channel locking* and suppresses *the delay line of the circuit concerned*.

1.2.3 Processing of TS-16 bits

CELTIC contains a device for taking out the significant bits of the TS 16 (a, b, c) in the transmitting direction and reinserting them in the receiving direction.

This device has two functions:

- transmitting direction: it detects changes in the state of the significant bits of the TS 16 and informs the computer.
- receiving direction: it can modify one or more bits of the TS 16 according to information provided by the computer (command to block junctor or to disable echo suppressor).

1.2.4 Echo suppressor

An echo suppressor multiplexed on 240 circuits is provided with CELTIC, if desired (an inexpensive addition).

In this case, the echo suppressor should be disabled on a telephone signalling phased circuit (one of the purposes of the above mentioned signalling detector).

Note – The 32 ms delay introduced by CELTIC in any case necessitates the use of echo suppressors on all circuits.

1.3 Links between CELTIC and the transit centre

There are four types of link:

- speech links,
- signalling links,
- links for circuit blocking command,
- links for echo protection disabling command, where necessary.

The number and nature of the links depend on the operational conditions of CELTIC:

- nature of transit centre,
- signalling system (CCITT Nos. 4, 5 and 6, R1 or R2),
- position of CELTIC in relation to the transit centre,
- position of echo suppressors in relation to signalling sets.

Circuit blocking is requested circuit by circuit or for 30 circuits common to the same PCM, in case of alarm, in case of gradual stopping of the CELTIC or in case of dynamic load control.

1.4 *Operation of CELTIC with different types of signalling*

1.4.1 *Signalling System No. 4*

The 32 ms delay introduced by CELTIC necessitates the use of echo suppressors, which must be disabled if they are below the signalling sets in the signalling sequence (echo suppressors integrated in CELTIC). Pulse bridging would lead to a prohibitive hangover time.

Adoption of a *fixed hangover time of 120 ms* for the speech detector will lead to a lower concentration rate, by preventing the CELTIC from operating in "freeze-out", in order to limit the number of unsuccessful calls.

1.4.2 *Signalling System No. 5*

A hangover of 120 ms is suitable for this type of signalling. The signalling detector disables echo protection where necessary.

1.4.3 *Signalling System No. 6*

The echo suppressors are disabled during the continuity test. No particular problems.

1.4.4 *Signalling System R2*

In the digital version, line signalling is transmitted by 2 bits of the TS 16:

The CELTIC 2G system examines these bits and transmits through the CELTIC signalling channel to the other end *any change in the state of these bits*, circuit by circuit.

The echo suppressors and the action of the delay line are disabled during the register signalling sequence (action of signalling detector).

1.4.5 *Conclusion*

The presence of delay lines implies systematic provision of echo suppressors. A single hangover time of about 120 ms in the speech detector will suffice, with a limitation for System No. 4, which requires a lower freeze-out rate.

2 **DSI characteristics**

The INTELSAT 120 Mbit/s time division multiple access (TDMA) system incorporates the use of digital speech interpolation (DSI). The TDMA/DSI system will be used with Intelsat V and post-Intelsat V satellites operating in 80-MHz hemisphere and zone beam transponders and will provide high quality service in accordance with CCIR Recommendation 522 [1].

The DSI system increases the capacity of the TDMA system by interleaving speech bursts from different terrestrial channels on the same satellite channel. Inputs to the DSI module are digitally encoded in accordance with Recommendation G.711 [2] using encoding referred to as "A-law" with alternate digit inversion.

The system is transparent to in-band Signalling System No. 5 and the speech detector hangover time is such as to avoid disconnection of the link between successive signalling packets.

Competitive clipping (of speech bursts) lasting more than 50 ms occurs on less than 2% of the voice spurts. This is made possible in part by appropriating (or stealing) the least significant bit (8th bit) of satellite channels to create overload channels when all normal satellite channels are in use.

A complete description of the INTELSAT TDMA/DSI system may be found in the INTELSAT document BG-42-65 [3].

3 **TASI characteristics affecting signalling**

3.1 During a normal telephone conversation each party usually speaks for only about 40% of the time (speech activity), 60% of his channel time being idle. TASI (Time Assignment Speech Interpolation) is an equipment which rapidly switches channels to talkers on a time-shared basis to make use of the otherwise idle channel time and thus permits a greater number of simultaneous calls than would otherwise be possible with the available channels in the cable.

TASI interpolates to associate an interchange circuit with a transmission channel when speech is detected on a circuit at one end and is required to be transmitted, over a channel, to the same circuit at the other end. Depending upon the need, circuit/channel association ceases, and the channel is made available to other circuits when the cessation of a burst of speech is detected.

When speech begins and a channel is available, but not yet associated, a time (the initial clip) elapses before detection of the speech (or signal) by the TASI speech detector and circuit/channel association at each end. Should the TASI system be heavily loaded, a channel may not be immediately available. In this situation a time (extended clip) in addition to the initial clip elapses before circuit/channel association.

To reduce the number of times clipping occurs, the TASI speech detector is given a hangover, maintaining circuit/channel association, to bridge the shorter gaps in speech, and thus reduce the interpolation. This feature permits the transmission of a sequence of short-pulse short-gap signals without signal clipping.

As signals must be detected by the TASI speech detector before transmission over the TASI system and as the total clip (initial clip + extended clip) reduces the duration of the received signal, TASI affects signalling.

3.2 There are three TASI systems in service. TASI-A and TASI-B make use of analogue – time division switching matrices while TASI-E uses a digital, time division matrix. Circuits can be connected directly from a digital switch to the TASI-E in digital format (Recommendation G.735 [4]). A primary multiplex per Recommendation G.733 [5] must be placed between an analogue switch and the TASI-E to provide the conversion to PCM digital format. If the outgoing transmission channels are analogue, a primary multiplex per Recommendation G.733 must be placed between the TASI-E equipment and the analogue channels. TASI-E is designed to work with Signalling System No. 5 using the standard inband line signalling, and of course with System Nos. 6 and 7 circuits. The continuous energy Signalling System R1 line signalling on each circuit is detected by the TASI-E terminal and then sent to the distant TASI-E terminal over the internal data links.

Clipping has been reduced in TASI-E by putting 50 ms fixed delay in each direction in the circuits so that processing and circuit/channel connections can be made while the inband signals are still in the delay circuits. The initial clip is thus eliminated and the extended clip reduced by about 20 ms.

3.3 The characteristics of TASI affecting signalling may be summarized as follows: TASI-A, TASI-B and TASI-E have similar characteristics except where noted:

3.3.1 TASI-A speech detector sensitivity; –40 dBm0.

TASI-B speech detector sensitivity: usually –36 dBm0 although it does change to –28 dBm0 if input level remains higher than –20 dBm0 in excess of 200 milliseconds. The TASI-E speech detector is made up of the basic speech detector, which adapts to the average speech level and background noise, and signalling-by-pass circuits which detect the presence of moderate level MF frequencies and provide extended hangover time to bridge the gaps between pulses.

3.3.2 To minimize speech activity on the RETURN channel due to reflection from the GO channel. The TASI speech detector on the RETURN channel is reduced in sensitivity in the presence of speech on the GO channel. This also applies to signalling. Thus in situations where simultaneous forward and backward signalling is required, the level of the backward signalling must be such as to take account of a reduction in the sensitivity of the speech detector at the end receiving the forward signal. TASI-A sensitivity may be reduced to as little as –25 dBm0. TASI-B sensitivity to –28 dBm0. In TASI-E the basic speech detector has echo protection but the signalling-by-pass circuits do not, thus allowing simultaneous signalling in both directions.

3.3.3 Nominal duration of speech detector hangover for a single burst:

TASI-A

- a) 50 ms for input signals of 50 ms or less;
- b) 240 ms for input signals greater than 50 ms;

TASI-B

- c) 10 ms plus burst length for burst lengths up to 40 ms;
- d) 180 ms for burst lengths greater than 40 ms.

TASI-E

- e) 128 ms for input signals greater than –19 dBm0;
- f) 88 ms for input signals between –19 and –25 dBm0;
- g) 16 ms for input signals less than –25 dBm0.

3.3.4 Nominal duration of clip of a signal (including the 5 ms response time of the TASI-A or TASI-B speech detector):

- a) initial clip: 18 ms;
- b) total clip when TASI-A or TASI-B is heavily loaded and a free channel is not immediately available, expressed as a probability that a signal will be clipped for a certain time or longer: (see Table 1).

TABLE 1

Total clip	Number of TASI-A or TASI-B systems in series on one circuit		
	1	2	3
125 ms	1/100	1/20	1/10
250 ms	1/700	1/140	1/60
500 ms	1/15 000	1/5000	1/1500

A total clip of 500 ms was assumed for the System No. 5 design, and the duration (850 ± 200 ms) of the forward-transfer pulse line signal concerned includes a 500-ms TASI prefix for TASI circuit/channel association.

3.3.5 For multiple pulses of short duration, a maximum duration of gaps between short-pulse signals has been determined to maintain continuous operation of the speech detector and thus continuous circuit/channel association. For TASI-A the maximum allowable duration of the gaps is twice the pulse duration over the pulse range 10 to 60 ms and over the operate level range of the speech detector.

This assumes prior energizing of the speech detector to give the 240 ms hangover [see § 3.3.3 b) above] before the short-pulse short-gap signalling is applied. Since TASI-A is more critical than either TASI-B or TASI-E in this respect, a short pulse signalling system designed to work properly over TASI-A circuits will also work properly over TASI-B or TASI-E circuits. For TASI-B prior energizing of the speech detector will give 180 ms hangover initially. The hangover for successive pulses will depend on the length of the pulse as given in §§ 3.3.3 c) and d). The hangover for TASI-E will depend on the level of the signal which energized the speech detector and will be up to 128 ms for the range of signalling frequency levels as shown in §§ 3.3.3 e) to g).

The register short-pulse short-gap multifrequency signalling adopted for the System No. 5 takes advantage of this continued speech detector operation and is transmitted without a TASI prefix, reliance being placed on the circuit/channel association due to the seizing signal.

References

- [1] CCIR Recommendation *Allowable bit error rates at the output of the hypothetical reference circuit for systems in the fixed satellite service using pulse-code modulation for telephony*, Vol. IV, Rec. 522, ITU, Geneva, 1978.
- [2] CCITT Recommendation *Pulse code modulation (PCM) of voice frequencies*, Vol. III, Fascicle III.3, Rec. G.711.
- [3] INTELSAT document, No. BG-42-65.
- [4] CCITT Recommendation *Characteristics required to terminate 1544-kbit/s digital paths on a digital exchange*, Vol. III, Fascicle III.3, Rec. G.735.
- [5] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 1544 kbit/s*, Vol. III, Fascicle III.3, Rec. G.733.

**INFORMATION RECEIVED ON NATIONAL VOICE-FREQUENCY
SIGNALLING SYSTEMS**

Country	Frequency (Hz)	Tolerance at the generator terminal (Hz)	Frequency variation possible at the entry to the international circuit (Hz)	Splitting time (milliseconds)	Absolute level of the power of signals at the point of zero relative level (decibels)
Algeria	2000	± 6	± 12	15 then 35 with attenuated 18 dB	-5
Saudi Arabia	3825	± 3	± 5	—	-5
Argentina	3825	± 4	± 10	—	-5
Australia	600-750 separate	± 5	± 15	160-210	0
Austria	2280	± 6	± 15	30	-6
Bahamas	2600	± 5	± 10	35 maximum	-8 and after attenuation -20
Bangladesh	3825	± 5	—	28-55	—
Benin	700-1700 separate 200	± 10	± 10	50	-6
Botswana	3825	± 3	± 10	25	-5
Brazil	3825	± 3	± 6	30 maximum	-5
Burundi	3825	± 6	± 15	—	-6
Cameroon	3825	± 4	± 15	—	-5 and after attenuation -20
Canada	2600	± 5	± 10	30 maximum	-8 and after attenuation -20
Chile	3825	± 4	± 10	—	-18 or -20
China	2600	± 5	—	30-50	-8
Cyprus	3825	± 3	± 8	35 maximum	-6 -18
Colombia	3825	± 4	± 4	40 ± 10	-20
Comoros	3825	± 5	—	—	-20
Korea (Rep. of)	3825	± 10	± 10	—	-15
Costa Rica	2280 3825	± 6 ± 4	± 10 ± 10	25 maximum —	-12 or -20 -20

Country	Frequency (Hz)	Tolerance at the generator terminal (Hz)	Frequency variation possible at the entry to the international circuit (Hz)	Splitting time (milliseconds)	Absolute level of the power of signals at the point of zero relative level (decibels)
Cuba	3825	± 6	± 15	25	-5
Denmark	3000 3825	± 6 ± 4	± 10 ± 6	30-50 —	-8 -20
Dominican (Rep.)	2600	—	—	—	—
Spain	2500	± 3	± 15	10	-6
United States of America	2600	± 5	± 10	30 maximum	-8 and after attenuation -20
Fiji	3825	± 3	—	—	-20
France	2280	± 3	± 6	35	-6
Ghana	3825	± 3	—	—	-5
Guatemala	3825	± 4	± 4	—	-20
Guinea-Bissau	3800	± 3	—	15	-6
Hungary	2100 or 2280 3825	± 6 ± 6	± 15 ± 15	25 25	-6 -6 -20
India	2400	± 2	± 10	25 filter loss at 2400 Hz → 50 dBm	-10
Indonesia	3825	± 4	± 15	30	-8
Iran	3825	± 4	± 6	35	-20 ± 1
Iraq	3825	± 5	—	—	-18
Ireland	3825	± 4	—	—	-20
Israel	3850 550-1980	± 4 ± 4	± 6 ± 10	—	-5 -11.5 ± 1
Italy	2040-2400 separate and compound	± 6	± 15	35	-9
Jamaica	2600	± 5	± 15	35 maximum	-8 and after attenuation -20
Jordan	3825	± 3	—	10	-18 -20

Country	Frequency (Hz)	Tolerance at the generator terminal (Hz)	Frequency variation possible at the entry to the international circuit (Hz)	Splitting time (milliseconds)	Absolute level of the power of signals at the point of zero relative level (decibels)
Kenya	3825	± 6	—	—	—6 and after attenuation —20
Lesotho	3825	± 5	± 10	—	—5
Liberia	3825	± 5	—	—	—6
Luxembourg	3825	± 3	± 5	35-40	—5
Madagascar	2280	± 3	± 6	35	—6
Malta	3825 3825	± 10 ± 1	— —	— —	—18 —18
Morocco	2280	± 3	± 10	25-35	—6
Mexico	2400	± 5	± 15	35 maximum	—8 and after attenuation —20
Mozambique	2400 500/20 1625 3350 3825	± 6 ± 6	± 15 ± 15	35-40 40-60	—5 —5
New Zealand	600-750 2280 3825	± 3 ± 6 ± 4	± 3 ± 6 ± 4	140 maximum 35 maximum —	—3 —10 —20
Oman	3825	± 5	—	10	—6 and after attenuation —18
Uganda	2040-2400	± 6	—	30-40	—9
Paraguay	3825	± 4	—	—	—5
Peru	3825 1380-1500 1620-1740 1860 1140-1020 900-780 660	± 4 ± 4 ± 4	± 6 ± 6 ± 10	— — —	In agreement with Recommendations Q.414 [1] Q.415 [2] Q.452 [3] Q.454 [4]
Philippines	2600(*) 3825 (*) This frequency will not be used in the future	± 5 ± 3	± 10 ± 15	40 $\pm$ 10 20	—8, —20 —14 and after attenuation +9

Country	Frequency (Hz)	Tolerance at the generator terminal (Hz)	Frequency variation possible at the entry to the international circuit (Hz)	Splitting time (milliseconds)	Absolute level of the power of signals at the point of zero relative level (decibels)
Poland	2280 3825 500/20 2100	± 6 ± 3 ± 10 ± 3	± 8 ± 4 ± 20 ± 10	— — — —	—6 —5 —3 —6
Portugal	3825	± 5	± 15	30-50	—18
Syria	3825	± 3	—	50	—18
Romania	3825 or 2280	± 4	—	—	—6
United Kingdom	600-750 separate 2280	± 3 ± 6	— —	140 maximum 35 maximum	—3 (600) —3 (750) —6
South Africa (Rep. of)	3825 2280	± 1 ± 5	— —	— 35 maximum	—5 —6
Sweden	2400	± 6	± 11	35-40	—6
Switzerland	3000	± 6	± 2	40	—3.5
Surinam	3825 1380-1500 1620-1740 1860-1980 1140-1020 900-780 660-540	± 0.8	± 10	—	—18 after attenuation In agreement with Recommendations Q.452 to Q.454
Swaziland	3825	± 3	—	—	—6 and —20
Tanzania	3825	± 6	—	—	—6 and after attenuation —20
Czechoslovakia	2280	± 6	± 15	150 then 130 with filter	—6
Thailand	3825	± 3	± 6	30-50	—6
Togo	3825 1380-1500 1620-1740 1860-1920 1140-1020 900-780 660-540	+ 5 + 4 + 4 + 4 + 4 + 4 + 4	± 10 ± 10	40-50 40-50	In agreement with Recommendations Q.414 Q.415 Q.452 Q.454
Tunisia	2400	± 6	± 15	40 maximum	—6

Country	Frequency (Hz)	Tolerance at the generator terminal (Hz)	Frequency variation possible at the entry to the international circuit (Hz)	Splitting time (milliseconds)	Absolute level of the power of signals at the point of zero relative level (decibels)
USSR	1200-1600 separate and compound	± 5	± 15	40 maximum before reply, 150 $\pm$ 50 after reply 50-75	-9
	2600	± 6	± 15		-9.5
Uruguay	3825	± 3	± 40	20	-18
Venezuela	3825	± 2	± 2	—	-6 -18
Viet Nam	3825	± 6	± 25	—	-6
Yugoslavia	2280	± 6	—	—	-6
	3825	± 6	—	—	-5
Zambia	3825	± 3	± 3	30-50	-20

References

- [1] CCITT Recommendation *Signal sender*, Vol. VI, Fascicle VI.4, Rec. Q.414.
- [2] CCITT Recommendation *Signal receiver*, Vol. VI, Fascicle VI.4, Rec. Q.415.
- [3] CCITT Recommendation *Requirements relating to transmission conditions*, Vol. VI, Fascicle VI.4, Rec. Q.452.
- [4] CCITT Recommendation *The sending part of the multifrequency signalling equipment*, Vol. VI, Fascicle VI.4, Rec. Q.454.

Supplement No. 4

VARIOUS TONES USED IN NATIONAL NETWORKS

(For this Supplement, see Supplement No. 2 of Fascicle II.2)

Supplement No. 5

NORTH AMERICAN PRECISE AUDIBLE TONE PLAN

(For this Supplement, see Supplement No. 3 of Fascicle II.2)

Supplement No. 6

TREATMENT OF CALLS CONSIDERED AS "TERMINATING ABNORMALLY"

(For this Supplement, see Supplement No. 4 of Fascicle II.2)

Supplement No. 7

MEASUREMENTS OF IMPULSIVE NOISE IN A 4-WIRE TELEPHONE EXCHANGE

(For this Supplement, see Supplement No. 7 in Volume VI-4 of the *Green Book*)

Supplement No. 8

SIGNALLING FOR DEMAND ASSIGNMENT SATELLITE SYSTEMS

(For this Supplement, see Supplement No. 8 in Volume VI-4 of the *Green Book*)

Supplement No. 9

DEFINITION OF RELATIVE LEVELS, TRANSMISSION LOSS AND ATTENUATION/FREQUENCY DISTORTION FOR DIGITAL EXCHANGES WITH COMPLEX IMPEDANCES AT Z INTERFACES

1 Introduction

During the studies of Study Group XI on transmission characteristics of exchanges it has been recognized that digital local exchanges may require complex impedances at the subscriber line interface (see Recommendation Q.517). These complex impedances result in difficulties with defining relative levels, transmission loss and attenuation/frequency distortion.

This Supplement gives the basis for coherent definitions which are in accordance with the principles outlined by Study Group XVI in the G.100 series of Recommendations, Fascicle III.1.

2 Relative levels

There is a clear statement by Study Group XVI that relative levels (L) — even at ports of complex impedance — relate to power (in general, apparent power) at a reference frequency of 1000 Hz. Accordingly, at a point of zero relative level (i.e. transmission reference point, cf. Recommendation G.101, item § 5.3.1) and at an impedance Z , the reference power of 1 mW¹⁾ (at 1000 Hz) corresponds to a voltage:

$$U_0 = \sqrt{1 \text{ mW} \cdot |Z|} \quad (1)$$

¹⁾ Watt is the unit of apparent power as well as of real power.

It follows that generally at a point of relative level L the voltage will be

$$U = 10^{L/20} \cdot \sqrt{1 \text{ mW} \cdot |Z|} \quad (2)$$

and that consequently the level L can be expressed as

$$L = 20 \log \frac{U}{\sqrt{1 \text{ mW} \cdot |Z|}} \quad (3)$$

This is the basis for a coherent definition of transmission loss, and subsequently of attenuation/frequency distortion, as derived below.

3 Nominal transmission loss

In the field of telecommunications, it is a well-established practice to define the nominal transmission loss (NL) between two points as the difference between the relative levels associated with these points. If, for instance, for a "connection through a digital exchange" the relative level at the input is L_i , and at the output, L_o , then the nominal loss is

$$NL = L_i - L_o \quad (4)$$

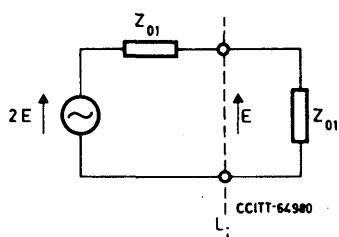


FIGURE 1

Power reference circuit

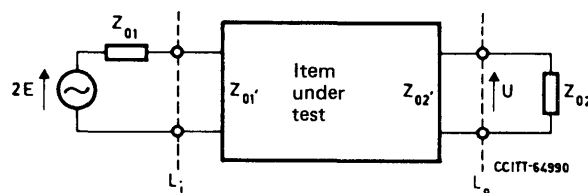


FIGURE 2

Test circuit

Taking into account that according to the definition of the power reference circuit (Figure 1), E is frequency-independent, one obtains from equations (3) and (4) the nominal loss.

$$NL = 20 \log \left| \frac{E}{U(1000 \text{ Hz})} \right| + 10 \log \left| \frac{Z_{02}(1000 \text{ Hz})}{Z_{01}(1000 \text{ Hz})} \right| \quad (5)$$

It may be noted that equation (5) represents the "composite loss" (ITU definition 05.20) at 1000 Hz. The composite loss is the only measure of attenuation that allows adding of the losses of "half-channels" (i.e. A-D and D-A) regardless of the specific impedances at the input and output ports.

4 Attenuation/frequency distortion

"Attenuation distortion" or "loss distortion" is the result of imperfect amplitude/frequency response and is generally specified in addition to the relative levels of a transmission section, from which the nominal transmission loss is derived. The definition of the attenuation/frequency distortion (LD) is well established: it is the difference between the actual response of voltage versus frequency $U(f)$ and the ideal (planned) response of voltage versus frequency $U^*(f)$, referred to the corresponding difference at 1000 Hz:

$$LD = \left[20 \log \left| \frac{E}{U(f)} \right| - 20 \log \left| \frac{E}{U^*(f)} \right| \right] - \left[20 \log \left| \frac{E}{U(1000 \text{ Hz})} \right| - 20 \log \left| \frac{E}{U^*(1000 \text{ Hz})} \right| \right] \quad (6)$$

Equation (6) can be rewritten as follows:

$$LD = 20 \log \left| \frac{U(1000 \text{ Hz})}{U(f)} \right| - 20 \log \left| \frac{U^*(1000 \text{ Hz})}{U^*(f)} \right| \quad (7)$$

For practical reasons the ideal response of voltage versus frequency, $U^*(f)$, is flat. Taking this into account, equation (7) reduces further to

$$LD = 20 \log \left| \frac{U(1000 \text{ Hz})}{U(f)} \right| \quad (8)$$

It should be noted that equation (8) is valid regardless of whether Z_{01} is equal to Z_{02} or not. However, impedance matching at input ($Z_{01}' \approx Z_{01}$) and output ($Z_{02}' \approx Z_{02}$) is assumed. A measurement in accordance with equation (8) is entirely in conformity with existing measuring techniques.

5 Conclusions

Nominal transmission loss and attenuation/frequency distortion are essential loss parameters. Their definitions in Sections 3 and 4 are based on the definition of relative (power) levels at 1000 Hz in accordance with Study Group XVI which has stated the following advantages:

- 1) an illustrative indication of passband performance (especially with regard to band-edge distortion and extraneous ripples);
- 2) a loss definition in accordance with the relative level definition;
- 3) the loss values are relevant to singing margin evaluation;
- 4) the loudness insertion loss will be (almost) equal to the exchange loss;
- 5) additivity with a fair degree of accuracy;
- 6) the definition is also suitable for half exchange loss currently envisaged by Study Group XI.

Supplement No. 10

IMPEDANCE STRATEGY FOR TELEPHONE INSTRUMENTS AND DIGITAL LOCAL EXCHANGES IN THE BRITISH TELECOM NETWORK

1 Introduction

When planning the introduction of digital local exchanges it is essential to take into account the subjective performance offered to customers. This will, of course, include provision of overall loudness ratings within an acceptable range of values. Noise, distortion and other impairments also need to be adequately controlled. However, it is also important to consider those parameters largely influenced by the impedances associated with telephone instruments, local lines and exchanges. In particular acceptance values of sidetone and echo/stability losses need to be obtained. These parameters are influenced by the choice of:

- i) Input and balance impedances of telephone instruments,
- ii) Input and balance impedances of the digital exchange hybrid,
- iii) Impedances of the 2-wire local lines.

This contribution outlines the impedance strategy adopted for telephone instruments and digital local exchanges in the British Telecom network. It is shown that there are major advantages in adopting complex impedances both for the exchange hybrid and for new telephone instruments. The contribution includes calculations of sidetone, echo and stability balance return losses based on a sample of 1800 local lines in the British Telecom network.

2 Impedance strategy for a digital local exchange

2.1 In order to adequately control echo and stability losses in the digital network the nominal hybrid balance impedance Z_B for lines of up to 10 dB attenuation is based on a 3 element network. This network consists of a resistor in series with a parallel resistor/capacitor combination, i.e:

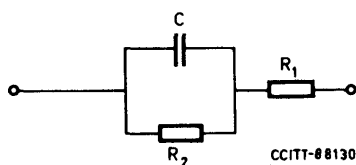


FIGURE 1

Network configuration

With appropriate component values it has been found that this network can give significantly improved echo and stability balance return losses compared with a resistive network.

2.2 The nominal exchange input impedance Z_I is also based on a 3 element network of the same form as the balance impedance Z_B . This network, with suitable component values, is required to give an acceptable sidetone performance on the lower loss lines. It has been found that a $600\ \Omega$ resistive input impedance gives unacceptable sidetone performance on these lower loss lines.

3 Impedance strategy for telephone instruments

It should be noted that the digital local exchange is designed to operate with a low feeding current ($\approx 40\text{ mA}$). The telephone instrument will therefore be operating as though it were connected to a long line on a conventional analogue exchange. In particular, any regulation function will be disabled.

The input impedance of present instruments is, under low current feeding conditions, substantially resistive. It has been found that there is a significant improvement in echo/stability balance return losses at the exchange hybrid if the telephone input impedance is also made complex. The preferred impedance is close to the design value for the exchange balance impedance Z_B .

4 Background to calculated results

This section includes the results of calculating STMR values, echo and stability balance return losses for a range of local connections.

Four groups of exchange lines have been used where the groups have mean attenuations of 1 dB, 3 dB, 6 dB and 9 dB. Each group consists of at least 100 samples of local lines in the British Telecom network with attenuations within 1 dB of the mean value for the group.

Two telephone instruments have been used with identical characteristics except for input impedance. One instrument retains a conventional, substantially resistive impedance; the other instrument uses a complex capacitive input impedance. The sidetone balance impedance is, in both cases, designed to match long lengths of 0.5 mm Cu cable.

Two cases for the exchange hybrid impedances are considered. The strategy outlined in Section 2 is used i.e., complex input and balance impedance, and for comparison purposes, a conventional "transmission equipment" hybrid is assumed with nominal $600\ \Omega$ input and balance impedances.

Using a computer program, values of echo and stability balance return losses, and sidetone masking rating are calculated for the four exchange line groups with the two telephone instruments and two exchange line hybrids.

5 **Results**

5.1 *Sidetone values*

For this case the comparison is made between a 600 Ω exchange input impedance and a complex input impedance. (It should be noted that the STMR values have been calculated as in Supplement No. 4 to Volume V).

The component values for the exchange input impedance are:

$R_1 = 300\ \Omega, R_2 = 1000\ \Omega, C = 220\ \text{nF}$ (see Figure 1).

The results are summarized in Table 1 below:

TABLE 1
Calculated values of STMR

Exchange termination	Mean value of STMR (dB)			
	Attenuation of local line group (dB)			
	1	3	6	9
600 Ω	2.6	5.2	8.1	12.4
Complex termination	13.9	14.8	12.7	13.0

It is clear from Table 1 that a 600 Ω termination gives far from satisfactory results with shorter local lines which will include at least 50% of local lines in the British Telecom network. Use of a complex input impedance improves these STMR values by approximately 10 dB and the values are closer to the recommended values given in Recommendation G.121.

These results show that a complex input impedance is essential for the case of sensitive telephone instruments directly connected to digital exchange hybrids. The performance with a resistive impedance is in fact worse than the performance on a conventional analogue exchange because of the low feeding current and impedance masking effect of the digital exchange.

5.2 *Echo and stability balance return losses*

As far as impedance is concerned the most important factor is the choice of the balance impedance for the exchange line hybrid as this determines the network echo and stability performance. Initially a comparison is made between a 600 Ω impedance and a complex impedance assuming existing telephone instruments. Having chosen a balance impedance it is then shown that a further improvement can be made by considering the telephone input impedance.

5.2.1 *Exchange balance impedance*

Table 2 below shows the summarized results for mean values of echo balance return loss (calculated according to Recommendation G.122, Volume III.1, Yellow Book), and stability balance return loss.

Note — The complex balance impedance has nominal values $R_1 = 370\ \Omega, R_2 = 620\ \Omega, C = 310\ \text{nF}$ (see Figure 1).

TABLE 2

Calculated values of mean echo (stability) balance return losses
assuming existing telephone input impedance

Exchange balance impedance	Mean value of echo (stability) balance return loss dB			
	Attenuation of local line group dB			
	1	3	6	9
600 Ω	22.5 (13.9)	12.9 (7.5)	9.4 (6.2)	8.3 (6.0)
Complex impedance	10.2 (8.0)	13.8 (9.1)	15.2 (11.2)	17.1 (12.9)

In addition to calculating mean values for the distributions it is important to consider the edges of the distributions. This is especially true for echo and stability performance where it is the worst case values that are likely to cause network difficulties.

Table 3 shows the minimum values of calculated echo and stability balance return losses for the samples of lines considered. The values for stability balance return loss are those given in brackets.

TABLE 3

Calculated values of minimum echo (stability) balance return losses
assuming existing telephone input impedance

Exchange balance impedance	<i>Minimum</i> value of echo (stability) balance return loss dB			
	Attenuation of local line group dB			
	1	3	6	9
600 Ω	20 (13)	11 (5)	8 (4)	6 (3)
Complex impedance	9 (7)	11 (7)	12 (9)	11 (7)

With the exception of the 1 dB sample of lines it can be seen from Table 2 that the complex impedance results in mean values for the distributions which are higher than the corresponding values using a 600 Ω impedance. The improvement is particularly marked for the higher loss exchange lines. When the minimum values of the distributions are also taken into account (Table 3) there is a clear advantage in using the complex balance impedance. A similar advantage would also be obtained with non-speech devices such as data modems which have an impedance similar to that of the telephone instrument (assuming a low feeding current).

5.2.2 Telephone input impedance

Having chosen a suitable complex balance impedance for the exchange hybrid, the options for changing the telephone input impedance can be considered. Tables 4 and 5 present calculated results for the distributions of echo and stability balance return losses at the exchange hybrid, comparing the effect of complex and resistive telephone input impedances.

Note – The input impedance has nominal values $R_1 = 370\ \Omega$, $R_2 = 620\ \Omega$, $C = 310\ \text{nF}$.

TABLE 4
Calculated value of mean echo (stability) balance return losses
assuming complex exchange balance impedance

Telephone input impedance	Mean value of echo (stability) balance return loss dB			
	Attenuation of local line group dB			
	1	3	6	9
Resistive	10.2 (8.0)	13.8 (9.1)	15.2 (11.2)	17.1 (12.9)
Complex	29.0 (23.6)	21.0 (13.9)	16.9 (12.8)	17.0 (11.8)

TABLE 5
Calculated value of minimum echo (stability) balance return losses
assuming complex exchange balance impedance

Telephone input impedance	Minimum value of echo (stability) balance return loss dB			
	Attenuation of local line group dB			
	1	3	6	9
Resistive	9 (7)	11 (7)	12 (9)	11 (7)
Complex	24 (18)	15 (11)	13 (10)	10 (7)

The results in Tables 4 and 5 show a significant improvement in echo and stability balance return losses for the lower loss local lines. There is little difference for the higher loss lines as the balance return loss is primarily determined by the cable characteristics. It can be concluded that there is a clear advantage in designing future telephone instruments with a complex input impedance.

6 New telephone instruments in the existing analogue network

In § 5.2.2 the advantages of a complex telephone input impedance have been illustrated when used with digital exchanges. However, there are also advantages if these instruments are used on conventional analogue exchanges.

The sidetone balance impedance of instruments is generally optimised around the capacitive impedance of unloaded cable. If the telephone input impedance is also capacitive then the sidetone performance of instruments on own exchange calls can be improved. The improvement will be most marked when both instruments are on short lines hence the sidetone is largely determined by the input impedance of the other instrument. This situation is widely encountered on analogue PABXs where the majority of extensions are of low loss.

7 Application to other voiceband terminal equipment

The discussions in this paper have concentrated on telephone instruments. However the conclusions concerning telephone input impedance can equally be applied to other voiceband equipment. e.g., data modems. Work in Study Group XVI has shown that higher speed modem service require signal to listener echo ratios approaching 25 dB for successful operation. If the data modem adopts a complex input impedance then the improvements in stability balance return losses (and hence signal to listener echo ratio) discussed in § 5.2.2 can be obtained.

8 Summary and conclusions

This paper has considered aspects of an impedance strategy for the local network with the introduction of digital local exchanges and new telephone instruments.

Calculations based on a large sample of local lines in the British Telecom network have shown that:

- i) The input impedance of the digital exchange must take into account the sidetone performance of the telephone instruments. To provide acceptable sidetone performance it has been found necessary to provide a complex input impedance which more closely matches the sidetone balance impedance of the telephone instrument.
- ii) Adopting a complex exchange balance impedance gives a significant improvement in echo and stability balance return losses. This improvement is considered necessary to provide adequate echo performance in the digital network without requiring extensive use of echo control devices.
- iii) A further improvement in echo and stability losses is obtained by using a complex input impedance for new telephone instruments. This impedance also improves the sidetone performance of connections on analogue exchanges.
- iv) The conclusions are also relevant to other voiceband apparatus. Signal to listener echo ratios on voiceband data connections can be improved if the modems use a complex input impedance.

