THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE

(C.C.I.T.T.)

FIFTH PLENARY ASSEMBLY

GENEVA, 4-15 DECEMBER 1972

GREEN BOOK

VOLUME VI - 4

Telephone signalling and switching

QUESTIONS OF STUDY GROUPS XI AND XIII

SUPPLEMENTS (Documentary Part)

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QUESTIONS ON TELEPHONE SIGNALLING AND SWITCHING ENTRUSTED TO STUDY GROUP XI FOR THE PERIOD 1973-1976

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[a] A Working Party of Study Group XI is to be responsible for examining not only Part A (technical aspects) of the Annex to this question but also Part B (economic, maintenance and staff training aspects). [See section 5 of the Minutes of the 11th Plenary Meeting, Fifth Plenary Assembly.]

Question 1/XI — Digital version of C.C.I.T.T. signalling system No. 6

Considering that:

1. the increasing application of PCM techniques in telephone networks gives rise to a requirement for digital versions of certain currently specified C.C.I.T.T. signalling systems;

2. increased use of common channel signalling will apply;

3. digital versions of the R1 and R2 C.C.I.T.T. signalling systems are specified;

4. the digital version of the C.C.I.T.T. signalling system No. 6 is envisaged in the No. 6 specification and that it is necessary to complete the desired range of specifications of digital version signalling systems as some Administrations may wish to apply the digital version of signalling system No. 6 between digital exchanges;

5. certain basic decisions and certain proposals on the digital version of system No. 6 have been made by Special Study Group D and Study Group XI resulting from the study of Question 3/Sp.D, but the detailed specification is not prepared;

6. the Annex details the present position in regard to the basic decisions reached together with further relevant information;

a) what detailed specification for the digital version of C.C.I.T.T. signalling system No. 6 should be recommended?

b) what arrangements, if any, should be recommended to permit the alternate use of analogue and digital data links?

This work will require close cooperation between Study Group XI and Special Study Group D.

ANNEX

(to Question 1/XI)

Digital version of C.C.I.T.T. signalling system No. 6

1. *Asynchronous and synchronous modes of operation for a digital version of system No. 6*

1.1 *Asynchronous mode of operation for a digital version of system No. 6*

Special Study Group D has considered the case where a complete 64 kbit/s PCM channel is available for common-channel signalling. In this case a 2400 bit/s data link can be derived by sampling the 2400 bit/s data stream asynchronously at 64 kHz.

It has been established that in some cases of practical significance there is a desire for the information bit rate of the digital version of the data link to be the same as that of the analogue data link as described in Recommendation Q.273. In these cases the digital and analogue data links may be used as direct substitutes, without in any way affecting the operation of the remainder of the common channel signalling system.

Furthermore, as most of the functions of modulation and demodulation can be performed by the 2048 kbit/s PCM multiplex, an additional advantage is obtained in that the 4-phase modem (Recommendation Q.274) can be replaced by a simple digital circuit.

The interface requirements are set out in Section 4.1 below.

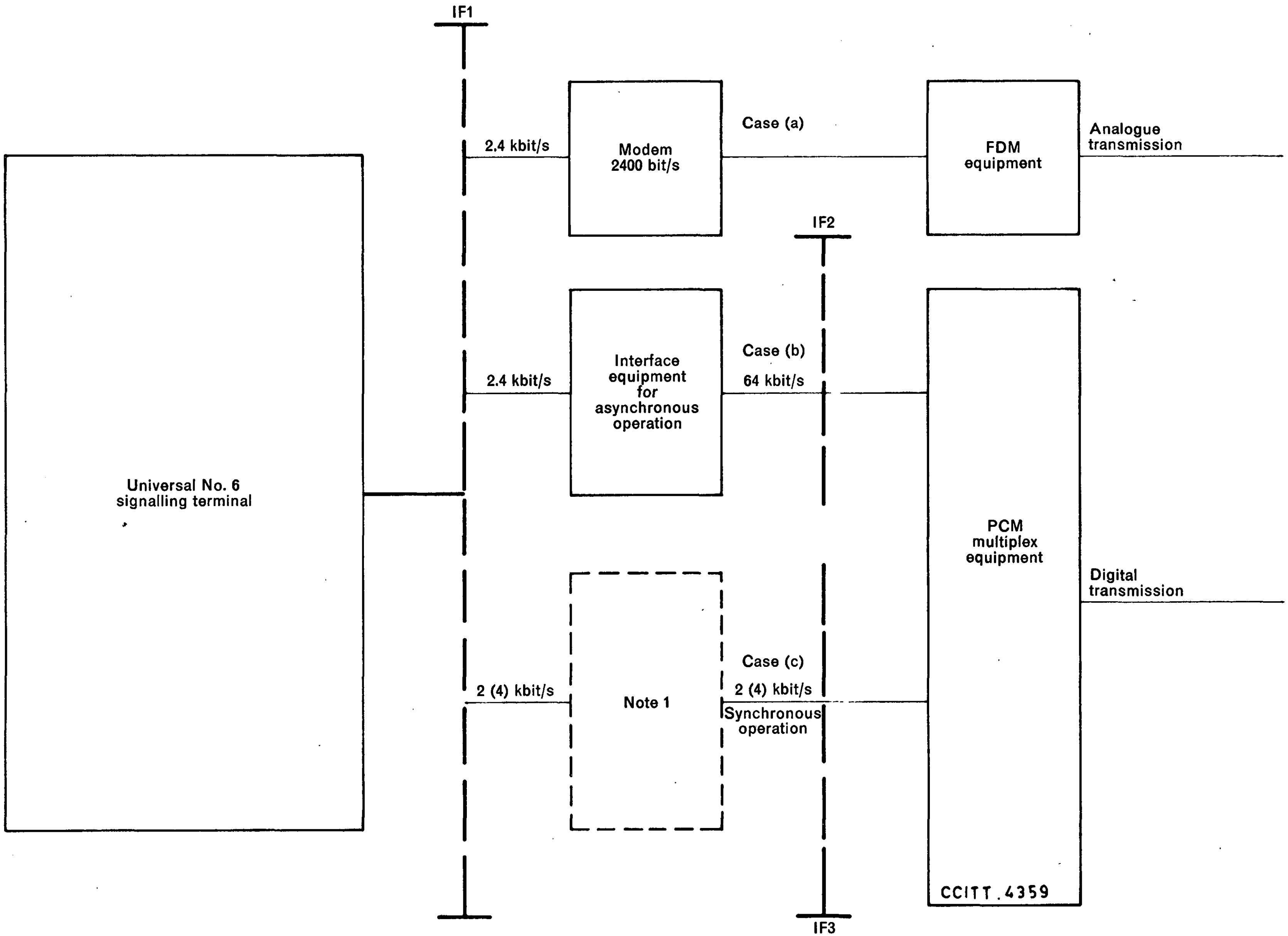
It is therefore proposed:

i) that this method be recommended for use in those cases where the advantages listed above apply;

ii) that a detailed specification be elaborated.

1.2 *Synchronous mode of operation for a digital version of system No. 6*

For synchronous operation a signalling speed of a submultiple of 8 kbit/s is mandatory.



Note 1. — Interface equipment required if interface 3 is not compatible with interface 1.

FIGURE 1/Question 1/XI

1.2.1 *2 kbit/s speed*

For the synchronous mode of operation of a digital version of system No. 6, a data rate of 2 kbit/s would provide a solution without restriction.

1.2.2 *4 kbit/s speed*

Considering that:

i) both specifications of the PCM primary multiplexes also permit the possibility of deriving a 4 kbit/s data channel conveniently without affecting a complete 64 kbit/s time slot; and

ii) on terrestrial circuits the propagation time would be such that there should be no block numbering problems;

a speed of 4 kbit/s has merit for the following reasons:

a) the signal transfer time is reduced and there is thus the possibility of serving a greater number of speech channels per signalling link;

b) reason a would be of particular significance for the quasi-associated mode of operation since the delay at a signal transfer point (which is a major part of the total delay) is minimized due to the reduced emission time. This is of considerable significance should extensive use be made of quasi-association in world-wide, regional or national network;

c) as a consequence of b, possible concentration of signalling on fewer routes may be achieved.

1.2.3 *8 kbit/s speed*

A signalling speed of 8 kbit/s would give rise to an ambiguity in the acknowledgement procedure as now specified. The cyclic block numbering (8 numbers) is not sufficient to cover the number of blocks in process which may not have been acknowledged. This problem would not arise when sufficiently short propagation times apply.

Further, the specification for the 1544 kbit/s PCM primary multiplex does not provide an 8 kbit/s signalling channel. For these reasons further consideration of an 8 kbit/s data rate is not recommended.

1.2.4 *Conclusions*

It is therefore proposed that:

i) the 2 kbit/s signalling data rate be recommended for use without restrictions;

ii) the 4 kbit/s signalling data rate may be applied for terrestrial circuits regardless of length, by bilateral agreement;

iii) the 8 kbit/s signalling data rate is not recommended.

2. *Locking of the clock frequencies (go and return PCM channels of the digital data link)*

a) The only simplification of the system No. 6 design that could be achieved by locking the go and return channels of the data link in synchronism is the omission of the drift compensation procedure;

b) Omission of the drift compensation procedure would not be a major simplification of system No. 6;

c) It would appear to be difficult to lock the go and return PCM channels between digital exchanges in all cases.

Locking of the go and return channels of the data link is not recommended. The drift compensation procedure of the No. 6 signalling system should be retained.

3. *Use of failure indication in PCM systems*

PCM systems provide for an indication to the common channel signalling equipment in the event of frame alignment being lost. That indication will be provided by the PCM equipment which detects the loss of frame alignment.

This indication will serve the same function as that given by the data carrier failure alarm detector in the analogue case (Recommendation Q.275).

4. *Interface arrangements between system No. 6 signalling terminal and PCM multiplex equipment (see Figure 1)*

4.1 *Asynchronous mode of operation (see Figure 1, case b)*

To permit the use of digital and analogue links as direct substitutes, the interface equipment, which samples the 2400 bit/s data, will have to provide a 2400 Hz send clock. In order to maintain the same drift performance, the tolerances of the send clock as specified in Recommendation Q.274, Section 6.4.2 should apply.

In addition, if the interface equipment is not integrated into the signalling terminal equipment, IF1 (Figure 1) will have to be specified as in Recommendation Q.274, Section 6.4.8.

A signalling interface, IF2 (Figure 1), between the PCM multiplex equipment and the interface[1] equipment will have to be specified and must include at least the following leads:

— signalling information incoming

— signalling information outgoing.

— 64 kHz send clock (or equivalent)

— transmission system failure indication.

The asynchronous mode of operation would be feasible if such a 64 kbit/s interface could be provided by all PCM transmission systems including higher order multiplexes yet to be designed.

4.2 *Synchronous mode of operation (see Figure 1, case c)*

Interface requirements for the synchronous mode of operation will have to be specified in a manner which is similar to that for the analogue version (e.g. see Recommendation Q.274, 6.4.6, 6.4.7, 6.4.8). In particular the timing should be derived from the PCM equipment for both the sending and receiving terminals.

A detailed specification will be required for the interconnections between the signalling terminal and the PCM terminal, e.g. data transmit, data receive, transmitting clock frequency, receiving clock frequency and loss of frame alignment indication, taking into account the expected separation between the signalling and PCM equipment and other environmental factors.

The synchronous mode of operation will be feasible if such a standard signalling interface for 2 or 4 kbit/s ports can be provided in digital terminal equipment, independent of the type of multiplex.

5. *Universal signalling terminal*

The aim should be to achieve a universal type No. 6 signalling system terminal to accommodate both digital and analogue data links, the data links to be switched as necessary.

This universal signalling terminal is interpreted as a terminal that can operate at various speeds (e.g. 2000 and 2400 and 4000 bit/s).

In order to achieve this objective, the signalling terminal (see Figure 1, in Recommendation Q.251) would need to work:

a) to an analogue channel via 2400 bit/s modem as now specified;

b) asynchronously to a 64 kbit/s port of a PCM transmission system via an appropriate interface equipment;

c) synchronously to a 2 kbit/s, or possibly a 4 kbit/s, port of a PCM transmission system.

The three cases are shown in Figure 1.

With the present arrangements for analogue working the timing is derived from the modem. The principle that the timing should be derived from the data link side for all forms of data link is recommended.

Question 2/XI — Maintenance methods for signalling system No. 6 [2]

Considering that:

1. Signalling system No. 6 was tested during study period 1968-1972;

2. Signalling system No. 6 uses a completely new and more sophisticated technique for signalling between international exchanges;

3. limited experience has been gained thus far concerning the maintenance of common channel signalling systems;

[1] See Question 7/D—Interfaces for digital systems.

[2] Study Group XIII will be associated in the study of this Question (Question 2/XIII).

4. failure of a common channel signalling system would affect a large number of speech circuits;

what operational procedures and techniques should be recommended in addition to Recommendation Q.295 for the maintenance of signalling system No. 6?

Question 3/XI — Structure of the international common channel signalling network

Considering that:

1. common channel signalling will be used in the future in national and international networks;

2. common channel signalling is suitable for use in the associated and non-associated signalling modes[1];

3. the use of non-associated common channel signalling is likely to provide significant operational and economic advantages, especially for small speech-circuit groups;

4. extensive application of non-associated signalling without restriction can result in excessive signalling delays;

5. common channel signalling permits the development of a signalling routing plan which can be independent of the speech circuit routing plan;

6. routing rules may influence the label allocation in signalling system No. 6;

what principles should be recommended for the structuring of the international common channel signalling network and what signalling routing rules should apply?

ANNEX 1

(to Question 3/XI)

Economics, signalling reliability and signalling delay considerations are basic factors in the study. Different considerations may also apply to national, regional and intercontinental parts of the world-wide network and different economic and technical characteristics of these parts of the world-wide network may influence the overall preferred structure of the international common channel signalling network. The delay of the answer signal should be an important consideration in the study. It may be desirable to recommend a maximum permissible overall delay time requirement.

The study may conclude that the number of signalling links per call should not exceed a certain number. Noting the increased use of common channel signalling in national and regional networks, possible alternatives could be:

- a maximum number of signalling links being allocated to each speech circuit link; or
- a maximum number of signalling links being allocated to each type of network; or
- a maximum number of signalling links being specified for the international network and requirements in terms of, for example, signalling delay being specified for national networks instead of a maximum number of signalling links.

[1] Signalling system No. 6 is designed to provide associated and quasi-associated modes of operation. The latter is a mode of non-associated signalling. Definitions and details are given in Recommendation Q.253.

ANNEX 2
(to Question 3/XI)

In addition to the technical problems, the introduction of international common channel signalling raises the problem of determination and apportionment of signalling charges as part of the total call charge and its apportionment. The situation is complicated by the possibility that the signalling links may transverse, and the signal transfer points may be in different countries from the countries involved in the speech connection routing. It is considered that just as the technical resolution of the signalling network structure needs to take account of the economic aspect, it is very important that the international accounting principles and procedures do not negate the technical advantages of a common channel signalling network, especially as it relates to the use of non-associated signalling.

Two very simple cases of per call signalling charge problems are given below as examples.

Case 1 — *Figure 1*

The circuit groups AC and BC justify associated common channel signalling links. Circuit group AB is small and does not justify an associated signalling link AB. The signalling for circuit group AB is via the path ACB, having been combined on signalling links AC and CB with the signalling for circuit groups AC and CB respectively. Point C functions as a signal transfer point for circuit group AB. A, B, and C may be in different countries.

Case 2 — *Figure 2*

All speech circuit groups DE, DF and FE justify associated common channel signalling links in their own right. Assuming breakdown of the signalling link DE, the signalling linkage DFE is brought into service for the speech circuit group DE. In this situation, point F functions as a signal transfer point. This case differs from case 1 in that signalling for the speech circuit group DE is routed via DFE only during breakdown of signalling ink DE.

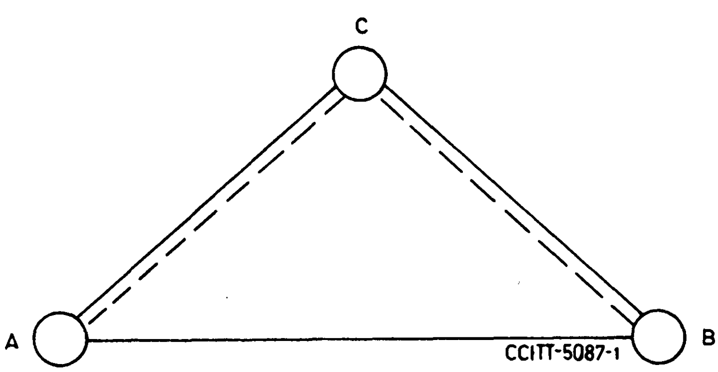


FIGURE 1/Question 3/XI

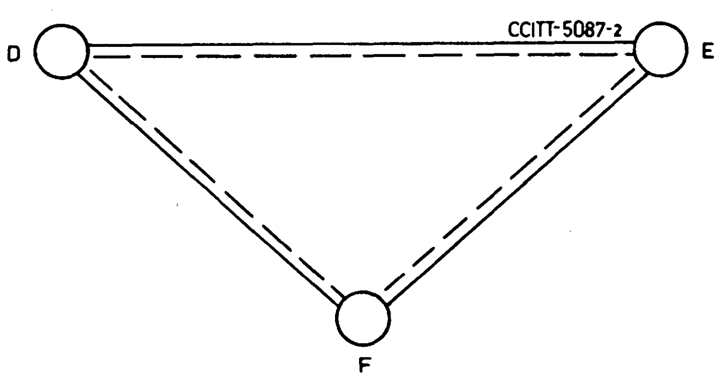


FIGURE 2/Question 3/XI

——— Speech circuit group

— — — — Common channel signalling link

Question 4/XI — Signalling arrangements for integrated (switching and transmission) digital telephone networks

Considering that:

1. *integrated digital switching and digital transmission* will apply in the future in national and international networks;

2. it is likely that this will be associated with the use of stored programme control of switching and signalling;

3. digital versions of the currently standardized C.C.I.T.T. R1 and R2 signalling systems are specified, and a digital version of the No. 6 signalling system will be specified[1] (but noting that common channel type of signalling seems to be most suitable);

4. the specifications for PCM systems produced by Special Study Group D provide means for carrying signalling information (Recommendations G.732/Q.46 and G.733/Q.47);

should these specifications and arrangements be adopted for signalling between stored programme control digital exchanges in a digital telephone network, or is it felt necessary to specify a new signalling system for this purpose? Should the latter apply, what requirements should be specified for such a new signalling system? Cooperation with Special Study Group D would be necessary.

Note.—Should it be the requirement that an *integrated services* network exist in international relations, and that the signalling arrangements be such as to accommodate the requirements for the telephone, data, etc., services, the requirements for the integrated digital telephone network would need to be determined as a contribution to the overall signalling requirement. In that case close cooperation between Study Group XI, Study Group X, Special Study Group D, Special Study Group A and Study Group VII would be a firm requirement.

Should an integrated digital *services* network not apply in international relations, the signalling arrangements resulting from the study could be specified for telephone network requirements only.

Question 5/XI — Interworking between international signalling system No. 6 and national common channel signalling systems

(continuation of Question 5/XI studied in 1968-1972)

Considering that:

1. in general, national networks may develop in a common philosophy;

2. the common philosophy is apparently based on stored programme control and common channel signalling;

3. national networks may incorporate forms of network management as part of the common philosophy;

4. as a possible consequence additional features or signals may be required on international circuits connecting such national networks;

5. System No. 6 has some spare signal capacity;

what recommendations could be formulated to facilitate interworking between an international network employing C.C.I.T.T. signalling system No. 6 and national networks employing national common channel signalling systems?

[1] See Question 1/XI.

ANNEX 1

(to Question 5/XI)

1. Summary of replies to Questionnaire on Question 5/XI (Circular Letter No. 86) issued by Study Group XI in study period 1968-1972

The questionnaire was issued in 1970. The replies were received in 1971. It is probable that changes made in system No. 6, such as the new format, would alter some replies.

1.1 *Question 1*

At what hierarchical level(s) in the network do you plan to apply common channel signalling (CCS), and what implementation timetable is contemplated?

Reply. — It is unanimously reported that introduction of CCS is considered for all hierarchical levels of the national networks. In some countries first steps are made in the trunk network, in others preference is given to a start in local networks. In Germany (F.R. of), simultaneous introduction at all levels is emphasized in order to make full use of the advantages of CCS from the beginning and to facilitate the interworking problem (partly overlay network).

On implementation timetables for national CCS no substantial details are furnished. As expected, the pace of implementation will be determined by the progress of introduction of SPC switching in the telephone exchanges. The choice of the network level at which to begin with CCS, evidently is also a function of this SPC introduction process and not of the signalling method, which is thought to be equally suited for all hierarchical network levels.

Japan has scheduled commercial tests between Tokyo and Osaka for 1972 to evaluate the economical feasibility of national CCS.

Belgium has scheduled national field trials for 1972.

A.T. & T. expects commercial service between trunk exchanges by 1974.

Germany (F.R. of) will operate national CCS by 1975.

The Netherlands plan national field trials by 1976.

It appears that only the second half of the 1970s may bring about a gradual shift from per-channel-signalling to CCS—even in the highly developed national networks this summary refers to.

1.2 *Question 2*

Does your proposed national system have operational or other requirements which cannot be satisfied by the C.C.I.T.T. No. 6 system, and what are those requirements?

Reply. — The first part of the question has received an affirmative answer from all countries, the " other requirements " ranging from " more economic solutions " to " full adaptation to the structure of an integrated digital network ". However, of the eight countries dealt with here, only four reported investigations with a view to satisfying their specific national requirements by not too far-reaching additions to C.C.I.T.T. system No. 6 specifications.

In the replies, reference is made to the following requirements for a domestic use of CCS:

a) need for much more signalling capacity than actually exploited in System No. 6:
   - more lone signals and new types of multi-unit messages are proposed;
   - there is the wish to have all the signals of a certain category systematically filed under a separate heading. Consequently, the use of more heading codes is also suggested;
   - the additional signals are to be used for:
     new services and facilities for the customers and operating organizations;
     signalling system control;
     interworking;
     remote control of exchanges;
     maintenance.

b) Need for more label capacity.

c) Continuity check of speech path:
— possibility of national end-to-end checking;
— two-tone checking in view of 2-wire sections;
— no " per call " continuity check.

d) Change and enlargement of signal unit format for easing signal processing:
— replacement of label indicator by a signal unit indicator;
— introduction of systematic numbering of all messages per call and label (for simplifying restoration of correct sequence);
— byte-oriented formats (multiples of eight bits).

e) Use of other types of signalling link:
— two or more parallel working channels;
— low level d.c. modulation or frequency shift modulation (speed less than 2400 bauds);
— 64 kbit/s channel of 2048 Mb/s PCM multiplex (with network synchronous frame transmission).

f) Use of other type of acknowledgement procedures.

g) Possibility of using the CCS system for the exchange of alpha-numerical messages between maintenance staffs at any two points (exchanges) in the networks.

1.3 *Question 3*

Briefly describe your system under the following headings, which are taken from the C.C.I.T.T. White Book, *Volume VI, Part XIV:*

— functional description of the signalling system;
— signalling procedures;
— signal unit formats and codes;
— continuity check of the speech path;
— definition and function of signals (other than those used in C.C.I.T.T. standard systems);
— description of the signalling link;
— signal traffic characteristics;
— security arrangements.

Reply.—From those countries investigating the domestic use of a CCS system based on system No. 6, Japan and Belgium have made available detailed descriptions of their systems. The contributions of Japan and A.T. & T. typically illustrate the adaptation of system No. 6 for national application (see Annex 2).

Only national specifications more or less differing from No. 6 specifications can cater for requirements referred to in 1.2 b-1.2 g.

1.4 *Question 4*

Do you foresee any problems regarding the interworking of your national common channel signalling system with the C.C.I.T.T. No. 6 system due to different operational requirements?

Reply.—None of the replies foresee problems regarding the interworking due to different nationa operational requirements.

2. Comments from Study Group XI

2.1 *General*

The replies to the questionnaire and further information available from contributions reveal that CCS systems based on system No. 6 cannot be expected to exist in all national networks. The signalling rapporteur of Special Study Group D came to the same conclusion.

So far only Belgium, Japan and A.T. & T. reported planned introduction of a national CCS system based on C.C.I.T.T. system No. 6. Hence the more general problem of interworking of various CCS systems (system No. 6 included) would deserve consideration and should be studied during the period 1973-1976.

2.2 *Transparency*

It is to be expected that in future the long distance network in many areas will be a mesh network of high density. Intensive use of transversal routes can be foreseen which in many cases will be operated with CCS in non-associated mode. Essentially then an overall signalling channel network will exist representing a link-by-link message switching system with messages and transfer procedures being different on different links—due to the various national CCS systems. In the nodes of that network, signal processing will be carried out, thereby including necessary signal translation operations if different CCS systems are joining at the particular point.

Signal translation, however, may entail laborious processing procedures which require costly computer time likely to increase in proportion to telephone traffic. Evidently, it is desirable to reduce to a minimum such additional processing, which also may introduce faults.

In existing C.C.I.T.T. interworking specifications it is pointed out that precautions are necessary with regard to signals which are lacking in one system or are used differently in the two systems, and that interworking is simplified if:

— supervisory signals have exactly the same meaning and the same function in both systems;

— the numerical information is sent in the same sequence in both systems;

— the language digits are the same in both systems.

The situation in the case of CCS obviously is similar. Lack of signals, however, should not be a problem, since such systems have a great signalling capability when compared with conventional systems. Therefore, it appears that a transparency for signals could be achieved within a signalling network which is built up of CCS links of various systems.

The following definition seems appropriate:

Transparency. — A transparent state may be said to exist between two defined points when a signal which exists at one point can be transmitted to the second point without any loss or change of information. Signal is understood here in the sense the word has in signalling systems, i.e. a piece or item of information with a standardized meaning.

Transparency of the network of signalling channels would ensure that transfer of signalling information from one link to any other is always achieved on a signal-per-signal basis. Thus, laborious analysis of several received signals for deciding which signal to transmit could be avoided.

The national CCS systems, described in the replies as not being based on system No. 6 are claimed to be designed with error correction methods which do not imply possibilities for spill-over and out-of-sequence of signals. The restoration of the correct signal sequence and the point at which it shall occur when interworking with system No. 6 will require study.

2.3 *Economy and signal capacity*

In one of the contributions received, it was observed that simplified national CCS might be expected since signalling information in national networks where conventional exchanges prevail is limited, e.g. to that transferable with C.C.I.T.T. system R2. From the available documentation on national CCS it can be gathered, however, that more economy is generally thought to be gained from different designs of the signalling link. There is definitely a trend to provide a very high signal capacity to cater for all future needs.

2.4 *Label translation*

What has been said in 2.2 regarding signal translation is also valid for label translation. It seems to be advantageous to dispense to a great extent with label translations by provision of ample label capacity (extension of format in national CCS systems).

2.5 *Continuity check*

In several replies to the questionnaire, the continuity check of the speech path has been identified as an interworking problem. It should be noted that in the French digital CCS system, continuity check is dispensed with on the assumption that in each primary multiplex there is a signalling channel used which will fail if the speech paths fail (only associated mode is applied).

2.6 *Interworking with conventional systems*

Interworking with conventional signalling and switching systems in the interior of national networks may require extra signals (see Annex 2).

3. Continuation of the study of Question 5/XI

The study of the replies to the questionnaire revealed that some common philosophy as mentioned in Question 5/XI actually exists. In future, operation of an extended network of signalling channels can be expected (see Question 3/XI). In its national parts this network will include both CCS systems differing from No. 6 and systems based on No. 6. Optimal operating conditions for the whole network through non-compromise interworking are highly desirable, particularly in view of the ultimate aim of achieving, economically, high service quality, an overall matter for which all countries are interdependent.

Recommendations on interworking of CCS systems could embrace the following subjects:

a) transparency as described in 2.2, including a complete list of signals for possible use and a systematical method of allocating the available No. 6 codes to the new signals;

b) advantages obtained through use of CCS systems based on No. 6 in national networks;

c) international/national continuity check compatibility (possibly in conjunction with methods for automatic identification and removal of faulty circuits);

d) new signals to facilitate interworking with conventional switching and signalling systems in the interior of national networks but reached over national CCS systems.

Use of a system based on No. 6 in the national networks obviously is the easiest method to simplify interworking with the international CCS system and to achieve transparency in the overall signalling network. An explicit recommendation stimulating such an application of the No. 6 specifications should be considered (item b) above). Study Group XI thinks that a high degree of commonality of CCS systems in international and national applications would have merit (e.g. C.C.I.T.T. specifications on system No. 6 to be extended with possibilities for option of alternative arrangements in favour of domestic use of the system).

ANNEX 2
(to Question 5/XI)

National common channel signalling system—based on C.C.I.T.T. system No. 6—under trial in Japan

(Reply by N.T.T. to Circular Letter No. 86: Questionnaire on Question 5/XI—See Annex 1 for question wording)

Introduction

The national common channel signalling system in Japan, based on the C.C.I.T.T. system No. 6, has been developed in connection with the development of N.T.T.'s electronic switching system (DEX), as a suitable signalling system for the stored-programme-controlled switching networks. This contribution has been prepared as a reply to the questionnaire annexed to Circular Letter No. 86 concerning the national common channel signalling system.

1. *Reply to Question 1*

Commercial tests are scheduled for the national common channel signalling system in 1972, between electronic trunk exchanges located in Tokyo and Osaka. The primary purpose of the tests is to evaluate the system's economical feasibility and to confirm the advantages of the common channel signalling, such as bothway operation, short post-dialling delay and many backward register signals, etc.

Introduction of this signalling system to the whole national telephone network, including local networks, will be further studied to reflect the experience obtained from the commercial tests, so as to cope with the various kinds of new and higher grade of telephone services foreseen in the near future.

2. *Reply to Question 2*

Our national common channel signalling system has been designed based on the original specifications for system No. 6 established in 1968. Therefore, it slightly differs from the present specifications for the international field trial. We will re-examine the national system in order to make it consistent with the final specifications for system No. 6 which will be established in 1972. For application to domestic use, however, some substantial requirements exist which cannot be satisfied by system No. 6. This section deals with outstanding features of the national common channel signalling system. Further detail is described under Section 3.

2.1 *Signal unit formats and codes*

2.1.1 *Calling party's category in the initial address message*

Bits 9-12 of the first subsequent signal unit of the initial address message are used for calling party's category. Each information in the category is defined independently from system No. 6. Therefore, in the case of interworking with system No. 6, it is necessary to convert the information by the international exchange.

2.1.2 *Second-check-OK signal and second-check-not-OK signal*

These signals, with heading code 0 1 1 0, are uniquely defined in the national network to indicate the result of second continuity check of the speech circuit. The method of continuity checking will be described under Section 3.

2.1.3 *Multi-unit message*

In the national system, all the signals with signal code 0 0 0 0 in its initial signal unit are defined as a multi-unit message, while in the system No. 6 signal code 0 0 0 0 is assigned only to the address messages associated with heading codes 1 0 0 0 to 1 1 1 1. Therefore, the following multi-unit messages may be used in the national system:

a) Multi-unit random messages carry much information in the forward or backward direction. Bits 5-12 of the first subsequent signal unit of these messages are available for additional signal information. One of these messages is a calling subscriber's number message which is used for charging at the international exchange;

b) New telephone service address messages carry the same information as the ordinary address messages, except for the calling party's information, indicating what kind of new services are being provided.

2.1.4 *One-unit data message*

One-unit data messages carry office data such as output information from maintenance typewriters. The one-unit data message uses the common channel signalling link as data link independent from the speech channels. The one-unit data message, therefore, needs no label code assigned to speech circuit. The sequence number of message block and message unit in this signal can prevent confusion when disordered messages are received.

2.1.5 *Interconnection signal*

When an international call terminates in the national network which includes another signalling system at the end of a connection, an interconnection signal shall be sent back from the last national exchange of the common channel signalling section of the connection to the incoming international exchange, in order to indicate in advance that some audible tone may be sent back from the last non-common channel signalling exchange.

2.1.6 *Label-group-blocking (unblocking) signals*

These signals are new system control signals used to perform administrative functions to block (or unblock) the speech circuits when the quasi-associated signalling link has failed (or recovered).

It is desirable that the circuit test method in the common channel signalling system be compatible with the method used in the existing national signalling systems. In the current speech circuit test method:

a) connection test is applied to the pre-blocked circuit(s) which is (are) in failure or is (are) being installed;

b) For address digits used in the connection test, the digits corresponding to various test purposes, as well as the digits for an automatic test device, are available.

To apply the above-mentioned tests to a common channel signalling system, a new test signal with address information is required other than the test signal recommended in system No. 6.

2.2 *Continuity check of the speech path*

In the national system, end-to-end continuity checking using two check-tone frequencies is adopted for the following reasons:

i) envisaged introduction of common channel signalling systems to the two-wire sections of the national network, as well as the four-wire sections, necessitates the use of two check-tone frequencies;

ii) end-to-end checking has the following advantages:
— reduction of processor load at the intermediate exchanges;
— saving of continuity check equipments at the intermediate exchanges;
— overall checking including intermediate switching paths.

When the check fails, a check-not-OK signal should be sent in a backward direction. An intermediate exchange, upon receipt of the check-not-OK signal, applies a test to each link to locate the trouble.

2.3 *Countermeasures for interruption of signalling procedures*

Interruption of signalling procedures is a commonplace phenomenon for a signalling system controlled by a processor. When a telephone signal is interrupted for more than one signal unit length, it is necessary to transmit some proxy signal(s) automatically from the terminal equipment. Upon receipt of more than several of these proxy signals, the receiving office might well interpret them as a procedure interruption. Then the receiving office may discard these proxy signals and await recovery from the interruption. When the interruption continues for a longer interval, the receiving office can alter its signalling route to avoid continued breakdown of calls so that network reliability will be ensured. The proxy signal is defined as an invalid signal unit as follows:

i) on transmitting invalid signal units
an invalid signal unit is transmitted automatically from the signalling terminal, when the processor should interrupt signalling procedures;

ii) on receiving the invalid signal units
The office receiving invalid signal units counts the number of signals and takes the measures specified in Table 1.

TABLE 1

ACTIONS TAKEN UPON RECEIPT OF INVALID SIGNAL UNITS

Degrees of continued receiving of invalid signal units	Actions
Short interval	Count the number of signals and transmit SYUs
Interval recognized as interruption of signalling procedures at the sending office	Block the speech circuit group controlled by the signalling link and type out the error record
Continued interval recognized as system breakdown or permanent failure of the sending office	Advise maintenance staff of the failure

3. *Reply to Question 3*

3.1 *Functional description of the national signalling system*

3.1.1 *Functional block diagrams*

Fundamentally similar to the C.C.I.T.T. signalling system No. 6.

3.1.2 *Signal transfer-time definitions*

Same as the C.C.I.T.T. signalling system No. 6.

3.1.3 *Operational modes of signalling link*

— Regular signalling link is in associated or quasi-associated mode.
— Standby signalling link is provided corresponding to the regular signalling link.

3.2 *Signalling procedures*

Signalling procedures of the national system are the same as signalling system No. 6, except for:

— no overlap operation is considered, viz. all address messages are sent in " enbloc " operation;
— neither address-complete nor address-incomplete signal is used;
— out of the congestion signal, only the national-network-congestion signal is used;
— in most cases, an appropriate audible tone will be sent back to indicate a called party's line condition, instead of some electrical signals.

3.3 *Signal unit formats and codes*

3.3.1 *Telephone signal*

1) Signal unit formats:
Same as signalling system No. 6.

2) Codes for the general parts of signal units:
   i) Label indicator: same as system No. 6.
   ii) Label: same as system No. 6.
   iii) Length indicator: a multi-unit message is restricted in length to a maximum of six signal units because the length indicator codes 1 0 1 in system No. 6 will be used for a part of the invariable pattern of a one-unit data message of the national common signalling system.
   iv) Check: same as system No. 6.

3) Codes for telephone signals
   i) Heading codes:
   Codes 1 0 0 1 to 1 1 1 1 are used because the subsequent address messages in system No. 6 are spare in the national system, and furthermore because no subsequent address message is used For further details, see paragraph 3.3.3 3).
   ii) Address information in the initial address message:
   Code 1 1 (1 0 1 1) and code 1 2 (1 1 0 0) are spare in the national system.
   iii) Additional information in the initial address message:
   Same as signalling system No. 6, except for bit 5 and bits 9 to 12.
   — Bit 5: terminal or transit indicator in the national networks.
   — Bits 9-12: as shown in Table 2.
   iv) Table 3 shows information in the initial signal units of telephone signal.

TABLE 2

BITS 9-12: CALLING PARTY'S CATEGORY (PROVISIONAL)

Codes 9-12	Information
0 0 1 1	Operator (offering)
0 1 0 0	Coin (local, booth type)
0 1 0 1	Coin (local, desk type)
0 1 1 0	Coin (DDD, booth type)
0 1 1 1	Coin (DDD, desk type)
1 0 0 0	Ordinary calling subscriber
1 0 0 1	Calling subscriber with priority
1 1 1 0	National test call
1 1 1 1	Incoming international call

TABLE 3

ISU INFORMATION OF TELEPHONE SIGNAL

Heading 13-16	Signal code 17-20	Signals	Remarks
0 0 0 0	X X X X	Reserved	For national new service
0 0 0 1	0 0 0 1	Originator-address-request	
0 0 1 0	X X X X	Reserved	For international use
0 0 1 1	X X X X	Reserved	For international use
0 1 0 0	0 0 1 0	Forward-transfer	
	0 1 0 0	Blocking	
	1 0 0 0	Unblocking	
	1 1 1 0	Clear-forward	
0 1 0 1	0 0 0 1	Check-OK	
	0 0 1 0	Check-not-OK	
	0 1 0 1	National-network-congestion	
	1 0 0 0	Ringing (electrical), charge	For international DDD
	1 0 0 1	Ringing (electrical), no charge	For international DDD
	1 0 1 0	Subscriber-busy (electrical)	
	1 0 1 1	Vacant-national-number	
	1 1 0 0	Line-out-of-service	
	1 1 1 0	Confusion	
	1 1 1 1	Interworking	For international DDD
0 1 1 0	0 0 0 1	Clear-back (No. 1)	
	0 0 1 0	Reanswer (No. 1)	
	0 0 1 1	Clear-back (No. 2)	
	0 1 0 0	Reanswer (No. 2)	
	0 1 0 1	Clear-back (No. 3)	
	0 1 1 0	Reanswer (No. 3)	
	0 1 1 1	Release-guard	
	1 0 0 0	Second-check-OK	
	1 0 0 1	Second-check-not-OK	
	1 1 0 1	Answer, charge	
	1 1 1 0	Answer, no charge	
0 1 1 1	X X X X	Reserved	For international use
1 X X X	X X X X	Spare	
0 0 0 0	0 0 0 0	New-service address message	
0 0 0 1	0 0 0 0	Multi-unit random message	
0 0 1 0			
	0 0 0 0	Spare	
0 1 1 1			
1 0 0 0	0 0 0 0	Initial address message	
1 X X X	0 0 0 0	Spare	

Note. — Codes X X X and X X X X are numbers except all-zero.

3.3.2 *Signalling-system-control signals*

1) Acknowledgement signal unit: same as system No. 6

2) Synchronization signal unit: same as system No. 6

3) Changeover signal:

   1 / 1 1 1 1 1 1 1 1 1 1 1 / 0 0 0 1 / 0 0 0 0 / X X X X X X X X
   check

4) Changeback signal:

   1 / 1 1 1 1 1 1 1 1 1 1 1 / 0 0 0 1 / 1 1 1 1 / X X X X X X X X
   check

5) One-unit data message

   Every unit of this message carries 8-bit data information.

   0 1 0 1 / X X X X X X X X / X / X X X X X X X / X X X X X X X X
   * ** *** check

   Note.— *: Data information.
   **: Sequence number of message block.
   ***: Sequence number of message unit.

6) Invalid unit

   This signal indicates that the processor is unable to send telephone signals to the signalling terminal for some reason.

   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 / X X X X X X X X
   check

7) Label-group-blocking (unblocking) signal

   These signals block (unblock) the speech circuits when the quasi-associated signalling link has failed (recovered from failure).

   a) Label-group-blocking signal

   1 / 1 1 1 1 1 1 1 1 1 1 0 / 0 0 0 0 / 0 0 0 0 / X X X X X X X X
   0 / 0 0 0 / X X X X / 0 / X X X X X X X X X X X / X X X X X X X X
   * ** check

   Note.— *: Number of quasi-associated links.
   **: Typical label to be blocked.

   b) Label-group-unblocking signal

   1 / 1 1 1 1 1 1 1 1 1 1 0 / 0 0 0 1 / 0 0 0 0 / X X X X X X X X
   0 / 0 0 0 / X X X X / 0 / X X X X X X X X X X X / X X X X X X X X
   * ** check

   Note.— *: Number of quasi-associated links.
   **: Typical label to be unblocked.

3.3.3 *New signals defined in the national system*

1) Interworking signal

   When an international call terminates in the national network, which includes other signalling systems at the end of the connection, an interconnection signal should be sent back from the last exchange of the common channel signalling section of the connection to the incoming international exchange, in order to indicate in advance that some audible tone may be sent back from the last non-common channel signalling exchange.

   1 / X X X X X X X X X X X / 0 1 0 1 / 1 1 1 1 / X X X X X X X X
   label check

2) Second check signal

   See Section 3.4, 4 and 5.

   a) Second-check-OK signal

   1 / X X X X X X X X X X X / 0 1 1 0 / 1 0 0 0 / X X X X X X X X
   label check

   b) Second-check-not-OK signal

   1 / X X X X X X X X X X X / 0 1 1 0 / 1 0 0 1 / X X X X X X X X
   label check

3) New service address message and multi-unit random message
These signals carry the calling party's information for charging or offering the new service.

An example of new address message with four signal unit is:

```
1 / X X X X X X X X X X X / X X X X / 0 0 0 0 / X X X X X X X X
          label                 *                    check
0 / 0 1 0 / X X X X X X X X / X X X X X X X X / X X X X X X X X
                **                 ***              check
0 / 0 1 0 / X X X X X X X X X X X X X X X X / X X X X X X X X
                        ***                     check
0 / 0 1 0 / X X X X X X X X X X X X X X X X / X X X X X X X X
                        ***                     check

   Note.—   *: 0 0 0 0: New-service address message.
               0 0 0 1: Multi-unit random message.
            **: Other signal information.
           ***: Address information.
```

3.4 *Continuity check of the speech path*

1) Method of continuity check:
A continuity check is made on a " per call " basis between the first CCS exchange and the last CCS exchange with an end-to-end method using two different check tones, as shown in Figure 3.

— A transponder is connected with the outgoing circuit at the first CCS exchange and a transceiver is connected with the incoming circuit at the last CCS exchange.

— The transceiver transmits f_2 (1300 Hz) and the transponder transmits f_1 (900 Hz) when it has received f_2.

— A check-OK signal is sent in the backward direction when the transceiver has received f_1. The first and the last CCS exchanges should complete the check with the signal.

2) Continuity-check signal:

— A check-OK signal is sent in the backward direction when the transceiver has received f_1.

— A check-not-OK signal is sent in the backward direction when the transceiver has not received f_1 within 2-4 seconds after transmitting f_2.

3) Method of second continuity check:
When a continuity check is not OK, a second continuity check is made in the manner described in 1 at each link to locate the trouble.

4) Second continuity check signal (see paragraph 3.3.3 2):

— Each CCS exchange (except for the first CCS exchange) sends the second check-OK signal in the backward direction and begins clear-forward-sequence when the second check is OK.

— Each CCS exchange (except for the first CCS exchange) sends the second-check-not-OK signal in the backward direction and initiates a clock sequence when the second check is not OK.

5) Transmission requirements for the continuity check:

i) Transmitting equipment

— Check-tone frequencies sent from:
First CCS exchange: 900 ± 6 Hz (f_1)
Last CCS exchange: 1300 ± 6 Hz (f_2).

— Sending level of the check tones:
Four-wire speech path: -9 ± 1 dBm
Two-wire speech path: -5 ± 1 dBm.

ii) Receiving equipment
— Signal frequencies received:
First CCS exchange: 1300±15 Hz (f_2)
Last CCS exchange: 900±15 Hz (f_1).
— signal level range: −3 to −33 dBm
— recognition time: 30 to 60 ms.

The non-operating requirements:
— signal level: below −43 dBm.

3.5 *New signals for the national system*

See paragraph 3.3.

3.6 *Signalling link*

Same as system No. 6, except for the following:

3.6.1 *Modem requirement*

1) Transmitter output level:
— carrier system: −15 dBm±3 dB
— other than the carrier system: −9 dBm±2 dB.
2) Receiver sensitivity range: −6 dBm to −30 dBm.

3.6.2 *Data carrier failure detector*

1) Level to indicate no failure: above −43 dBm
2) Level to indicate failure: below −48 dBm
3) No signal guard technique is used to distinguish carrier power from noise power.

3.6.3 *Synchronization*

Similar to system No. 6.

1) Initial synchronization: same as system No. 6
2) Synchronization in the case of loss of synchronism
i) Loss of synchronism at the receiving terminal:
— loss of synchronism is detected by continuous failure of three signal units;
— recovery of loss of synchronism.
The incoming bit stream will be monitored to find the SYU pattern. Once the SYU pattern is found and verified, the sequence number of units can be determined.
ii) Loss of synchronism at the opposite terminal:
— the loss of synchronism is detected on receipt of the following ACU:

```
0 1 1 / X X X X X X X X X 1 1 1 / X X X / X X X / X X X X X X X X
          acknowledgement                          check
             indicators
```

— recovery of loss of synchronism.
Three synchronization signal units should be transmitted to the opposite office with high priority.

3.6.4 *Interruption of signalling procedures*

See Sections 2.3 and 3.3.3 5.

3.7 *Signal traffic characteristics*

It is fundamentally the same as system No. 6, except for the rules of the handling time and the cross office transfer time. Every effort is being made to satisfy the design objectives of system No. 6.

3.8 *Security arrangements*

A full-time reserved asynchronous facility is provided as security arrangements for a failure of the signalling link.

1) 1-1 full-time reserved asynchronous facility
The voice-frequency link is equipped with modems and signalling terminals, thus forming a reserve signalling link. This reserve link is not synchronized and provided for the principal regular link. See Figure 2.

2) *N*-1 full-time reserved asynchronous facility
The voice-frequency link is not equipped with modems and signalling terminals, as defined in system No. 6. See Figure 3.

3) When a regular quasi-associated signalling link fails, a label-group-blocking signal is transmitted to inform of the failure and the speech circuit group corresponding to the failure link is blocked. When the failure is recovered, a label-group-unblocking signal is transmitted to inform of its recovery and to unblock the speech circuit group.

3.9 *Testing and maintenance*

Same as for system No. 6, except for the overall test. Overall connection test is not defined in system No. 6, but it is necessary in the national system, as is described in paragraph 2.1.7. It may be done over all links using the ordinary address message.

The test code format is as follows:

Calling-party's-category indicator: National test call (see Table 2)
Terminal or transit indicator: As appropriate
Nature-of-circuit indicator: As appropriate
Address signal: Toll number + office code + test device code.

The continuity of the speech path is checked before the test call is set up, in the same manner as in an ordinary call.

4. *Reply to Question 4*

Problems for interworking between system No. 6 and the national system are as follows:

1) Conversion of address message
Address message in the national system is transferred only in " en bloc " operation to simplify the call processing. The national local exchanges are not provided with international translators, because of the difficulty of updating. Therefore, the national local exchanges cannot know, by digit analysis, that the final digit has been sent, in the case of an outgoing international call. Terminated local exchange may send back neither the address-complete nor address-incomplete signal after the reception of incoming international address signals.

Therefore, when the address message is processed in overlap operation in the international system, the outgoing/incoming international exchange in Japan must convert the sending and receiving mode of address messages.

2) Conversion of electrical signal
As is described in the preceding sections, some electrical signals in the national system differ from the signals in system No. 6. An international gate-way exchange, therefore, must convert them, including the conversion between electrical signals and tones.

3) Continuity check
An international gate-way exchange must convert the continuity check method as is described in Reply to Question 3.

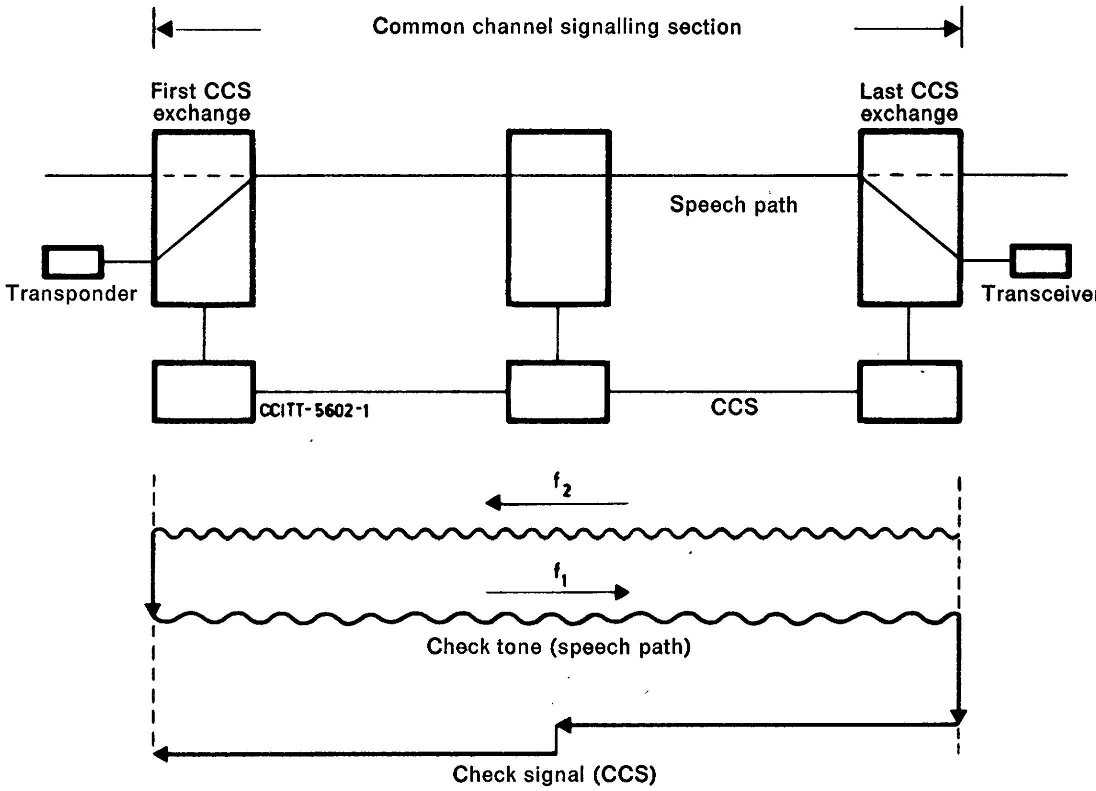


FIGURE 1/Question 5/XI. **Method of continuity check**

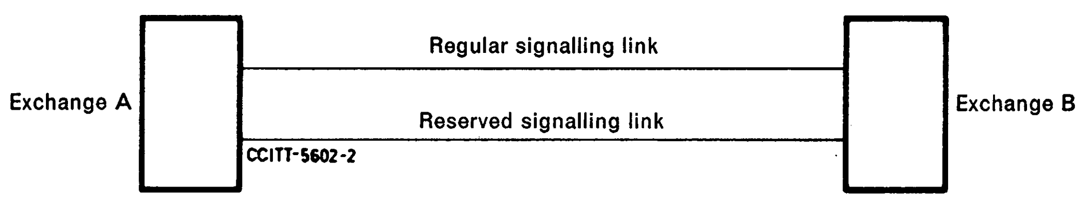


FIGURE 2/Question 5/XI. **1-1 full-time reserved asynchronous facility**

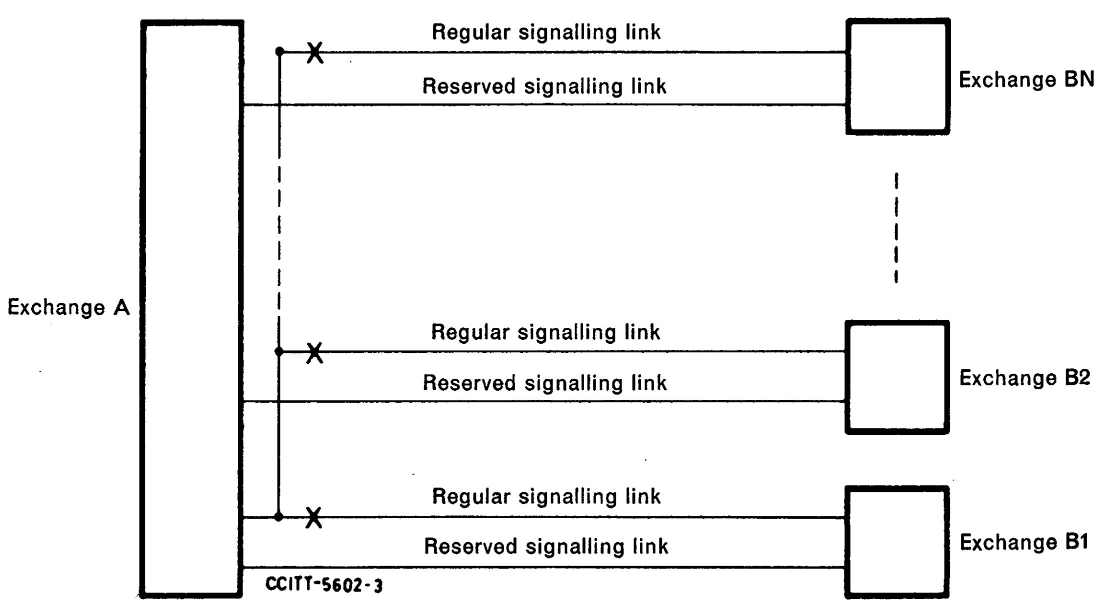


FIGURE 3/Question 5/XI. **N-1 full-time reserved asynchronous facility**

Question 6/XI — Influence of stored-programme control on the development of communication networks

(continuation of Question 6/XI studied in 1968-1972)

Considering that:

1. stored-programme-control (SPC) techniques are being applied widely in new switching system development;

2. the unified approach possible with SPC systems may lead to plant and operational economies through the standardization of the control of switching centres, the combination of switching centres and the integration of communication networks;

3. the use of SPC systems is expected to provide a degree of flexibility and a range of new technical features not previously attainable;

4. the use of SPC switching systems is likely to create new possibilities for Administrations;

5. the characteristics of traffic and messages handled by the present communications networks are changing;

what potential does stored-programme control offer for the development of communications networks, in particular telephone networks, including analogue voice networks, digital voice networks, taking also into account videotelephone networks?

Note.—The study may be divided between those influences of SPC which may affect the further development of already well established national networks and the international network and those influences which may affect the requirements for national resources and infrastructure in developing countries. There may, of course, be a considerable degree of overlapping interest between these two areas. Administrations in developed countries may also be concerned with national resource and infrastructure requirements and Administrations in developing countries may be interested in the more advanced technical possibilities with SPC.

ANNEX

(to Question 6/XI)

Suggestions for the further study of Question 6/XI

A. Influence on already developed communication networks

In studying the influence of SPC systems on already developed communication networks, the following aspects might be considered:

1. *Technical features*

The application of SPC systems should make feasible the introduction of a number of new features into communication networks. These might include:

1.1 *New network configurations*

New network configurations or changes to existing network configurations may be possible and desirable with the use of SPC techniques. For example, there may be fewer but larger centres than at present, greater flexibility in charging and numbering and changes in the relationship between switching and control nodes.

1.2 *Routing strategies*

a) Modern common control systems generally have multiple alternative routing controlled at each node (switching point) of the network. This normally operates within the constraints of a hierarchical network structure. Changes to this approach may occur in a network of SPC switching systems. For example, non-hierarchical routing strategies, time-variable routing strategies, and conditional selection or routing control across two or more network nodes may be features of SPC networks.

b) Additional dynamic overload (network management) controls over routing may follow the introduction of SPC. The use of such controls in the international network particularly may require special consideration.

1.3 *Signalling*

SPC may facilitate the introduction of common channel signalling (C.C.I.T.T. No. 6) and other new signalling methods. It should also be capable of handling and providing an interface for all existing signalling methods. The study might consider how network signalling plans might exploit the growing number of SPC centres.

1.4 *Advanced subscriber facilities*

SPC should allow the introduction of new subscriber facilities not readily attainable with existing exchanges. The study may need to consider whether such advanced facilities might impose new requirements on national and international networks. The study might also consider how the national and international networks might exploit new subscriber facilities.

1.5 *New operational facilities*

The application of SPC should allow the provision of substantially better facilities for the operation and maintenance of networks. For instance, SPC should greatly facilitate the adoption and extension of centralized service and management techniques. The benefits of such facilities within national networks are well established (concentration of expertise, fewer maintenance staff, improved monitoring and control of the network, etc.), but the application of such facilities in the international network may require considerable study.

1.6 *Facility changes*

SPC systems should allow modification to both individual exchanges and to the network as a whole for the introduction of new facilities or the changing of existing facilities to be carried out more readily. The study may need to consider, however, the extent to which such modifications might require changes to hardware and software.

2. *The introduction of new networks*

SPC systems should provide the capability for interfacing and interworking between new networks and existing networks more readily than has previously been the case.

3. *Impact on existing switching systems*

The introduction of new facilities with SPC systems may create a demand for these facilities in existing systems. Possible approaches to this impact may need some consideration. They might include:

a) deferring the introduction of new facilities until the penetration of SPC systems into the network has reached a sufficient level;

b) providing for an accelerated replacement of obsolescent systems. This could include a more rapid depreciation of existing systems with the aim of providing a fully SPC network in the shortest possible time;

c) the modernization of existing systems to incorporate the advanced facilities, possibly by utilizing SPC techniques.

4. *Size limitations on switching centres and traffic routes*

Any reduction in the number of network nodes, any combination of nodes (local/trunk, etc.) and any integration of different service networks all tend to increase the trend towards very large switching centres and traffic (circuit) groups. While increased size often has economic advantages there may be reasons for placing upper limits on size. Some examples of such reasons might be security and diversity, changes in the effects of overload with increased size, and physical (electrical) limitations to the size of the switchblock and to the number of control processors that can be multiplexed.

B. INFLUENCE ON NATIONAL RESOURCES AND INFRASTRUCTURE

In studying the influence of SPC systems on the resource requirements and necessary infrastructure in a country, the following aspects might be considered:

1. *Human resources*

The introduction of SPC switching systems may require changes in the number, quality and training of staff, or even the organization, within an Administration. If these human resources are inadequate, it may become necessary for specialists in such fields as programming, installation and maintenance to be provided by the exchange equipment supplier. In particular, the following aspects may require consideration:

a) whether the present staff is of sufficient quality, given further training in SPC systems, to carry out the installation and maintenance of SPC exchanges, or whether a new type of staff must be recruited;

b) whether changes are required in the number and geographical distribution of operational staff or even the way in which this staff is organized;

c) whether the present training resources, perhaps adequate for existing systems, would be adequate for SPC systems;

d) whether an Administration should provide its own software development capability. If this is deemed necessary, then the demands made upon national resources of skilled manpower in providing programming staff may need consideration.

2. *Material resources*

The introduction of SPC systems may affect the requirements for material resources which, apart from the initial capital funding, might include the following:

2.1 *The provision of spares*

Particular study may be required to determine the quantity and location of spares, e.g. whether some or all spares should be located at each exchange or at a central spare parts depot.

2.2 *The provision of equipment for training purposes*

It may be necessary to consider whether special equipment is needed for training purposes or whether " hands-on " training may be permitted in operating exchanges.

2.3 *The provision of equipment for programme development*

Should an independent software development capability be deemed necessary then consideration may be given to the hardware facilities that might be required, such as a captive office (model exchange) and special computers, peripherals, etc.

3. *Capital resources*

The approach taken to the application of SPC systems may be affected by the differing requirements of SPC systems *vis-à-vis* existing systems. The higher initial investment which is required for SPC systems, firstly in the general introduction of a new system into a network and secondly in the provision of control processors in a given exchange, may encourage techniques that spread this investment over as wide an area of application as possible. These techniques might include the combination and/or remote control of switching centres in order to share the initial investment in control processors over as many lines as possible. For example, centres may be combined at the same level of the hierarchy, leading to fewer but larger local, trunk centres, etc.; or centres may be combined at different levels of the hierarchy, leading to combined local/trunk, trunk/international centres, etc.

4. *General aspects*

The general provision, operation and maintenance of a network using SPC systems may involve different requirements from a network using existing systems, through the influence of various factors such as:

4.1 *Maintenance practices*

While the overall reliability of SPC systems may be much better than that of existing systems, the reliability characteristics (deterioration of service without corrective maintenance) may be quite different. Thus, an SPC system may ultimately be subject to a more severe deterioration of service if left to operate without maintenance for an extended period. Consequently, maintenance practices which are suitable with existing systems may not be so with SPC systems.

In particular they should apply to software as well as to hardware. The degree to which maintenance activities can be centralized and the location of spare parts depots should also be considered.

4.2 *Power*

The power consumption of SPC systems is likely to differ from existing systems. In particular, the variation in power consumed with variations in traffic load is likely to be less than is the case with conventional systems; different approaches to the provision of electrical power may be indicated.

4.3 *Environment*

The requirements for environmental control (e.g. air-conditioning) for SPC systems may be different from those for existing systems. This aspect may particularly affect the requirements for the provision and maintenance of basic services in telecommunications buildings.

4.4 *Local manufacture and construction*

The introduction of SPC switching systems into a country's network may have an impact on that country's ability either to undertake or to continue local manufacture of equipment and on its ability to install equipment using its own indigenous staff. Conversely, decisions on what aspects of manufacturing should be undertaken within a country may affect the choice of switching system. Factors which may be significant could include economic considerations (e.g. volume of manufacture) and technological considerations (e.g. skills required).

5. *The standardization of hardware and software*

Standardization should allow a wider range of application of SPC systems and consequently should tend to spread the initial investment in the introduction of a new system over a larger number of projects. Consideration may therefore be given to:

a) the extent to which SPC techniques facilitate standardization of switching and control hardware for local (terminal and tandem), trunk (toll) and international exchanges;

b) the extent to which SPC techniques encourage the standardization of hardware for switching systems of different communication networks (e.g. telephone, telex, data, etc.);

c) the extent to which standardization for these different functions could be applied to the software.

Question 7/XI — Methods of presentation of functional specification and of description of internal logic processes in SPC telephone exchange

(Questions 7/XI, 8/XI and 9/XI are a continuation of Question 7/XI studied in 1968-1972)

Considering:

1. that virtually all operating organizations are planning to install SPC exchanges in their networks;
2. the interim answer to Question 7/XI prepared during 1968-72 study period in which it was agreed:
   a) that the development of standardized methods of presentation of functional specifications and description of internal logic processes for SPC telephone exchanges was recommended;
   b) that the form of presentation should be easy to learn, to use and to interpret in relation to the needs of the operating organization;
   c) that the methods should be capable of providing operating organizations with information enabling them to make meaningful comparisons between competitive types of exchanges;
   d) that there is an inter-relation between the requirements of the specification methods and the high-level programming and command languages to be developed and that this relationship must be considered in their development. The establishment of a common standard terminology is of the greatest importance;

what methods of presentation of functional specification and of description of internal logic processes should be recommended?

ANNEXES

See after Question 9/XI the Annexes common to Questions 7/XI, 8/XI and 9/XI.

Question 8/XI — High-level programming language for SPC telephone exchanges

(Questions 7/XI, 8/XI and 9/XI are a continuation of Question 7/XI studied in 1968-1972)

Considering:

1. that virtually all operating organizations are planning to install SPC exchanges in their networks;

2. the interim answer to Question 7/XI prepared during the 1968-72 study period, in which it was agreed:

a) that the development of a high-level programming language for SPC telephone exchanges would be justifiable;

b) that a number of organizations, some with experience in language development, are ready and able to participate in a C.C.I.T.T. study of a high-level programming language;

c) that the high-level programming language should be at procedural (e.g. Algol) level, with the possibility of machine-dependent and problem-oriented language level extensions and macro-assembly level interworking;

d) that the high-level programming language should admit possibilities of compilation into machine code and should take into account means of achieving economies in real time consumption and memory occupancy;

e) that the high-level programming language should be easy to learn, to use, to interpret and to extend, in relation to the needs of the operating organizations;

f) that there is an inter-relation between the requirements of the high-level programming language and the specification methods and command languages to be developed and that this relationship must be considered in their development. The establishment of a common standard terminology is of the greatest importance;

what high-level programming language should be recommended?

ANNEXES

See after Question 9/XI the Annexes common to Questions 7/XI, 8/XI and 9/XI.

Question 9/XI — Command language for SPC telephone exchanges

(Questions 7/XI, 8/XI and 9/XI are a continuation of Question 7/XI studied in 1968-1972)

Considering that:

1. virtually all operating organizations are planning to install SPC telephone exchanges in their networks;

2. SPC exchanges of different types and generations will be interconnected;

3. to facilitate operation and maintenance of switching systems of different types, a common command language is required;

4. the structure of the command language should embrace the needs of international interworking and information exchange at network level;

5. the requirements of the command language in relation to facilities, procedures, safeguards and network management and maintenance using international signalling systems, must be established;

6. there is an inter-relation between the requirements of a command language and those of a high-level programming language and methods of functional specification to be developed, and that this relationship must be considered in their development. The establishment of a common standard terminology is of the greatest importance;

what command language should be recommended?

Note. — The establishment of the facilities and requirements of a command language is currently the subject of Question 8/XIII.

ANNEXES

(Common to Questions 7/XI, 8/XI and 9/XI)

Annex 1—State of the art on the programme logic for SPC telephone exchanges

Annex 2—High-level (problem oriented) languages for SPC telephone exchanges

Annex 3—Standard methods for functional specifications of SPC telephone exchanges

Annex 4—Summary of replies to a questionnaire on SPC telephone exchanges

Annex 5—Summary of replies to a questionnaire on high-level programming languages for SPC telephone exchanges

Annex 6—Summary of replies to a questionnaire on standard methods for functional specification of SPC telephone exchanges

ANNEX 1

(Common to Questions 7/XI, 8/XI and 9/XI)

State of the art on the programme logic for SPC telephone exchanges

A. *General*

This Annex contains a cross-section of viewpoints on the state of the art in 1970.

B. *Language feasibility*

1) The diversity of design and performance characteristics of present switching computers makes the development of a common language a remote goal.

2) Call-processing programmes make use of a high-level language to a varying degree in some systems.

3) At this time no common high-level language is foreseen for programming the entire set of SPC functions. Specifically, the following types of programme do not seem to lend themselves to early attack:

— supervisory programmes;
— certain maintenance programmes;
— input/output programmes.

4) Any high-level common language must be problem-oriented to achieve comprehensibility and efficiency.

5) An important contribution to compiler efficiency is made by good source language design, particularly in the areas of subroutine communication and handling of iterative processes. Given proper attention to these details in the language design, it should be possible to write an efficient compiler generating code no more than 5% larger than code produced by a skilled programmer.

6) The compiler should in any case be backed up by an assembler written to produce output which looks (to the loader) just like the compiler output. The loader could then link together code produced by the compiler and assembler into a common programme.

7) The telephone programming language should be capable of handling single bit and variable length data entities. The language should be machine independent and open-ended.

8) Algol 68, produced within International Federation of Information Processing Societies (IFIPS) TC2, WG 2.1, includes many features of interest for telephone programming, including manipulation and labelling of bits and variable length slices. The language is aimed at high-object code efficiency with low compile time cost.

C. *Flow charts and standardization of terms*

9) A functional flow-chart specification would describe the expected operations of the office without regard to any specific implementation.

10) The system flow chart is an implementation of the functional flow chart for some specific machine. Certain auxiliary functions may also be described by system flow charts. The exposition of these system flow charts could be standardized.

11) A programme flow chart is a conventional drawing of a programme or process intended to display its structure and general sequence of operation.

D. *Administration aspects*

12) Synthesis of programmes or modifications thereto requires:
- experienced programmers;
- support software facilities;
- test environments, both simulated and real.

A real test environment implies a captive office.

13) The question of object code efficiency has not been sufficiently attacked until now in the specification and design of Algol-type languages.

14) Most switching computers would be unsuited for the economic compilation of object code from Algol-type source programmes.

15) The supply of trained programming staff being insufficient to meet the growing demands of many manufacturers and Administrations, it has become necessary to develop tools, comprising among others high-level programming languages, to increase programmer efficiency.

16) For those Administrations which do not wish to implement or debug programme alterations, some means should be provided to permit changes in translation tables, numbering plan assignments and pre-specified quantitative programme parameters associated with minor extensions.

17) In order to evaluate competitive types of exchanges, Administrations will have to consider machine structure and software details in assembly language. These aspects are not amenable to expression in a high-level programming language.

E. *Impact of language on machine design*

18) There would be a definite hazard to future systems if a common programming language were defined at too early a stage. If the language contained any weaknesses, these would be carried into the machine itself.

19) Any inefficiencies inherent in the preparation of programmes using a common language could possibly be minimized in the future if improvements in processing speeds were not directed solely towards controlling larger offices but were also used to absorb these inefficiencies.

20) Switching computers developed following the specification of a common programming language would have strong advantages over switching computers on which the language capability had to be retro-fitted.

21) Various contributions expressed interest in supporting studies of methods for specification of:
- programme logic, primarily;
- exchange capabilities and characteristics, secondarily.

22) The study of a language for specifying telephone exchange requirements should be clearly distinguished from the study of a language for specifying the logical processes used within the exchanges.

ANNEX 2

(Common to Questions 7/XI, 8/XI and 9/XI)

High-level (problem-oriented) languages for SPC telephone exchanges

1. In the study of high-level programming languages for SPC exchanges it may be best to approach the problem with a single programming language entity, perhaps with a number of subsets, as the aim. This aim may be easier to achieve in certain areas, for a variety of reasons, including the degree of independence of hardware implementation.

The areas of easier achievement were:

1.1 Call handling programmes.

1.2 Automatic internal test and maintenance programmes for telephone functions only.

1.3 Software for implementing the man-machine language (not the man-machine language itself).

The areas of more difficult achievement were

1.4 Executive programmes (these include the operating system and those dealing with diagnosis of and recovery from faults).

1.5 On-line support programmes.

1.6 Off-line support programmes.

1.7 Acceptance testing programmes.

1.8 Automatic internal test and maintenance programmes for functions other than telephonic.

2. The possible use of subsets of the language for different areas is foreseen but where concepts are common to different areas they would be defined only once.

3. The need for a part of the language to describe the environment should be recognized (e.g. number of subscribers, number of junctions, types of signalling).

4. *Possible study programme for 1973-1976*

The items are given in a sequence which it might be helpful to follow:

4.1 Gather information on the concepts which should be included in the language (e.g. list handling mechanisms, conversion of data, conditional statements logic functions).

4.2 Gather information on the features which the language should possess (e.g. extensibility, production of relocatable code, suitability for compilation, ability to include machine code or assembly code blocks).

4.3 Gather opinions on the relative values of the various concepts and features.

4.4 Set-up a small specialist group. Delegates should include experts in compilers and computer languages. They should analyze these concepts, features and values and make a definitive selection of them.

4.5 Define in this group the syntax and semantics of the language.

4.6 Perform during the period as much work as possible with the language to examine its suitability for writing and compiling programmes.

4.7 The goal is a report on the language, which could form the basis for a C.C.I.T.T. Recommendation to be submitted to the Plenary Assembly in 1976.

ANNEX 3

(Common to Questions 7/XI, 8/XI and 9/XI)

Standard methods for functional specifications of SPC telephone exchanges

1. *Objective*

In the study of standard methods for functional specifications of SPC exchanges the objective should be to determine whether a suitable basis exists for the development of a standardized method of specifying functional requirements which is suitable, not only for the specification of an individual exchange, but also for all functional aspects of a telephone network, and which can remain open-ended in the sense that it can be extended to cover new developments.

2. *Realization of the objective*

The steps necessary to achieve the full objective are:

2.1 definition of functional requirements;[1]

2.2 collection of data;

2.3 analysis of data;

2.4 establishment of criteria for assessing methods of specification;

2.5 examination of proposed methods of specification;

2.6 selection of dummy exchanges;

2.7 proving of proposed method;

2.8 reporting of studies.

3. *Criteria for assessing methods of specification for SPC telephone exchanges*

3.1 Does the method of specification avoid prejudicing the method of realization of the specification?

3.2 Can the method express all the kinds of functional requirements needed in the specification of SPC telephone exchange systems or sub-systems?

3.3 Can the consistency of the resulting specification be readily checked?

3.4 Can constraints of sequencing and timing be readily expressed and checked?

3.5 Can the logical procedures for realization of the specification be readily derived from the specification?

3.6 Can the same method be used to describe a realization of the specification in such a way that correlation with the specification can be assured?

3.7 If the method is used to describe a realization of the specification, to what extent is the description amenable to automatic procedures for checking its consistency?

3.8 If the method is used to describe a realization of the specification, to what extent does the description enable the performance to be checked by simulation or other automatic procedures?

3.9 Is the method applicable to the specification of other telecommunication systems or sub-systems?

ANNEX 4

(Common to Questions 7/XI, 8/XI and 9/XI)

Summary of replies to a questionnaire circulated in 1970 on SPC telephone exchanges

The questionnaire contained four questions. Questions 1 and 2 dealt with the general policy of operating organizations on the introduction of SPC exchanges in their networks and on programme management. Questions 3 and 4 were intended to find out in what areas C.C.I.T.T. recommendations were likely to be of interest to members.

Question 1

In this question, operating organizations were asked what plans they had for the introduction of SPC exchanges in their telephone or other networks.

a) Of the eleven operating organizations which replied, four have decided to install SPC automatic telephone switching in the fairly near future, in local, trunk and, in a few cases, international exchanges. A few of these systems have already been introduced in Belgium, France, Japan, the Netherlands and Sweden.

It appears, however, that large-scale development of stored programme switching will only begin towards 1975—the date mentioned in five replies. For the eight Administrations which gave forecasts[2] for 1980, the situation at that date would be as follows:

[1] A functional requirement defines the controlled responses of a telephone system or sub-system to defined state changes.

[2] Since 1970 these forecasts have been greatly changed for some countries.

Administration	Local centres	Trunk centres
Belgium	80 exchanges (600 000 lines)	12 exchanges
France	40 to 50% of orders (E1)	
Netherlands	180 exchanges (PRX 205)	1 AKE exchange and some PDX exchanges
Federal Republic of Germany	2 million lines (EWS1)	8 exchanges (EWS1)
United Kingdom	100 exchanges (TXE 4)	5 exchanges (TXE 4)
Sweden	25 exchanges	3 exchanges
Australia	30 exchanges	17 exchanges
India	2 exchanges	1 exchange

b) In the majority of cases the operating organizations are considering installing SPC systems for uses other than telephony, mostly in data centres and sometimes in centres for the management and maintenance of the telephone network. Telex centres and private exchanges are also mentioned.

c) Two Administrations refer, one explicitly and the other implicitly, to the use of a single switching system to cover requirements in various categories of automatic exchanges (local and trunk centres).

Others envisage specifically the co-existence of several different systems in their networks.

Question 2

This question asked what programming capabilities an organization operating SPC exchanges should build up.

a) All the replies stated that it was essential for an operating organization to build up capabilities in all branches of programming mentioned in the questionnaire so that they would be able to assume responsibility for the management and maintenance of SPC system software. However, nine replies said, in particular of the industrial organization, that to be efficient, these services should collaborate with the manufacturer. In some cases the possibility of operating organizations having a team capable of producing programmes was considered. One reply stressed that for software management it was not enough just to have the staff but that provision should also be made for hardware such as a computing centre, captive offices, etc.

b) The structure generally envisaged for these programming services is on two levels. The first consists of operating personnel working in the exchanges who must be able to read programmes and communicate with the computers so as to perform routine operations. The second level consists of a central team of specialists who should cover at least all the branches mentioned in the questionnaire and who would specify programmes, evaluate and approve new systems, introduce new operating facilities or new peripheral equipment and prepare modifications to programmes. One Administration even considers that this central service should be responsible for managing the programme library and producing the package for each new exchange in accordance with its parameters.

c) Some operating organizations intend to introduce a third, intermediate, level consisting of operational and maintenance centres common to all the automatic exchanges in any one area.

d) One reply refers to the question of the separate supply of hardware and software for SPC exchanges. In this case the hardware would be purchased from the telephone equipment manufacturer and the software sub-contracted to software firms.

Question 3

This question asked in what areas C.C.I.T.T. recommendations on SPC systems would be most useful:

a) Most replies made a distribution between regulations on the methods of presentation of specification of functions for hardware and software and those relating to the logic characteristics of these functions.

b) The majority stressed the advantage to operating organizations of standardizing the methods of presentation and specification for all the functions performed by SPC systems and listed in the questionnaire. C.C.I.T.T. recommendations on terminology, symbols, flow charts, languages and documentation appear to be widely favoured.

c) The situation is far less clear, on the other hand, with regard to the functional features of the systems. Some replies reject any standardization in this area lest it hinder the development of SPC techniques; others would welcome recommendations for call-handling or for support programmes and acceptance test procedures.

Question 4

This question asked each organization whether the definition of a high-level (problem-oriented) programming language for SPC systems was a worthwhile aim and whether it was prepared to assist in the development of such a language under the auspices of the C.C.I.T.T.

Of the twelve organizations which replied:

a) Eight considered it advisable at present to standardize such a programming language; the others considered that for the moment only the feasibility of such a language should be studied, either because any standardization in this field is dangerous or because the objective is unattainable [1].

b) Nine were ready to participate straight away in the work under C.C.I.T.T. auspices to the best of their ability.

Conclusion

The replies received to the questionnaire demonstrate clearly the almost universal intention of the operating organizations to introduce SPC exchanges in their networks either immediately or sometime later. It would also appear that they are aware of the new problems which will arise with the software management of these exchanges and have decided to procure the teams of specialists required to solve them.

To facilitate the work of these specialists, the organizations would be in favour of C.C.I.T.T. recommendations on the presentation, specification and documentation of the hardware and software functions performed in SPC exchanges. In particular, the majority of them are ready to participate in a C.C.I.T.T. study of an advanced-level programming language.

ANNEX 5

(Common to Questions 7/XI, 8/XI and 9/XI)

Summary of the replies to a questionnaire circulated in 1971 on high-level programming languages for SPC telephone exchanges

The questionnaire comprised six questions, numbered 2 to 7. Questions 2, 3 and 4 were concerned with justifying a high-level language (HLL), Question 5 with its specification and range of application, and Question 6

[1] One of these prefers the use of assembly-level language in order not to lower the real-time call handling capacity of systems. Another thinks that I.S.O. is a more suitable body than C.C.I.T.T. to control the development of such high-level language.

with organizations with which liaison could be usefully established. Question 7 dealt with the subject of a symposium on telecommunication programming languages.

Question 2

In this question, it was asked to what extent an HLL would be useful in comparing different systems and to what extent the development of an HLL could be justified on this basis alone.

Five organizations replied favourably, feeling that an HLL would be useful in making system comparisons. Of these, two felt that this application would be a sufficient justification for an HLL, while the remainder felt that it would be insufficient justification. One reply felt that an HLL would only be useful in cost and maintainability factor comparisons.

Of the two unfavourable replies, one preferred a facility specification for system comparisons, while the other preferred a language at a higher level than Algol-level, i.e. problem-oriented language (P.O.L.) level.

Question 3

In this question, it was asked whether an HLL would be useful in other areas.

There was general agreement that an HLL would be justified on the grounds of maintenance, education of staff, administration and software modification. One reply felt that an HLL would not be useful for information transfer, while two replies felt that information transfer is the primary justification for an HLL. Accuracy and readability in describing programme logic were also mentioned.

Question 4

This question asked for further justification of an HLL, taking all areas into account.

Most replies consolidated this question with questions 2 and 3, but some replies cited as additional justification decreased software cost, simplicity of information transfer among users, and the facility for software maintenance and extension. The concensus of the replies is that the development of an HLL would be justifiable. However the reply which did not refer specifically to the questions indicated that the benefits of an HLL have not been proven.

Question 5

Question 5 asked whether an HLL would be preferable only for call handling, telephonic test and maintenance programmes and machine software, or preferable for the complete range of software including on-line and off-line support, acceptance test and non-telephonic test and maintenance programmes.

One reply felt that application of an HLL should be restricted to control programmes for hardware equipment.

Three replies felt that an HLL could be applied to the complete range of software cited above, while a fifth reply felt that an HLL would be applied to all but telephonic and non-telephonic test and maintenance programmes. A sixth reply felt that it would be desirable to apply HLL to all but non-telephonic test programmes and not necessarily to off-line support programmes.

Question 5 also asked for the input and output language levels proposed for an HLL. Five levels were suggested: machine, assembly, macro-assembly, HLL, machine independent HLL and problem-oriented.

Two replies covered output language level, citing assembly level (and macro-assembly level for one-one macros).

Concerning input language level, two replies favoured a problem-oriented level for call handling programmes, with other programmes being written in either assembly or macro-assembly language. One of these replies favoured using a problem-oriented level for test and maintenance programmes (telephonic) as well. Another reply favoured assembly or macro-assembly language only.

Four replies favoured extensive use of an HLL, not precluding the use of a problem-oriented language for all software. These replies differed however on the question of whether the HLL should or should not be independent of machine architecture.

Question 5 also asked for proposed criteria for testing the suitability of an HLL. Efficiency was the criterion most cited. Also cited were ease of understanding and use, value for documentation readability, extend-ability, adaptability to compilation, independence of machine architecture, cost ability to provide facilities for complex data structure descriptions, and interworking with assembly language. One reply particularly emphasized cost.

Question 6

The following international organization was suggested for liaison activity:

I.F.I.P.S. (International Federation of Information Processing Societies).

The following national organizations were suggested for liaison activity:

I.E.E.E. (Institute of Electronic and Electrical Engineers).
A.C.M. (Association for Computing Machinery).
Communications Industries Association of Japan.
Institute of Electronics and Communication Engineers of Japan.

One reply felt that the control of the development of an HLL would be more properly the concern of the I.S.O. (International Standards Organization) than the C.C.I.T.T.

Question 7

This question dealt with the subject of organizing a symposium on telecommunication programming languages. Such a symposium was organized by the University of Essex, Colchester, England, in April 1973.

Conclusion

Based on the replies received, there appears to be a concensus of opinion that the development of an HLL would be justifiable but not solely for the purpose of making system comparisons. Opinion appears to favour an HLL at Algol-level, not excluding problem-oriented level extensions. Some replies favoured an HLL at problem-oriented language level with macro-assembly level interworking. These two favoured approaches to an HLL are not incompatible.

ANNEX 6

(Common to Questions 7/XI, 8/XI and 9/XI)

Summary of replies to a questionnaire circulated in 1971 on standard methods for functional specification of SPC telephone exchanges

The questionnaire contained five questions. Questions 1 and 2 dealt with the past work and future intentions of each organization as regards a systematic method of functional specification for SPC exchanges. Questions 3 and 4 were aimed at determining the type of standard system that each organization would prefer, while Question 5 attempted to determine to what extent each organization desired standardization of the system of specification.

Question 1

Organizations were requested to give information about any development of a systematic uniform method of stating functional requirements for SPC telephone exchanges, and their intentions, if any, to establish such a method.

Of the nine organizations that replied, seven indicated that they are studying some form of systematic uniform method for functional specification, at least in certain areas.

The other two organizations felt that a narrative specification was adequate for this purpose, and that, with the inclusion of SPC terminology, would continue to prove adequate in the future. They intended, therefore, to make no attempt to develop a different form of specification language.

Question 2

Organizations were requested to give information about their work on a systematic uniform method of describing the internal logical processes in SPC telephone exchanges.

The replies to this question were unanimous in stating that they were developing, and intended to continue to develop, a systematic uniform method of describing the internal logic processes in SPC telephone exchanges.

Question 3

Organizations were asked to select the type of statements or descriptions that they would prefer in relation to both Question 1 and Question 2.

The choices of each organization as regards the two questions are shown in the table below. In addition to the information given in the table, some organizations gave examples of additional techniques that they felt were useful. N.V. Philips suggested that the " Reasonableness Check Tables ", as used in the system No. 6 specification would be of use if an attempt was to be made to standardize on a common system for both Questions 1 and 2.

The United Kingdom Post Office suggested that a " state channel chart " could be used in the analysis procedure.

The Australian Administration felt that a systematic method for the specification of internal logic processes was desirable, but the problem was essentially that of simple meaningful presentation and is largely a drafting of symbols matter.

From the table it may be seen that although individual methods occur, by far the most popular way of specification would be a combination of these, though the constituents of such a combination are not at all clear from the replies received.

Organization	Question 1 (Functional Spec)	Question 2 (Internal Logic)
BHG Hungary	a, b, d	a, b, d
Germany (Deutsche Bundespost)	a	a, b
Nippon Telegraph & Telephone	a, b, c	b, c, d
N.V. Philips	b, d & HLL	b, d & HLL
L. M. Ericsson	a, b, c, d, e	b, HLL
India	a	a, b
United Kingdom Post Office	a, b, c, d, e	a, b, c, d, e
Australia	a, b, c	See text [1]

[1] a) Narrative.
b) Flow charts.
c) Logic state diagrams.
d) Decision tables.
e) Other types of charts.

Question 4

Organizations were requested to supply a list of types of functional requirements which they considered necessary for a complete specification, or examples of sets of functional specifications already in use.

Five organizations enclosed lists of functional requirements. BHG Hungary stated that they had not at the time compiled a complete list of requirements, while the Federal Republic of Germany prefers the use of ordinary unabbreviated language to determine the operational possibilities. One organization included examples of functional specifications already in use.

Question 5

Organizations were asked if they considered that one method should be established for achieving the aims of both Questions 1 and 2.

Two organizations felt that it would be advisable to establish the same method for each purpose differing only in the narrative comments.

Two organizations felt that a limited variety of methods should be standardized, and that combinations of the standard methods should be used where appropriate.

One organization proposed standardization initially only on the description of functional requirements; two organizations did not feel that standardization was essential.

One thought that it would be inadvisable to standardize on a common method for both purposes.

Conclusion

The replies to the questionnaire show the intention of all nine organizations to introduce a systematic method for the specification of programme logic. A majority of the organizations feel that a uniform method for functional specification is desirable. However, opinions vary more widely both over the methods that should be employed to achieve the aim of standardization, and as to the degree of standardization that would be desirable.

Question 10/XI — Interworking of signalling systems

(continuation of Question 10/XI studied in 1968-1972)

Considering that:

1. interworking between signalling systems No. 4, No. 5 and No. 5 *bis* is specified;

2. procedures for interworking between signalling system No. 6 and signalling systems No. 4 and No. 5 is specified;

3. interworking between signalling system R1 and other C.C.I.T.T. signalling systems is not specified in the *Green Book*;

4. digital systems (for example PCM) may give rise to new interworking problems;

5. new recommendations concerning interworking of the C.C.I.T.T. signalling systems with new types of signalling systems working over radio circuits to provide automatic service to ships and aircraft, may be required;

what new recommendations and extensions to existing recommendations should be considered?

ANNEX
(to Question 10/XI)

Status of the studies on interworking of signalling systems at the end of 1972

1. In several cases the study of interworking specifications has led to a detailed study of the specifications of the signalling systems. From this study it has been advisable and in some cases even necessary to propose an up-dating of the specifications. The study under Question 10/XI was carried out as far as signalling systems

No. 4, No. 5, No. 5 *bis* and R2 are concerned. Up-dating of the specifications of signalling system No. 6 was dealt with under Question 1/XI—signalling system No. 6.

2. *Interworking between system R1 and system No. 4, No. 5 and No. 5* bis

Interworking between system R1 and other C.C.I.T.T. signalling systems has so far not been requested.

3. *Interworking between system R2 and system No. 4, No. 5 and No. 5* bis

Specifications for interworking between system R2 and system No. 4, No. 5 and No. 5 *bis* are in Part XVII of this Volume.

4. *Up-dating of signalling specification for system R2*

Amendments to the signalling specification for system R2 are included in Part XVI of this Volume.

5. *Up-dating of signalling specifications for system No. 4, No. 5 and No. 5* bis

Signalling specifications have been up-dated for the echo suppressor control signal in system No. 4 and for the address-complete, charge and the subscriber-transferred signals in system No. 5 *bis.*

Further study is required in the use of system No. 4 interworking with other system, e.g. system No. 6 for world-wide automatic operation.

6. *Interworking between system No. 6 and system No. 4, No. 5, No. 5* bis *and R2*

The study of interworking between system No. 6 and system No. 4, No. 5, No. 5 *bis* and R2 has followed two forms of presentation.

The interworking between system No. 6 and systems No. 4 and No. 5 have been included in Chapter IV, Part XIV of Volume VI.

The interworking between system No. 6 and R2 has been specified in a separate part of the R2 specification and is given in Recommendations Q.388 and Q.389.

7. *Form of presentation, location and technical requirements of interworking specifications*

The form of presentation, location and technical requirements of interworking specifications is still under study. The increasing number of possible combinations of interworking between signalling systems may be a reason for further study. Also, some C.C.I.T.T. signalling systems include rules for interworking with national networks and some of these rules imply that new national signalling systems should include certain signalling procedures, e.g. time-out intervals on automatic international connections.

8. *Titles and definitions of signals*

The different C.C.I.T.T. signalling system specifications have been developed over a long period of time. Revisions should be made to ensure that titles and definitions of signals in the different signalling systems are identical whenever the same signals have the same significance.

Question 11/XI — Satellite signalling systems

Considering that:

1. various methods of future satellite operation can be visualized;
2. satellite systems need to interwork with the terrestrial part of the international network;
3. satellite systems can provide some new facilities for serving the signalling needs of the international network (Note 1);
4. the C.C.I.T.T. has recommended (Note 2) those characteristics of a type (Note 3) of demand assignment (DA) satellite system, which assures that such a system can be successfully incorporated into the international network,

what, if any, new signalling and switching recommendations are necessary to ensure the proper working of existing and future satellite systems in the international telephone network?

Note 1. — A satellite system may include both pre-assigned and demand-assigned circuits and the demand-assignment signalling system might be used to carry the signalling information for both pre-assigned and demand-assigned circuits.

A type of broadcast operation of common channel signalling serving several small groups of pre-assigned circuits might also be considered. The possibility of signalling in this manner is of interest to countries which—having small groups of circuits to different relations—wish to introduce a signalling system for use on satellite circuits in an economical way and with similar facilities and possibilities as the most modern signalling systems.

Note 2. — See Recommendation Q.48 and Supplement 8 to this Volume.

Note 3. — C.C.I.T.T. has so far considered only a DA system having the control at the earth station and not at the CT. See Annex 2 of Supplement 8 to this Volume.

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QUESTIONS ON AUTOMATIC TELEPHONE OPERATION ENTRUSTED TO STUDY GROUP XIII FOR THE PERIOD 1973-1976

Question No.	Title	Remarks
1/XIII	— General maintenance organization	Same as Question 14/IV
2/XIII	— Maintenance methods for signalling system No. 6	Same as Question 2/XI. To be studied in association with Study Group XI
3/XIII	— Network maintenance information	Continuation of Question 4/XIII studied in 1968-1972
4/XIII	— Criteria for the application of network management actions	
5/XIII	— Procedures for traffic measurement and computation	
6/XIII	— Calculation of the number of circuits in a group carrying overflow traffic	
7/XIII	— Influence of non-coincident busy hours on network planning	
8/XIII	— Requirements of a command language for SPC international exchanges	The study is of interest to Study Group XI in relation to Question 9/XI
9/XIII	— Field trials of centralized processing of service observation results	Continuation of Question 9/XIII studied in 1968-1972
10/XIII	— Repeated attempts	
11/XIII	— Information on traffic routing in the international network	The results of the study to be transmitted to Study Group XVI
12/XIII	— Subscriber-to-subscriber type test calls as a means to obtain information on quality of service. Characteristics of responding equipment	
13/XIII	— Use of computers for network planning and circuit group dimensioning	Continuation of Question 18/XIII studied in 1968-1972
14/XIII	— Internal blocking characteristics in digital exchanges	

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Question 1/XIII — General maintenance organization

Considering that:

1. the rapid growth of subscriber dialling of international telephone calls;

2. the increase in the number of international gateway exchanges in individual countries;

3. the need for investigations to be made into the reasons for poor quality of service;

4. consistent difficulties in establishing overall end-to-end connections which may arise from inadequate performance or maintenance of international transmission, switching or signalling equipment;

5. the difficulty of identifying the point in the distant Administration from which cooperation can be obtained to conduct maintenance investigations;

6. the need to ensure that the system is maintained in accordance with procedures which minimize out of service time and thus maximize the revenue obtained from the plant;

what measures should be taken to keep the general maintenance organization up to date, particularly what additional or revised methods in maintenance organization should be recommended in order to increase the effectiveness of the liaison and cooperation between I.T.M.C.s, I.S.M.C.s and I.S.C.C.s in different countries?

Note.—Question 14/IV is the same as Question 1/XIII.

Question 2/XIII — Maintenance methods for signalling system No. 6

Considering that:

1. signalling system No. 6 was tested during study period 1968-1972;

2. signalling system No. 6 uses a completely new and more sophisticated technique for signalling between international exchanges;

3. limited experience has been gained thus far concerning the maintenance of common channel signalling systems;

4. failure of a common channel signalling system would affect a large number of speech circuits;

what operational procedures and techniques should be recommended in addition to Recommendation Q.295 for the maintenance of signalling system No. 6?

Note.—Study Group XI will be associated in the study of this Question (Question 2/XI).

Question 3/XIII — Network maintenance information
(continuation of Question 4/XIII studied in 1968-1972)

Considering:

1. the rapid development of international automatic working;

2. the implementation of new types of switching and signalling equipment in the network, e.g. electronic exchanges, common channel and demand-assignment satellite signalling systems;

3. the new methods of automatic surveillance of equipment;

4. the need for quick diagnosis and clearance of faults;

a) what network maintenance information should be exchanged internationally?
b) at which points (e.g. ISMC, ISCC, etc.) should the network maintenance information be made available?
c) how should the network maintenance information be used?

Note.—The advent of common channel signalling systems provides a new potential for the transfer of network maintenance information which augments the conventional means also available.

ANNEX

(to Question 3/XIII)

Reply by Study Group XIII to Question 4/XIII studied in 1969-1972—(What information for maintenance purposes should be transmitted by means of network maintenance signals?)

The Study Group considered this Question strictly from the maintenance standpoint even though some items were considered to be also of interest for network management.

It recognized that specifications would have to be drawn up for the means by which the transfer of information between desired maintenance units could be performed. The Study Group felt, however, that these specifications should not be detailed at this time. Nevertheless, it was considered that the following factors should be taken into account during the preparation of the specifications:

1) The transfer of the initial message and the subsequent message which cancels the initial message, should each be suitably acknowledged.

2) The message format should contain an " address " and/or " classification " which could be interpreted by the receiving equipment in order to direct the information to the appropriate maintenance unit. The requirements for this facility would not necessarily be the same for all Administrations.

3) The message format should be such as to be capable of transferring as much information as will be deemed necessary.

This latter point is made because it was recognized that the length of the message might depend on bilateral agreements regarding the composition and significance of the information, and the action which could be taken on receipt of such information.

Whilst considering the items of information which might usefully be exchanged for maintenance purposes, the Study Group took into account a most important factor—what would the maintenance unit do on receiving such items of information? In consequence the Study Group concluded that the exchange of the following items of information would usefully enhance the maintenance of the international telephone network:

1) Indication and identification of one or more circuits out of service and the expected outage time. An indication of the reason why a circuit is taken out of service would also be helpful if it is feasible to transmit such additional information.

2) Indication and identification of the failure of the reference pilot of a group, supergroup, etc., especially in those circumstances where no automatic failure indication mechanism exists within the system.

3) Indication of when a bilaterally agreed percentage of circuits in a circuit group or route, unavailable for service is exceeded, together with the information concerning the circuits out of service. This was considered desirable because the resultant destination may be different from that to which the individual circuit information was transferred.

Study Group XIII did not consider the above reply sufficient to terminate Question 4/XIII (1968-1972) and therefore introduced the present Question 3/XIII (1973-1976).

Question 4/XIII — Criteria for application of network management actions

The criteria for initiating network management actions described in Recommendation Q.55 (E.410) were developed in an environment of limited experience with international network management and were based on a minimal number of formal contributions.

Considering that:

1. in order to prevent the spread of congestion and permit effective network management actions, variations in traffic must be quickly and easily recognized;

2. a number of different parameters are presently observed for measuring such variations;

3. a variety of traffic data collection systems is used in the international network;

4. although the present scope of automatic alternate routing in the international network is limited, experience in network management is needed to develop sound recommendations;

5. while the development of standard parameters for the evaluation of variations in traffic and for the application of network management remain long-term objectives, such standardization may not be adopted universally for some time;

what additional criteria and evaluation procedures can be devised to determine the application of network management actions to permit earlier and wider participation in the practical introduction of international network management?

Accordingly, all Administrations are requested to submit contributions describing their methods and experiences in network management, giving particular attention to the measurements or criteria that they use. Administrations' views on the effectiveness of these criteria and methods together with suggestions on how they might be supplemented or improved would also prove invaluable in answering the question.

Furthermore, Administrations are urged to participate in and report on joint network management ventures in order to make further progress in establishing effective international network management.

Question 5/XIII — Procedures for traffic measurement and computation

The measuring procedure and traffic values recommended at present are given in Recommendation Q.80 (E.500).

Similarly, the definition of the nominal properties of traffic flow is, at present, based on the concept of the mean busy hour and related only to the volume of traffic carried.

Considering that:

1. one objective of traffic measurement is to assess the grades of service in automatic international connections;

2. a second objective of traffic measurement is to evaluate the real subscriber demand and the different traffics offered;

3. present parameters for the measurement of traffic flows are more relevant to the design of individual traffic streams and are based only on the mean busy hour;

4. present parameters for the measurement of traffic flow do not accurately reflect the real traffic demand;

5. new parameters might be found (for example, those parameters which express the concepts of efficiency rate and total traffic offered) which are more suitable to the dimensioning of international networks, including the common control devices in transit exchanges;

6. because of time differences providing traffic peaks at different points of time in different countries, traffic values are required for more hours of the day; in principle, a 24-hour profile would be required;

7. possible new and improved grade of service criteria may require traffic values giving a more complete description of the traffic variations (peaks);

8. methods of measuring and expressing the traffic flows should conform to a reliable calculation method and should be easy to use and understand, account being taken of both the theoretical aspects and the practical difficulties involved, especially those concerned with the combination of different streams of traffic;

9. computers are likely to be used more extensively for traffic data processing;

what new or revised procedures for measurement and computation of the traffic data should be recommended to provide information necessary for planning, dimensioning and managing the international network, including the transit exchanges?

Question 6/XIII — Calculation of the number of circuits in a group carrying overflow traffic

Calculation procedures recommended at present are given in Recommendation Q.88 (E.521).

Considering that:

1. measurements in national networks on final routes have shown that the two methods recommended and described in the Annex to Recommendation Q.88 (E.521) tend to underestimate the number of required circuits;

2. the methods do not allow for variations in traffic offered to the first routes beyond those of pure-chance traffic;

3. measurements have proved the occurrence of day-to-day variations far beyond pure-chance variations;

4. day-to-day variations may be expected to be of significant importance in the international network;

what revisions to Recommendation Q.88 (E.521) should be made to guarantee that the average loss probabilities of final routes will meet the recommended values?

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Question 7/XIII — Influence of non-coincident busy hours on network planning

Considering:

1. that large national and international networks have different busy hours in different parts of the network;

2. the possibility of planning a telephone network taking advantage of different loads in different parts of the network at different hours of the day;

what practices should be recommended to take into account the influence of non-coincident busy hours on the optimal dimensioning of alternative routing networks?

REFERENCES

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Question 8/XIII — Requirements of a command language for SPC international exchanges

Considering that:

1. SPC exchanges are being installed in both national and international networks;

2. SPC exchanges will interwork in the international network;

3. a common command language may facilitate the operation and maintenance work at the international level;

4. as a logical consequence from 3, a common command language in relation to network management and maintenance may have merit;

what requirements and facilities of a common command language in relation to international network management and maintenance should be recommended?

Note. — The study is of interest to Study Group XI in relation to Question 9/XI.

Question 9/XIII — Field trials of centralized processing of service observation results (2nd series of field trials)

(continuation of Question 9/XIII studied in 1968-1972)

What benefits can be obtained from centralized computer processing of service observation results?

ANNEX 1
(to Question 9/XIII)

Study Group XIII carried out, in 1968-1972, a manual processing of the service observation results, and the conclusions of this first series of field trials were that:

" the results achieved are both useful and helpful. The first series of field trials have provided service observation data not heretofore available and, in the absence of automatic methods of monitoring the quality of international telephone service, enables more effective use to be made of the rather small samples available from manual service observations. The participating Administrations also see the trials as an important means of hastening the standardization of quality of service observation procedures and definitions."

Annex 2 is a set of instructions for the second series of field trials which should be initiated as soon as the new I.T.U. computer is available in 1973.

ANNEX 2
(to Question 9/XIII)

Instructions for processing the service observation results

1. *General*

It is proposed that the field trial should start with observations taken for the second quarter of 1973. To simplify the work of Administrations, it is suggested that observations recorded in accordance with Recommendations Q.61 and Q.62 (Tables 1 and 2) should be sent to the I.T.U. For the purpose of the field trial the observations should be submitted quarterly. Observations should be received by the I.T.U. not later than four weeks after the observation period. Processing the observations within the I.T.U. should be completed within two weeks.

2. *Confidentiality of the processing procedures*

The names of Administrations participating would be kept confidential in the second series of field trials to avoid any possibility of a leak to persons not directly concerned in the supervision of service quality in international traffic.

The following procedure will be followed:

- each country will be designated by a key letter;
- these letters will be communicated to each rapporteur personally appointed by a country participating in the trials and will be kept secret by him in any way he thinks fit. No official documents mentioning a country will be distributed by the C.C.I.T.T.

3. *Sending of data to the C.C.I.T.T. Secretariat*

3.1 The observation results should be sent to:
Mr. M. Betancourt, C.C.I.T.T. Secretariat, 2 rue de Varembé, Geneva 20, Switzerland 1211.

3.2 An Information Directory of the names of the officials appointed by participating Administrations will be published as a contribution of Study Group XIII in early 1973.

4. *Processing of data by the I.T.U. for Table 1*

4.1 *Assembly of information recorded in Table 1 of Recommendation Q.61*

The observation results received from Administrations and recognized private operating agencies should be processed under the two headings:

a) observations spread over the day;

b) observations limited to the 4 busy hours.

If the observations received are shown as having been taken over different time periods of the day, the summation of the observations should be taken under the heading " observations spread over the day."

If the observations relating to a particular incoming CT are taken at several outgoing CTs in one country, the observations should be summed by the I.T.U. to give the total observations of the particular outgoing country with respect to the incoming CT, providing the same signalling system is used.

The information received for Table 1 should be assembled in the following order:

Item 1: Successful calls. This is category 1 of Table 1.

Item 2: No answer. This is category 2.1 of Table 1.

Item 3: Busy or congestion. This is a summation of categories 2.2, 2.3, 3.1, 3.2, 3.3 of Table 1.

Item 4: Other unsuccessful calls. This is a summation of categories 3.4, 3.5, 3.6, 3.7, 3.8, 3.9 of Table 1.

Item 5: Callers' errors. This is a summation of categories 4.1, 4.2, 4.3, 4.4, 4.5 of Table 1.

Item 6: Unclassified failures. This is category 5 of Table 1.

Item 7: Total calls. This is the last category of Table 1.

4.2 *Signalling systems*

Administrations will have advised the C.C.I.T.T. of the signalling system used for each relationship for which service observation results are being submitted. This information must be correlated with the observations received for Table 1.

4.3 *Processing of assembled information for Table 1*

In each incoming international switching centre the total observations for each of the items 1-7 of paragraph 4.1 should be obtained for each relationship, for each of the C.C.I.T.T. signalling systems used. Items 1-6 should then be calculated as a percentage of item 7.

5. *Processing of data by the I.T.U. for Table 2*

5.1 *Assembly of information recorded in Table 2 of Recommendation Q.62*

The observation results received from Administrations and recognized private operating agencies for categories 1-7 should be processed under the two headings:

a) ordinary;

b) pre-avis or personal.

For category 8, only observations for Code 11 and Code 12 should be considered, and for these only the mean waiting time should be assessed.

If the observations are shown as having been taken over different time periods of the day, the observations should be combined.

If the observations relating to a particular incoming CT are taken at several outgoing CTs in one country the observations must be combined by the I.T.U. for the particular outgoing country with respect to the incoming CT providing the same signalling system is used.

5.2 *Signalling system*

Administrations will have advised the C.C.I.T.T. of the signalling system used for each relationship for which service observations results are being submitted. This information must be correlated with the observations received for Table 2.

5.3 *Processing of information for Table 2*

In combining the observations, the mean values must be calculated with reference to the number of observations (category 4).

In each incoming international switching centre the mean values for categories 1, 2, 3, 5, 6, 7 and the two items of category 8 should be determined for each relationship for each of the C.C.I.T.T. signalling systems used.

6. *Computer print out*

The computer should print out the information assembled as described in paragraphs 4.1 and 5.1 and processed as described in paragraphs 4.3 and 5.3 in the following combinations:

6.1 On a country basis

a) without reference to signalling system;
b) in each signalling system used.

6.2 In each incoming CT

a) without reference to signalling system;
b) in each signalling system used.

6.3 In tabular form for all countries

a) without reference to signalling system;
b) in each signalling system used.

In Table 1 observations, the print out should show separately the results under the two headings:

a) spread over the day;
b) limited to four busy hours.

In Table 2 observations the print out should show separately the results under the two headings:

a) ordinary calls;
b) pre-avis or personal calls.

7. *Dissemination of tables prepared by the I.T.U. computer*

7.1 The I.T.U. should send the information detailed in paragraphs 6.1 and 6.2 to the country to which the observations relate. The information detailed in paragraph 6.3 should be sent to each of the countries participating in the field trial.

7.2 The information processed will be communicated to the officials appointed by participating Administrations.

Question 10/XIII — Repeated attempts

Considering that:

1. subscribers often make repeated attempts when they fail to reach the desired party at the initial attempt;

2. unsuccessful attempts constitute a load on the network, both on network circuits and common controls at switching centres;

a) to what extent do repeated dialling attempts have significant effects on the performance of the international network?
b) to what extent should international traffic engineering practice take account of these effects?

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2. CLOS C.: Behaviour of DDD customers' repeated attempts on Christmas Day 1958; Contribution to Working Party No. 5 of *C.C.I.T.T. Study Group XIII* (January 1962).

3. COHEN, J. W.: Basic problems of telephone traffic theory and the influence of repeated calls; *Philips Telecommunic. Rev.*, Nederl., 18, No. 2 (August 1957), pp. 49-100.

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5. KEREBEL, R.: Résultats d'observations des appels téléphoniques inefficaces dans le réseau de Paris; *Commut. et électron.*, Fr. (July 1969), No. 26, pp. 95-112.

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13. THE FRENCH ADMINISTRATION (LE GALL, P.): A theory concerning repeat telephone calls. C.C.I.T.T.; Contribution COM XIII—No. 10 (30 September 1969).

Question 11/XIII — Information on traffic routing in the international network

Considering that:

1. Study Group XVI has been asked to reconsider the present circuit noise recommendations with respect to their adequacy from the point of view of customer satisfaction, transmission planning and circuit provision;

2. Study Group XVI needs for this purpose relevant information on the actual routing of traffic in the international network, i.e. the percentages of telephone calls traversing various combinations of international and national long-distance circuits, in order to arrive at traffic-weighted models of connections;

a) What traffic data concerning actual connections of international telephone calls can be supplied to Study Group XVI?

b) How can these data be processed in order to arrive at representative traffic-weighted models of connections, taking into account the number of circuits switched in tandem, the total length of the connections including (if possible) national long-distance circuits and the frequency of occurrence of these different types of calls?

Question 12/XIII — Subscriber-to-subscriber type test calls as a means to obtain information on quality of service. Characteristics of responding equipment

Considering:

1. the difficulties and expense of manually obtaining a sufficient number of service observations on international calls to assess adequately the quality of service of the international network;

2. that subscriber-to-subscriber type test calls are being used in national networks to obtain information on the quality of service as seen by the subscriber;

3. that automatic equipments programmed to send test calls to specific responding equipments eliminate subscribers' errors, subscriber busy, and ringing tone - no answer conditions;

4. that the use of simulated traffic permits a sample size adequate for statistical accuracy to be obtained more readily than is practical with manual methods;

a) to what extent could subscriber-to-subscriber type test calls be used to supplement manual service observations and obtain information on the quality of service of the international networks?

b) what are the characteristics of responding equipments that should be recommended?

ANNEX

(to Question 12/XIII)

Reply given by Study Group XIII, in 1968-1972, to Question 8/XIII—
New methods of collecting information on quality of service

The methods for assessing service quality outlined in Recommendation Q.60 are:

i) service observations;
ii) simulated traffic (test calls);
iii) customer interviews.

Study Group XIII identified the following methods of deriving information on quality of service:

a) service observation results (manual, partially automatic and automatic);

b) subscriber-to-subscriber type test call results (simulated traffic generated, for example, by test call senders);

c) results of test calls of type 1, 2 and 3 in Recommendation Q.63;

d) information furnished by the equipments used by analyzing international traffic and possibly the equipments used for international accounting.

The Study Group considered that only methods a) and b) fully met the requirements for determining service quality on subscriber-to-subscriber connections in the international service. Methods c and d cover only part of the connection and are therefore mainly applicable to maintenance operations.

Service observations, as described in Recommendation Q.60 *bis*, Q.61 and Q.62, provide an indication of the quality of service in the international telephone network actually experienced by subscribers. Moreover, simulated traffic of the subscriber-to-subscriber type provides an indication of network quality, including grade of service, but excluding such items as subscribers' errors, subscriber busy, and ringing tone - no answer. Study Group XIII, whilst studying Question 11/XIII proposed the addition to Recommendation Q.63 of a definition for a " subscriber-to-subscriber " type test call. Simulated calls of the subscriber-to-subscriber type will affect the international accounting arrangements. However, the sending equipment could be arranged to provide the information required for the adjustment of accounts, if this is desired.

Study Group XIII proposed that a new question be set for study in the next study period that is specifically related to the use of simulated subscriber-to-subscriber type test calls, and that Question 8/XIII in its present form be superseded by this new question.

Question 13/XIII — Use of computers for network planning and circuit group dimensioning

(continuation of Question 18/XIII studied in 1968-1972)

Considering that:

1. Administrations have ready access to computers either locally or to that of the I.T.U.;

2. traffic measurement techniques have been established which provide statistics in a suitable form for machine processes;

3. there is adequate dimensioning information available for use by computers;

4. it is desirable that the results of processing should be on a comparable basis for bilateral agreements;

a) what practices should be recommended in the application of computers for network planning and dimensioning?

b) what recommendations should be made for the collection and analysis of data?

ANNEX

(to Question 13/XIII)

Extracts from the reply in 1972 to Question 18/XIII
Use of computers for network design and dimensioning, especially for national networks

1. *General considerations*

a) Many Administrations already have in use computer programmes for network planning and circuit provision purposes. There is a wide variety of applications, e.g.:
— gathering, compilation and display of traffic data;
— calculation of traffic volumes and distributions and forecasting traffic growth;
— determination of the number of exchanges, their locations and the boundaries of the exchange areas in multi-exchange local networks;
— dimensioning and optimization of the routing and number of circuits in local, trunk and international networks.

The computer programmes vary in complexity as regards both the dimensioning methods and the economic calculations. Often heuristic or simplified mathematical models are used in the dimensioning work in order to minimize the costs for computer implementations. Some programmes take account of limited availability of the switching equipment and of the degeneration of traffic in the overflow network, others do not. The economic calculations may range from more simple cross-sectional studies a number of years ahead, without taking into close consideration the existing plant configuration and capacity for more dynamic studies paying attention to the existing network, and its most economic development from year to year as regards both the size and type of extensions and the time interval between the extension steps.

A simultaneous optimization of all variables in network planning is not possible. Iterative methods giving a number of sub-optima are normally used giving an acceptable approach to an optimal network plan. The cost minimum is fairly flat and slight deviations from the optimum point are normally of less importance.

b) The use of computers for network design and dimensioning offers the following advantages:
- by using computer techniques it is possible to make extensive numerical calculations which are not realistically performed by manual means;
- possibility of examining more complex networks and various network alternatives. The computations can be performed on the basis of different assumptions as regards the traffic growth (e.g. using one " optimistic " and one " pessimistic " growth of demand), the costs for circuits and switching equipments, the anticipated technical development, etc.;
- reduction of human error in computation;
- consistency in the treatment of each network model which helps to ensure that the results are on a comparable basis;
- the computer technique aids in keeping the network plans up-to-date with a minimum of effort on the part of the planning staff. If changes occur which are not originally anticipated, a new study can be made by simply changing the input information (stored on punched cards, magnetic tape, etc.) and resubmitting the problem to a computer;
- possibility of obtaining accurate, up-to-date statistics for network design and management.

c) Computer programmes which could be used by different Administrations require great flexibility to meet various situations. Probably many situations must be left for manual judgement, particularly in planning the international network where political and commercial considerations often are of importance. However, for the more routine frequently performed dimensioning work, standard programmes would be useful and make bilateral agreements easier.

Study Group XIII came to the conclusion that an ultimate aim of the study should be standardization of computer programmes with respect to input and output data and with respect to logic and programme language, bearing in mind that some Administrations are interested principally in the input and output data.

2. *General remarks and useful references*

It is obvious that computer technique paves the way for using more sophisticated dimensioning methods which may prove beneficial. Of importance is that the running costs for computer implementation can be held at a low level without too rough approximations in the calculations. Thus, the computer implementation may have a strong effect on the choice of calculation methods.

Attention is drawn to a series of papers on the use of computers for network planning in the November and December 1971 issues of the I.T.U. *Journal.*

Additional references are:

Contributions COM XIII—Nos. 51 (March 1971) and 71 (November 1971) from K.D.D.

Contribution COM XIII—No. 66 (September 1971) from O.T.C. (Australia).

Question 14/XIII — Internal blocking characteristics in digital exchanges

Considering that:

1. digital exchanges appear to be capable of economically providing a very low internal blocking probability, which would not exert a significant influence on the end-to-end blocking probability in a digital network;

2. the internal blocking probabilities associated with contemporary analogue exchanges do influence the end-to-end blocking probability of present networks:

a) what recommendation can be made for the internal blocking probability which should be the design aim for digital exchanges in a digital network?

b) would this internal blocking probability be varied for digital exchanges which interwork with analogue exchanges in a mixed analogue/digital network?

DOCUMENTARY PART

SUPPLEMENTS

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SUPPLEMENTS CONCERNING THE WORK OF STUDY GROUP XI

SUPPLEMENT No. 1. — Report on the energy transmitted by control signals and tones.

SUPPLEMENT No. 2. — TASI characteristics affecting signalling.

SUPPLEMENT No. 3. — Information received on national voice-frequency signalling systems.

SUPPLEMENT No. 4. — Various tones used in national networks.

SUPPLEMENT No. 5. — North American precise audible tone plan.

SUPPLEMENT No. 6. — Treatment of calls considered as " terminating abnormally ".

SUPPLEMENT No. 7. — Measurements of impulsive noise in a 4-wire telephone exchange.

SUPPLEMENT No. 8. — Signalling for demand assignment satellite systems.

SUPPLEMENTS CONCERNING THE WORK OF STUDY GROUP XIII

SUPPLEMENT No. 9. — Table of the Erlang loss formula (Erlang No. 1 formula, also called Erlang B formula).

SUPPLEMENT No. 10. — Curves showing the relation between the traffic offered and the number of circuits required according to Recommendations Q.85 and Q.87.

Supplement No. 1

REPORT ON THE ENERGY TRANSMITTED BY CONTROL SIGNALS AND TONES

This report dates from 1956. It was used for designing signalling system No. 3 and signalling system No. 4.

1. *The problem*

In 1956, the C.C.I.F. endeavoured:

a) to calculate the energy of control signals for international signalling and of national tones which may be transmitted on an international circuit in automatic working (subscriber-to-subscriber) in the international network;

b) bearing in mind the limit in Recommendation Q.15 for the overall energy that can be transmitted for signalling on an international circuit, to see whether an increase in the permissible power for control signals and/or a limitation of the sent power of national tones should be proposed;

c) to indicate to what extent Administrations should be recommended to use the principles established in reply to b above as the basis for signalling in national networks.

2. *Operating assumptions*

In the calculations, it was assumed from *experience in automatic trunk operation in the national networks of various Administrations* that in international automatic operation there would be about 20 calls per circuit in the busy hour including:

12 successful calls;
1 call with no reply by the called subscriber; and
7 calls for which the line or the called subscriber was busy.

3. *Calculation of control signal energy*

With these assumptions, the following figures were obtained:

— a total energy, for both directions of transmission, of 21 000 microwatts × seconds during the busy hour, for system No. 3; and
— a value which is slightly below half of the above, for system No. 4.

4. *Assumptions relative to national tones*

The maximum national tone *level* specified, on the basis of the information available in 1956, is —0.2 neper (absolute power level (referred to 1 milliwatt) at a zero relative level point). Moreover, allowances should be made for the fact that an additional attenuation of 0.4 neper is always inserted in the international connection during the period in which tones may be sent. A level of —0.6 neper or a power of 300 microwatts, at a zero relative level point, was therefore considered as a maximum.

As regards the cadences of tones, it was noted that, according to Tables 3 and 4 on pages 25 and 26 of the C.C.I.F. *Green Book*, Volume V:

— in almost all cases, the length of the tone period of busy tone is not greater than the length of the silent period;
— for all the countries mentioned (except for Spain and the Paris network), the most unfavourable ringing tone conditions will be a tone period having a duration of one-third that of the silent period.

It was finally assumed for the calculation that the duration of connection of the various tones was:

- 10 seconds of ringing tone in the case of a successful call;
- 60 seconds of ringing tone if there is no reply;
- 10 seconds of busy tone under engaged conditions.

5. *Calculation of the energy transmitted for the national tones*

The calculated total sending duration of tones in the busy hour is shown in the following table:

	Duration of tones per call (in seconds)	Number of calls	Total duration of tones (in seconds)	Ratio of tone period to silent period	Total sending duration (in seconds)
Successful calls	10	12	120	1/3	30
No reply	60	1	60	1/3	15
Engaged	10	7	70	1/1	35

Total = 80 s

Thus, in the busy hour and in the most unfavourable conditions, a total energy of

$$300\ \mu W \times 80\ s = 24\,000 \text{ microwatts} \times \text{seconds}$$

is obtained.

This is the value for the direction in which the tones are transmitted (backwards, as far as operation is concerned), i.e. it is applicable to both directions of transmission.

In the special case of the Paris network the durations corresponding to the first two lines of the table should be doubled and the total sending duration would be increased to 125 seconds; as the tone level is much lower than —0.6 neper in this case, the maximum value calculated above would not be reached.

6. *Calculation of the energy transmitted in the international service for control signals and national tones*

A calculation of the energy of control signals in standardized systems (paragraph 3 above) shows that, when system No. 3 is used in the automatic international service, the value to be expected for the combination of both directions of transmission is about 21 000 microwatts × seconds.

In the case of system No. 4, the energy of the control signals is appreciably less.

Hence, if the calculated energy for national tones assuming the most unfavourable conditions, say 24 000 microwatts × seconds, is added to the higher of the two calculated values (i.e. 21 000 microwatts × seconds for system No. 3), a total energy (for the two directions of transmission) of 45 000 microwatts × seconds is obtained, which is much lower than the value of

$$2 \times 36\,000 = 72\,000 \text{ microwatts} \times \text{seconds}$$

defined in Recommendation Q.15.

However, this does not mean that the level of the signalling pulses can be raised, since the choice of this level was based on crosstalk considerations.

Supplement No. 2

TASI CHARACTERISTICS AFFECTING SIGNALLING

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 a trunk (circuit) with a transmission channel when speech is detected on a trunk at one end and is required to be transmitted, over a channel, to the same trunk at the other end. Depending upon the need, trunk/channel association ceases, and the channel is made available to other trunks 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 trunk/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 trunk/channel association.

To reduce the number of times clipping occurs, the TASI speech detector is given a hangover, maintaining trunk/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.

The characteristics of TASI affecting signalling may be summarized as follows; TASI-A and TASI-B have similar characteristics except where noted:

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.

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.

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.

4. Nominal duration of clip of a signal (including the 5 ms response time of the TASI speech detector):

a) initial clip: 18 ms;

b) total clip when TASI 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:

Total clip	Number of TASI systems in series on one circuit		
	1	2	3
125 ms	1/100	1/20	1/10
250 ms	1/700	1/40	1/60
500 ms	1/15 000	1/5000	1/1500

A total clip of 500 ms was assumed for the No. 5 system design, and the duration (850±200 ms) of the forward-transfer pulse line signal concerned includes a 500-ms TASI prefix for TASI trunk/channel association.

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 trunk/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 energization of the speech detector to give the 240 ms hangover (see item 3 b above) before the short-pulse short-gap signalling is applied.

Since TASI-A is more critical than TASI-B in this respect, a short pulse signalling system designed to work properly over TASI-A circuits will also work properly over TASI-B circuits. Prior energization 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 sections 3 c and 3 d.

The register short-pulse short-gap multifrequency signalling adopted for the No. 5 system takes advantage of this continued speech detector operation and is transmitted without a TASI prefix, reliance being placed on the trunk/channel association due to the seizing signal.

Supplement No. 3

INFORMATION RECEIVED ON NATIONAL VOICE-FREQUENCY SIGNALLING SYSTEMS

	Germany[a] (Federal Republic)		Algeria	Argentina	Australia		Austria	Cameroon	Canada	Cuba
Frequency (Hz)	3000	(2280)*	2000	2040-2400 compound 500	600-750 separate	2280	2280	3825	2600 (for 2 wires: 2400-2600)	2150
Tolerance at the generator terminal (Hz)	± 7.5	± 6	± 6	± 6	± 5	± 6	± 6		± 5	± 3
Frequency variation possible at the entry to the international circuit (Hz)	± 15	± 15	± 12	± 15	± 15	± 15	± 15	± 15	± 15	± 10
Splitting time (milliseconds)	20	20	15 then 35 with attenuated 18 dB	60	160-210	35	30		35 maximum	60
Absolute level of the power of signals at the point of zero relative level (decibels)	−8	−8	−6	−9	0	−6	−6		−8 and after attenuation −20	−10
	* for narrow-band circuits									

[a] In the future the national voice-frequency signalling system will no longer be used.

	Denmark	Dominican Rep.	East African Post and Telecomm. Corp. (Kenya, Uganda and Tanzania)	Spain	United States of America	France	Ghana	India	Ireland		Italy	Madagascar	Morocco
Frequency (Hz)	3000	2600	2040-2400	2500	2600	2280	3825	2400	2040-2400 compound	2280	2040-2400 separate and compound	1000	2280
Tolerance at the generator terminal (Hz)	± 3		± 6	± 3	± 5	± 3	± 10	± 2	± 6	± 6	± 6	—	± 3
Frequency variation possible at the entry to the international circuit (Hz)	± 8		—	± 15	± 10	± 6	—	± 10	—	—	± 15	± 20	± 10
Splitting time (milliseconds)	35		30-40	10	35 maximum	35	—	25 filter loss at 2400 Hz → 50 dBm	60	35	35	—	25-35
Absolute level of the power of signals at the point of zero relative level (decibels)	−8		−9	−6	−8 and after attenuation −20	−6	−6	−10	−9	−6	−9	—	−6

INFORMATION RECEIVED ON NATIONAL VOICE-FREQUENCY SIGNALLING SYSTEMS

	Mexico	Norway	New Zealand		Netherlands	Poland	Portugal		Syria
Frequency (Hz)	2400	2400	600-750	2280	2400-2500 separate	2280	2400	2040-2400 compound *	2040-2400 compound standardization proposed =2280
Tolerance at ghe generator terminals (Hz)	± 5	± 2	± 3	± 3	± 2	± 6	± 6	± 6	± 6
Frequency variation possible at the entry to the international circuit (Hz) . . .	± 15	—	± 3	± 3	± 5	± 8	± 15	± 15	—
Splitting time (milliseconds)	35 maximum	35	160-210	20-35	30-55	45	35-40	40-60	70
Absolute level of the power of signals at the point of zero relative level (decibels) . .	−8 and after attenuation −20	−6	−9	−9	+ 3.5	−6	−9	−9	−11 ± 1

* standardization considered

	Rhodesia		United Kingdom		South Africa (Rep. of)		Sweden	Switzerland	Czechoslovakia	Thailand	Tunisia	U.S.S.R.		Yugoslavia
Frequency (Hz)	3250 Tone-on-idle signalling	2280 *	600-700 separate	2280	600-750 separate	2280	2400	3000	2280	2280	2280 500-20	1200-1600 separate and compound	2100 or 1600	2280
Tolerance at ghe generator terminals (Hz)	± 7.5	± 6	± 3	± 6	± 2.5	± 5	± 6	± 3	± 6	± 6	± 5	± 5	± 5	± 6
Frequency variation possible at the entry to the international circuit (Hz)	—	—	—	—	—	—	± 11	± 6	± 15	± 8	—	± 15	± 15	—
Splitting time (milliseconds)	filter loss at 3250 →30 dBm	2280	140 or 400 320	35 max.	160-210	35 max.	35-40	70	150 then 130 with filter	35 max.	66-34	40 before reply, 150 after reply	50-75	—
Absolute level of the power of signals at the point of zero relative level (decibels)	−14	−14	−3	−6	−7	−6	−6	−3.5	−6	−6	−6	−4	−6	−6

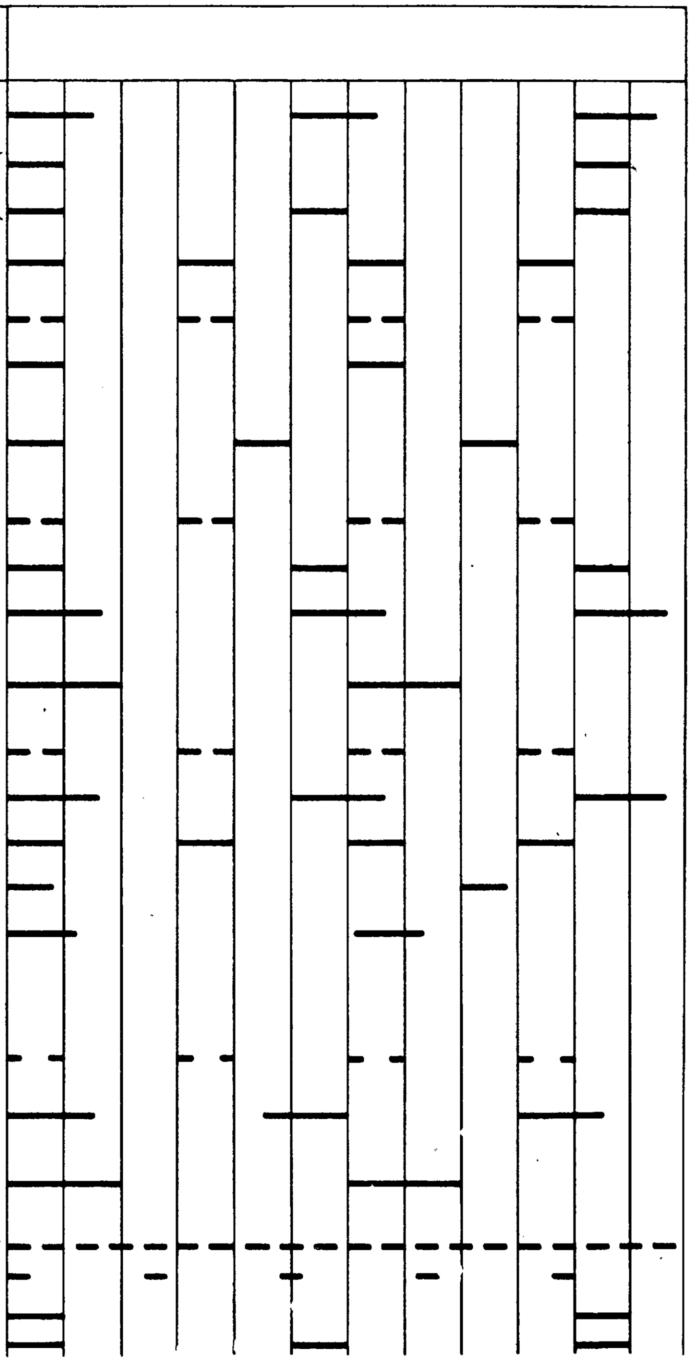
*For narrow-band circuits

Supplement No. 4

VARIOUS TONES USED IN NATIONAL NETWORKS

TABLE 1. — RINGING TONE

Country	Frequency (Hz)
ALGERIA	25 or 50
GERMANY (F.R.)	450 or 425
ARGENTINA	25 + 450 × 16⅔
AUSTRALIA	400 × 17
AUSTRIA	450
BELGIUM	450 Exceptionally 450 × 25 [a]
BOTSWANA	400/450
BRAZIL	400 or 450
CAMEROON	425
CANADA	420 × 40 or 440 [b] + 480 [b]
CHILE	16⅔
IVORY COAST	50
CUBA	420 + 40
DENMARK	450
EL SALVADOR	425
EAST AFRICAN P. and T. Corp. (KENYA, UGANDA and TANZANIA)	133 + 17 or 400 + 17 or 400 + 450
SPAIN	400
UNITED STATES	420 × 40 or 440 [a] + 480 [b]
FIJI	133 × 16⅔ 400 × 25
FINLAND	400 or 450 [c] 425 ± 25 [d]



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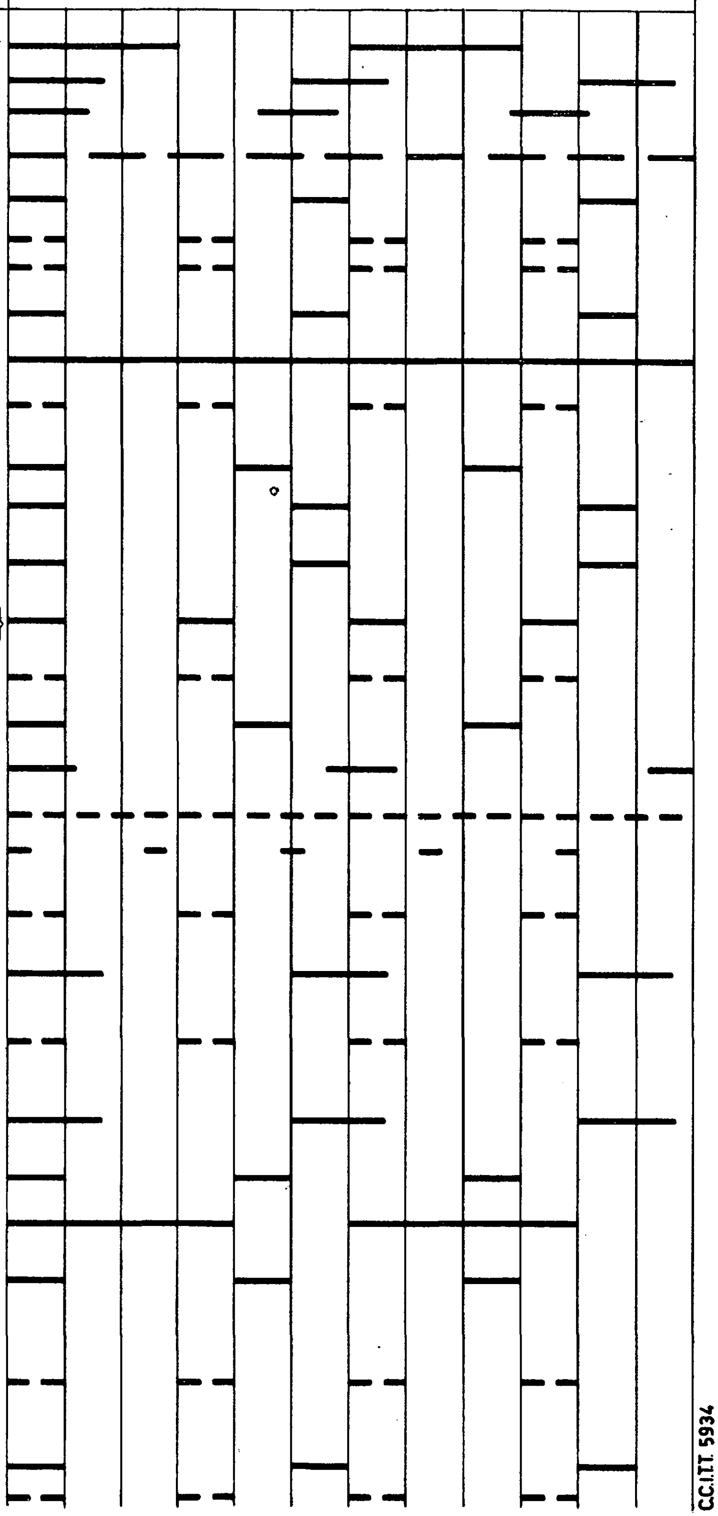
Note. — In these tables
$f_1 \times f_2 = f_1$ modulated by f_2
$f_1 + f_2 = f_1$ plus f_2

[a] The frequency is between 400 and 450.
[b] New precise tone. Frequencies ±0.5% of nominal values.
[c] Exchanges supplied in 1970 or earlier.
[d] Exchanges supplied in 1970 or later.

TABLE 1. — RINGING TONE *(continued)*

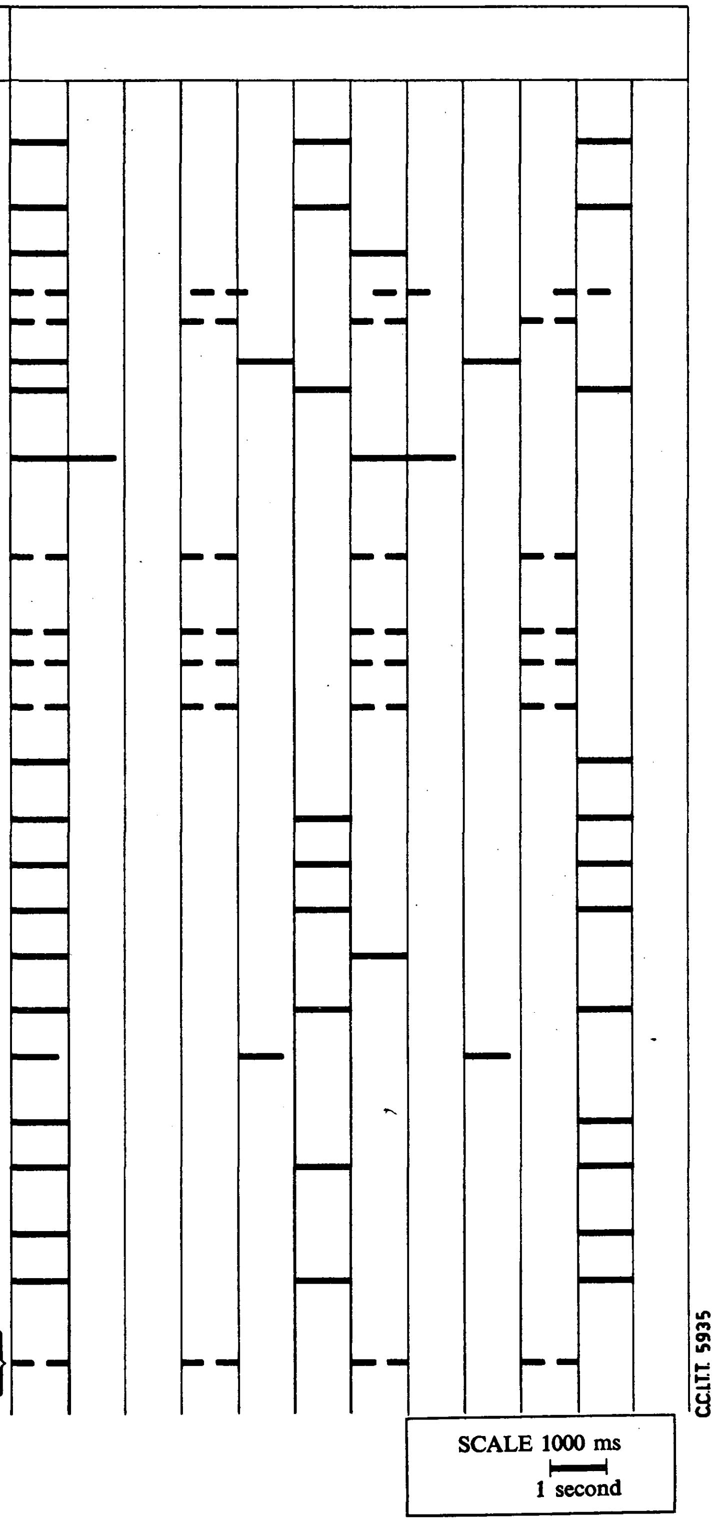
Country	Frequency (Hz)
FRANCE — Paris	425 ± 25
FRANCE — Province	425 ± 25 [a]
GHANA	450 or 135
GREECE	450
INDIA	133 + 16⅔ 400 + 16⅔
INDONESIA	435 or 450
IRAQ	400
IRELAND	400/450
ISRAEL	400 ± 8 400 ± 8 or 450 ± 9
ITALY	400 or 450
JAPAN	400 × 16⅔ 350 × 33⅓ [b]
JORDAN	400 + 16⅔
KUWAIT	400
LEBANON	435
MALAYSIA	133 or 400 × 25
MALAWI	400 133
MADAGASCAR	25
MALTA	400 ± 450 400 × 25 400 × 16⅔
MOROCCO	450/50 or 450
MAURITANIA	50
NIGERIA	133 + 17
NORWAY	400 + 450 or 425
NEW ZEALAND	(400 + 16⅔ and 400 + 25 to be eliminated) 400 × 33 400 + 450
PAKISTAN	450 400 + 16⅔



[a] The tone period varies between 1.4 and 1.8 seconds and the silent period between 3 and 3.8 seconds.
[b] Exchanges supplied in 1970 or earlier.

TABLE 1. — RINGING TONE *(conclusion)*

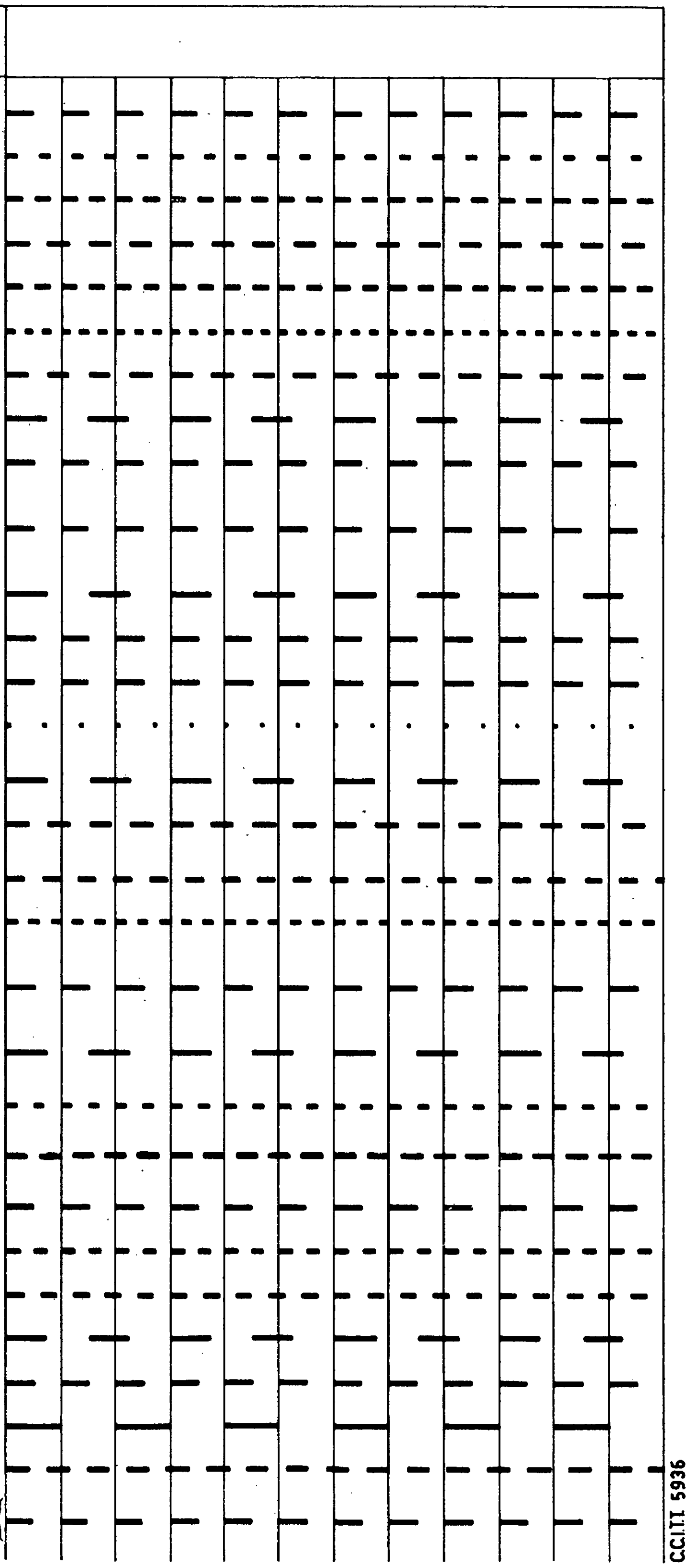
Country	Frequency (Hz)
NETHERLANDS	425 or 450 or 25 + harmonics [a]
POLAND	400
PORTUGAL	400
QATAR	400 + 450 or 400
SYRIA	450/50 450/25
ROUMANIA	16⅔ or 450/25 or 450/50
UNITED KINGDOM	400 + 450 400 × 25 400 × 16⅔ 133⅓ × 16⅔
SINGAPORE	400 × 16⅔ 400 × 24
SOUTH AFRICA (Rep. of)	400 × 33⅓
SWEDEN	425 or 425 [b]
SWITZERLAND	400
CZECHOSLOVAKIA	450
THAILAND	400
TUNISIA	400 ± 80
U.S.S.R.	450 ± 50 at present 425 ± 25 in future
URUGUAY	450 + 25 at present 450 in future
YUGOSLAVIA	450 or at present 25 × 450 in future
ZAMBIA	133⅓ or 400 + 450



[a] It will be deleted in 1980.
[b] New equipment.

TABLE 2. — BUSY TONE

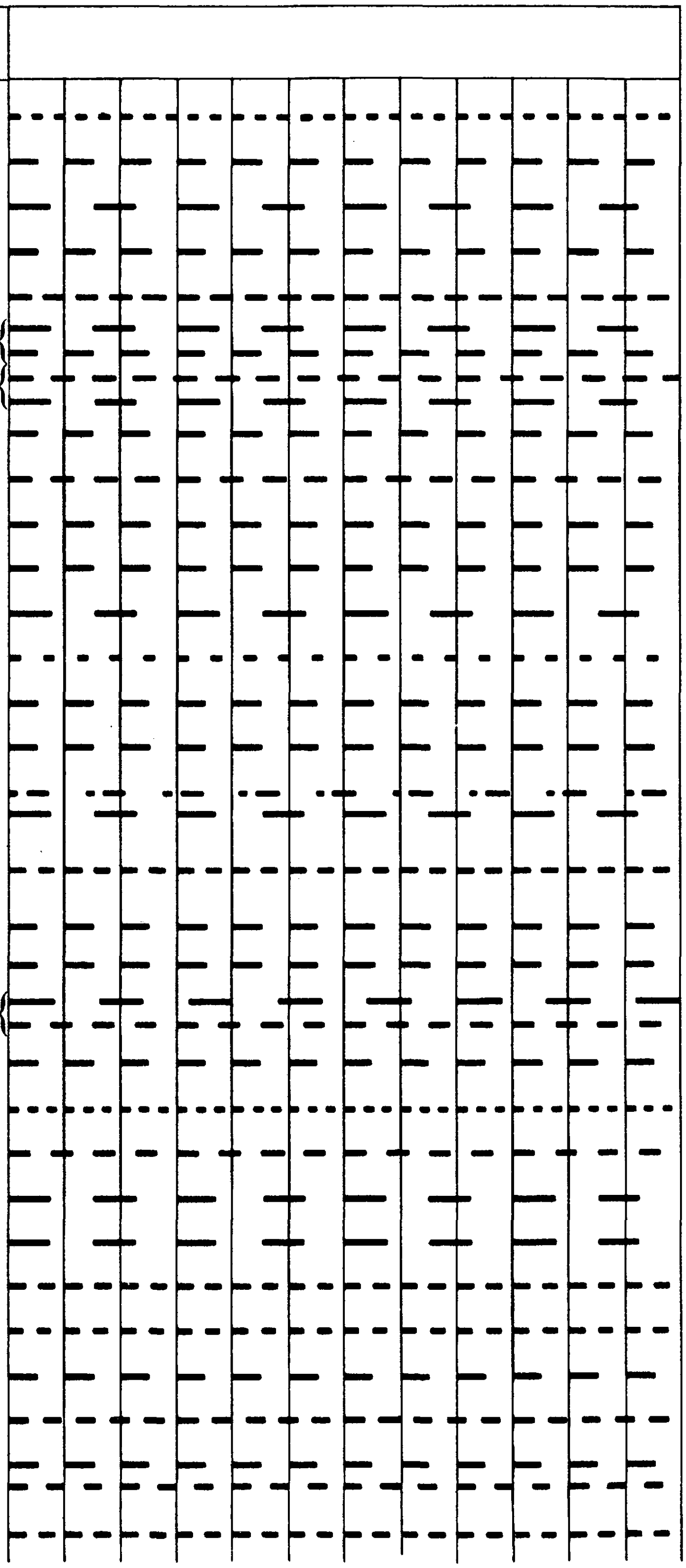
Country	Frequency (Hz)
ALGERIA	450
GERMANY (F.R.)	450 or 425 [a]
ARGENTINA	450
AUSTRALIA	400
AUSTRIA	450
BELGIUM	450
BOTSWANA	400
BRAZIL	400 or 450
CAMEROON	425
CANADA	600 × 120 or 480 [a] + 620 [a]
CHILE	400
IVORY COAST	450
CUBA	600 + 120
DENMARK	450
EAST AFRICAN P. and T. Corp. (KENYA, UGANDA and TANZANIA)	400
EL SALVADOR	425
SPAIN	400
UNITED STATES	600 × 120 or 480 [a] + 620 [a]
FIJI	400
FINLAND	At present: 400 or 450 In future: 425 ± 25
FRANCE	425 ± 25
GHANA	400
GREECE	450
INDIA	400
INDONESIA	435 or 450
IRAQ	400
IRELAND	400
ISRAEL	400 ± 8 400 ± 9



[a] Denotes new precise tone plan. Frequencies ± 0.5% of nominal values.

TABLE 2. — BUSY TONE *(continued)*

Country	Frequency (Hz)
ITALY	400 or 450
JAPAN	400
JORDAN	400
KUWAIT	400
LEBANON	435
MALAYSIA	400
MALAWI	400
MADAGASCAR	450
MALTA	400
MOROCCO	400 or 450
MAURITANIA	600
NIGERIA	400
NORWAY	400 or 450 In future 425
NEW ZEALAND	400
PAKISTAN	450 400
NETHERLANDS	At present 425 or 450
POLAND	400
PORTUGAL	400
QATAR	400
SYRIA	450
ROUMANIA	133 or 450
UNITED KINGDOM	400
SINGAPORE	400
SOUTH AFRICA (Rep. of)	400
SWEDEN	425
SWITZERLAND	400 (standardized) 450 [a]
CZECHOSLOVAKIA	450
THAILAND	400 450
TUNISIA	400 ± 80



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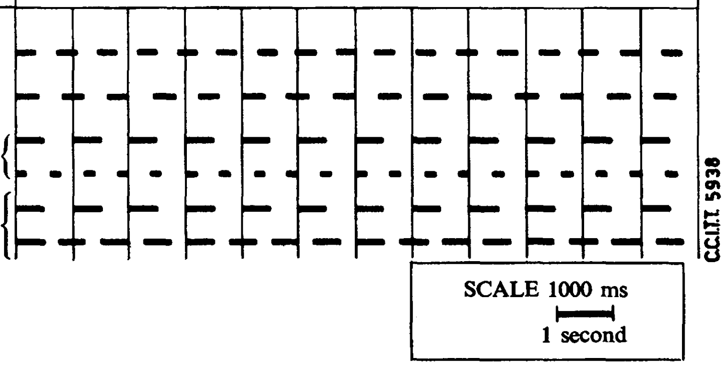
[a] Obsolete equipment still in service.

TABLE 2. — BUSY TONE *(conclusion)*

Country	Frequency (Hz)	
U.S.S.R. [a]	450 ± 50 at present 425 ± 25 in future	
YUGOSLAVIA	450	
ZAMBIA	400	

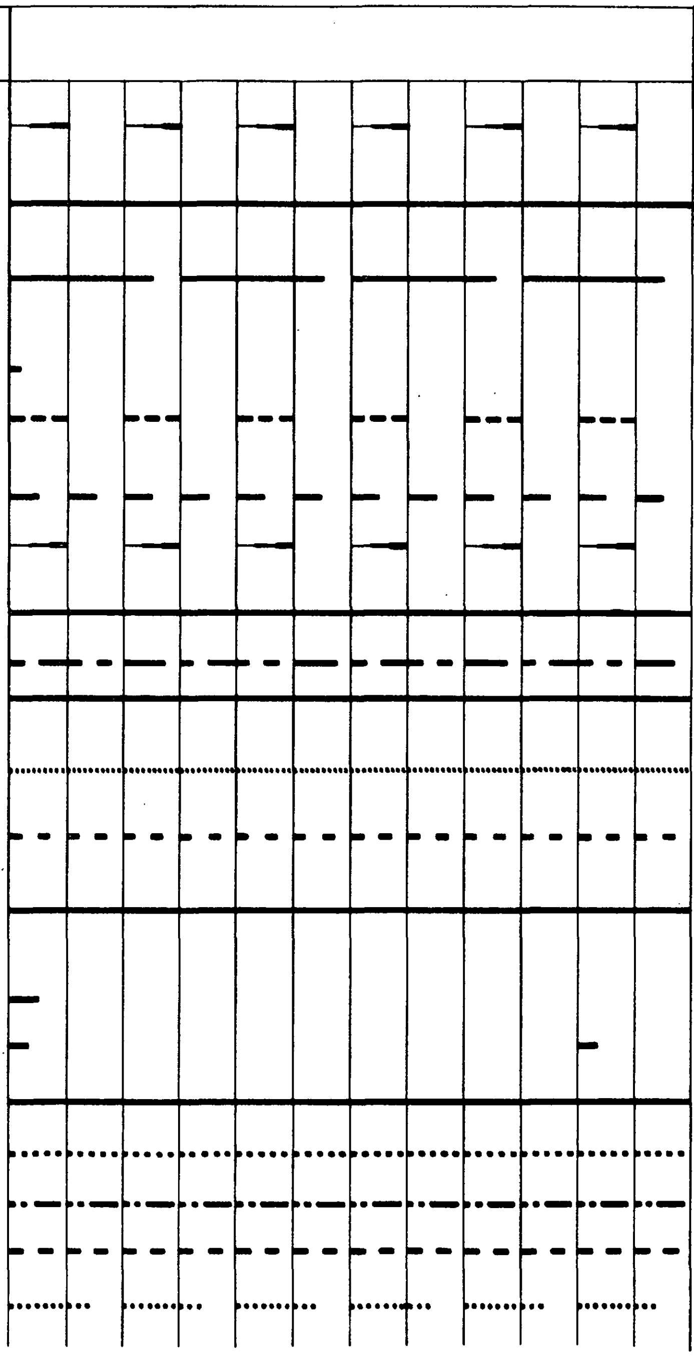


[a] A signal of the same frequency and periodicity is used to indicate both a busy line and a busy subscriber.

TABLE 3. — OTHER TONES

(Reference, information, number unobtainable, congestion tones [1])

Country	Frequency (Hz)
GERMANY (F.R.) Information tone	950/1400/1800
ARGENTINA Dial tone . . .	450
AUSTRALIA: Number unobtainable .	400
AUSTRALIA: Recording tone [a]	1400 ± 100
AUSTRIA Information tone .	950/1400/1800
BELGIUM: Congestion tone .	450
BELGIUM: Information tone .	900/1380/1860
BOTSWANA: Number unobtainable . . .	400
BRAZIL: Number unobtainable / Dial tone	400 or 450
CAMEROON Routing tone .	425
CANADA: Reorder (congestion) tone	600 × 120 or 480 [b] + 620 [b]
CANADA: Dial tone	600 × 120 or 350 [b] + 440 [b]
CANADA: Recorder warning tone	1400 [c]
CANADA: Call waiting tone .	440 [b, d]
CHILE: Dial tone	33⅓ or 400 × 33⅓
CHILE: Waiting tone	(1100 + 900) × 10
CUBA: Number unobtainable	520
CUBA: Congestion tone . . .	600 + 120
DENMARK Information tone	450 or 950/1400/1800



[1] It may be advantageous to provide the intervention of an assistance operator at the incoming international exchange in the event of receipt of these tones.

[a] Applied for 0.200 second every 15 seconds.

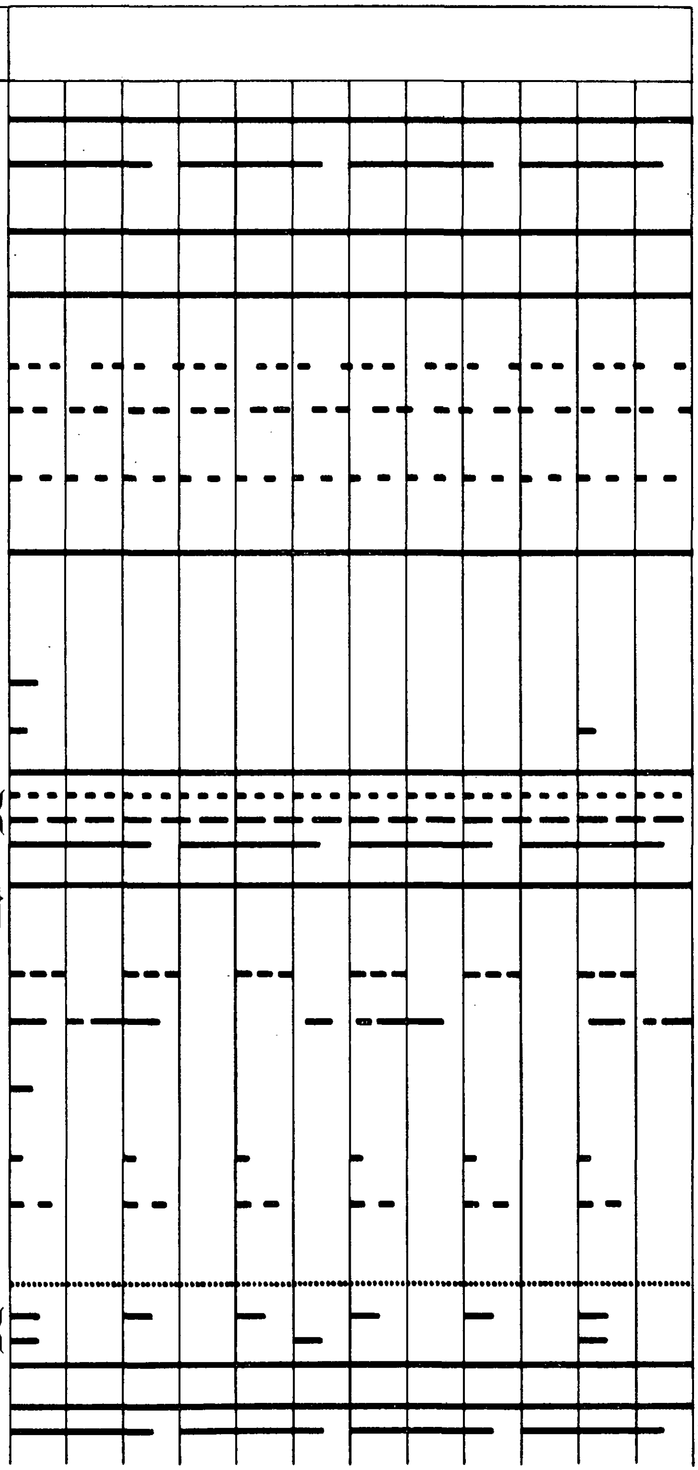
[b] Denotes new precise tone plan. Frequencies ± 0.5% of nominal values.

[c] Applied for 0.500 second every 15 seconds.

[d] Applied for 0.300 second every 10 seconds.

TABLE 3. — OTHER TONES *(continued)*

Country		Frequency (Hz)
EAST AFRICAN P. and T. Corp. (KENYA, UGANDA and TANZANIA	Number unobtainable .	400
		400
	Dial tone .	33 or 50
EL SALVADOR	Dial tone . .	425
SPAIN	Information tone . .	400
	Spare level	400
UNITED STATES	Reorder (congestion) tone	600 × 120 or 480[a] + 620[a]
	Dial tone	600 × 120 or 350[a] + 440[a]
	Recorder warning tone . .	1400[b]
	Call waiting tone . .	440[a, c]
FIJI	Dial tone	33 or 50
	Trunk offer	400
	Number unobtainable	400
	Continuous ringing	133 × 16⅔ or 400 × 25
FINLAND	Information tone	950/1400/1800
	Waiting tone . .	950/950/1400
	Recording tone .	1400 ± 50
	Warning tone, operator intervening . . .	400 or 450[d]
		425 ± 25[e]
FRANCE	Routing or transfer tone[f]	425
GHANA	Number unobtainable	150 or 450
		400
INDIA	Number unobtainable .	400
		400



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[a] Denotes new precise tone plan. Frequencies ±0.5% of nominal values.

[b] Applied for 0.500 second every 15 seconds.

[c] Applied for 0.300 second every 10 seconds.

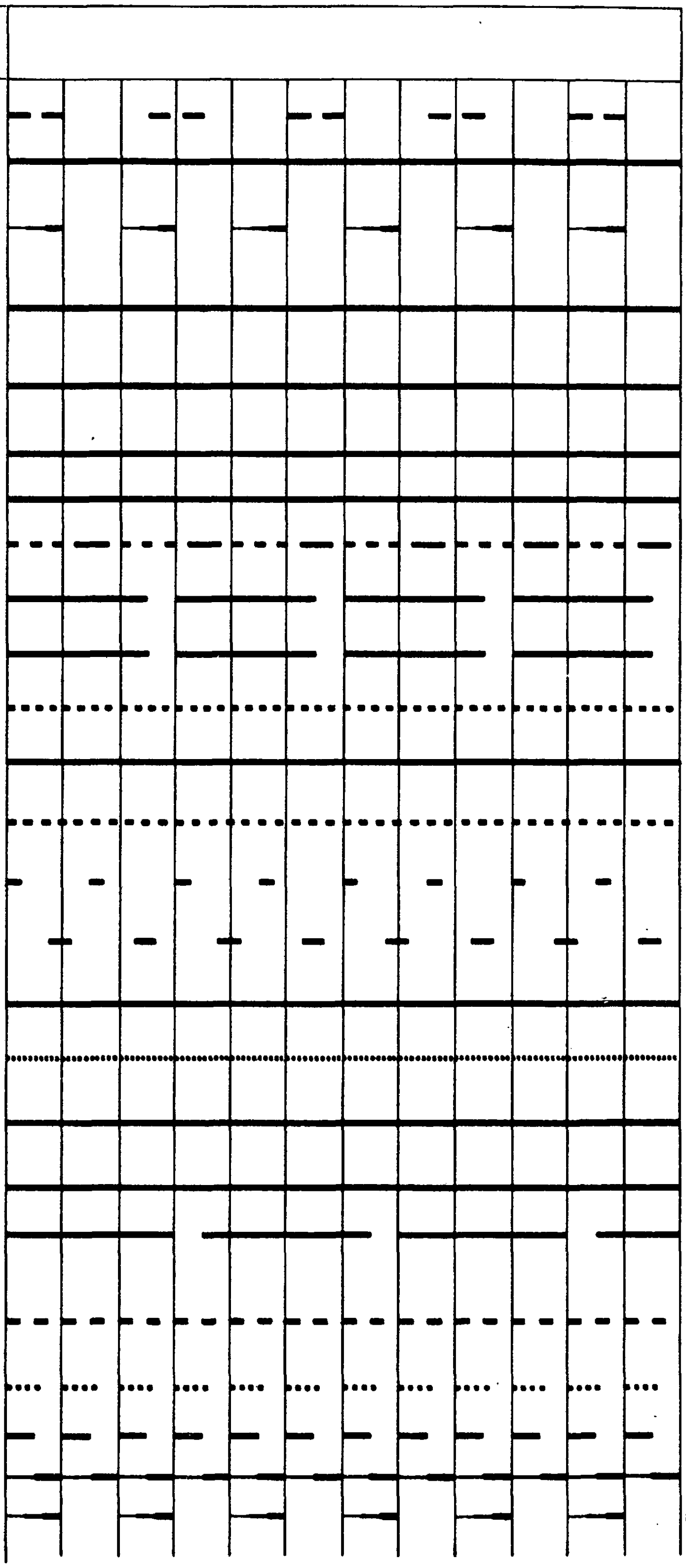
[d] Exchanges supplied in 1970 or earlier.

[e] Exchanges supplied in 1970 or later.

[f] In principle, this tone is not retransmitted outside the French network. However, it may be retransmitted in the case of calls arriving at Paris via distant transit connections in the French network and for some nearby international relations. The French Administration is considering designing a device to put an end to this.

TABLE 3. — OTHER TONES *(continued)*

Country	Frequency (Hz)
IRAQ Ring back tone	133
IRELAND	400
ISRAEL Information tone . . .	100/1400/ 1800 ±2 ± [a]
JAPAN Dial tone	400
JORDAN Number unobtainable	400
KUWAIT — Dial tone	33
KUWAIT — Number unobtainable . . .	400
LEBANON	435
MALAYSIA — Number unobtainable tone	400
MALAWI Number unobtainable	400
MADAGASCAR Waiting tone	450
MALTA — Number unobtainable	400
MALTA — Pay tone	400
MALTA — Equipment engaged	400 — Normal level / Reduced level
MALTA — Dial tone	33⅓ or 50
MOROCCO Waiting tone . .	450
MAURITANIA Dial tone . .	600
NIGERIA — Dial tone	33
NIGERIA — Number unobtainable . . .	400
NORWAY — Congestion tone (planned)	425
NEW ZEALAND — Number unobtainable . .	400
NEW ZEALAND — Congestion tone	900
NETHERLANDS — Special information tones	150/450 or 950/1400/ 1800



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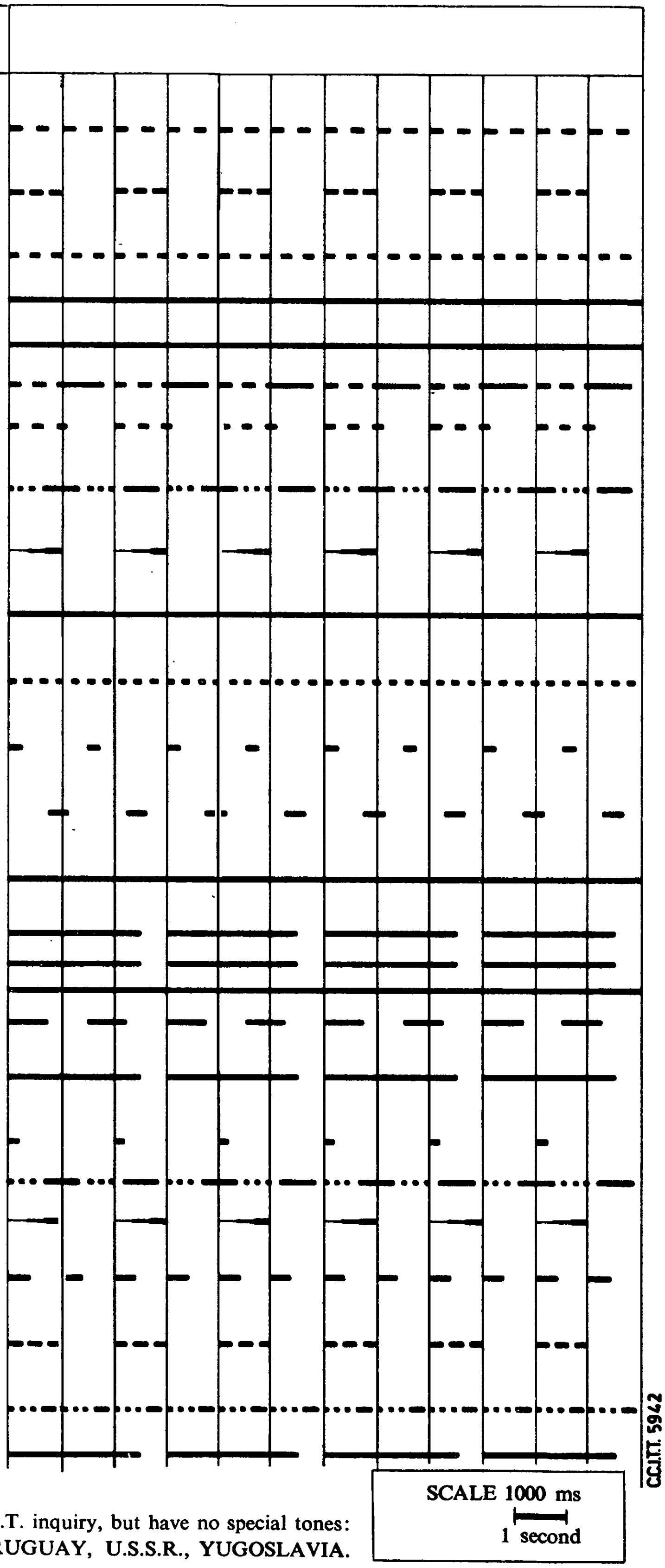
[a] Alternating with a recorded announcement.

TABLE 3. — OTHER TONES *(conclusion)*

Country	Frequency (Hz)
POLAND — Congestion tone	400
POLAND — Information tone	950/1400/1800
PORTUGAL Number unobtainable	400
QATAR Number unobtainable	400
SYRIA — Re-call tone	450
SYRIA — Number unobtainable	450
SYRIA — Dead level	450
ROUMANIA — Number unobtainable	400 × 133 or 450
ROUMANIA — Information tone	950/1400/1800
UNITED KINGDOM — Number unobtainable	400
UNITED KINGDOM — Pay tone	400
UNITED KINGDOM — Equipment engaged	400 — Normal level
	400 — Reduced level
UNITED KINGDOM — Dial tone	33⅓ or 50
SINGAPORE — Reference	400
SINGAPORE — Number unobtainable	400
SINGAPORE — Congestion	400
SOUTH AFRICA (Rep. of) — Number unobtainable	400
SOUTH AFRICA (Rep. of) — Call office pay tone	900
SWEDEN — Information tone	425
	950/1400/1800 [a]
SWEDEN — Congestion tone	425
SWITZERLAND Information tone	950/1400/1800
THAILAND Number unobtainable	400
ZAMBIA	200



[a] New equipment.

The following countries replied to the C.C.I.T.T. inquiry, but have no special tones: ALGERIA, ITALY, JAPAN, TUNISIA, URUGUAY, U.S.S.R., YUGOSLAVIA.

Supplement No. 5

NORTH AMERICAN PRECISE AUDIBLE TONE PLAN

Table 1 is a description of a new audible tone plan which is currently being installed in the North-American network and which is expected to:

1. achieve uniformity in the quality of audible tones;
2. minimize customer confusion as to meaning of audible tones;
3. enable machine recognition of audible tones for purposes of service observing, etc.

Basically, the new plan provides four frequencies that are used singly or in combination with varying cadences to form the audible tone signals shown in Table 1, and some other special purpose, limited use signals.

TABLE 1

Use	Frequencies[1] (Hz)				Power per frequency at exchange where tone is applied	Cadence
	350	440	480	620		
Dial tone	●	●			–13 dBm0	Continuous
Busy tone			●	●	–24 dBm0	0.5 s " on " 0.5 s " off "
Re-order tone			●	●	–24 dBm0	0.2 s " on " 0.3 s " off ", or 0.3 s " on " 0.2 s " off "
Audible ringing tone		●	●		–19 dBm0	2 s " on " 4 s " off "
Call waiting tone		●			–13 dBm0	0.3 s " on " every 10 s

[1] Frequency limits are ± 0.5% of nominal.

TREATMENT OF CALLS CONSIDERED AS "TERMINATING ABNORMALLY"

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
Algeria	Operator or ringing tone Recorded announcement proposed		Busy tone	Operator	Operator or busy tone or ringing tone			Busy tone
Germany (Federal Republic)	Special information tone, alone or with a recorded announcement (use according to Q.35, 5.1, cases a and c, Volume VI, *Green Book*)			Operator or recorded announcement	Ringing tone or busy tone	Ringing tone (alone without any other indication) or special information tone, alone or with recorded announcement	Special information tone, alone or with a recorded announcement (use according to Q.35, 5.1, cases a and c, Volume VI, *Green Book*)	Busy tone
Argentina	Ringing tone		Normally, operator; exceptionally, ringing tone	—	Ringing tone		Busy tone	
Australia	Operator, recorded announcement or number unobtainable tone		Operator or recorded announcement		Ringing tone, busy tone or recorded announcement	Number unobtainable tone, ringing tone or recorded announcement	Recorded announcement or number unobtainable tone	Busy tone or recorded announcement

Note. — In Australia, busy tone is now known as try again tone whilst number unobtainable tone is known as check number tone.

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
Austria	Operator or busy tone or special information tone, the latter if necessary also at the initiative of the operator	Busy tone or special information tone	Operator or recorded announcement or busy tone or special information tone; the latter may also be transmitted during the intervals of the announcement or if necessary on the initiative of the operator	Operator or recorded announcement or special information tone to be transmitted during the intervals of the announcement or on the initiative of the operator	Ringing tone or busy tone	Busy tone or special information tone	Busy tone	
Belgium	Operator (information tone complemented by recorded announcement proposed)		Operator for individual cases; recorded announcement in case of transfer of groups of subscribers	Operator	Ringing tone. In certain cases information tone complemented by recorded announcement	Ringing tone	In principle, no indication; special tone in certain networks (information tone complemented by recorded announcement proposed)	Recorded announcement incoming to Bruxelles. At other points on the trunk network where congestion can be expected, the sending of information tone complemented by recorded announcements
Brazil	Number unobtainable tone or recorded announcement		Operator, number unobtainable tone or recorded announcement		Busy tone or ringing tone	Number unobtainable tone or recorded announcement		Busy tone

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
Cameroon	Ringing tone or recorded announcement			Ringing tone or operator	Ringing tone or bury tone	Recorded announcement or ringing tone		Recorded announcement or busy tone
Canada	Operator or recorded announcement *			Service usually provided by persons not in the employ of the Telephone Company	Operator, busy tone or ringing tone	Operator or recorded announcement		Re-order (congestion) tone or recorded announcement
Chile Telephone Company	Ringing tone	Ringing tone or recorded announcement	Operator or recorded announcement	Service not provided	Ringing tone or busy tone	Ringing tone	Busy tone	
Ivory Coast	Regular ringing tone or operator			Service not provided. Ringing tone	Ringing tone or busy tone	Busy tone or re-call of an operator		
Cuba	Ringing tone		Operator for individual cases; operator or recorded announcement in case of transfer of groups of subscribers	Service not provided	Ringing tone or busy tone	Ringing tone	Number unobtainable tone or congestion tone	No tone is provided

* In many cases, the recorded announcement is followed by cut-through to an operator.

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
Denmark	Information tone or ringing tone, or operator or recorded announcement			Operator or recorded announcement	Ringing tone	Information tone or ringing tone	Information tone	Busy tone
Spain	Special tone		Operator or recorded announcement	Operator or recorded announcement		Ringing tone	Special tone	
United States	Operator or recorded announcement *			Service usually provided by persons not in the employ of the Telephone Company	Operator, busy tone or ringing tone	Operator or recorded announcement		Re-order (congestion) tone or recorded announcement
East African P. & T. Corp. (Kenya, Uganda and Tanzania)	Number unobtainable tone		Operator		Number unobtainable tone			Busy tone
Fiji	Operator or number unobtainable tone	Number unobtainable tone	Operator or recorded announcement or number unobtainable tone	Service not provided	Number unobtainable tone. Continuous, busy or ringing tone	Number unobtainable tone		Busy tone

* In many cases, the recorded announcement is followed by cut-through to an operator.

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
Finland	Ringing tone or operator or recorded announcement	Ringing tone or busy tone or recorded announcement	Operator or recorded announcement or ringing tone	Operator or recorded announcement	Ringing tone or busy tone	Ringing tone or busy tone	Busy tone or information tone	Busy tone. In certain cases no tone
France	Operator or recorded announcement			Operator	Operator or recorded announcement or busy tone or ringing tone	Operator or recorded announcement or busy tone or ringing tone		Busy tone or recorded announcement
Ghana	Number unobtainable tone		Ringing tone and operator	Number unobtainable tone	Ringing tone or busy tone	Number unobtainable tone		Busy tone
India	Number unobtainable tone		Operator or recorded announcement or number unobtainable tone	Service not provided	Number unobtainable tone			Busy tone
Ireland	Number unobtainable tone		Operator	Service not provided		Number unobtainable tone		Busy tone
Israel		Information tone with a recorded announcement			Busy tone or ringing tone	Information tone with a recorded announcement	Busy tone	Busy tone alone or with a recorded announcement

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
Italy	Busy tone or ringing tone		Operator or recorded announcement	Operator	Busy tone or ringing tone	Ringing tone	Busy tone	
Japan	Recorded announcement or operator			Service not provided	Recorded announcement or operator	Recorded announcement or operator	Recorded announcement	Busy tone or recorded announcement
Lebanon	Ringing tone (recorded announcement proposed)			Operator	Ringing tone (recorded announcement proposed)	Ringing tone	Special tone	Busy tone
Madagascar	Ringing tone			Operator	Ringing tone		Busy tone	
Malta	Operator or number unobtainable tone	Number unobtainable tone	Operator	Call answered by an operator or a private answering service or a call transferred to another subscriber	Number unobtainable tone			Busy tone
Morocco	Ringing tone or recorded announcement			Operator	Busy tone or ringing tone	Ringing tone or recorded announcement	Busy tone	
Norway	Operator or recorded announcement or special tone or ringing tone			Operator	Ringing tone or special tone		Special tone or operator	No tone or busy tone

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
New Zealand	Number unobtainable tone	Busy tone or ringing tone	Operator	Service not provided	Busy tone or ringing tone	Number unobtainable tone		Congestion tone
Netherlands	Information tone or recorded announcement	Information	Information tone or recorded announcement	Service not provided	Information tone or ringing tone		Information tone or busy tone or recorded announcement	Busy tone or congestion tone
Poland	Ringing tone						Special tone or busy tone	
Portugal	Busy tone or number unobtainable tone	Busy tone or number unobtainable tone	Operator or busy tone for individual cases; recorded announcement in case of groups of subscribers	Service not provided	Ringing tone or busy tone	Busy tone or number unobtainable tone	Operator or busy tone or number unobtainable tone	Busy tone
Syria	Ringing tone. Operator (proposed)	Number unobtainable tone	Operator or ringing tone or recorded announcement	Ringing tone. Operator (proposed)	Ringing tone		"Barred level" tone	Busy tone
Rhodesia	Operator or number unobtainable tone	Number unobtainable tone	Operator or recorded announcement	Service not provided	Number unobtainable tone			Busy tone or recorded announcement

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
Roumania (P.R.)	"Spare line tone" or operator			Service not provided	Busy tone or ringing tone	"Spare line tone" or operator		
United Kingdom	Number unobtainable tone		Operator or recorded announcement	Call answered by an operator or a private answering service or a call transferred to another subscriber	Number unobtainable tone or busy tone	Number unobtainable tone		Equipment engaged tone or recorded announcement
Singapore	Number unobtainable tone		Operator			Number unobtainable tone		Busy tone
South Africa (Rep. of)	Number unobtainable tone		Operator or recorded announcement		Ringing tone or busy tone	Number unobtainable tone		Busy tone
Sweden	Operator or information tone				Ringing tone or busy tone or no tone	Operator or information tone or no tone		Congestion tone or no tone
Switzerland	Operator or recorded announcement			Operator	Ringing tone		Busy tone	
Yugoslavia	Ringing tone		Normally ringing tone; exceptionally, operator or recorded announcement		Ringing tone or busy tone	Ringing tone	Busy tone	

Supplement No. 7

MEASUREMENTS OF IMPULSIVE NOISE IN A FOUR-WIRE TELEPHONE EXCHANGE

(Results from study in 1969-1972 of Question 8/XI on impulsive noise in an exchange, which led to the specification clause of Recommendation Q.45 on impulsive noise)

1. *Documentation and results of measurements*

The text of the Question 8/XI was published in 1969 in Volume VI of the *White Book*. Results were obtained from measurements in twelve four-wire international exchanges.

2. *Evaluation of measurement results*

Evaluation of the measurement results submitted by Administrations was made by plotting all comparable results on one single diagram (Figure 1 in this Supplement). For this purpose a logarithmic plot of the average number of noise impulses per 5-minute period in 4-decades from 0.01 to 100 versus the threshold level indicated linearly from 0 dBm0 to –70 dBm0 was used. The noise measurement results were plotted and Study Group XI considered that it was possible to draw straight lines for each set of results and still retain reasonable accuracy.

Whilst evaluating the measurement results it was borne in mind that with equal periods of observations for the different threshold levels the measurement results at the higher threshold levels (–10, –20 and –30 dBm0) were naturally subject to a greater uncertainty than at the lower threshold levels because high impulsive noise levels are rare. This was evident from several submissions where the average number of noise counts at threshold levels of –30 dBm0 and higher was given with the value of 0. This value could not be reproduced on a logarithmic scale.

Other factors having an influence on impulsive noise in exchanges, such as size of exchange, number of circuits, time of day, traffic density, and switching system have not been indicated in Figure 1 or in any other form because the conditions of the exchanges concerned differed too widely. However, the majority of the measurements were taken during the busy periods of the exchanges in order to cover the most unfavourable circumstances with regard to data transmission.

In so far as the reply to Question 8/XI is concerned, only international and national four-wire exchanges have been considered of first importance. This maintains consistency with Recommendation Q.45. However, information regarding local and trunk national two-wire exchanges has been provided and because of the difficulty of defining the relative level in such exchanges these results have not been compared directly with those submitted for international and national four-wire trunk exchanges. (See Figure 1, " Impulsive noise measurement results for four-wire exchanges ".)

3. *Analysis of measurement results*

Although the number of four-wire exchanges in which measurements were taken in accordance with the condition in Circular letter No. 87 is comparatively small, Study Group XI considered that the following conclusions could be drawn:

The plotted results for each exchange show a steady declining slope.

The average slope is seen to be about one decade of noise impulses per threshold level difference of 10 dB.

The slopes in general do not deviate very much; for a decade of noise impulses the level difference is only about $\pm$ 5 dB.

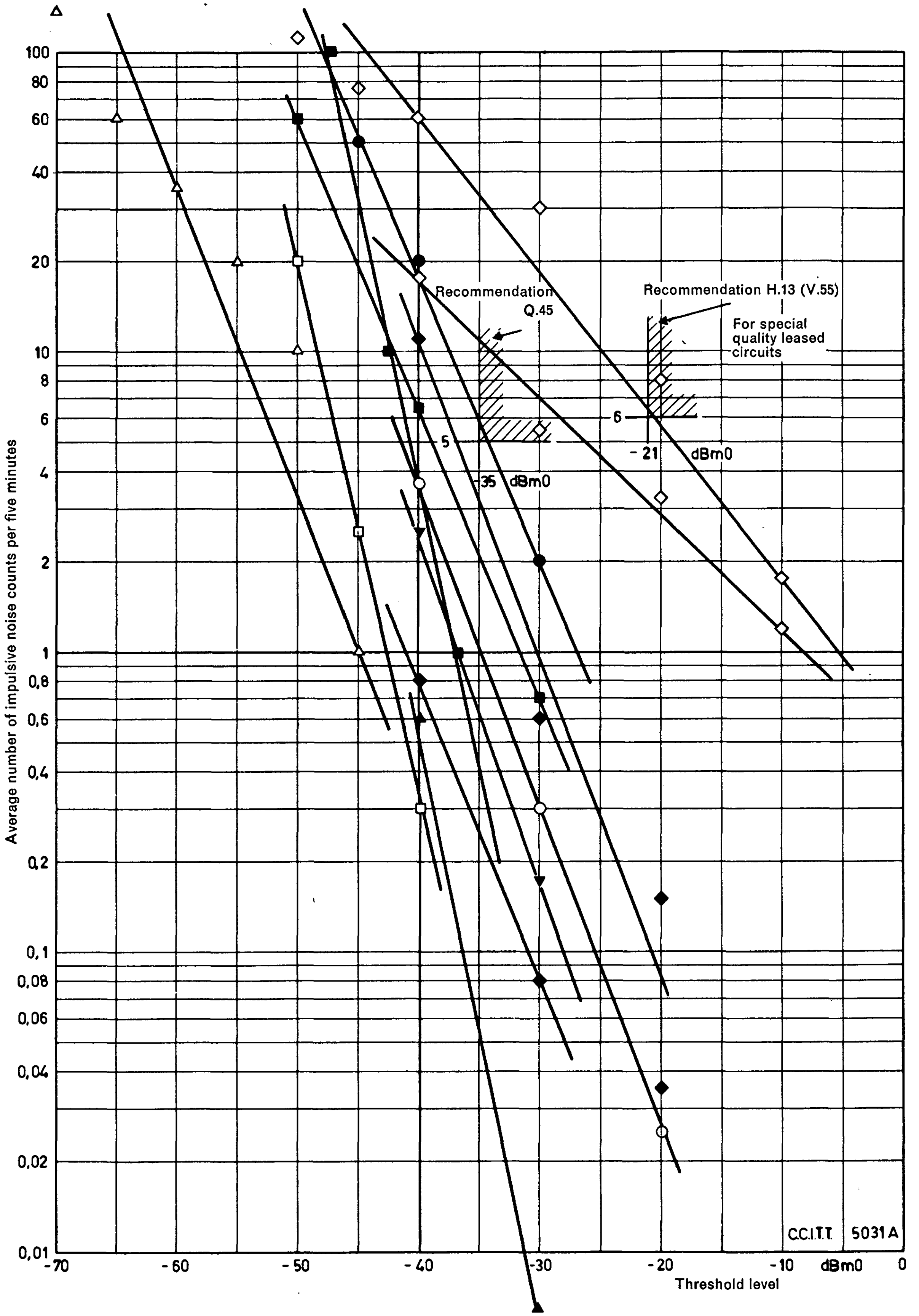


FIGURE 1/Supplement No. 7. — **Impulsive noise measurement results for four-wire exchanges**

4. *Determination of a limit for impulsive noise*

Bearing in mind the conclusions drawn from the analysis of the measurement results (see Figure 1), it was the opinion of Study Group XI that only a single limit needs to be given to describe the behaviour of a telephone exchange with regard to impulsive noise. This is in conformity with the single limit in the Annex to Recommendation H.13 (V.55) which indicates the admissible impulsive noise for data transmission on leased circuits.

In determining this single limit for impulsive noise the following factors were taken into account:

a) that the limit should be economically realistic and reasonable as a *design objective*;

b) that the limit should be so related to lower *data transmission levels* within such exchanges, as to minimize the data error rate. A reasonable signal/noise ratio of 4 to 6 dB was considered to be appropriate;

c) that new switching equipment may have to function in an *environment of older equipment* which could act as an external noise source;

d) that exchange impulsive noise is only *one contributory factor of* many possible sources in a switched connection which can cause errors in data transmission;

e) that the *threshold level* should not be so high as to prevent a reliable statistical result from being obtained;

f) that in order to obtain results for an adequate variety and number of routing paths through the switching block, the *duration of measurement* should not be too long. In contrast to Recommendation H.13 where the limit is given for a 15-minute observation period for leased circuits, for exchange connections a period of 5 minutes has been found to be adequate;

g) that the limit is " intended to be used only for type tests, acceptance tests, or for special investigations " according to *Recommendation Q.45, paragraph 1.3*;

h) that in accordance with *Recommendation H.13, Annex, paragraph 3* " for the general switched telephone network, there should be no recommended maintenance limits for impulsive noise counts ";

i) that, in general, *signalling systems* are so designed as to be unaffected by impulsive noise encountered in automatic exchange switching blocks.

5. *Conclusions*

Following all of these considerations, Study Group XI considered that the single limit for impulsive noise in new four-wire international (and new four-wire national) exchanges should be such that there should be an the average number of impulsive noise counts of five in five minutes at a threshold level of −35 dBm0.

Supplement No. 8

SIGNALLING FOR DEMAND ASSIGNMENT SATELLITE SYSTEMS

This Supplement provides technical information on which the design of a Demand Assignment (DA) signalling system could be based. See characteristics of a Demand Assignment satellite signalling system in Recommendation Q.48.

1. A single standardized DA signalling system which could serve different types of DA arrangements will be desirable.

2. The DA signalling system should operate in a broadcast mode with common channel signalling.

3. The control of the DA system should be distributed. With this arrangement there would be no single master station.

4. In the design of the DA signalling system, it is important to have as objectives both compatibility with the structure of the No. 6 signalling system and optimization of the DA signalling system in relation to the TDM techniques of the satellite link.

5. There are three basic reasons why it is advantageous to combine (integrate) the DA signalling and the telephone signalling.

First, the capacity of the DA system must be sufficient to provide a fast set-up, and this implies spare capacity.

Secondly, the DA set-up system requires substantially the same information as a normal call set-up; it seems undesirable to send the same information twice.

Thirdly, if the initial set-up message contained similar information to C.C.I.T.T. No. 6 initial address message, call set-up could continue immediately on receipt of the initial signal. This would save about 500 milliseconds in the set-up of every call.

6. For calls originating from certain CTs, the address signalling information in the DA system will be received in ESB digit by digit (see Table 1 of Recommendation Q.48). In a variable destination system, the backward channel between CTB and ESB on the access route to CTB could be directly associated in the DA system with an up-link channel to the satellite. Since status information indicated that an access circuit was available, a satellite channel ESA to ESB may be seized. However, since in the No. 5 signalling system the circuit ESB-CTB cannot be seized before the ST condition is recognized at ESB (originating end of the No. 5 signalling link), there will be a delay between the receipt of the first digit in ESB and the seizing of an access circuit ESB-CTB; this delay is as long as the digit by digit transmission of the address information, and may be, say, of the order of 10 seconds when digits are received as they are dialled by a calling subscriber. During this delay, the No. 5 circuits of the route ESB-CTB can be seized for calls originating from CTB. In that case the call attempt CTA-ESB will fail at ESB and a congestion signal is to be given.

7. Several methods have been proposed to obviate difficulties due to the presence of a No. 5 link on access circuits, and some of these are described in Figures 1, 3, 4 and 5 of Annex 1 to this Supplement.

In Figure 1, a switching device (I) is introduced in the Earth station to give access from the DA system to one of the various circuits of the access group to the terminating CT.

In Figures 3 and 4, the group of circuits between CT and ES is subdivided into two groups of unidirectional circuits; in Figure 3, the sum of the number of circuits of the two groups is equal to the number of channels from the Earth station to the satellite; in Figure 4, to provide better traffic loading, the sum is greater than the number of channels from the Earth station to the satellite, and again a switch is needed.

Figure 5 illustrates the case where a switching device is necessary to route the traffic from Earth station to two different CTs.

In case of double seizure on the circuits of the access link to the terminating CT it is possible to give priority to a seizure from the DA system. This would prevent the call from the DA system being lost; the call will proceed after a delay of approximately 1 second.

8. The DAS system should be capable of sending out address digits from ESB in the correct order (order of dialling). (ESB is acting as a CT—in an interface case—between two different signalling systems.) There might be various means to obtain this result. In the No. 6 system numbering of the address messages makes it possible to provide the correct order in ESB.

9. It is advantageous that the message format is such that the identity of the called Earth station (and CT when required) can be obtained without complete analysis of the message content.

10. The DA signalling system should be provided on a time division basis. This agreement affects the procedures required to cater for multiple seizures. Depending on the choice of frame length, it may also have an effect on signal-delay.

11. The DA signalling system should use synchronous transmission of signal units.

Note. — The advantages and disadvantages of asynchronous and synchronous transmission of signal units were previously considered during the development of the No. 6 system. It was then decided that synchronous operation was to be preferred.

12. There is a need for error detection and correction suitable for the broadcast mode of operation. It is considered that the error control should use the negative unit acknowledgement technique.

13. The continuity check procedure of the DA system may be slightly different from the continuity check procedures in the No. 6 system to take advantage of the fully digital environment, possible in the DA system, which could provide a much simpler procedure and reduce the delay in getting the connection.

14. A prime aim is to have a short transfer time for the answer signal. The signal priority method is one possible means of achieving this. It is possible that in designing the DA signalling system, the values of Table 2 of Recommendation Q.48 may be attained by means other than priority.

15. *Information flow.*

15.1 *Information flow for the choice and switching of satellite speech channels or speech circuits*

To meet the requirements of both fully variable and variable destination DA systems, the following information is required:

a) identity of circuit or go-and-return channels seized;

b) designation of incoming Earth station;

c) designation of incoming CT.

There may also be a need for a congestion signal to indicate that no return channel or access circuit is available.

Note. — With a TDMA signalling system the identity of the originating Earth station can be determined, for example from the position in the frame or from the preamble of the burst.

15.2 *Information flow for maintenance reasons*

The coordinated working of the DA terminals necessitates an interchange of information between DA terminals when a DA terminal discovers a fault which affects the traffic-carrying capability in either its own or in some other DA terminal. For example, if the message retransmission rate between two given DA terminals exceeds a pre-set limit, it may be desirable to exchange information between these DA terminals to locate the fault.

Depending on the degree of supervision that a CT has regarding the maintenance of the DA system, a lesser or larger amount of information concerning the DA system needs to be transferred from the DA terminal to the CT.

15.3 *Information flow for the management of the DA system*

Status signals are required to indicate the availability of access circuits from Earth stations to their respective CTs.

In the case of a variable destination system, status signals may also be required to indicate available return channels.

Signals required to change the burst length in a TDMA system or to change the circuit or channel allocation should also be considered as demand assignment management signals.

15.4 *Information flow for the DA signalling system control signals*

The DA signalling system should include some signals designed exclusively for the internal control of the signalling system. The synchronizing signal and the signals concerned with requests for retransmission of signals received in error fall into this category.

16. Study Group XI has so far considered only a variable destination DA system having the control at the Earth station. See Annex 2.

ANNEX 1
(to Supplement 8)

Methods to obviate difficulties due to the presence of a No. 5 link on access circuits to Earth stations
(see items 6 and 7 of this Supplement)

Examples of CT-ES (Earth station) combinations in the case of the variable destination mode

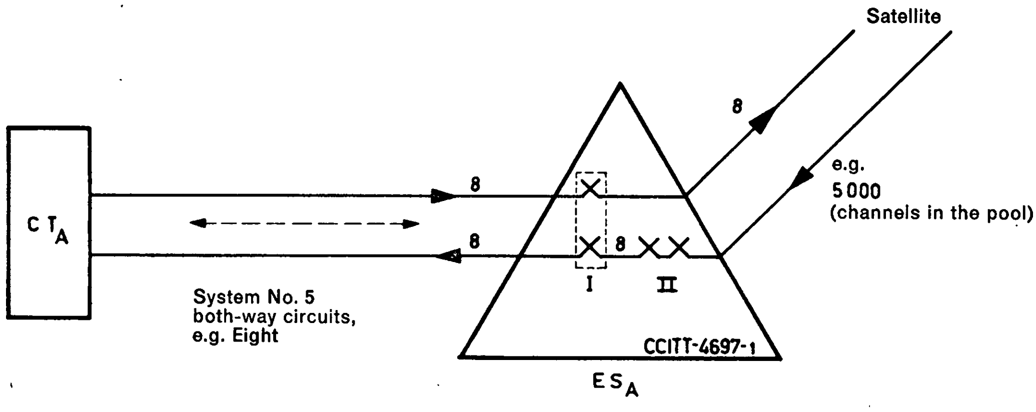


FIGURE 1/Annex 1/Supplement No. 8

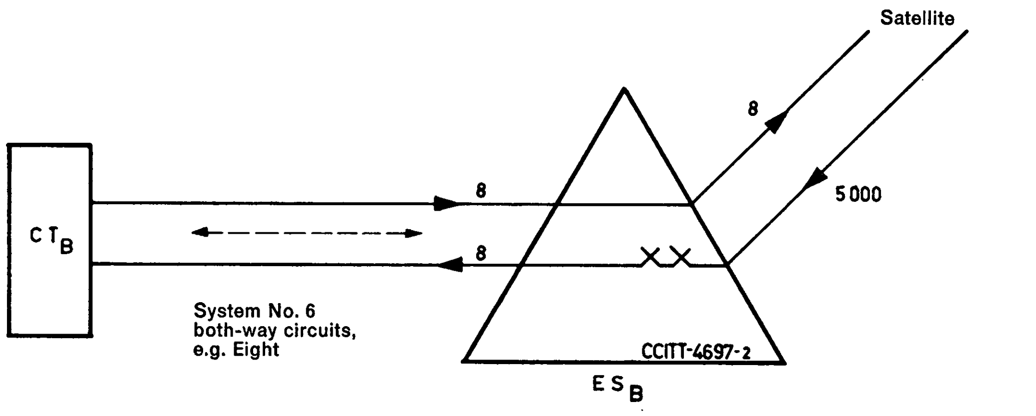


FIGURE 2/Annex 1/Supplement No. 8

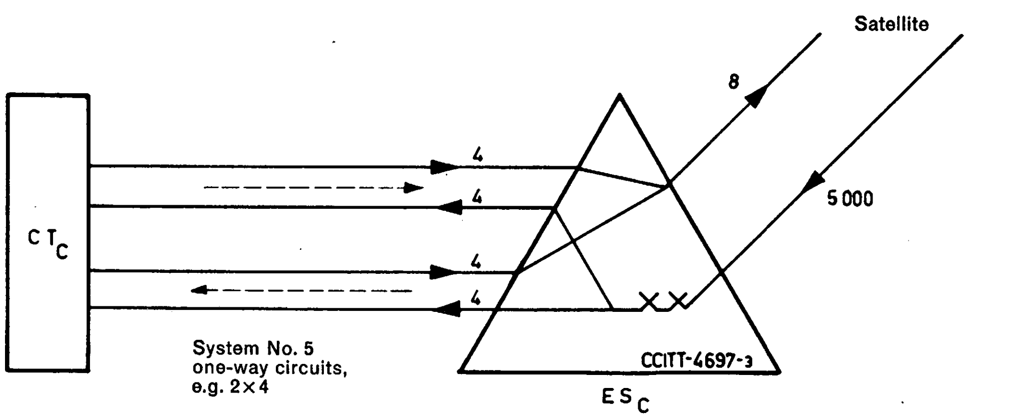


FIGURE 3/Annex 1/Supplement No. 8

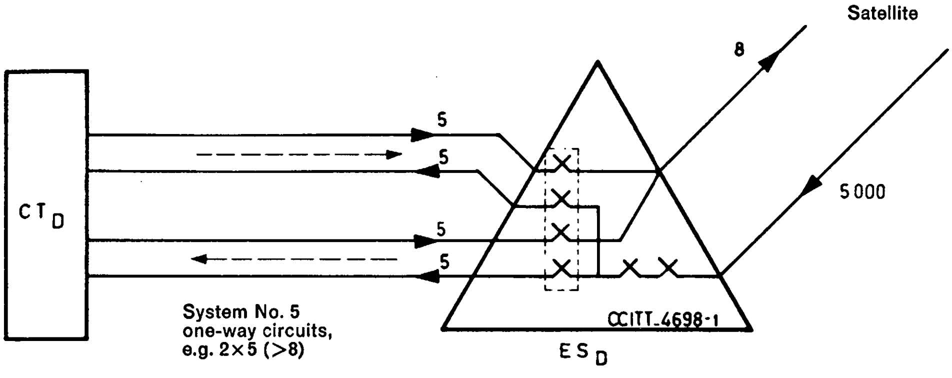


FIGURE 4/Annex 1/Supplement No. 8

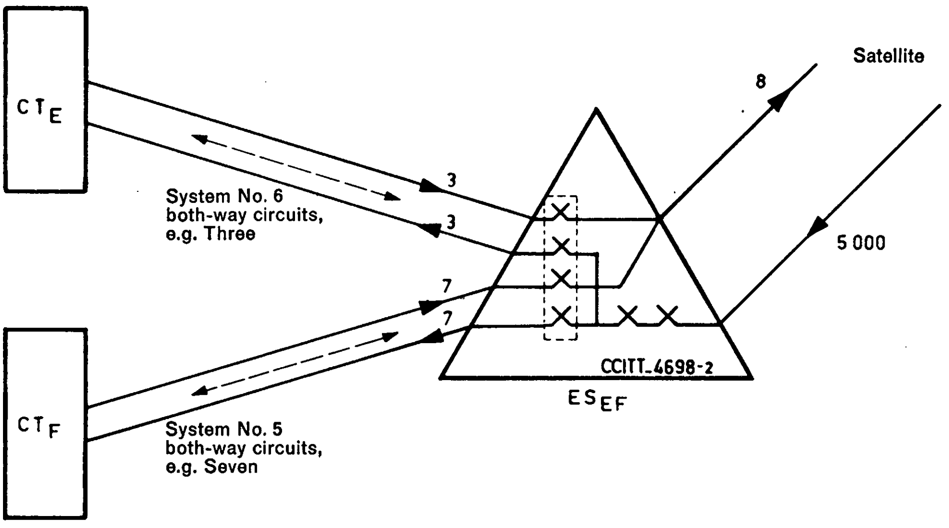
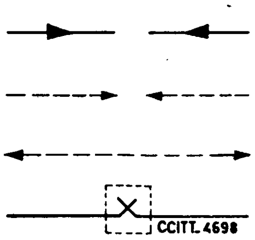


FIGURE 5/Annex 1/Supplement No. 8



Channel plus transmission direction

One-way traffic direction

Both-way traffic direction

Additional switching stage, required in some situations

ANNEX 2
(to Supplement 8)

Diagram and description of demand assignment satellite arrangement

——— Speech
- - - - - - Signalling

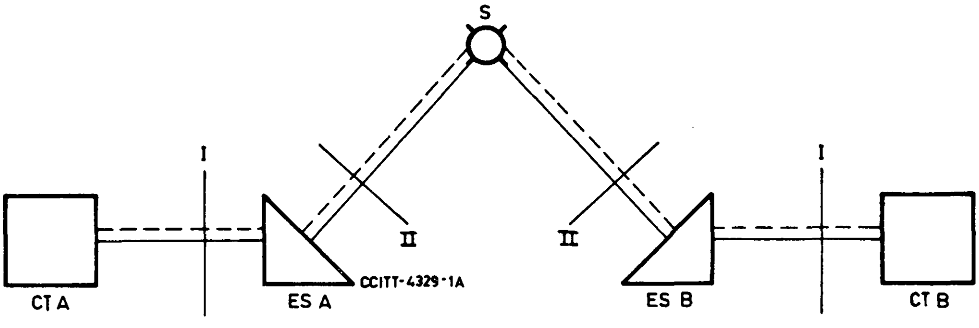


FIGURE 1/Annex 2/Supplement No. 8

In Figure 1 it is assumed that control of the DA switching and signalling system is provided at the Earth station. Cross section II represents the DA signalling system which includes all the telephone signals. Cross section I represents the signalling system used on the access circuits, which may be C.C.I.T.T. No. 6, No. 5, R2 or, in special cases, another standardized C.C.I.T.T. signalling system or a national system.

——— Speech
- - - - - - Signalling

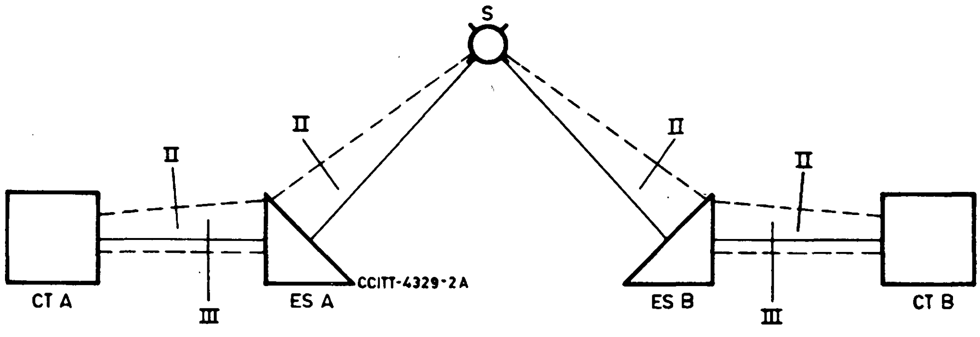


FIGURE 2/Annex 2/Supplement No. 8

In Figure 2 it is assumed that the control of the DA switching and signalling system is at the CT. Switching at the Earth station is controlled remotely from the CT using for this purpose the signalling system on cross section III. The DA signalling system is controlled from the CT and is represented again by cross section II which is an identical interface to that used in Figure 1.

It is perfectly possible therefore that in the same DA system a situation could exist where one Administration was using the configuration in Figure 1 and another was using the configuration in Figure 2.

ANNEX 3
(to Supplement 8)

Alternative routing in relation to a DA system

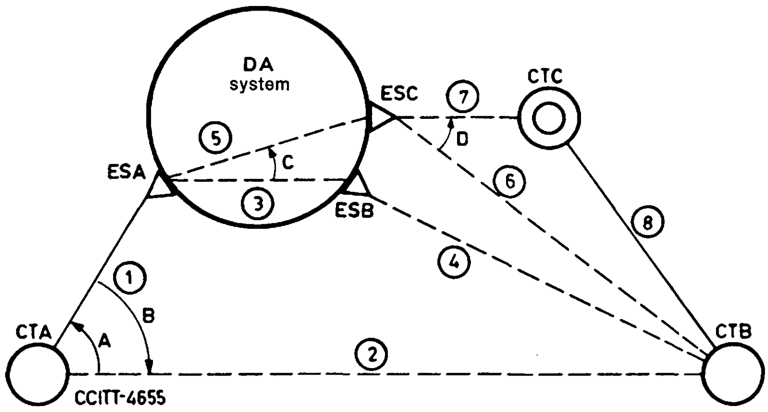
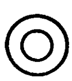


FIGURE 1/Annex 3/Supplement No. 8

 indicates a CT capable of handling overflow traffic to CTB

ES: Earth station

CT: Transit centre

1. In CT_A it is technically feasible to overflow from route 2 to route 1 (overflow A) or from route 1 to route 2 (overflow B): these are classical cases of alternative routing outside the DA system.

1.1 In ES_A we must consider two cases:

a) No advance information is available at ES_A on the condition of route 4. In that case a call through route 3 arriving at ES_B and finding congestion on route 4 may be taken back to ES_A and re-routed to route 5. Such case is to be called " internal re-routing of the call in the DA system ".

b) At ES_A advance information on the status of route 4 is available, for example, through management signalling in a broadcast mode in the DA system. If route 4 is busy, route 3 will not be taken and overflow to route 5 will occur. Such a case is described as " alternative routing in the DA system ".

2. Thus, the introduction of alternative routing in the DA system assumes the existence, at each Earth station, of status information concerning its relevant access routes. Such status information is related only to the condition of the routes ES-CT, and not to routes beyond the CTs directly served by the DA system.

3. When calls are routed into the DA system two possibilities exist:

a) Dimension all access and satellite links in the DA system on the final probability basis.

b) Arrange internal re-routing or alternative routing in the DA system to an alternate CT in accordance with arrangements agreed upon by the Administrations involved.

4. No signalling difficulty is seen in implementing internal re-routing or alternative routing in the design of the DA system.

It is recognized that the arrangement 3 b has not been examined from network operation, accounting and maintenance points of view.

5. In the case of a variable destination DA system, status signals should be given at the Earth stations to indicate available return channels.

6. It will be noted that providing status information to allow internal alternative routing in the DA system does not require special arrangements at the CT.

7. The status information for internal alternative routing which is available at an Earth station will need to be extended to its CT to permit additional alternative routing (outside of the DA system). Should this be required, additional signalling facilities on the access links will be required beyond those presently provided by standardized C.C.I.T.T. signalling systems.

Supplement No. 9

TABLE OF THE ERLANG LOSS FORMULA

(Erlang No. 1 formula, also called Erlang B formula)

Loss probabilities: 1 %, 3 %, 5 %, 7 %.

let p = the loss probability
y = the traffic offered (in erlangs)
n = the number of circuits

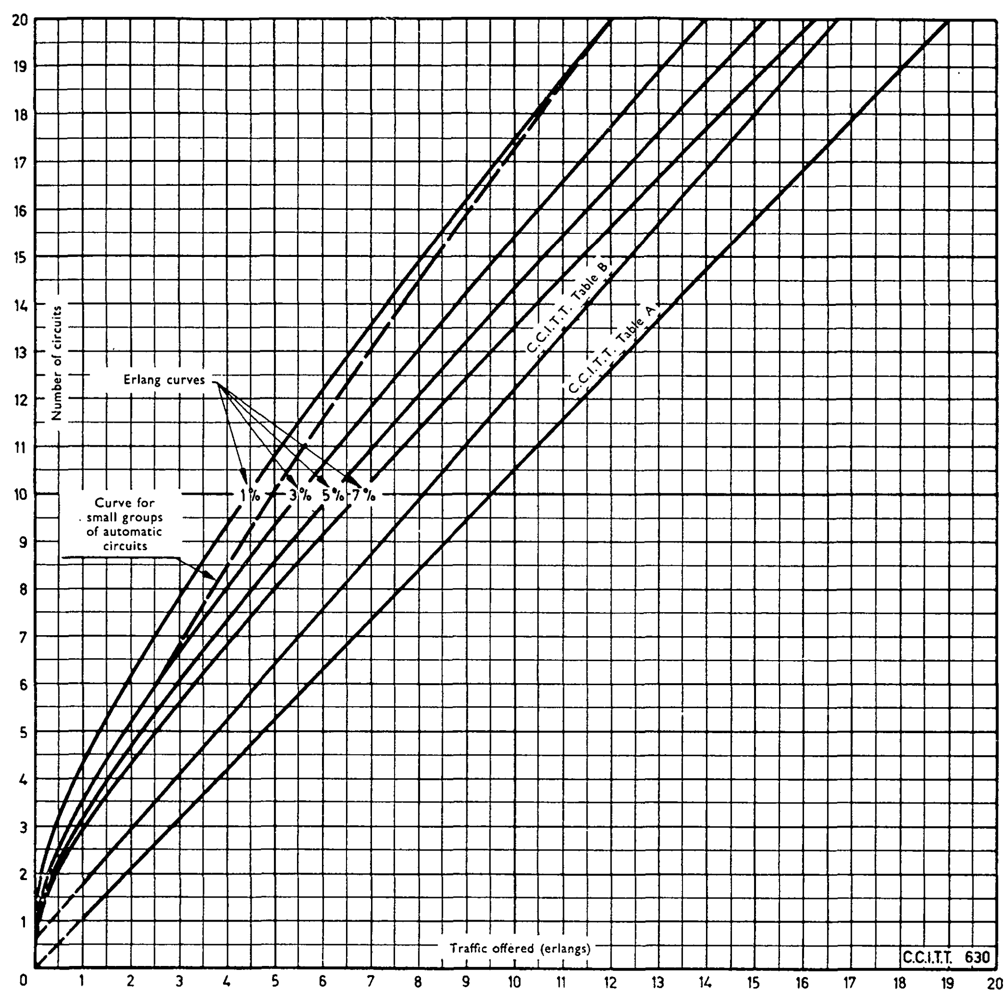
Formula:

$$E_1, n(y) = p = \frac{\frac{y^n}{n!}}{1 + \frac{y}{1} + \frac{y^2}{2!} + \cdots + \frac{y^n}{n!}}$$

n	$p = 1\%$	$p = 3\%$	$p = 5\%$	$p = 7\%$	n	$p = 1\%$	$p = 3\%$	$p = 5\%$	$p = 7\%$
1	0.01	0.03	0.05	0.08	51	38.80	42.89	45.53	47.72
2	0.15	0.28	0.38	0.47	52	39.70	43.85	46.53	48.76
3	0.46	0.72	0.90	1.06	53	40.60	44.81	47.53	49.79
4	0.87	1.26	1.53	1.75	54	41.50	45.78	48.54	50.83
5	1.36	1.88	2.22	2.50	55	42.41	46.74	49.54	51.86
6	1.91	2.54	2.96	3.30	56	43.31	47.70	50.54	52.90
7	2.50	3.25	3.74	4.14	57	44.22	48.67	51.55	53.94
8	3.13	3.99	4.54	5.00	58	45.13	49.63	52.55	54.98
9	3.78	4.75	5.37	5.88	59	46.04	50.60	53.56	56.02
10	4.46	5.53	6.22	6.78	60	46.95	51.57	54.57	57.06
11	5.16	6.33	7.08	7.69	61	47.86	52.54	55.57	58.10
12	5.88	7.14	7.95	8.61	62	48.77	53.51	56.58	59.14
13	6.61	7.97	8.84	9.54	63	49.69	54.48	57.59	60.18
14	7.35	8.80	9.73	10.48	64	50.60	55.45	58.60	61.22
15	8.11	9.65	10.63	11.43	65	51.52	56.42	59.61	62.27
16	8.88	10.51	11.54	12.39	66	52.44	57.39	60.62	63.31
17	9.65	11.37	12.46	13.35	67	53.35	58.37	61.63	64.35
18	10.44	12.24	13.39	14.32	68	54.27	59.34	62.64	65.40
19	11.23	13.11	14.31	15.29	69	55.19	60.32	63.65	66.44
20	12.03	14.00	15.25	16.27	70	56.11	61.29	64.67	67.49
21	12.84	14.89	16.19	17.25	71	57.03	62.27	65.68	68.53
22	13.65	15.78	17.13	18.24	72	57.96	63.24	66.69	69.58
23	14.47	16.68	18.08	19.23	73	58.88	64.22	67.71	70.62
24	15.29	17.58	19.03	20.22	74	59.80	65.20	68.72	71.67
25	16.13	18.48	19.99	21.21	75	60.73	66.18	69.74	72.72
26	16.96	19.39	20.94	22.21	76	61.65	67.16	70.75	73.77
27	17.80	20.31	21.90	23.21	77	62.58	68.14	71.77	74.81
28	18.64	21.22	22.87	24.22	78	63.51	69.12	72.79	75.86
29	19.49	22.14	23.83	25.22	79	64.43	70.10	73.80	76.91
30	20.34	23.06	24.80	26.23	80	65.36	71.08	74.82	77.96
31	21.19	23.99	25.77	27.24	81	66.29	72.06	75.84	79.01
32	22.05	24.91	26.75	28.25	82	67.22	73.04	76.86	80.06
33	22.91	25.84	27.72	29.26	83	68.15	74.02	77.87	81.11
34	23.77	26.78	28.70	30.28	84	69.08	75.01	78.89	82.16
35	24.64	27.71	29.68	31.29	85	70.02	75.99	79.91	83.21
36	25.51	28.65	30.66	32.31	86	70.95	76.97	80.93	84.26
37	26.38	29.59	31.64	33.33	87	71.88	77.96	81.95	85.31
38	27.25	30.53	32.62	34.35	88	72.81	78.94	82.97	86.36
39	28.13	31.47	33.61	35.37	89	73.75	79.93	83.99	87.41
40	29.01	32.41	34.60	36.40	90	74.68	80.91	85.01	88.46
41	29.89	33.36	35.58	37.42	91	75.62	81.90	86.04	89.52
42	30.77	34.30	36.57	38.45	92	76.56	82.89	87.06	90.57
43	31.66	35.25	37.57	39.47	93	77.49	83.87	88.08	91.62
44	32.54	36.20	38.56	40.50	94	78.43	84.86	89.10	92.67
45	33.43	37.16	39.55	41.53	95	79.37	85.85	90.12	93.73
46	34.32	38.11	40.54	42.56	96	80.31	86.84	91.15	94.78
47	35.22	39.06	41.54	43.59	97	81.24	87.83	92.17	95.83
48	36.11	40.02	42.54	44.62	98	82.18	88.82	93.19	96.89
49	37.00	40.98	43.53	45.65	99	83.12	89.80	94.22	97.94
50	37.90	41.93	44.53	46.69	100	84.06	90.79	95.24	98.99

Supplement No. 10

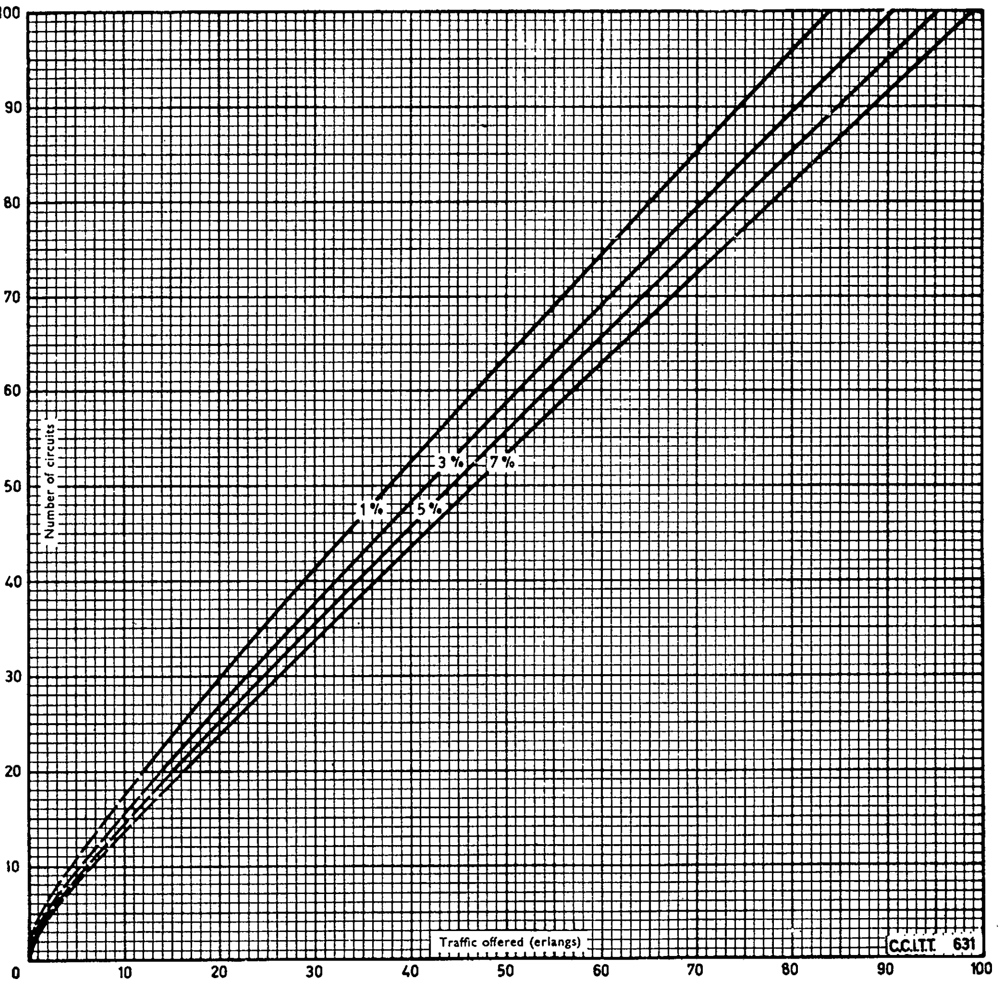
CURVES SHOWING THE RELATION BETWEEN THE TRAFFIC OFFERED AND THE NUMBER OF CIRCUITS REQUIRED



Relation between the traffic (in erlangs) offered and the number of circuits required in the case of:

— the C.C.I.T.T. Tables A and B (Recommendation E.510 and Q.85)
— the Erlang formula ($p = 1\%$, 3%, 5% and 7%)
— the curve for small groups of automatic circuits (see Annex to Recommendation E.520 and Q.87)

FIGURE 1/Supplement No. 10. — **Number of circuits between 1 and 20.**



Relation between the traffic (in erlangs) offered and the number of circuits required in the case of the Erlang formula for ($p = 1\%$, 3%, 5% and 7%)

FIGURE 2/Supplement No. 10. — **Number of circuits between 1 and 100.**