INTERNATIONAL TELECOMMUNICATION UNION

ITU-T Q.4

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GENERAL RECOMMENDATIONS ON TELEPHONE SWITCHING AND SIGNALLING

INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING

AUTOMATIC SWITCHING FUNCTIONS FOR USE IN NATIONAL NETWORKS

ITU-T Recommendation Q.4

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation Q.4 was published in Fascicle VI.1 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation Q.4

AUTOMATIC SWITCHING FUNCTIONS FOR USE IN NATIONAL NETWORKS

1 Preamble

The CCITT,

considering

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

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

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

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

and also considering

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

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

recommends

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

2 Automatic switching functions for use in national networks

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

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

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

3 Requirements for ISDN

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

4 Requirements other than automatic switching functions

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

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

5 Technical cooperation possibilities

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

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

6 Definition of requirements in terms of services and facilities

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

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

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

TABLE 1/Q.4

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

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

TABLE 1/Q.4 *(cont.)*

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

TABLE 2/Q.4

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

CCITT Manual *Local telephone networks*, ITU, Geneva, 1968 (Gas 2 Handbook).

CCITT Manual *Transmission planning of switched telephone networks*, ITU, Geneva, 1976 (Gas 3 Handbook).

CCITT Manual *Economic and technical aspects of the choice of telephone switching systems*, ITU, Geneva, 1981 (GAS 6 Handbook).

CCITT Manual *Economic and technical aspects of the transition from analogue to digital telecommunication networks*, ITU, Geneva, 1984 (GAS 9 Handbook).

CCITT Rec. E.130 *Choice of the most useful and desirable supplementary telephone services.*

CCITT Rec. E.131 *Subscriber control procedures for supplementary services.*

CCITT Rec. E.132 *Standardization of elements of control procedures for supplementary telephone services.*

CCITT Rec. E.151 *Conference calls.*

CCITT Rec. E.160 *Definitions relating to national and international numbering plans.*

CCITT Rec. E.161 *Arrangement of figures, letters and symbols on rotary dials and pushbutton telephone sets.*

CCITT Rec. E.163 *Numbering plan for the international telephone service.*

CCITT Rec. E.170 *Overflow - alternative routing - rerouting - automatic repeat attempt.*

CCITT Rec. E.171 *International routing plan.*

CCITT Rec. E.180 *Characteristics of the dial tone, ringing tone, busy tone, congestion tone, special information tone and warning tone.*

CCITT Rec. E.181 *Customer recognition of foreign tones.*

CCITT Rec. E.182 *Application of tones and recorded announcements in telephone services.*

CCITT Rec. E.211 *Numbering and dialling procedures for VHF/UHF and maritime mobile satellite services.*

CCITT Rec. E.220 *Ergonomic aspects of visual display terminals.*

CCITT Rec. E.221 *Human interface to visual display terminals.*

CCITT Recs. E.230-E.232 *Charging (determination of collection charges) in the international telephone service.*

CCITT Rec. E.500 *Measurement and recording of traffic.*

CCITT Rec. E.521 *Calculation of the number of circuits in a group carrying overflow traffic.*

CCITT Rec. E.543 *Grades of service in analogue/digital international telephone exchanges.*

CCITT Rec. E.410, E.411, E.412 and E.413 *Network management.*

CCITT Series E. Recommendations Supplement No. 1 *List of possible supplementary telephone services which may be offered to subscribers.*

CCITT Series E. Recommendations Supplement No. 2 *Various tones used in national networks.*

CCITT Recs. G.120-G. 123 *General characteristics of national systems forming part of international connections.*

CCITT Rec. G.121 *Corrected reference equivalents (CREs) of national systems.*

CCITT Rec. G.122 *Influence of national networks on stability and echo losses in national systems.*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

CCITT Rec. Q.103 *Numbering used.*

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

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

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

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

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

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

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

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

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

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

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

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

CCITT Recs. Q.500-Q.554 *Digital local, transit, combined and international exchanges in integrated digital networks and mixed analogue-digital networks.*

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

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

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

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

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

CCITT Rec. Q.931 *ISDN user-network interface layer 3 specification for basic call control*

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

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

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

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

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

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

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

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

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

ANNEX A

(to Recommendation Q.4)

List of possible subscriber services and facilities

Subscriber services

Basic services

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

Supplementary services

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