SECTION 2

## NUMBERING PLAN AND DIALLING PROCEDURES

## IN THE INTERNATIONAL SERVICE

**Recommendation Q.10**

# DEFINITIONS RELATING TO NATIONAL

# AND INTERNATIONAL NUMBERING PLANS

### 1 prefix

*F: pr´efixe*

*S: prefijo*

A prefix is an indicator consisting of one or more digits, that allows the selection of different types of number formats (e.g., local, national or international), transit networks and/or the service.

Prefixes are not part of the number and are not signalled over internetwork or international boundaries.

*Note* — When prefixes are used, they are always entered by the user or automatic calling equipment.

### 2 international prefix

*F: pr´efixe international*

*S: prefijo internacional*

The combination of digits to be dialled by a calling subscriber making a call to a subscriber in another country to obtain access to the automatic outgoing international equipment.

### 3 national (trunk) prefix

*F: pr´efixe (interurbain) national*

*S: prefijo (interurbano) nacional*

A digit or combination of digits to be dialled by a calling subscriber, making a call to a subscriber in his own country but outside his own numbering area. It provides access to the automatic outgoing trunk equipment.

This Recommendation is an extract of Recommendation E.160 [1]. For the examples relating to §§ 1 to 11, see Fascicle II.2.

**4 escape code**

*F: code d'´echappement*

*S: c´odigo de escape*

An escape code is an indicator consisting of one or more digits which is defined in a given numbering plan and is used to indicate that the digits that follow are from a specific numbering plan which is different from the given numbering plan.

For example, escape codes are currently used within the X.121 numbering plan to interwork with E.164 (ISDN) and F.69 (Telex) numbering plans.

An escape code can be carried forward through the originating network and can be carried across internetwork and international boundaries. Therefore the digits used for escape codes should be standardized.

## 5 country code

*F: indicatif de pays*

*S: indicativo de país*

The combination of one, two or three digits characterizing the called country.

## 6 trunk code

*F: indicatif interurbain*

*S: indicativo interurbano*

A digit or combination of digits [not including the national (trunk) prefix] characterizing the called numbering area within a country (or group of countries included in one integrated numbering plan).

The trunk code has to be dialled before the called subscriber's number where the calling and called subscribers are in different numbering areas.

## 7 subscriber number

*F: numéro d'abonné*

*S: número de abonado*

The number to be dialled or called to reach a subscriber in the same local network or numbering area.

This number is the one usually listed in the directory against the name of the subscriber.

## 8 national (significant) number

*F: numéro national (significatif)*

*S: número nacional (significativo)*

The number to be dialled following the national (trunk) prefix to obtain a subscriber in the same country (or group of countries included in one integrated numbering plan) but outside the same local network or numbering area.

The national (significant) number consists of the trunk code followed by the subscriber number.

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Care should be taken not to use the term ''local number'' instead of ''subscriber number''.

It should be noted that, in some countries, it is customary to consider *for national purposes* | that the national (trunk) prefix is included in the national number [which is then not the national (significant) number]. A careful distinction must therefore be made between such national definition or practice and the CCITT definition, which is internationally valid. In order to avoid misunderstanding, the CCITT definition includes the word ‘‘significant’’ between brackets, reading as follows: ‘‘national (significant) number’’.

## 9 international number

*F: num´ero international*

*S: n´umero internacional*

The number to be dialled following the international prefix to obtain a subscriber in another country.

The international number consists of the country code of the required country followed by the national (significant) number of the called subscriber.

**10 national destination code (NDC)**

*F: indicatif national de destination (IND)*

*S: indicativo nacional de destino (IND)*

A code field, within the E.164 numbering plan, which combined with the subscriber’s number (SN) will constitute the national (significant) number of the international ISDN number. The NDC will have a network and/or trunk code selection function.

The NDC can be a decimal digit or a combination of decimal digits (not including any prefix) characterizing a numbering area within a country (or group of countries included in one integrated numbering plan).

The NDC has to be inserted before the called subscriber’s number when the calling and called parties are located in different number areas.

NDC assignments are a national responsibility and therefore the NDC structure varies from one country to another. It may take a trunk code format or serve for selection of a destination network.

The NDC can in some instances, provide a combination of both the above functions.

**11 destination network (DN) code**

*F: indicatif de r´eseau de destination (RD)*

*S: indicativo de red de destino (RD)*

An optional code field within the E.164 numbering plan which identifies the destination network serving the destination subscriber. It performs the destination network selection function of the NDC. In some instances it can be combined with a trunk code to form the NDC. The DN code can be a decimal digit or a combination of decimal digits (not including any prefix).

**Reference**

[1] CCITT Recommendation *Definitions relating to national and international numbering plans* , Vol. II, Fascicle II.2, Rec. E.160.

## Recommendation Q.11

## NUMBERING PLAN FOR THE INTERNATIONAL TELEPHONE SERVICE

### Introduction

This Recommendation describes the numbering plan for the International Telephone Service. Recommendation E.164 describes the numbering plan for the ISDN era. It is for each Administration to choose the method of application from the two Recommendations which would provide the optimum approach to meeting their

This Recommendation is also included in the Series E Recommendations under the number E.163.

future national numbering plan needs. Evolution between the plans is for further study. However, for new equipment, it is recommended that E.164 [2] be adopted.

## 1 National numbering plan

1.1 Each telephone Administration should give the most careful consideration to the preparation of a *national numbering plan* for its own network. This plan should be designed so that a subscriber is always called by the same number in the trunk service. It should be applicable to all incoming international calls.

See the CCITT manual cited in [1] for a comprehensive study of national numbering plans from the national point of view.

Administrations are strongly urged to advise the ITU or CCITT of national numbering plan changes well in advance of the event, so that this information can be published in the ITU *Operational Bulletin* .

### 1.2 *Number analysis*

1.2.1 The national numbering plan of a country should be such that an analysis of a minimum number of digits of the national (significant) number (see definitions in Recommendation E.160 [3]):

a) gives routing that reflects economic and other appropriate network factors;

b) indicates the charging area in those countries where there are several.

1.2.2 In the case of a country with a two- or three-digit country code, not more than two digits of the national (significant) number need be analyzed for these purposes.

In the case of a country with a one-digit country code, not more than the three digits of the national (significant) number need be analyzed for these purposes.

1.2.3 In the case where an integrated numbering plan covers a group of countries, the digit analysis specified in § 1.2.2 should also determine the country of destination.

1.2.4 For the requirements relating to frontier traffic, see Recommendation D.390 R [4].

## 2 Limitation of the number of digits to be dialled by subscribers

### 2.1 *International number*

The CCITT recommended in 1964 that the number of digits to be dialled by subscribers in the automatic international service should not be more than 12 (excluding the international prefix). It is emphasized that this is the maximum number of digits and Administrations are invited to do their utmost to limit the digits to be dialled to the smallest possible number.

### 2.2 *National (significant) number*

Noting that:

a) the international number (excluding the international prefix) consists of the country code followed by the national (significant) number;

b) the smallest possible number of digits to be dialled in the automatic international service is achieved by limiting the number of digits of the country code and/or of the national (significant) number;

c) in some countries where telephony is already developed to an advanced stage, the national numbering plans in force enable the number of digits of the international number to be limited to less than 12;

d) some other countries which drew up their national numbering plans some time before 1964 have taken steps to ensure that the number of digits of the international number will not exceed 12 and may even be less;

the CCITT recommends that the number of digits of the national (significant) number should be equal to a maximum of 12 — $n$ , where $n$ is the number of digits of the country code.

## 3 Digit capacity of international registers

The CCITT considers it advisable to recommend that the digit capacity of registers dealing with international traffic should allow for future conditions that may arise, but not possible to specify at the present time. In this regard, registers dealing with international traffic should have a digit capacity, or a capacity that can be expanded, to cater for more than the maximum 12-digit international number envisaged at present. The increase in the number of digits above 12 is left as a matter of decision to be taken by individual Administrations. However, for new applications, a minimum digit capacity of 15 digits is recommended (see Recommendation E.164 [2]). Administrations are recommended, when making such a decision, to take account of the new applications likely to be introduced in the international service, and which are now being studied by the CCITT.

## 4 Prefixes and codes

See definitions in Recommendation E.160 [3].

### 4.1 *International prefix* |

It is recommended by the CCITT that the Administrations of countries that have not yet introduced automatic international operation, or Administrations that are, for various reasons, revising their numbering plans should adopt an international prefix (a code for access to the international automatic network) composed of the two digits 00.

The reasons for this recommendation are:

— to provide a maximum degree of standardization such that dialling is made as easy as possible for a person travelling in different countries (many countries already use the code 00),

— to minimize the number of digits to be dialled in automatic international operation,

— to simplify, for a future time when the use of the international prefix might have become a universal international standard, the format for writing an international telephone number.

### 4.2 *Country code* |’ |

4.2.1 Country codes will be used:

— in semiautomatic operation, to route calls to the required country when the calls are transit calls or when, on the outgoing positions, there is common dialling access to all the outgoing routes;

— in automatic operation.

4.2.2 A list of country codes was prepared by the CCITT within the framework of a worldwide automatic telephone numbering plan.

This list was set up according to the following principles:

a) The number of digits of the country code is one, two or three according to the foreseeable telephonic and demographic development of the country concerned.

b) The nine digits from 1 to 9 have been allocated as the country code or as the first digit of the country code. These digits define *world numbering zones* .

c) In the case of Europe, owing to the large number of countries requiring two-digit codes, the two digits 3 and 4 have been allocated as the first digit of the country codes.

4.2.3 The list of country codes already assigned is given in Annex A.

### 4.3 *Assignment of country codes*

4.3.1 The existing world numbering plan should be maintained and codes presently assigned should not be changed, unless consolidation of an existing numbered area yields an advantage in terms of code usage.

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A ‘‘country code’’ may be assigned either to an individual country or to a geographical area.

4.3.2 All spare country codes will be assigned on a 3-digit basis, as detailed in Annex B. The list of spare country codes for the international semiautomatic and automatic service is given in Annex C.

4.3.3 In the case where all the country codes in a world numbering zone have been assigned and an additional code is required in that zone, a spare country code from another world numbering zone can be used in accordance with the following rules:

4.3.3.1 Preference should be given to the assignment of a spare country code from an adjacent world numbering zone.

4.3.3.2 If spare codes are not available from an adjacent world numbering zone, assignments will be made from the zones with the most spare codes.

### 4.4 *Codes for new international services*

The introduction of some international services requires the allocation of a country code. In such cases, the assignment of a country code will be determined by the rules detailed in Annex B.

4.5 *Trunk prefix* |

4.5.1 The *national (significant) number* (see definition 8 of Recommendation E.160 [3]) does not include the trunk prefix. Accordingly, in the international service, the trunk prefix of the country of destination must not be dialled.

It should be noted that, in some countries, it is customary to consider *for national purposes* that the trunk prefix is included in the national number [which is then not the national (significant) number]. A

careful distinction must therefore be made between such national definition or practice and the CCITT definition, which is internationally valid. In order to avoid misunderstanding, the CCITT definition includes the word ‘‘significant’’ between brackets, reading as follows: ‘‘national (significant) number’’.

4.5.2 It is recommended by the CCITT that the Administrations of countries that have not yet adopted a trunk prefix for access to their national automatic trunk network should adopt a prefix composed of a single digit, preferably 0. Irrespective of what digit is adopted as a trunk prefix, this digit should be precluded from being used also as a first digit of the trunk codes.

The reasons for this recommendation are:

— to provide the maximum degree of standardization of the trunk prefixes used in different countries, so that dialling is made as easy as possible for a person travelling from one country to another,

— to minimize the number of digits to be dialled in the automatic national service,

— to reduce user problems which arise because of the requirement, in automatic international operation, that the trunk prefix of the country of destination must not be dialled.

4.5.3 In the automatic international service, following the international prefix and country code of the called country, the caller should dial the national (significant) number of the called subscriber (i.e. without dialling the trunk prefix).

4.5.4 The use and printing of symbols and separators in national and international telephone numbers is detailed in Recommendation E.123 [5].

4.6 *Use of zero as an escape code*

The use of the digit ‘‘0’’ (zero) as an escape code for numbering plan interworking is described in Recommendation E.166.

ANNEX A
(to Recommendation Q.11)

**List of country codes incorporating amendments proposed**

**by the World Plan Committee, 1988**

**World numbering ZONE 1**

2 col

Anguilla 1 | ua)

Canada 1 | ua)

United States of America, including

| | |
|---|---|
| Puerto Rico and the Virgin Islands | 1 \| ua) |
| Jamaica | 1 \| ua) |
| Barbados | 1 \| ua) |
| Antigua and Barbuda | 1 \| ua) |
| Cayman Islands | 1 \| ua) |
| British Virgin Islands | 1 \| ua) |
| Bermuda | 1 \| ua) |
| Bahamas (Commonwealth of the) | 1 \| ua) |
| Dominican Republic | 1 \| ua) |
| Grenada | 1 \| ua) |
| Montserrat | 1 \| ua) |
| Saint Kitts and Nevis | 1 \| ua) |
| Saint Lucia | 1 \| ua) |
| Saint Vincent and the Grenadines | 1 \| ua) |
| Turks and Caicos (Islands) | 1 \| ua) |

a) Integrated numbering area.

**World numbering ZONE 2**

2 col

| | |
|---|---|
| Egypt (Arab Republic of) | 20 |
| Morocco (Kingdom of) | 21 \| ua) |
| Algeria (People's Democratic Republic of) | 21 \| ua) |
| Tunisia | 21 \| ua) |
| Libya (Socialist People's Libyan Arab Jamahiriya) | 21 \| ua) |
| Gambia (Republic of the) | 220 |
| Senegal (Republic of) | 221 |
| Mauritania (Islamic Republic of) | 222 |
| Mali (Republic of) | 223 |
| Guinea (Republic of) | 224 |
| C \| te d'Ivoire (Republic of) | 225 |
| Burkina Faso | 226 |
| Niger (Republic of the) | 227 |
| Togolese Republic | 228 |
| Benin (People's Republic of) | 229 |
| Mauritius | 230 |
| Liberia (Republic of) | 231 |
| Sierra Leone | 232 |
| Ghana | 233 |
| Nigeria (Federal Republic of) | 234 |
| Chad (Republic of) | 235 |
| Central African Republic | 236 |
| Cameroon (Republic of) | 237 |
| Cape Verde (Republic of) | 238 |
| Sao Tome and Principe Democratic Republic of) | 239 |
| Equatorial Guinea (Republic of) | 240 |
| Gabonese Republic | 241 |

Congo (People’s Republic of the) 242

Zaire (Republic of) 243

Angola (People’s Republic of) 244

Guinea-Bissau (Republic of) 245

Diego Garcia 246

Ascension 247

Seychelles (Republic of) 248

Sudan (Republic of the) 249

Rwandese Republic 250

Ethiopia 251

Somali Democratic Republic 252

Djibouti (Republic of) 253

Kenya (Republic of) 254

Tanzania (United Republic of) 255

Uganda (Republic of) 256

Burundi (Republic of) 257

Mozambique (People’s Republic of) 258

Zanzibar (Tanzania) 259

Zambia (Republic of) 260

Madagascar (Democratic Republic of) 261

Reunion (French Department of) 262

Zimbabwe (Republic of) 263

Namibia 264

Malawi 265

Lesotho (Kingdom of) 266

Botswana (Republic of) 267

Swaziland (Kingdom of) 268

Comoros (Islamic Federal
Republic of the) 269

South Africa (Republic of) 27

San Marino (Republic of) 295

Trinidad and Tobago 296

Aruba 297

Faroe Islands (Denmark) 298

Greenland (Denmark) 299

*Spare codes*

280, 281, 282, 283, 284, 285, 286, 287, 288, 289

290, 291, 292, 293, 294

a) *Integrated numbering area with subdivisions:*

— Morocco: 210, 211, 212 (212 in service);

— Algeria: 213, 214, 215;

— Tunisia: 216, 217;

— Libya: 218, 219.

**World numbering ZONES 3 and 4**

2 col

Greece 30

Netherlands (Kingdom of the) 31

Belgium 32

France 33 | ua)

Monaco 33 | ua)

Spain 34

Gibraltar 350

Portugal 351

Luxembourg 352

Ireland 353

Iceland 354

Albania (Socialist People's Republic of) 355

Malta (Republic of) 356

Cyprus (Republic of) 357

Finland 358

Bulgaria (People's Republic of) 359

a) Integrated numbering plan.

| | |
|---|---|
| Hungarian People’s Republic | 36 |
| German Democratic Republic | 37 |
| Yugoslavia (Socialist Federal Republic of) | 38 |
| Italy | 39 |
| Romania (Socialist Republic of) | 40 |
| Switzerland (Confederation of) | 41[a)] |
| Liechtenstein (Principality of) | 41[a)] |
| Czechoslovak Socialist Republic | 42 |
| Austria | 43 |
| United Kingdom of Great Britain and Northern Ireland | 44 |
| Denmark | 45 |
| Sweden | 46 |
| Norway | 47 |
| Poland (People’s Republic of) | 48 |
| Germany (Federal Republic of) | 49 |

BLANC

a) Integrated numbering plan.

**World numbering ZONE 5**

2 col

| | |
|---|---|
| Falkland Islands (Malvinas) | 500 |
| Belize | 501 |
| Guatemala (Republic of) | 502 |
| El Salvador (Republic of) | 503 |
| Honduras (Republic of) | 504 |
| Nicaragua | 505 |
| Costa Rica | 506 |
| Panama (Republic of) | 507 |
| St. Pierre and Miquelon (French Department of) | 508 |
| Haiti (Republic of) | 509 |
| Peru | 51 |
| Mexico | 52 |
| Cuba | 53 |
| Argentine Republic | 54 |
| Brazil (Federative Republic of) | 55 |
| Chile | 56 |
| Colombia (Republic of) | 57 |
| Venezuela (Republic of) | 58 |
| Guadeloupe (French Department of) | 590 |
| Bolivia (Republic of) | 591 |
| Guyana | 592 |
| Ecuador | 593 |
| Guiana (French Department of) | 594 |
| Paraguay (Republic of) | 595 |
| Martinique (French Department of) | 596 |
| Suriname (Republic of) | 597 |
| Uruguay (Eastern Republic of) | 598 |
| Netherlands Antilles | 599 |

**World numbering ZONE 6**

2 col

| | |
|---|---|
| Malaysia | 60 |
| Australia | 61 |
| Indonesia (Republic of) | 62 |
| Philippines (Republic of the) | 63 |
| New Zealand | 64 |
| Singapore (Republic of) | 65 |
| Thailand | 66 |
| Mariana Islands | 670 |
| Guam | 671 |
| Australian External Territories | 672 |
| Brunei Darussalam | 673 |
| Nauru (Republic of) | 674 |
| Papua New Guinea | 675 |
| Tonga (Kingdom of) | 676 |
| Solomon Islands | 677 |
| Vanuatu (Republic of) | 678 |
| Fiji | 679 |
| Palau | 680 |
| Wallis and Futuna Islands | 681 |
| Cook Islands | 682 |
| Niue Island | 683 |
| American Samoa | 684 |
| Western Samoa (Independent State of) | 685 |
| Kiribati (Republic of) | 686 |
| New Caledonia and Dependencies | 687 |
| Tuvalu | 688 |
| French Polynesia | 689 |
| Tokelan | 690 |
| F.S. of Micronesia | 691 |
| Marshall Islands | 692 |
| *Spare codes* | 693, 694, 695, 696, 697, 698, 699 |

**World numbering ZONE 7**

Union of Soviet Socialist Republics 7

**World numbering ZONE 8**

2 col

Japan 81

Korea (Republic of) 82

Viet Nam (Socialist Republic of) 84

Democratic People’s Republic of Korea 850

Hong-Kong 852

Macao 853

Democratic Kampuchea 855

Lao People’s Democratic Republic 856

China (People’s Republic of) 86 | ua)

Maritime Mobile Service 87 | ub)

Bangladesh (People’s Republic of) 880 | uc)

*Spare codes* 800, 801, 802, 803, 804, 805, 806, 807, 808, 809

830, 831, 832, 833, 834, 835, 836, 837, 838, 839

851, 854, 857, 858, 859

890, 891, 892, 893, 894, 895, 896, 897, 898, 899

a) Within this national code, the Telecommunications Administration of the People’s Republic of China has notified that the code 866 has been allocated to the province of Taiwan. (Reference: Notification No. 1157 of 10 December 1980.)

b) The country code 87 is reserved for the Maritime Mobile Service. The following three digit country codes are assigned: 871 INMARSAT (Atlantic), 872 INMARSAT (Pacific), 873 INMARSAT (Indian Ocean).

c) The remaining combinations in series 88 will not be allocated until the stock of spare 3-digit codes for the region is exhausted.

**World numbering ZONE 9**

2 col

| | |
|---|---|
| Turkey | 90 |
| India (Republic of) | 91 |
| Pakistan (Islamic Republic of) | 92 |
| Afghanistan (Democratic Republic of) | 93 |
| Sri Lanka (Democratic Socialist Republic of) | 94 |
| Burma (Socialist Republic of the Union of) | 95 |
| Maldives (Republic of) | 960 |
| Lebanon | 961 |
| Jordan (Hashemite Kingdom of) | 962 |
| Syrian Arab Republic | 963 |
| Iraq (Republic of) | 964 |
| Kuwait (State of) | 965 |
| Saudi Arabia (Kingdom of) | 966 |
| Yemen Arab Republic | 967 |
| Oman (Sultanate of) | 968 |
| Yemen (People's Democratic Republic of) | 969 |
| United Arab Emirates \| ua) | 971 |
| Israel (State of) | 972 |
| Bahrain (State of) | 973 |
| Qatar (State of) | 974 |
| Kingdom of Bhutan | 975 |
| Mongolian People's Republic | 976 |
| Nepal | 977 |
| Iran | 98 |
| *Spare codes* | 970, 978, 979 |

990, 991, 992, 993, 994, 995, 996, 997, 998, 999

a) E.A.U: Abu Dhabi, Ajman, Dubai, Fujeirah, Ras Al Khaimah, Sharjah, Umm Al Qaiwain.

## ANNEX B
(to Recommendation Q.11)

**Rules for the assignment of spare country codes**

The rules listed in this Annex are provided as a basis for the most effective utilization of the spare country codes.

B.1 Single isolated 3-digit codes should be assigned prior to the assignment of any 3-digit code which is part of a series of more than two consecutive 3-digit codes.

B.2 The assignment of spare codes of a zone, both within that zone and also to another zone, will take place as follows:

a) When assigning a code to a country in the same zone:

start with the lowest numbered 3-digit codes in ascending order, e.g. 670, 680 . | |

b) When assigning a code to a country in another zone:

start with the highest numbered 3-digit codes in descending order, e.g. 688, 685 . | |

c) Within code 87 reserved for the Maritime Mobile Service a third digit will be assigned to codes used for maritime satellite ocean area systems, with the restriction that codes 878 and 879 may not be touched because they are reserved for national purposes.

B.3 Country codes for new international services or for the automation of some existing services should be taken from the world numbering zone with the most spare codes.

ANNEX C
(to Recommendation Q.11)

**List of spare country codes for the international**

**semiautomatic and automatic service**

*Spare codes* 280, 281, 282, 283, 284, 285, 286, 287, 288, 289

290, 291, 292, 293, 294

693, 694, 695, 696, 697, 698, 699

800, 801, 802, 803, 804, 805, 806, 807, 808, 809

830, 831, 832, 833, 834, 835, 836, 837, 838, 839

851, 854, 857, 858, 859

890, 891, 892, 893, 894, 895, 896, 897, 898, 899

970, 975, 978, 979

990, 991, 992, 993, 994, 995, 996, 997, 998, 999

**References**

[1] CCITT manual *National telephone networks for the automatic service* , ITU, Geneva, 1964, 1968, 1978.

[2] CCITT Recommendation *Numbering plan for the ISDN era* , Vol. II, Rec. E.164.

[3] CCITT Recommendation *Definitions relating to national and international numbering plans* , Vol. II, Rec. E.160.

[4] CCITT Recommendation *Accounting system in the international automatic telephone service* , Vol. II, Rec. D.390 R.

[5] CCITT Recommendation *The use and printing of symbols and separators in national and international telephone numbers* , Vol. II, Rec. E.123.

**Recommendation Q.11 | fR** *bis*

## NUMBERING PLAN FOR THE ISDN ERA

### 1 Introduction

The rapid advances in telecommunications technology coupled with increased diversification of customer demands served by a number of different types of dedicated public switched networks (telephone, telex, data, etc.) have created a need to provide a uniform customer access and network structure. Such a structure is called the Integrated

This Recommendation appears in the Series E Recommendations as Recommendation E.164 and in the I series Recommendations as I.331.

Services Digital Network (ISDN). Implementation of ISDNs have begun in a number of countries and eventually these will carry all existing and new services.

To facilitate ISDN evolution internationally, this Recommendation defines the numbering arrangements for an ISDN. The timetable for implementation of this numbering plan is described in Recommendation E.165.

## 2 Definitions

Within the integrated service environment, the terms used for all networks and services must be compatible and consistent. A list of terms and their definitions relating to numbering are contained in Recommendation E.160.

## 3 ISDN numbering plan principles

### 3.1 *General*

The ISDN numbering and addressing principles are described in Recommendation I.330. The ISDN numbering plan will be based on and evolve from the existing numbering plans applicable to national and international public telephone networks.

In view of the evolutionary nature of ISDN, the international numbering plan should provide for substantial capacity to accommodate future network requirements.

Country or geographical area.
Where multiple destinations (i.e., RPOAs/networks) serve the called party's geographic area, the national ISDN numbering arrangement in the country of destination shall provide for discrimination between these RPOAs/networks. The procedure for discrimination between multiple transit-RPOAs/networks is not considered to be a destination address requirement and shall therefore be excluded from the ISDN numbering arrangements.

Before the ISDN numbering arrangement attains global penetration, it must allow for interworking between the ISDN and other public networks. Such arrangements are discussed in Recommendation E.166. Interworking with private networks shall also be taken into account. The definition of private networks and the methods of interworking are for further study and will be covered in future Series E Recommendations.

The 10 digit decimal character set 0-9 is used throughout the ISDN numbering plan format including subscriber number, national (significant) number and the country code.

Prefixes and other information concerned with identifying selection procedures or network service parameters (such as quality of service or transit delay) do not form part of the ISDN number.

The ISDN numbering plan shall include an unambiguous identification of a particular country networks and/or ISDNs within these countries , if required. In doing so, it shall retain the integrity of the telephone country code as defined in Recommendations E.160 and E.163.

### 3.2 *Structure of the international ISDN number*

The international ISDN number is composed of a variable length of decimal digits arranged in specific code fields. The international ISDN number code fields are the country code (CC) and the national (significant) number.

The country code (CC) is used to select the destination country and varies in length as outlined in Recommendation E.163.

The national (significant) number N(S)N is used to select the destination subscriber. In selecting the destination subscriber, however, it may be necessary to select a destination network. To accomplish this selection, the national (significant) number N(S)N code field comprises a national destination code (NDC) followed by the subscribers number (SN).

The NDC field will be variable in length depending upon the requirements of the destination country. Each NDC may have one of the following structures:

a) a Destination Network (DN) code, which can be used to select a destination network serving the destination subscribers;

b) a Trunk Code (TC), the format of which is defined in Recommendation E.160;

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See definitions in Recommendation E.160.

c) any combination of Destination Network (DN) code and Trunk Code (TC).

The NDCs of an Administration may consist of any of the above structures.

*Note* — The sequences DN-TC and TC-DN are a national matter. This is a subject for further study.

The subscriber’s number (SN) varies in length depending on the requirements of the destination country and is in accordance with Recommendation E.160.

Figure 1/Q.11 | fIbis shows the number structure.

Where appropriate, identification of an ISDN within the destination country shall be through the use of a national destination code (NDC) incorporated in the ISDN number.

**Figura 1/Q.11 | is, p.**

### 3.3 *Number length*

The international number may be of variable length. The maximum number length shall be 15 digits. However, some Administrations may wish to increase their register capacity to 16 or 17 digits. The decision on register capacity is left as a matter to be taken by individual Administrations.

The length does not include prefixes, language digit , address delimiters (e.g., end of pulsing signals, etc.) since these items are not considered as part of the international ISDN number.

### 3.4 *Number analysis*

In order to determine:

— the country of destination,

— the most appropriate network routing,

— the proper charging,

the originating country must analyse a number of digits of the international number. The national destination code (NDC) increases the potential requirement for number analysis because it provides for a combination of either a trunk code (TC) and/or a network identification function. Careful consideration should be given to the preparation of the national destination code (NDC) assignments.

On international calls the number analysis performed at the originating country need not be more than the country code and:

— three digits of the NSN in the case of a country with a three digit country code,

— four digits of the NSN in the case of a country with a two digit country code,

— five digits of the NSN in the case of a country with a one digit country code.

(Translation beyond this requirement could be arranged by bilateral agreement if required, e.g., countries assigned a 1 digit country code may require analysis of up to 6 digits beyond the country code.)

## 4 Number allocation principles

The assignment of country codes is administered by the CCITT, while NSN (NDC plus SN) code assignments are a national responsibility.

ISDN subscriber numbers may be allocated from the range of subscriber numbers available in the local ISDN exchange. These will be assigned to customers who subscribe only to the telephone service, customers with one or more data services and customers with a mixture of telephony and data services.

Subscribers equipped with basic access (the definition of ISDN basic access is given in the Series I Recommendations) should normally be allocated one unique number.

## 5 Network identification

In countries served by more than one ISDN and/or Public Switched Telephone Network (PSTN) the network identification of each is a national matter.

Network identification within the national (significant) number shall be such that:

— in a country all destination ISDN and PSTN networks shall operate under a single Recommendation E.163 country code,

— the international number maximum length of 15 digits shall not be exceeded, nor shall it be necessary for the number of digits for number analysis to exceed that specified in § 3.4,

— provision of network identification is not mandatory for countries using a single integrated numbering plan arrangement for their ISDNs and PSTNs.

## 6 Service identification

The ISDN number by itself will not identify the particular nature of the service, type of connection or quality of service required. An indication of parameters describing the service required by the calling terminal will be included in a service identifier in the signalling information. This service identifier is not considered to be part of the numbering plan.

## 7 Calling/called line identity

Calling/called line identity (CLI/CDLI) is address information which is passed across the network to provide supplementary services such as calling (or called) line identification presentation. The format of the CLI and CDLI for international calls should be the full international number, i.e., Country Code (CC), National Destination Code (NDC) and Subscriber Number (SN). No other information, such as prefixes or symbols (e.g. ‘‘+’’), should be included, although a subaddress may be associated with the CLI/CDLI.

## 8 Dialling procedures

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This termiminology needs further study.

The subscriber dialling procedures for local, national and international calls shall be in accordance with Recommendation E.163. However, subscribers' control procedures for supplementary services will be as defined in Recommendation E.131 or in separate Recommendations for each service.

ISDN subscribers will always be called by the same subscriber number irrespective of where in the network the call originates. For calls in the same numbering area or local network the subscriber number alone is dialled. For national calls between numbering areas or local networks the subscriber number may be preceded by the national prefix and the national destination code.

The addressing procedures for calls using sub-addressing are described in § 11.

## 9 Prefixes

The use of prefixes shall be in accordance with Recommendations E.160, E.163 and E.166. Where necessary, prefixes can also be used for network and service selection.

## 10 Escape code

The use of the digit ‘‘0’’ as an escape code for numbering plan interworking is described in Recommendation E.166.

## 11 Address information

Identification within a subscriber’s installation of a point beyond that defined by the ISDN number requires the transfer of address information from the public network to the subscriber’s equipment. The following methods apply:

### 11.1 *Direct dialling-in*

With direct-dialling-in (DDI) the last few digits forming the end of the ISDN subscriber number are transferred to the called subscriber’s installation (see Figure 2/Q.11 | fIbis ). The number of digits used varies and depends upon the requirements of the called subscriber’s equipment and the capacity of the numbering plan used.

ISDN subscriber numbers used for DDI may be those published in the public directory.

**Figure 2/Q.11 | is, p.**

### 11.2 *Sub-addressing (network address extension)*

Sub-addressing provides a separate additional addressing capacity outside the ISDN numbering plan but constitutes an intrinsic part of the ISDN addressing capabilities. As shown in Figure 2/Q.11 | fIbis up to 20 octets (or 40 digits) may follow the ISDN number and form the ISDN sub-address, which is transferred to the equipment at the subscriber’s premises.

When required, the sub-address is sent by the calling party within the call set-up procedure and is passed transparently through the network as a separate entity from both the ISDN number and user-to-user information. Sub-address information is not required to be processed within the public network.

Sub-addressing procedures are the subject of a separate Recommendation.

11.3 *Combination of sub-addressing and direct dialling-in*

Sub-addressing may be used separately or in combination with DDI (see Figure 2/Q.11 **|** fIbis ).

11.4 *Address delimiters*

DDI address information may contain an ‘‘end of address’’ (e.g., ST) delimiter. In the case of sub-addressing, an ‘‘end of subscriber number/beginning of sub-address’’ delimiter and the ‘‘end of address’’ delimiter are required.

(The use of an address delimiter at the end of an ISDN address is for further study.)

**Recommendation Q.11 | fR** *ter*

**TIMETABLE FOR COORDINATED IMPLEMENTATION OF THE FULL CAPABILITY**

**OF THE NUMBERING PLAN FOR THE ISDN ERA (RECOMMENDATION E.164)**

## 1 Introduction

Recommendation I.330 describes ISDN numbering and addressing principles, while Recommendation E.164 describes the numbering plan for the ISDN era. Recommendation E.164 also identifies the need for interworking arrangements between ISDN and present dedicated networks.

This Recommendation sets a specific time (Time *T* ), after which all ISDNs and PSTNs can use the full capability of Recommendation E.164, ‘‘Numbering plan for the ISDN era’’, and identifies the numbering requirements on ISDNs and on dedicated networks intending to interwork with ISDNs, before and after Time *T* .

Among the significant principles which form the basis for this Recommendation, the following are considered especially useful for ready reference:

— An E.163/E.164 telephony subscriber may become an ISDN subscriber without a number change.

— Numbers according to Recommendation E.164 apply to both PSTN and ISDN subscribers in the ISDN era. A mixture of PSTN and ISDN terminations on the same exchange is allowed.

— E.164 numbering arrangements may be used to distinguish between ISDN and PSTN subscribers. This is not necessary but is allowed, provided that possible effects on routing and digit analysis remain within the limits of Recommendation E.164.

## 2 Application and evolution of Time T

ISDNs are expected to interwork with dedicated networks. However, due to the different addressing capabilities between the ISDN and existing numbering plans, some temporary constraints need to be imposed on the number length and digit analysis required to access the user network interfaces of the ISDNs before Time *T* .

This Recommendation es also included in the series E Recommendations under the number E.165.

### 2.1 *Numbering constraints before Time T*

#### 2.1.1 *ISDNs interworking with dedicated networks*

To allow numbering plan interworking with dedicated networks before Time *T*, an ISDN will not assign international E.164 numbers longer than 12 digits to its user network interfaces capable of receiving calls from dedicated networks.

In addition, for ISDNs and PSTNs, digit analysis as defined in Recommendation E.163 will apply.

### 2.1.2 *ISDNs which do not interwork with dedicated networks*

These ISDNs are allowed to assign numbers to user network interfaces according to the full capability of the numbering plan for the ISDN era.

Digit analysis according to Recommendation E.164 may be required to access user network interfaces connected to these networks.

### 2.2 *Evolution after Time T*

After Time *T* , ISDNs and PSTNs can make use of the full capability of E.164 numbers to identify their user network interfaces and terminals respectively. In addition, for routing purposes, the ISDNs and PSTNs conforming to Recommendation E.164 must be capable of analysing the ISDN international number to the extent required in that Recommendation.

*Note* — Digit analysis for other dedicated networks is for further study.

## 3 Date of Time T

The date for Time *T* has been set for 31 December 1996 at 23h59m Coordinated Universal Time (UTC).

## 4 Network requirements at Time T

ISDNs and PSTNs supporting number length and digit analysis as described in Recommendation E.164 are said to be ‘‘E.164-conforming’’ networks.

All ISDNs must be E.164-conforming networks. Functions associated with E-164-conforming networks are:

a) for calls originated within such a network, provision for carrying E.164 numbers of up to 15 digits to interfacing networks;

b) comparable treatment for transit calls;

c) capability for conducting digit analysis for ISDNs and PSTNs as indicated in Recommendation E.164;

d) screening to ensure that, taking into account agreements between the networks concerned, no transit calls are offered to non-conforming networks incapable of handling number lengths as defined in Recommendation E.164;

e) provision of interim procedures, such as two-stage selection, for internal network sources, e.g., local exchanges, not equipped to handle 15 digits, so that all internal network sources can originate calls to all E.164 addresses.

*Note 1* — Other requirements on conforming networks are for further study. Non-conforming networks may seek bilateral agreements with conforming networks, or adopt intra-network procedures to provide means by which subscribers of the non-conforming networks may originate calls to subscribers connected to ISDNs and PSTNs requiring a number length or analysis in excess of the capabilities of the non-conforming network.

*Note 2* — Limitations of non-conforming networks and interworking procedures are for further study.

SECTION 3

## ROUTING PLAN FOR INTERNATIONAL SERVICE

**Recommendation Q.12**

## OVERFLOW — ALTERNATIVE ROUTING — REROUTING —

## AUTOMATIC REPEAT ATTEMPT

**1** When a call cannot find a free circuit in one group of circuits (first choice), technical arrangements can be made to route the call automatically via another group of circuits (second choice), at the same

exchange; this process is called *overflow* . There may also be overflow, at the same exchange, from a second choice group of circuits to a third choice group of circuits, etc.

**2** When the group of circuits over which the overflow traffic is routed involves at least one exchange not involved in the previous choice route, the process is called *alternative routing* .

**3** It should be noted that overflow can occur without alternative routing for cases such as, when there are in one relation two groups of circuits, one group reserved for one-way operation and the other group used for both-way operation. In this case, when all one-way circuits are busy, the call can overflow to the both-way circuit group.

**4** When congestion occurs at a transit exchange, arrangements can be made in some signalling systems, at the outgoing international exchange on receipt of a busy-flash signal or a congestion signal sent by the transit exchange, to reroute the call automatically from the outgoing international exchange over another route. This process is called *re-routing* rerouting is not envisaged in the International Routing Plan.

**5** When a difficulty is encountered in the setting-up of a connection — such as double seizure on both-way circuits or error detection — arrangements can be provided to make another attempt to set up

the connection for that call from the point where the first attempt took place. This process is called *automatic repeat attempt* .

An automatic repeat attempt may take place:

— on the same circuit; or

— on another circuit of the same group of circuits; or

— on a circuit in another group of circuits.

**Recommendation Q.13**

## INTERNATIONAL TELEPHONE ROUTING PLAN

### 1 Introduction

1.1 This Plan describes an international telephone routing plan designed to enable Administrations to select routings for their traffic which will result in a satisfactory connection between any two telephone stations in the world. The Plan relates to automatic and semi-automatic telephone traffic from fixed and mobile (both land and maritime) stations. The Plan is necessary to allow the objective to be achieved with maximum economy by the most efficient use of costly circuits and switching centres while safeguarding the grade of service and quality of transmission.

1.2 The Plan is one of the basic CCITT Recommendations which influence many other Recommendations, for example the transmission plan (Recommendation G.101).

1.3 In practice the large majority of international telephone traffic is routed on direct circuits (i.e. no intermediate switching point) between International Switching Centres (ISCs). It should be noted that it is the rules governing the routing of connections consisting of a number of circuits in tandem that this Recommendation primarily addresses. These connections have an importance in the network because:

— they are used as alternate routes to carry overflow traffic in busy periods to increase network efficiency,

— they can provide a degree of service protection in the event of failures of other routes,

— they can facilitate network management when associated with ISCs having temporary alternative routing capabilities.

1.4 This Plan replaces the previous one established in 1964 and it can be applied to all existing switching equipment and signalling systems and is intended to be flexible enough to incorporate new switching and signalling developments.

Nevertheless, it is recognized that the Plan, which is complementary to the plan contained in Recommendation E.172, will have to be reviewed and revised to take account of developments in telecommunications.

1.5 The Plan accomplishes its basic purposes unconstrained by, and requiring no changes to, the numbering plan , the rules for charging the calling subscriber and the rules for the apportionment of charges ( international accounting ).

### 2 Principles

2.1 The Plan preserves the freedom of Administrations:

a) to route their originating traffic directly or via any transit Administration they choose;

b) to offer transit capabilities to as wide a range of destinations as possible in accordance with the guidelines which it provides.

2.2 The Plan provides guidance on possible international routings. Any routing chosen must be subject to agreements between the Administrations involved before implementation.

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This Recommendation is also included in the E Series Recommendations under the number E.171

The freedom of Administrations to choose the routing of their terminal and transit traffic may be limited by technical, commercial and administrative considerations including:

— the capability of precisely measuring traffic volumes for accounting purposes,

— the need to maximize route profitability,

— the desirability of simplicity in international accounting.

2.3 The governing features of this Plan are:

a) it is not hierarchical;

b) Administrations are free to offer whatever transit capabilities they wish, providing they conform to this Recommendation;

c) direct traffic should be routed over final (fully provided) or high usage circuit groups;

d) no more than 4 international circuits in tandem should be involved between the originating and terminating ISCs;

e) advantage should be taken of the non-coincidence of international traffic by the use of alternative routings to effect circuit economies and provide route diversity (Recommendation E.523);

f ) the routing of transit switched traffic should be planned to avoid the possibility of circular routings ;

g) when a circuit group has both terrestrial and satellite circuits the choice of routing should be governed by:

— the guidance given in Recommendation G.114,

— the number of satellite circuits likely to be utilized in the overall connection,

— the circuit which provides the better transmission and overall service quality ;

h) the inclusion of two or more satellite circuits in the same connection should be avoided in all but exceptional cases. Annex A contains details on the effects of satellite communications.

Recommendation Q.14 defines the means to control the number of satellite links in an international telephone connection;

i) both originating and transit traffic should be routed over the minimum number of international circuits in tandem unless this is in conflict with one of the above-mentioned features.

## 3 Number of circuits in tandem

### 3.1 *International circuits*

For reasons of transmission quality as well as the minimization of post-dialling and answer signal delays and the avoidance of signalling time-outs, it is desirable to limit the number of circuits in tandem in an overall connection (Recommendations G.101 and G.114, § 1). Recommendation Q.7 gives signalling considerations on tandem routings.

In this Plan the number of international circuits in a connection is limited to a maximum of 4. (See § 3.3.2 for a special case with multiple ISCs within the area of one Administration.)

### 3.2 *National circuits*

Limitations in the national section of the international connection are given in Recommendation G.101, § 3.1.

Many Administrations have fulfilled the requirements of Recommendation G.101, § 3.1 by establishing a national routing plan based on a theoretical final route structure with low-loss-probability circuit groups between switching centres of different categories.

The actual structure in many cases involves direct routes which bypass the theoretical final route or part of it, the structure being rather similar to the former international routing plan.

*Note* — The former international routing plan was last published in the *Orange Book* , Volume II.2, Recommendation E.171.

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When there are circuits between ISCs using different geographical routes with different transmission means, preference should be given to those circuits which provide better transmission quality as long as this is not conflicting with any other part of this Recommendation.

### 3.3 *Multiple ISCs in a country*

#### 3.3.1 *In the originating or terminating country*

Administrations may find it advantageous for technical or economic reasons, or for the protection of service, or to use multiple originating and/or terminating

ISCs. In some cases this could result in a routing for a call which includes a circuit between two ISCs in the originating or terminating country. Such circuits may be regarded as national circuits in applying this Plan and as such should be included in the national link allocation (see Recommendation E.172).

### 3.3.2 *In a transit country*

Some Administrations may find it desirable to route transit traffic between two ISCs in their own country. In this case the allowable number of international circuits in tandem may be increased from 4 to 5 (this is the only exception to § 3.1 above).

## 4 Routing techniques

With advanced SPC exchanges and enhanced signalling systems new routing techniques are emerging (see Recommendation E.170). These techniques can be used nationally as found necessary by individual Administrations or bilaterally between Administrations.

## 5 Basic routing rules

### 5.1 *Originating traffic*

5.1.1 Originating traffic at an ISC may be offered to any route, taking into account all factors in this Plan, and the following guiding principles, to ensure good overall service quality for the call connection:

a) an originating ISC should first select the direct route to the destination, if it is available;

b) if the direct route is unavailable (because all circuits are busy or because no direct route is provided) then the originating ISC may select the route to any transit ISC which conforms to the principles in § 5.2 below. An agreement should first be reached between the originating, terminating and transit Administrations involved, for the use of this transit route.

5.1.2 A circuit group may be designed as a high usage circuit group (see Recommendation E.522) or as a final circuit group (see Recommendations E.520 or E.521).

5.1.3 Examples of some possible routings are given in Annex B.

### 5.2 *Transit traffic*

### 5.2.1 *Two and three international circuits in tandem*

An Administration offering transit capabilities may do so without special arrangements or restrictions to all destinations served by:

a) direct circuit groups, or

b) switching via an additional transit ISC that has a direct final circuit group to the destination, or

c) a combination of a) and b).

Examples of two and three international circuits in tandem are given in b) to e) of Figure B-1/Q.13.

5.2.2 *Four international circuits in tandem*

If an Administration has provided a routing for its originating traffic that involves a maximum of 3 international circuits in tandem to a destination, it may offer this capability to other Administrations for transit traffic. In this case, these other Administrations must not themselves offer transit capabilities to the same destination as this would exceed 4 international circuits in tandem.

Examples of 4 international circuits in tandem are given in f ) and g) of Figure B-1/Q.13.

5.2.3 A circuit group may be designed as a high usage circuit group (see Recommendation E.522) or as a final circuit group (see Recommendations E.520 or E.521).

5.2.4 *Special arrangements*

Some Administrations may route transit traffic differently from their own originating traffic to a given destination. These routings will in some cases involve offering transit traffic to direct routes, but not to overflow routes via alternative transit ISCs. On the other hand, originating traffic offered to the same direct routes is given access to overflow routes.

This arrangement may be used for:

a) limiting the number of international circuits in tandem for transit calls, yet allowing originating calls up to the maximum of 4 international circuits in tandem.

b) preventing transit traffic from overflowing from direct routes, to minimize subsequent transit charges.

c) minimizing transmission propagation delay for transit calls.

In such cases, care must be exercised to avoid grade of service problems. Consideration should be given to :

i) the analysis of 24-hour traffic profiles ;

ii) the exchange of network status information between Administrations.

In implementing such arrangements, Administrations offering transit capability should provide the necessary information on traffic profiles and network status capabilities. Originating Administrations should evaluate such information taking into account transmission costs, and call completion factors. (See Recommendations E.522 and E.523.)

Examples of some routings involving special arrangements are given in a) and b) of Figure B-2/Q.13.

## 6 List of international transit capabilities

6.1 To aid in the application of transit routings, a list of international transit capabilities via an Administration is desirable.

6.2 Each Administration that wishes to offer transit capabilities should develop and distribute its own list.

6.3 Annex C details the essential information that should be contained in a list of international transit capabilities plus additional information that might also be distributed by Administrations offering transit capabilities or might be requested by Administrations seeking transit routings.

ANNEX A

(to Recommendation Q.13)

## The effects of satellite communication

A.1 The use of geostationary satellite circuits does not call for any alteration in the basic principles and rules of this Plan. However, because of the mean propagation time on satellite circuits, the precautions specified in Recommendation G.114 must be observed.

A.2 At originating ISCs, calls which are to be transit switched at another ISC and likely to use a satellite circuit elsewhere in the connection should be routed using terrestrial circuits from the originating ISC, if available.

A.3 At ISCs arrangements should be made to guard against the inclusion of two or more satellite circuits in the same connection in all but exceptional cases. (See § A.6 below.)

Avoidance of two or more satellite circuits is made more feasible when the signalling systems used have signals indicating whether the connection already includes a satellite circuit. (See Recommendation Q.7.)

In those cases when the signalling system does not provide the necessary information, bilateral agreement should be sought between the Administrations involved to establish a special circuit group on which traffic can be routed that has already one or more satellite circuits in the connections. (See Figure A-1/Q.13.)

A.4 The use of national satellite circuits for international originating and terminating connections should be avoided to the extent possible.

A.5 Connections (originating, terminating or transit) to and from the international maritime mobile satellite service should not, so far as possible, comprise other satellite circuits. In the shore-to-ship direction the country codes allocated to the maritime mobile satellite service should be analysed in order to apply this provision.

A.6 There will be cases when the above provisions cannot be fully applied. These are:

a) routing to and from Administrations with exclusive or almost exclusive use of satellite circuits for international service;

b) routings containing more than one international circuit in tandem in which the signalling systems used on one or more of the circuits in the connection does not provide nature of circuit indicators, or when no agreement can be reached with respect to the special circuit group;

c) when no other reliable means of communication is available; then two or more satellite circuits in one connection may be used.

*Note* — When it is unavoidable to use more than one satellite circuit in an international connection, attention to echo control as indicated in Notes 2 and 3 of Recommendation G.114 should be exercised.

A.7 Control methods for echo suppressors are given in Recommendation Q.115.

A.8 The use of demand assigned satellite systems in international telephony (e.g. SPADE) is governed by the same general and special considerations given above. The entirety of a demand assigned system and its access circuits may be regarded as a single international circuit for transmission purposes and as a transit ISC for routing purposes.

**Figure A-1/Q.13, p. MONTAGE:** — 2cic.

Echo cancellers are also now in use.

ANNEX B

(to Recommendation Q.13)

**Examples of possible routings and special arrangements**

**Figure B-1/Q.13, p. 4**

**Figure B-1/Q.13, p.**

ANNEX C

(to Recommendation Q.13)

## List of international transit capabilities

### C.1 *Essential information on international transit capabilities*

#### C.1.1 *Use*

Every Administration offering transit capabilities should compile and distribute a list including at least the information shown below in order to enable other Administrations to make a first choice of possible transit routings.

#### C.1.2 *Suggested format*

See Figure C-1/Q.13.

**Figure C-1/Q.13 [T1.13], p. (a traiter comme tableau MEP)**

### C.1.3 *Instructions for completing the list*

*Item A — Administration or RPOA*

Enter the name of the Administration or recognized private operating agency responsible for preparing this list.

*Item B — Date of information*

Enter the date for which the information below applies.

*Item C — Address for inquiries*

Enter the name, address, telex and telephone number of the organizational unit or individual who will respond to enquiries concerning transit capabilities.

*Column 1 — Destination country or Administration*

Enter the name of the destination country or Administration. These destinations should be listed alphabetically within each World Zone grouping. Only those destinations for which this ISC can carry automatic transit traffic should be listed in this column. All destinations for which transit capabilities are being offered should be listed.

*Column 2 — Transit ISCs*

Enter the name or location that identifies the international switching centre(s) that has automatic transit access to the destinations in column 1. For multiple transit ISCs within the same Administration list each ISC in sequence.

*Column 3 —*

Enter whether the transit route to the destination is either:

DIR — If ‘‘direct’’ to the terminating ISC.

IND — If ‘‘indirectly’’ first routed via a further transit ISC. The name of the further transit ISC should also be entered.

ALT — If either the ‘‘DIR’’ or ‘‘IND’’ route automatically overflows to an ‘‘alternative’’ transit ISC. The name of the alternative transit ISC should also be entered.

*Column 4 — Terrestrial possible*

Enter YES if at least some transit calls to this destination can obtain an all-terrestrial route beyond the transit ISC.

Enter NO if all transit calls to this destination will use a satellite circuit in the route beyond the transit ISC.

*Column 5 — Special restrictions*

Enter YES if the transit traffic is subject to overflow restrictions (see § 5.2.4) that might affect the grade of service achieved.

Enter NO if no such restrictions apply.

## C.2 *Additional information on international transit capabilities*

### C.2.1 *Use*

The information shown below is of value in comparing and selecting possible transit routes. Administrations offering transit capabilities might choose to compile and distribute some or all of these items with their basic list of international transit capabilities. Alternatively, Administrations selecting a transit route may use the items shown below as a basis for enquiries.

### C.2.2 *Format*

No particular format is suggested for this information. However, it is recommended that both transit and originating Administrations use the terminology and definitions given below.

If changes are planned in any of the items the change should be indicated together with the effective date.

### C.2.3 *Details of additional items*

*traffic profile*

Under this item the busy hour traffic on the circuit group used beyond the transit ISC should be given together with an indication of the traffic variations during the day. Preferably the variations should be presented in the form of hourly traffic distributions as shown in Recommendation E.523.

*Transit charges*

Under this item details of the applicable transit charges should be given.

*Grade of service*

The grade of service normally experienced to the destination should be given. This may be supplemented by time of day variations. If overflow restrictions for transit traffic apply, the information must include at least the hours during which the grade of service is 1% or better.

*Circuit quantities*

The total circuit quantities available and subtotals for each type of transmission medium should be given.

If indirect routing is used this information should be given for the circuit groups to the next transit ISC.

*Signalling*

The signalling systems used for the onward routing from the transit ISC should be listed.

*Restoration*

This item should outline the restoration policy in the case of a major transmission facility outage in the onward routing.

*Echo control*

This item should list the echo control capabilities at the transit ISC.

*Prevention of two or more satellite circuits in tandem*

This item should explain the capabilities at the transit ISC for preventing the connection of two satellite circuits in tandem.

Where indirect routing is used, this item should also identify whether a specially designated circuit group has been agreed to allow prevention of two satellite circuits in the same connection at a subsequent ISC.

**Recommendation Q.14**

## MEANS TO CONTROL THE NUMBER OF SATELLITE LINKS IN AN INTERNATIONAL TELEPHONE CONNECTION

Recommendation Q.41 states that connections with a mean one-way propagation time in excess of 400 ms should be avoided apart from exceptional circumstances. Means should therefore be provided in international switching centres to prevent the multiple connection of satellite links whenever possible.

The following principles should apply in controlling such connections:

a) If an exchange can determine the prior connection of a satellite link in a connection by:

— information relating to the incoming circuit,

— receipt of the Nature of Circuit Indicator: ‘‘satellite included’’,

the exchange should forward the call on a terrestrial circuit. A satellite circuit may be used in the following exceptional circumstances:

— where no terrestrial circuits are provided to the required destination,

— where only a few terrestrial circuits are provided on a final route and the loss of quality of service of a double satellite connection (echo problems and ‘‘double-talk’’) is preferable to the degradation of grade of service that would be caused by the exclusion of the satellite circuits.

A Nature of Circuit Indicator ‘‘satellite included’’ should be forwarded on the outgoing circuit where possible.

b) If an exchange can determine by an analysis of the call destination that a satellite link will definitely or most probably be included at a later point in the call connection, it should give priority to terrestrial links in its outgoing circuit selection. Special attention is drawn to the analysis of country code 87S which may indicate that the call will include a maritime satellite link. (For the use of the S digit, see Recommendations E.210 [1] and E.211 [2].)

The above principles apply to all international exchanges and to all national exchanges which may connect to circuits via domestic satellite systems.

### References


[1] CCITT Recommendation *Ship station identification for VHF/UHF and maritime mobile-satellite services* , Vol. II, Rec. E.210.

[2] CCITT Recommendation *Selection procedures for VHF/UHF maritime mobile services* , Vol. II, Rec. E.211.

ANNEX A
(to Recommendation Q.14)

**Call processing logic — Nature of circuit indications**

**Figure CCITT-50650, p. 7**

**MONTAGE:** PAGE BLANCHE = PAGE PAIRE

SECTION 4

## GENERAL RECOMMENDATIONS RELATIVE TO SIGNALLING AND SWITCHING SYSTEMS

## (NATIONAL OR INTERNATIONAL)

### 4.1 Power limits of signals of a signalling system

### Recommendation Q.15

### NOMINAL MEAN POWER DURING THE BUSY HOUR

*(Remark of Recommendation G.222, Volume III of the* | Red Book,

*amended at Geneva, 1964; further amended)*

**Nominal mean power during the busy hour**

To simplify calculations when designing carrier systems on cables or radio links, the CCITT has adopted a *conventional* value to represent the *mean absolute power level* (at a zero relative level point) of the speech plus signalling currents, etc., transmitted over a telephone channel in one direction of transmission during the busy hour.

The value adopted for this mean absolute power level corrected to a zero relative level point is —15 dBm0 (mean power = 31.6 microwatts); this is the mean with time and the mean for a large batch of circuits.

*Note 1* — This conventional value was adopted by the CCIF in 1956 after a series of measurements and calculations had been carried out by various Administrations between 1953 and 1955. The documentation assembled at the time is indicated in [2]. The adopted value of about 32 microwatts was based on the following assumptions:

i) mean power of 10 microwatts for all signalling and tones (Recommendation Q.15 [2], gives information concerning the apportionment on an energy basis of signals and tones);

ii) mean power of 22 microwatts for other currents, namely:

— speech currents, including echoes, assuming a mean activity factor of 0.25 for one telephone channel in one direction of transmission;

— carrier leaks (see Recommendations G.232, § 5 [3]; G.233, § 11 [4]; G.235, § 5 [5]); and the Recommendations cited in [6] and [7];

This Recommendation is, basically, an extract of Recommendation G.223 [1].

— telegraph signals, assuming that few telephone channels are used for VF telegraphy systems (output signal power 135 microwatts (the Recommendation cited in [8])) or phototelegraphy (amplitude modulated signal with a maximum signal power of about 1 milliwatt (the Recommendation cited in [9])).

On the other hand, the power of pilots in the load of modern carrier systems has been treated as negligible.

The reference to ‘‘the busy hour’’ in § 1 is to indicate that the limit (of —15 dBm0) applies when transmission systems and telephone exchanges are at their busiest so that the various factors concerning occupancy and activity of the various services and signals are to be those appropriate to such busy conditions.

It is not intended to suggest that an integrating period of one hour may be used in the specification of the signals emitted by individual devices connected to transmission systems. This could lead to insupportably high short-term power levels being permitted which give rise to interference for durations of significance to telephony and other services.

*Note 2* — The question of reconsidering the assumptions leading to this conventional value arose in 1968 for the following reasons:

— changes in the r.m.s. power of speech signals, due to the use of more modern telephone sets, to a different transmission plan, and perhaps also to some change in subscriber habits;

— change in the mean activity factor of a telephone channel due, *inter alia* , to different operating methods;

— increase in the number of VF telegraphy bearer circuits and sound-programme circuits;

— introduction of circuits used for data transmission, and rapid increase in their number.

During several Study Periods these points have been under study and various Administrations carried out measurements of speech signal power and loading of carrier systems. The results are shown in Supplement No. 5. These results indicate that there is no sufficiently firm information to justify an alteration to the conventional mean value of —15 dBm0 (32 μW0) for the long-term mean power level per channel.

Indeed, the steps envisaged by Administrations to control and reduce the levels of non-speech signals indicate a tendency to limit the effect of the increase in the non-speech services.

As regards the subdivision of the 32 μW into 10 μW signalling and tones and 22 μW speech and echo, carrier leaks, and telegraphy, again there is no evidence which would justify proposals to alter this subdivision.

As a general principle, it should always be the objective of Administrations to ensure that the *actual* load carried by transmission systems does not significantly differ from the *conventional* value assumed in the design of such systems.

**References**

[1] CCITT Recommendation *Assumptions for the calculation of noise on hypothetical reference circuits for telephony* , Vol. III, Rec. G.223.

[2] *CCITT collected documents on the volume and power of speech currents transmitted over international telephone circuits* , Blue Book, Vol. III, Part 4, Annex 6, ITU, Geneva, 1965.

[3] CCITT Recommendation *12-channel terminal equipments* , Vol. III, Rec. G.232, § 5.

[4] CCITT Recommendation *Recommendations concerning translating equipments* , Vol. III, Rec. G.233, § 11.

[5] CCITT Recommendation *16-channel terminal equipments* , Vol. III, Rec. G.235, § 5.

[6] CCITT Recommendation *Characteristics of group links for the transmission of wide-spectrum signals* , Vol. III, Rec. H.14, § 2.3.

[7] CCITT Recommendation *Characteristics of supergroup links for the transmission of wide-spectrum signals* , Vol. III, Rec. H.15, § 2.3.

[8] CCITT Recommendation *Basic characteristics of telegraph equipments used in international voice-frequency telegraph systems* , Vol. III, Rec. H.23, § 1.2.

[9] CCITT Recommendation *Phototelegraph transmission on telephone-type circuits* , Vol. III, Rec. H.41, § 2.3.

## MAXIMUM PERMISSIBLE VALUE FOR THE ABSOLUTE POWER LEVEL

## OF A SIGNALLING PULSE

The CCITT recommends that, for crosstalk reasons, the absolute power level of each component of a short duration signal should not exceed the values given in Table 1/Q.16.

The values given in this table result from a compromise between the characteristics of various existing channel filters.

**H.T. [T1.16]**
TABLE 1/Q.16
**Maximum permissible value of power at a zero relative level point**

| Signalling frequency (Hz) Maximum permissible power for a signal at a zero relative level point (microwatts) } Corresponding absolute power level. Decibels referred to 1 mW (dBm0) } | { { | |
|---|---|---|
| 800 | 750 | —1 |
| 1200 | 500 | —3 |
| 1600 | 400 | —4 |
| 2000 | 300 | —5 |
| 2400 | 250 | —6 |
| 2800 | 150 | —8 |
| 3200 | 150 | —8 |
| { If the signals are made up of two different frequency components, transmitted simultaneously, the maximum permissible values for the absolute power levels are 3 decibels below the above figures } | | |

**Table 1/Q.16 [T1.16] p.**

**Reference**

[1] CCITT Recommendation *Maximum permissible value for the absolute power level (power referred to one milliwatt) of a signalling pulse* , Vol. III, Rec. G.224.

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

**Recommendation Q.20**

This Recommendation also appears as Recommendation G.224 [1].

## COMPARATIVE ADVANTAGES OF ‘‘IN-BAND’’

## AND ‘‘OUT-BAND’’ SYSTEMS

Signalling over telephone circuits may be effected *in* | the frequency band used for speech (‘‘in-band’’ signalling), or *outside* it (‘‘out-band’’ signalling). In the latter case, the same channel carries both the signalling and speech frequency bands, the signalling band being separate from the speech band, and signalling equipment is an integral part of the carrier system.

In a further type of out-band signalling, a circuit, not used for speech, can be used to effect the signalling requirements of a number of speech circuits. This may be termed ‘‘separate channel signalling’’. The separate channel may be:

a) a channel in a carrier system used to effect the signalling requirements of the remaining channels in the same carrier system which are used for speech, signalling equipment being an integral part of the carrier system: this may be termed ‘‘built-in separate channel signalling’’;

b) completely separate, in which case signalling equipment is not an integral part of the carrier system; this may be termed ‘‘completely separate channel signalling’’.

## 1 Advantages of in-band signalling

1.1 In-band signalling can be applied to any type of line plant. The application of out-band signalling, and built-in separate channel signalling, is limited to carrier systems.

1.2 Through-signalling can be employed at transit points, and at carrier system terminals when a telephone circuit comprises two or more carrier links. No direct current repetition and thus no delay and no distortion of signals arises at such points. Out-band signalling and built-in separate channel signalling require a direct current repetition at such points.

1.3 Replacement of a faulty line section is easy. In the case of completely separate channel signalling, replacement of a faulty line section is based on security arrangements.

1.4 It is impossible to set up a connection on a faulty speech path. In the case of completely separate channel signalling, a continuity check of the speech path is required.

1.5 The full bandwidth of the speech channel is available for signalling. This facilitates the use of more than one signalling frequency. Normally the full bandwidth permits faster signalling than with a smaller signalling bandwidth. With in-band signalling, realization of this advantage is limited to those signals not required to be protected against signal imitation due to speech currents.

## 2 Advantages of out-band signalling

2.1 Relative freedom from disturbances due to speech currents; freedom from disturbances due to echo-suppressors; freedom from disturbances which might arise from connections to other signalling systems. With in-band signalling it is necessary to take steps to guard against such disturbances.

2.2 Possibility of signalling, during the setting-up of the call, by either discontinuous or continuous transmission, and the possibility of transmitting those signals during speech. Signalling during speech is not compatible with in-band signalling.

2.3 Simplicity of terminal equipment due to § 2.1 above and to the possibility of continuous signalling.

Out-band signalling (where the same channel carries both speech and signalling) also has the advantage of § 1.3 of in-band signalling.

Built-in separate channel signalling has the advantages of §§ 2.1, 2.2 and 2.3 of out-band, and the advantage of § 1.3 of in-band signalling.

Completely separate channel signalling has the advantages of §§ 2.1 and 2.2 of out-band signalling and, compared with out-band signalling and built-in separate channel signalling, has the additional advantages that no direct current repetition is necessary, and no distortion of signals arises, at carrier system terminals when a circuit comprises two or more carrier links.

## SYSTEMS RECOMMENDED FOR OUT-BAND SIGNALLING

When Administrations wish to make mutual agreements to use out-band signalling systems, the CCITT considers it desirable, from the transmission viewpoint, for them to use one of the types of signalling systems (outside the speech band) defined in the following annexes:

Annex A: Normal carrier systems with 12 channels per group;

Annex B : Carrier systems with 8 channels per group.

ANNEX A

(to Recommendation Q.21)

### Out-band signalling systems for

### carrier systems with 12 channels per group

(The signal levels are quoted in terms of absolute power level at a zero relative level point in dBm0.)

A.1 *Type I* (discontinuous signals)

Frequency: virtual carrier (zero frequency).

Level: high,

for example —3 dBm0.

A.2 *Type II*

1) (discontinuous signals)

Frequency: 3825 Hz.

Level: high,

for example —5 dBm0.

2) (semi-continuous signals)

Frequency: 3825 Hz

Level: low,

for example —20 dBm0.

A.3 The *Type I* signalling system is compatible with only those group and supergroup reference pilots having a displacement from the virtual carrier frequency (zero frequency) of 140 Hz.

*Types II-1 and II-2* are compatible with only those group and supergroup reference pilots having a displacement from the virtual carrier frequency (zero frequency) of 80 Hz.

ANNEX B

(to Recommendation Q.21)

### Out-band signalling systems for

### carrier systems with 8 channels per group

[The signal levels are quoted in terms of absolute power level (reference 1 mW) at a zero relative level point.]

Frequency: 4.3 kHz ± 10 Hz.

Level:

— discontinuous signals: —6 dBm0;

— semi-continuous signals: value between —20 dBm0 and —17.4 dBm0.

**Recommendation Q.22**

## FREQUENCIES TO BE USED FOR IN-BAND SIGNALLING

To reduce the risk of signal imitation by speech currents, the frequencies for an in-band signalling system should be chosen from the frequencies in the band in which speech signal power is lowest, i.e. frequencies above 1500 Hz.

The desirability of this was confirmed by tests carried out in London, Paris and Zurich in 1946 and 1948 to choose the signalling frequencies of systems standardized by the CCITT. These tests led to the conclusion that, if relative freedom from false signals was to be obtained other than by undue increase in signal duration, frequencies of at least 2000 Hz would have to be used.

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

**Recommendation Q.23**

## TECHNICAL FEATURES OF PUSH-BUTTON TELEPHONE SETS

**1** The introduction of push-buttons on telephone sets may have an effect on the operation of international circuits:

a) owing to the greater dialling speed, the post-dialling may be longer, since national and international networks will only be gradually adapted to allow for this greater speed;

b) when pressing the buttons after an international call has been set up, the signalling frequencies for push-button sets may cause interference to foreign signalling systems on the connection. However, the subscriber can be warned of the possible disadvantages of touching the buttons in conditions different from those prescribed.

**2** There can be no doubt that, owing to the high dialling speed which can be obtained with push-button sets, their use is bound to spread widely and rapidly and it is desirable for the signalling methods for such sets to be internationally standardized.

One factor in favour of such standardization is the advantage it offers for countries which have to import their equipments from various other countries. This argument, admittedly, applies to any type of telephone equipment.

Other advantages of standardization are:

— the possibility of using the push-button of such sets for signalling directly from one subscriber to another subscriber via a national and/or international connection;

— the standardized allocation of signalling frequencies for push-button sets facilitates the choice of signalling frequencies in the frequency band of a telephone circuit for any other use (data transmission, telephone signalling system, etc.) for which provision might have to be made. The risk of mutual interference among the signalling systems (see Recommendation Q.25) makes it necessary to have an orderly arrangement of the spectrum of frequencies used for signalling.

**3** The general use of push-button sets for purposes other than telephone dialling is envisaged by some Administrations. However, some Administrations observe that it would seem advisable to reserve such uses for a network of relatively limited extent; in their view the reliability of standards for data transmission should not make any demands on the push-button set system other than those required for the transmission of telephone numerical information to the local exchange, if the design of push-button sets is to remain within economical limits compatible with their widespread use.

However, the CCITT considered, at Mar del Plata in 1968 that, even if the transmission of data from a push-button telephone set is at present to be envisaged in international traffic on a limited scale only, it would nonetheless be wise not to rule out the possibility of such transmission of data on a general scale.

**4** In choosing a signalling system for push-button sets, Administrations may be guided by conditions which vary considerably from one country to another. Economic considerations may, for instance, lead them to prefer a direct current system which might be less expensive than a voice-frequency system. The numerical dialling information would then be transmitted only as far as the telephone exchange to which the subscriber is connected. There are no tones that could affect the connection after its establishment. Data would not be transmitted from the push-button sets unless a suitable converter were used in the exchange.

Standardization of a direct current system for signalling from push-button sets does not seem justified at the international level; it may depend on the conditions peculiar to the local networks of the country concerned.

**5** The signalling system for push-button sets recommended by the CCITT applies solely to voice-frequency signals.

A multifrequency code for such signalling is recommended in which the dialling signal is composed of two frequencies emitted simultaneously when a button is pressed. It is planned to have 10 decimal digits and 6 reserve signals, making 16 signals in all. The two frequencies composing each signal are taken from two mutually exclusive frequency groups of four frequencies each, a code known as the ‘‘2 (1/4) code’’.

**6** The low group frequencies of this 2 (1/4) code are:

697, 770, 852, 941 Hz.

The high group frequencies are:

1209, 1336, 1477 and 1633 Hz.

The allocation of frequencies to the various digits and symbols of a push-button set appears in Figure 1/Q.23.

**7** The frequency variation tolerances and the permissible intermodulation products are defined as follows:

7.1 each transmitted frequency must be within ± | .8% of the nominal frequency;

7.2 the total distortion products (resulting from harmonics or intermodulation) must be at least 20 dB below the fundamental frequencies.

**8** The CCITT determined, at Mar del Plata in 1968, that it was not practicable to specify a standardization of the levels for the frequencies transmitted when a push-button is pressed, as these level conditions depend essentially on national transmission plans which are not the same in all countries.

However, the sending level conditions must be such that on an international connection they do not exceed the values specified in Recommendation Q.16 (maximum permissible value for the absolute power level of a signalling pulse).

**Figure 1/Q.23 p.**

# MULTIFREQUENCY PUSH-BUTTON SIGNAL RECEPTION

## 1 Introduction

Characteristics of multifrequency push-button (MFPB) telephone sets using voice frequency signals are included in Recommendation Q.23. This Recommendation Q.24 is intended primarily for application in local exchanges for the reception of MFPB signals. Other MFPB signal receiving applications, such as transit exchanges, would need to take into account the effects of transmission impairments, such as signal clipping, that could be introduced in long distance telephone networks. Since technical factors, such as transmission loss, vary among national networks, varying national standards exist. Varying

standards may also exist, for example, to incorporate differences between local and transit exchange applications. This Recommendation is not intended to supersede existing national standards nor is it intended to imply that Administrations should modify those standards.

## 2 Technical parameters

### 2.1 *General*

The technical parameters identified herein are fundamental to the MFPB receiving function and reasons are given for the importance of each parameter. The parameters require operational values to be specified for compatibility with the MFPB sending equipment (Recommendation Q.23) and the network environment in which the receiving equipment must function. Annex A contains a Table showing values for some of these parameters that have been adopted by various Administrations and RPOAs. In addition to the fundamental parameters covered by this Recommendation, Administrations should consider whether other parameters need specification to account for operating conditions found in their networks.

### 2.2 *Signal frequencies*

Each signal consists of two frequencies taken from two mutually exclusive frequency groups (a high group and a low group) of four frequencies each, as specified in Recommendation Q.23. These frequencies and their allocation to form the various digits and symbols of the push-button signalling code are defined in Recommendation Q.23. The exchange shall provide a check for the simultaneous presence of one and only one frequency from the high group and one and only one from the low group.

### 2.3 *Frequency tolerances*

The exchange should respond to signals whose frequencies are within the tolerances for MFPB sending. Somewhat wider tolerances may be appropriate, for example to cater for transmission impairments encountered in subscriber cables or FDM transmission facilities. However, wider limits may increase susceptibility to noise and digit simulation by speech.

### 2.4 *Power levels*

The exchange should provide proper reception of signals whose power levels are determined by the amplitude of the sending equipment and loss that may be introduced by the subscriber cables or other network elements. The sending amplitude and transmission attenuation may be different for different frequencies. The reception characteristics may take advantage of a limitation, if specified, on the maximum difference in power level between the two received frequencies forming a valid signal to facilitate improved overall performance.

### 2.5 *Signal reception timing*

The exchange should recognize signals whose duration exceeds the minimum expected value from subscribers. To guard against false signal indications the exchange should not respond to signals whose duration is less than a specified maximum value.

Similarly, pause intervals greater than a specified minimum value should be recognized by the exchange. To minimize erroneous double-registration of a signal if reception is interrupted by a short break in transmission or by a noise pulse, interruptions shorter than a specified maximum value must not be recognized. The maximum rate at which signals can be received (signalling velocity) may be related to the above minimum values. All of these values may also be determined by subscriber feature requirements.

2.6 *Signal simulation by speech*

Because telephone set speech transmitters are normally connected in the circuit during the push-button dialling interval, it is necessary for the exchange to properly receive valid MFPB signals in the presence of voice or other disturbances. The nature of such disturbances may vary from one geographical area to another. The number of calls affected by signal simulation should not significantly degrade the overall telephone network performance experienced by subscribers.

Since actual immunity to digit simulation may be difficult to measure, a test environment using recorded speech, music, and other voice frequency sounds may be utilized to verify design performance.

2.7 *Interference by dial tone*

MFPB reception should not be adversely affected while dial tone is being applied. Characteristics of dial tone such as frequencies, power levels and spurious components are covered in Recommendation Q.35. These characteristics are specified to minimize the interference between the dial tone sending and the MFPB receiving functions. These functions are normally provided by closely related exchange equipment which must be designed to function properly over the entire range of signal characteristics and transmission impairments to be encountered.

2.8 *Interference by echos*

MFPB signal reception from extended subscriber lines having long 4-wire transmission sections must discriminate between a true signal condition and an echo condition which may persist for a number of milliseconds. Failure to provide such discrimination could result in signal reception errors, for example due to a reduction of the detected pause duration. Administrations having such extended subscriber lines with MFPB signalling should therefore specify the echo conditions under which the MFPB signalling function must operate.

2.9 *Noise immunity*

Noise sources such as power lines, electric railways and telecommunication circuits may induce electrical disturbances with various characteristics into MFPB signalling paths. These disturbances may cause MFPB signals to be missed, split (double signal registration) or cause signal simulation. The distortion products produced by the MFPB signalling source should also be included in the noise environment. A realistic noise environment specification and facilities for testing MFPB reception under the specified conditions, e.g., using recorded test tapes, are important to ensure that performance standards will be met under actual service conditions.

BLANC

ANNEX A
(to Recommendation Q.24)

**H.T. [T1.24]**

TABLE A-1/Q.24
{
**Values of multi-frequency push-button receiving parameters**
**adopted by various Administrations/RPOAs**
}

{

{

| | |
|---|---|
| same as left column | same as left column |
| same as left column | same as left column |

{

{

{

| | | | | | |
|---|---|---|---|---|---|
| Power level difference between frequencies } | Max. 5 dB | +4 dB to —8 dB | ub) | Max. 6 dB | Max. 10 dB | Max. 9 dB |
| Unable to convert table | | | | | |

**Table A-1/Q.24 [T1.24], p.**

### 4.4 Protection of ‘‘in-band’’ signalling systems against each other

## Recommendation Q.25

## SPLITTING ARRANGEMENTS AND SIGNAL RECOGNITION TIMES

## IN ‘‘IN-BAND’’ SIGNALLING SYSTEMS

### 1 General

In each ‘‘in-band’’ signalling system precautions should be taken so that, when the signalling in that system is taking place:

1.1 no interference in the voice-frequency range from outside the system can pass into the system (i.e. into the transmission path between the sending end and the receiving end of the voice-frequency signals), and

1.2 as far as possible, no signalling current used in the system can pass into other systems, connected in tandem.

### 2 Sending-end splitting arrangements

2.1 In order to satisfy the condition in § 1.1 above, care should be taken that the correct operation of the signal receiver at the other end of the circuit is not disturbed by:

— surges (transient currents) caused by the opening or closing of direct current circuits connected to the speech wires of the switching equipment, whether these surges precede or follow the sending of a signal;

— noise, speech currents, etc., coming from tandem switched circuits, preceding or during the sending of a signal.

2.2 For this reason the following arrangements have been made in the Signalling Systems No. 4 and No. 5 for the transmission of voice-frequency signals on the international circuit:

i) The exchange side of the circuit shall be disconnected 30 to 50 ms before a voice-frequency signal is sent over the circuit.

ii) The exchange side of the circuit will not be reconnected for 30 to 50 ms following the end of the sending of a voice-frequency signal over the circuit.

2.3 Arrangements of the same type are required on System R1 and on national ‘‘in-band’’ systems [see § 3.4.1 b) below].

### 3 Receiving-end splitting arrangements

#### 3.1 *General*

3.1.1 In order to satisfy the condition in § 1.2 above, the length of the part of a signal which passes into another system is limited by splitting the speech wires beyond the signal receiver when a signal is received and detected by this receiver.

The time during which the first part (sometimes called *spillover* ) of a received signal passes into another system, until the splitting becomes effective, is called ‘‘ splitting time

Too long a splitting time may result in interference to signalling on a tandem system depending on the signal recognition time on the tandem system.

Too short a splitting time may result in an increase in the number of false operations of the splitting device by speech currents (*signal imitation* ) and so impair speech transmission.

The splitting time must therefore be a compromise between the above two factors.

The splitting device also serves to limit the duration of signals on one path of the 4-wire circuit from returning over the other path by reflections at the termination; these reflections may give rise to faulty operation of signalling equipment on the other path.

3.1.2 The protection against mutual interference between in-band signalling systems in international service involves limitations of the length of any part of:

3.1.2.1 the *international* signal that may be able to pass:

a) from the international signalling system into a national signalling system (protection of the national system);

b) from one international signalling system into another international signalling system, when they are switched in tandem (protection of the international systems);

c) from one international circuit into another international circuit of the same system when they are switched in tandem in the case of link-by-link signalling.

3.1.2.2 the *national* | signal that may be able to pass:

a) from the national signalling system into an international signalling system (protection of the international system);

b) from one national signalling system into the national signalling system of another country via an international connection (protection of the national system).

### 3.2 *Protection of national and international systems against international systems*

Conditions in § 3.1.2.1 above are met because international signalling systems have a splitting device on each circuit. The splitting times of such systems are:

55 milliseconds for the compound signal element in System No. 4;

35 milliseconds for a signal in System No. 5;

20 milliseconds for a signal in System R1.

### 3.3 *Protection of the international system against national systems*

The condition in § 3.1.2.2 a) above is generally covered because:

— the values given in the specifications of the CCITT standard systems as the minimum recognition time of a line signal are

in general greater than the splitting times of national systems (see the tables giving the basic characteristics of national signalling systems in Supplement No. 3 at the end of this fascicle);

— the signalling frequencies used in the international systems are, in the majority of countries, different from those used in national systems.

It may be necessary, if the splitting time of a national signalling system is greater than the minimum signal recognition time of an international system and the signalling frequencies used in the national system and international system are the same or nearly the same, to insert a device at the international exchange which will prevent a part of the national signal from passing into the international circuit for longer than this recognition time.

### 3.4 *Interference between national signalling systems when they are interconnected via an international circuit*

3.4.1 To ensure protection of national signalling systems one against the other [protection defined under § 3.1.2.2 b) above], it has been recommended by the CCITT since 1954 that new national ‘‘in-band’’ signalling systems should comply with the following two clauses:

a) not more than 35 milliseconds of a national signal should be able to pass into another country;

b) the connection between an international circuit and a national circuit should be split on the national circuit at the international exchange 30 to 50 milliseconds before that exchange sends any signal over the national signalling system.

*Note* — The object of these two clauses is to avoid interference, especially in conditions that may exist on international automatic connections.

3.4.2 The requirement of § 3.4.1 a) permits the signalling system used in country A to have a minimum signal recognition time based on this value of 35 milliseconds. It will then be possible to ensure, without taking any other precautions at the incoming end of an international circuit, that no fraction of a signal coming from country B, and being of the same, or nearly the same, frequency as that used in country A, will be wrongly recognized as a signal in country A.

One method of meeting the requirement of § 3.4.1 a) is to adopt a splitting time of less than 35 milliseconds for the national systems.

Another method exists which does not involve such a limitation in the splitting times of national systems, and which might be preferred when the design of the national signalling system is such that a short splitting time is not normally justified for that system alone. This second method involves

the introduction, in the international exchange, of an arrangement for limiting the length of national signals which are liable to pass into the international circuit. Such an arrangement would be used only on circuits to those countries where there is a danger that interference might arise.

3.4.3 The requirement of § 3.4.1 b) avoids the false operation of the guard circuit of a signal receiver situated at the distant end of a national circuit.

### 4.5 Miscellaneous provisions

## Recommendation Q.26

## DIRECT ACCESS TO THE INTERNATIONAL NETWORK

## FROM THE NATIONAL NETWORK

The choice of the method of access to an outgoing international exchange from the national network is a purely national matter. Nevertheless, if an international connection is set up by automatic switching from an

exchange other than the international exchange which is the outgoing point of the international circuit used, arrangements should be made in the national network to transmit over the international circuit at least the signals required to ensure the satisfactory setting-up, control and clearing-down of the international connection.

In addition, where a group of national circuits used in the above manner carries both semi-automatic and automatic traffic, means should be provided for distinguishing between these two classes of traffic for the purposes of international accounting [1].

### Reference

[1] CCITT Recommendation *Basic technical problems concerning the measurement and recording of call durations* , Vol. II, Rec. E.260, § 2.

## Recommendation Q.27

## TRANSMISSION OF THE ANSWER SIGNAL

It is essential for the answer signal to be transmitted with a minimum of interference to the transmission of speech currents, because the called subscriber may already be announcing his presence at this stage of the call.

On a connection which has been set up, the answer signal generally entails, at a certain number of points:

a) repetitions and conversions, which delay transmission; and

b) splitting of the speech path, where in-band signalling is used.

It is therefore desirable to minimize the delays and the duration of the interruption of the speech path. Minimization of the latter can be achieved by:

— short send line splitting;

— short duration of the signal; and

— fast termination of the sending and receiving splits on cessation of the signal.

**Recommendation Q.28**

## DETERMINATION OF THE MOMENT OF THE CALLED SUBSCRIBER'S ANSWER IN THE AUTOMATIC SERVICE

**1** Arrangements should be made in the national signalling system of the incoming country to determine (in the outgoing international exchange) the moment when the called subscriber replies; this information is necessary in the international service for the purposes of:

— charging the calling subscriber [1];

— measuring the call duration [2].

**2** Where subscribers in an outgoing country have direct access to an operator's position (in a manual exchange, for instance) in a public exchange of an incoming country, arrangements should be made in the national network of the incoming country to ensure that — in the outgoing country — the calling subscriber is charged, and the call duration measured, only from the moment when the called subscriber replies. This means that an answer signal is not sent when the operator in a public exchange of the incoming country replies. These provisions are set out in detail for CCITT standardized systems (see Recommendation Q.102).

**References**


[1] CCITT Recommendation *Chargeable duration of calls* , Vol. II, Rec. E.230.

[2] CCITT Recommendation *Basic technical problems concerning the measurement and recording of call durations* , Vol. II, Rec. E.260.


**Recommendation Q.29**

## CAUSES OF NOISE AND WAYS OF REDUCING NOISE IN TELEPHONE EXCHANGES

Circuit noise may be classified as follows:

1) power supply noise,

2) noise generated in the speech path circuit,

3) noise induced in the speech path circuit.

### 1 Power supply noise

#### 1.1 *Power sources*

The interference resulting from the harmonics, ripple and current fluctuation of machines, rectifiers and batteries.

This noise may be reduced by d.c. generators with low harmonics and good regulation and rectifiers with good regulation, effective filters, and batteries with large capacity (i.e. with low internal impedance).

1.2 *Supply leads*

The interference in the speech circuits of an exchange due to power supply equipment originates mainly in the common impedances of the supply paths of speech and switching circuits, and is caused mainly by the sudden fluctuation of the current resulting from the sudden operation and release of the different relays, magnets and contacts.

These common impedances may be reduced by:

a) the use of common power supply leads of sufficiently low resistance, the use of large capacitors fitted at apparatus ends of supply leads with minimum impedances, e.g. minimum distance between bus bars, or coaxial feeders. Another method employs close-spaced cables with alternate polarity;

b) the use of a common battery with separate power supply leads for speech and switching circuits. Better results may be obtained at an increased cost by independent batteries adequately separated;

c) the arrangement of the cells of the battery in a U formation.

### 1.3 *Earth returns*

Independent earth returns should be used for signalling-frequency supply circuits.

## 2 Noise generated in the speech circuit

### 2.1 *Contact noise caused by vibration*

This kind of noise is caused by contact resistance variations of the various commutator, switch and relay contacts due to mechanical vibration.

This contact noise may be reduced by:

a) the use of damping devices to reduce the generation of vibration caused in particular by relay sets, mechanical and electromagnetic clutches;

b) the use of multiple brushes, spring or resilient mountings to reduce the transmission of vibration;

c) a suitable choice of contact materials;

d) the use of the best contact shape and of twin contacts;

e) maintaining atmospheric conditions at an appropriate relative humidity and the use of air filters; use of dust covers on equipment, arranging design of columns, window sills, radiators and floor to avoid harbouring dust;

f ) careful maintenance cleaning and lubrication in accordance with specifications.

### 2.2 *Frying noise*

In speech circuits some contact materials are liable to cause frying noise.

This noise may be reduced by the use of suitable contact materials and by keeping an appropriate relative humidity.

### 2.3 *Contact noise caused by wetting currents*

Speech circuits without d.c. currents are liable to fading due to contact resistance fluctuations. Fading may be reduced by wetting. However, wetting currents may introduce frying noise on the lines.

### 2.4 *Charge and discharge clicks*

Clicks may frequently be caused by the charging or discharging of capacities (cable capacity) by switches when rotating over occupied and non-occupied terminals.

Objectionable clicks are also likely to result from sudden battery reversals, dialling and other abrupt changes in the current flowing in the speech circuits.

These effects may be reduced:

a) by disconnecting the speech circuits from the brushes during the hunting period of the switch;

b) by the use of twisted pairs, by limiting the length of cabling and also by locating relays as close as possible to the selectors they control.

### 2.5 *Unsound contacts*

Objectionable noise may be due to unsound contacts on distribution frames, particularly when work is in progress such as adding or changing jumpers, etc. Such unsound contacts may be due to ‘‘dry’’ contacts inadequately soldered, poorly wrapped joints, or to the use of distribution frame equipment having inadequate contact pressure. It is suspected that this type of trouble is responsible for most of the ‘‘hits’’ and ‘‘misses’’ and usually for an increase in noise.

### 2.6 *Tapping losses*

When lines are tapped for service interception, observation, etc., the tapping circuit should be designed to give the minimum of unbalance to earth and the transmission loss introduced should be a minimum. Semi- permanent connections should be used in preference to base-metal sliding connections at the tapping point.

### 2.7 *Reduction of the number of switching contacts*

Circuits should be designed so that at each switching stage there is a minimum number of contacts in the speech circuit in order to reduce the risk of microphonic noise from ‘‘dry’’ contacts.

## 3 Noise induced in the speech circuit

### 3.1 *Noise induced in the speech circuit may be due to:*

a) speech crosstalk;

b) signalling frequency crosstalk;

c) induction from tone supplies;

d) direct current pulses;

e) clicks caused by abrupt changes in inductive and capacitive circuits.

Clicks may be reduced at the source by the use of spark quench devices or other means to reduce the steepness of the interfering wave-front concerned. In addition, noise may be reduced by balancing, by using twisted pairs and/or by screening.

### 3.2 *Noises due to unbalanced transmission bridge circuits*

A well-balanced circuit is necessary for the transmission bridge to avoid noise interference. This can be achieved by:

a) the use of balanced components;

b) the separation of components used for speech from those used for control and switching;

c) the separation of individual transmission bridges by screening or spacing;

d) the addition of balancing components, e.g. balancing transformers of retardation coils;

e) taking the precautions listed at the end of § 3.1 above.

### 3.3 *Low-level speech circuits*

Low-level electronic speech circuits are particularly susceptible to noise induction and should therefore be screened.

### 3.4 *Longitudinal interference*

Such noise may be induced into the speech circuit from the line by power distribution systems and traction circuits or by earth potential differences.

These may be reduced by balancing the line or by the addition of transformers.

*Note* — Interference which is sufficiently severe to cause unwanted operation of relays, etc., may be overcome by the use of loop circuits which should also reduce noise.

**Recommendation Q.30**

## IMPROVING THE RELIABILITY OF CONTACTS IN SPEECH CIRCUITS

The following methods can be used for improving the reliability of contacts in speech circuits:

a) use of precious metals such as platinum, palladium, gold, silver, or alloys of these metals. If, for one reason or another, it is not desired to ‘‘wet’’ the contacts, or if enough contact pressure cannot be provided, it is preferable to use the metals or alloys mentioned above, with the exception of pure silver;

b) use of high contact pressure;

c) double contacts;

d) lubrication (with suitable oils) of certain non-precious metal contacts in the case of sliding contacts;

e) direct current ‘‘wetting’’ of contacts, care being taken to avoid the introduction of noise due to transients when the contacts are made or broken;

f ) air filtration or other protective measures to avoid dust;

g) the maintenance of suitable humidity;

h) the use of protective covers;

i) protection against fumes, vapours and gases;

j ) avoidance of the use, near contacts, of materials likely to be detrimentral to the contacts.

When voice-frequency signals are sent over a transmission path, as it is not possible to use direct current wetting for the voice-frequency signal transmitting contacts due to the surges which occur on closing and opening the contact, it is preferable to use static modulators with rectifier elements.

**Recommendation Q.31**

## NOISE IN A NATIONAL 4-WIRE AUTOMATIC EXCHANGE

It is desirable that the requirements concerning noise conditions for a national 4-wire automatic exchange be the same as for an international exchange (see Recommendation Q.45, § 5).

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