INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.802

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

DIGITAL NETWORKS

INTERWORKING BETWEEN NETWORKS BASED ON DIFFERENT DIGITAL HIERARCHIES AND SPEECH ENCODING LAWS

ITU-T Recommendation G.802

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.802 was published in Fascicle III.5 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

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

Recommendation G.802

INTERWORKING BETWEEN NETWORKS BASED ON DIFFERENT DIGITAL HIERARCHIES AND SPEECH ENCODING LAWS

(former Recommendations G.722 of Volume III of the Yellow Book, further amended)

1 Introduction

This Recommendation deals with the following aspects of interworking between networks for transport of 64 kbit/s digital information:

- encoding law and conversion rule for interworking between networks using the different encoding laws based on Recommendations G.711, G.721 and G.722.;
- interworking hierarchy between networks which incorporate the different digital hierarchies based on Recommendation G.702;
- interworking arrangements between networks incorporating the different hierarchies and encoding laws; and,
- interconnection by plesiochronous operation between networks which each has an independent synchronization.

This Recommendation is applicable also to ISDNs for transport of B channels specified in Recommendation I.412.

Note - The future specifications on channels and their bit rates to support ISDN broadband services for customer-to-customer applications may require additional interworking arrangement specifications other than those specified below.

2 Terms and definitions

The terms used in this Recommendation and not defined below are described in Recommendations G.701 or I.112.

2.1 z-operation

Conversion of the μ-law character signal "00000000" (all-zero octet) into the μ-law character signal "00000010", where "l " is the bit numbered seven in the octet (see Recommendation G.711).

Note - Bit number indicates the chronological order of transmission of bits in serial processing.

2.2 1.5/2 Mbit/s multiplex system conversion (1.5/2 Mbit/s MSC)

A function which embodies the following properties:

1) termination of a digital link operating at a digital hierarchical level of 1544 kbit/s;
2) termination of a digital link operating at a digital hierarchical level of 2048 kbit/s; and,
3) rearrangement of 64 kbit/s channels between 1544 kbit/s and 2048 kbit/s digital terminations.

Note - The hierarchical levels and the frame structures are specified in Recommendations G.702 and G.704, respectively.

2.3 pulse density requirement (PDR) at 1544 kbit/s

The minimum requirement for an entire 1544 kbit/s digital signal is that there should be no more than 15 binary

"0"s between successive binary "1"s and that there should be an average binary "1"s density of at least one in every eight bits. This requirement is due to the design of a number of existing systems (see Recommendation G.703.)

Moreover, the requirement for an octet-structured source in a 1544 kbit/s digital link is that at least one binary "1" should be contained in any octet.

3 Unrestricted 64 kbit/s transfer capability of a digital link

Newly introduced digital transmission systems should have the capability to provide bit sequence independence for 64 kbit/s digital links. This capability should be activated as soon as unrestricted 64 kbit/s transfer capability can be practically realized.

During a transition period, however, 56 kbit/s bit sequence independent transfer capability may be provided by bilateral agreement. (Important constraints on the data formats transmitted by source data terminal equipment are given in Annex 1 to this Recommendation.)

4 Encoding law conversion between A-law and μ-law

4.1 *Encoding law on an international digital link*

International digital links between countries which have adopted different PCM encoding laws (A-law or μ-law) should carry signals encoded in accordance with the A-law specified in Recommendation G.711.

Where both countries have adopted the same law, that law should be used on digital links between them.

4.2 *Conversion rule*

A-law/μ-law conversion necessary between countries which have adopted different PCM encoding laws will be performed according to Recommendation G.711 by the μ-law country. The conversion includes the even-bit inversion of the A-law character signal.

Note - Location of the conversion function in a μ-law country is a national matter depending upon the structure of domestic digital networks, and is left to the discretion of the Administrations in the μ-law country.

4.3 *Control of conversion function*

In switched public network applications enabling/disabling of the conversion function should be under control of the international switching system, and will be carried out on a call-by-call or during-a-call basis depending upon the service category requested by the signalling protocol.

It should also be possible to enable/disable this conversion function manually and/or via an operator terminal on a per-channel or semi-permanent basis. This capability would be necessary for configuring leased line circuits not passing through the international switching system, or if the international switching system were not capable of controlling this function.

Note - Control of conversion function in ISDN environment is specified in I.300-series and I.500-series Recommendations.

5 Interworking hierarchy

For international interworking between networks using different digital hierarchies specified in

Recommendation G.702, the following interworking hierarchy should be employed:

2048 - 6312 - 44 736 - 139 264 kbit/s.

For interworking between networks with different digital hierarchies but with 1544 kbit/s primary level, however, levels other than those specified for the above interworking hierarchy may be employed (e.g. 1544 kbit/s).

Note 1 - National networks with a 1544 kbit/s primary level may offer transit of international traffic of 6312 kbit/s composed of three 2048 kbit/s signals or of 44 736 kbit/s containing twenty-one 2048 kbit/s signals. These networks will provide the property of bit sequence independence at 6312 and 44 736 kbit/s and hence at 2048 kbit/s.

Note 2 - The frame structures for 2048-6312 kbit/s, 6312-44 736 kbit/s and 44 736-139 264 kbit/s multiplexing stages are specified in Recommendations G.747, G.752 and G.755, respectively.

6 Interworking arrangements

Based on the general specifications described in the previous Sections, establishment of an international digital interconnection between networks using the different digital hierarchies and speech encoding laws should conform to the interworking arrangements specified in Table 1/G.802.

7 Transport of a 1544 kbit/s signal within a G.704-structured 2048 kbit/s signal

For international leased line applications, the transmission of 1544 kbit/s signals may be considered using a special mapping into point-to-point 2048 kbit/s signals. Annex B to this Recommendation specifies the method for this mapping.

Note - The possible development of specific mappings of 8448 or 34 368 kbit/s signals into 44 736 kbit/s signals is not precluded.

8 Synchronization of an international digital link

8.1 *Links not synchronized to the national networks*

Where independently synchronized national networks are interconnected via an international digital link, the timing of which is independent of the national networks, the link should be operated in a plesiochronous mode with the accuracy specified in Recommendation G.811.

8.2 *Links synchronized to the network in the transmitting country*

Where independently synchronized national networks are interconnected via an international digital link, the timing of which is synchronized to the national network in the transmitting country, the plesiochronous operation will be performed in the receiving country.

TABLE 1/G.802

Interworking arrangements

Type of information	Voice or voiceband data						Non-voice information		Signalling information (Note 1)	
Encoding law at IRP (Note 2) / Function	PCM G.711		ADPCM G.721		SB-ADPCM G.722		.....		.....	
Network (Note 3)	A	B	A	B	A	B	A	B	A	B
1.5/2 Mbit/s MSC	—	X	—	X	—	X	—	X	—	X
A/μ and μ/A conversion	—	X	—	—	—	—	—	—	—	—
Z-operation	—	X (Note 4)	—	X (Notes 4 and 5)	—	X (Notes 4 and 6)	—	X (Note 4)	—	—
Transcoding	—	—	X	X	—	—	—	—	—	—

— Not allowed

X May be applied

Note 1 - Signalling information is transferred on unrestricted channels between International Switching Centers (ISCs).

Note 2 - IRP = Interworking reference point between Network A and Network B.

Note 3 - "A" is a network within the country incorporating the A-law and 2048 kbit/s-based digital hierarchy. "B" is a network within the country incorporating the μ-law and 1544 kbit/s-based digital hierarchy.

Note 4 - Z-operation in the μ-law country will be applied when the link in that country contains transmission systems that have to meet PDR; in this case unrestricted 64 kbit/s transfer capability cannot be provided due to PDR and the bit sequence independent transfer capability is restricted to 56 kbit/s.

Note 5 - 32 kbit/s digital signals, which are voice or voiceband data signals encoded in accordance with the ADPCM algorithm specified in Recommendation G.721, do not contain a "0000" code word. (See Recommendation G.721.) This implies that even when PDR exists in the μ-law country, these signals will not be affected by the z-operation and will be transferred transparently.

Note 6 - 64 kbit/s audio signals, where the audio signals having the bandwidth of 50 to 7000 Hz are encoded at 64, 56 or 48 kbit/s in accordance with the coding algorithm specified in Recommendation G.722, do not contain an all-zero octet. (See Recommendation G.722.) This implies that even when PDR exists in the μ-law country, these signals will not be affected by the z-operation and will be transferred transparently.

ANNEX A

(to Recommendation G.802)

Impact on terminal equipment designed to work with 56 kbit/s bit sequence independent transfer capability

During a transition period 56 kbit/s bit sequence independent transfer capability may be provided by bilateral agreement. In this case a 56 kbit/s bit sequence independent transfer capability requires that the source data terminal equipment (DTE) fix the eighth bit of each octet to binary "1". This must be done on both ends of the digital connection even if one portion of the connection has unrestricted 64 kbit/s transfer capability. Failure to keep the eighth bit fixed to binary "1" will cause any all-zero octet to be converted to "00000010" by z-operation in the μ-law country.

ANNEX B

(to Recommendation G.802)

Mapping method of a 1544 kbit/s signal into a G.704-structured 2048 kbit/s signal

The following is a means of accommodating a bit synchronous 1544 kbit/s signal, which may be unstructured or structured, within a G.704-structured 2048 kbit/s frame, for the purpose of providing leased line applications at 1544 kbit/s only. The 1544 kbit/s signal is transmitted transparently without regard to its frame structure within the 2048 kbit/s signal.

The 193 bits of an arbitrary 125 μs period of the 1544 kbit/s signal should be accommodated within a G.704-structured 2048 kbit/s frame as follows:

TS	0:	Frame alignment signal according to Recommendation G.704
TS	1-15	193 contiguous bits of the 1544 kbit/s signal
TS	17-25	
Bit	1 in TS 26	
TS	16, 27-31:	Reserved for possible accommodation of additional information at up to 384 kbit/s (Note 2)

Note 1 - In cases where only the 1544 kbit/s signal is to be transported, the timing of the 1544 kbit/s (or 2048 kbit/s) outgoing signal should be derived from the 2048 kbit/s (or 1544 kbit/s) incoming signal for each direction of transmission.

Note 2 - In some cases, e.g. where information is transported by the reserved time-slots, the timing of the outgoing signal should be traceable to the national reference clock conforming to Recommendation G.811. This will require the use of 125 μs slip buffers.

Note 3 - The maximum capacity available to end-users for transparent transport of their information is 1536 kbit/s and not 1544 kbit/s. Depending on the national regulations some network operators may offer the user of part of the 8 kbit/s overhead associated with a 1544 kbit/s signal for performance monitoring and its reporting.