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INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

INTERNETWORK INTERFACES

SERVICE INTERWORKING

ITU-T Recommendation I.501

(Previously “CCITT Recommendation”)

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation I.501 was prepared by the ITU-T Study Group XVIII (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

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

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Recommendation I.501

SERVICE INTERWORKING

(Helsinki, 1993)

1 General

In the provision of services in an ISDN, there will exist situations where a service will require interworking with one or more other services. The intent of this Recommendation is to develop the general principles of service interworking and identify the key interworking requirements needed to support service interworking in ISDNs, between ISDNs, and between ISDNs and other networks.

Specific ISDN service descriptions, as viewed from a user perspective, are provided in the I.200-Series Recommendations. Network interworking is provided in the I.500-Series Recommendations.

2 Definitions

teleservice interworking: Refers to the functions and requirements supporting the communication of terminals belonging to different ISDN teleservices (e.g. ISDN teletex to ISDN telefax). Such interworking will involve the use of communication-dependent interworking functions as defined in Recommendation I.510. Teleservice interworking can be supported by interworking functions provided by the network, by a service provider, and/or by terminals.

bearer service interworking: Refers to the funnctions and requirements supporting the communication of terminals operating over different ISDN bearer services within an ISDN.

ISDN internal interworking: Refers to the functions and requirements for interworking between different connection elements within an ISDN, for example to support the communication of terminals belonging to one and the same teleservice but supported by different low layer capabilities.

network interworking: Refers to the functions and requirements supporting the interworking of networks with different low layer capabilities in order to support the interworking of services across the network boundary, for example, to support 3.1 kHz audio transfer.

Teleservices interworking and bearer services interworking may also include the support of supplementary services as appropriate.

These types of interworking are not mutually exclusive. In certain scenarios, more than one type of interworking may take place; for example, both teleservice interworking and network interworking may occur in the case of ISDN facsimile group 4 to PSTN facsimile group 3 interworking. It is also-noted that the functionality to support bearer services interworking and ISDN internal interworking may be the same in most ISDNs (see Tables 1 and 2).

TABLE 1/I.501

Interworking aspeects of teleservices

Communication between terminals belonging to	Supported by low layer capabilities		Technical consequences for interworking	Characteri-zation of interworking
	Same	Different		
1. Different ISDN teleservices	x		Service provider or terminal provided high layer IWFs	Teleservice interworking (Note)
		x	Service provider or terminal provided high layer IWFs and ISDN internal interworking	
2. An ISDN teleservice and a teleservice offered by a dedicated network (e.g ISDN facsimile group 4 to facsimile group 3 offered by a PSTN)		x	Network interworking; additionally, service provider or terminal provided IWFs may or may not be required depending on service category	Teleservice interworking and network interworking
3. One and the same ISDN teleservice but supported by different ISDN bearer capabilities (e.g ISDN teletex circuit mode to ISDN teletex packet mode)		x	ISDN internal interworking	ISDN internal interworking

IWF Interworking function

NOTE – Teleservice interworking may include the support of supplementary services as appropriate.

TABLE 2/I.501

Interworking aspects of bearer services

Communication between terminals belonging to	Technical consequences for interworking	Characterization of interworking
1. Different ISDN bearer services (e.g. circuit mode data on a 64 kbit/s unrestricted bearer to packet mode data on a virtual circuit bearer)	ISDN internal interworking	Bearer service interworking (Notes 1, 3)
2. An ISDN bearer service and a network service offered by a dedicated network (e.g. PSPDN)	Network interworking; additionally network or terminal provided IWFs may or may not be required depending on service category (see Figure1/I.515)	Bearer/network service interworking (Note 2)

NOTES

1 Clarification may be required on the commonalities and/or differences between bearer service interworking and ISDN internal interworking

2 Assumes network interworking.

3 Bearer service interworking may include the support of supplementary services as appropriate.

3 Terminal functionality for service interworking

3.1 ISDN speech terminals

An ISDN speech terminal should:

a) be capable of responding to an incoming call offering for bearer capability (BC)[1] equal to speech;

b) generate an outgoing call request with bearer capability set to speech;

c) be capable of responding to an incoming call offering for bearer capability equal to 3.1 kHz audio when such call offering is accompanied by a call progress indicator that interworking with the PSTN has been encountered.

3.2 ISDN 3.1 kHz audio terminals

An ISDN terminal that uses the 3.1 kHz Audio bearer service should:

a) be capable of responding to an incoming call offering for bearer capability equal to 3.1 kHz audio;

b) generate an outgoing call request with bearer capability set to 3.1 kHz audio;

c) be capable of responding to an incoming call offering for bearer capability equal to 3.1 kHz audio when such call offering is accompanied by a call progress indicator that interworking with the PSTN has been encountered.

3.3 ISDN terminals that use the bearer capability selection option

3.3.1 ISDN terminal characteristics

ISDN terminals that intend to use the bearer capability selection option[2] of the Multi-Use bearer service (e.g. appropriately implemented 7 kHz audio terminals, videophones, group 4/group 3 facsimile machines, etc.) should have the capabilities to:

a) Generate an outgoing call request with the following combinations of bearer capabilities: speech followed by UDI-TA[3], or 3.1 kHz audio followed by UDI-TA.

The speech/UDI-TA combination indicates to the network that interworking with the PSTN and ISDN speech terminals is allowed. If the CONNECT message from the destination contains a UDITA BC, then the terminal shall operate in a mode using a 64 kbit/s unrestricted connection. If the CONNECT message received from the destination contains a speech BC, or no BC, then the terminal shall operate in the G.711 mode.

The 3.1 kHz Audio/UDI-TA combination indicates that interworking with the PSTN and ISDN 3.1 kHz audio terminals is allowed. If the CONNECT message from the destination contains a UDI-TA BC, then the terminal shall operate in a mode using a 64 kbit/s unrestricted connection. If the CONNECT message received from the destination contains a 3.1 kHz audio BC, or no BC, then the terminal shall operate in the G.711 mode. As an example, this BC combination would be used by group 4/group 3 facsimile machines that wish to avail themselves of the automatic fallback mechanism.

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1) BC refers to the bearer capability information element defined in Recommendation Q.931.

2) The bearer capability selection option allows a calling terminal Lo encode two bearer capabilities in a setup message, such that the alternative bearer capability is automatically invoked in case the preferred bearer capability is unavailable or if interworking (e.g. to the PSTN) is encountered (Recommendation Q.931.). The term 'fallback' is used hereafter Lo refer to the automatic invocation of the alternative bearer capability.

NOTE – If a single bearer capability is encoded in the call request, this indicates that fallback is neither desired nor allowed.

3) UDI-TA: Unrestricted digital information, with tones and announcements (Recommendation Q.931).

b) Respond to an incoming call request containing the Speech/UDI-TA or 3.1 kHz Audio/UDI-TA BC combination by including the UDI-TA BC in the CONNECT message when answering the call (if the terminal is available) and operate in a mode using the 64 kbit/s unrestricted connection. If the terminal's UDI-TA capability is unavailable for some reason, then the terminal may respond to the alternative bearer capability and include it in the CONNECT message.

In addition, terminals that intend to use the Multi-use bearer service for inter-regional communication[4)] should have the capability to transmit and receive both A-law and μ-law encoded PCM signals according to Recommendation G.711 (selected through prior knowledge or in-band detection) for speech or 3.1 kHz audio information transfer.

3.3.2 Customer Access Signalling

To invoke this service, a SETUP message is sent which has 2 BCs in ascending order of desirability if fallback is allowed, but only the desired BC is used for no fallback. This is summarised in the Table 3.

TABLE 3/I.501

SETUP message for service invocation

		Bearer capability 1		Bearer capability 2	
		Octet 3	Octet 5	Octet 3	Octet 5
With fallback	7 kHz	Speech (Note 1)	Rec. G.711	UDI-TA (Note 3)	H.221/H.242/H.230 (Note 4)
	Data/facsimile	3,1 kHz Audio (Note 1)	Rec. G.711	UDI-TA (Note 3)	[e.g. V.110] (Note 2)
No fallback	7 kHz	UDI-TA (Note 3)	H.221/H.242/H.230 (Note 4)		
	Data/facsimile	UDI-TA (Note 3)	[e.g. V.110] (Note 2)		

NOTES

1 The difference between the speech and 3.1 kHz audio bearers is that the former may be subject to coding algorithms which will not support the transmission of voiceband data; also, echo control devices on speech bearers may not be capable of being disabled. The 3.1 kHz audio bearer is specifically intended for voiceband data, but still requires echo control.

2 Octet 5 may be absent.

3 The codepoint label *UDI- TA* signifies that the "bearer capability" requested by the user and the "connection type" provided by the network include the same attributes as those requested or provided for 64 kbit/s unrestricted digital. The difference is that tones and announcements (encoded to Recommendation G.711) are provided for the Multi-use bearer service a-nd are not provided for 64 kbit/s unrestricted digital service. Although both 7 kHz and data/facsimile could work (in thecase of no fallback) with the use of 64 kbit/s unrestricted digital information (UDI) BC, use of the UDI-TA BC would provide the benefit to users of tones and announcements. Tones and announcements are not incompatible with most modems and facsimile machines, and are in fact desirable for most users.

4 The codepoint G.722/G.725 (Rec. Q.931 *Blue Book*) has been relabeled "H.221/H.242/H.230". This new label is more appropriate, since the Multi-Use bearer is suitable for videotelephony, which has similar requirements to 7 kHz.

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4) Inter-regional communication refers Lo calls between G.711 A-law and μ-law coding regions.

4 Interworking requirements supporting service interworking

4.1 Interworking of speech and 3.1 kHz audio services

ISDNs will recognize and accept service requests for both speech and 3.1 kHz audio bearer capabilities. The ISDN will handle and route the service request according to the bearer capability indicated in the call setup message.

However, if an ISDN (say ISDN A) decides to support only one of these bearer services, no interworking functions need to be provided by other ISDNs for calls to/from ISDN A because other ISDNs support both speech and 3.1 kHz audio services.

For calls originating from a PSTN, or which have encountered interworking with the PSTN, the interworking functions at the ISDN/PSTN interworking point will identify call requests to an ISDN as 3.1 kHz audio calls and accompany such call request with a call progress indicator. ISDN speech or 3.1 kHz audio calls will be allowed to interwork to the PSTN. See Recommendation I.530 for further information.

4.2 Interworking options for Multi-use bearer service

The Multi-use bearer service provides the option for an ISDN to support interworking with the PSTN and with ISDN speech and 3.1 kHz audio terminals. Terminals that intend to use the Multi-use bearer service should indicate the type of interworking desired (via the bearer capability selection option) or interworking not allowed (by using a single bearer capability) on a per-call basis as described in 3.3.

If interworking is not allowed, the ISDN should process the call like a 64 kbit/s unrestricted digital call, providing tones and announcements[5)] as appropriate. Calls with interworking not allowed shall be blocked upon encountering PSTN interworking or upon arriving at ISDN interfaces for which the Multi-use bearer service is not subscribed to, and an appropriate cause indication shall be returned by the network to the calling user.

4.3 Interworking of group 4 and group 3 facsimile terminals

It may be required for the group 4 facsimile terminals to interwork with the group 3 facsimile terminals in ISDN and PSTN. This function may be performed using the fallback function from group 4 facsimile to group 3 facsimile at the calling terminal. The action will be taken following an unsuccessful attempt with incompatible indications.

The functions required to support communication of Group 4 and Group 3 facsimile terminals using terminal-based interworking are as follows:

1) Network

   When interworking with the PSTN is encountered, the network should release the call with an appropriate cause indication.

2) Called terminal

   When the called terminal detects the terminal incompatibility and expects that the interworking function will be initiated by the calling terminal, the called terminal should release the call with an appropriate cause indication.

3) Calling terminal

   When the calling group 4 terminal receives the incompatible indications and supports the interworking function to group 3, the calling terminal can initiate a new call attempt in group 3 mode.

Alternatively, the Multi-Use bearer service can be used; for this application, the calling terminal would use the 3.1 kHz Audio/UDI-TA BC combination in the call request, and automatic fallback to 3.1 kHz Audio would be provided (i.e. a second call attempt will not be required if group 4 capability is unavailable).

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5) The inclusion of A/μ-law conversion is required in the call setup phase to support tones and announcements in an understandable manner whether or not interworking is allowed.

5 Network interworking requirements supporting the bearer capability selection

If the bearer capability selection option is used with a Multi-use bearer service call request, and interworking with the PSTN and ISDN speech or 3.1 kHz audio terminals is allowed, an ISDN should:

a) Route the call on 64 kbit/s unrestricted digital connections where signal processing functions required for Speech or 3.1 kHz audio connections can be enabled if fallback occurs. These functions include echo control on long distance connections and A/μ-law conversion on international connections crossing A/μ-law boundaries. Tones and announcements should be provided as appropriate.

b) If fallback occurs, the network should enable echo control and A/μ-law conversion, if they are required.

NOTE – Since networks will not have this capability in the near future, it would be acceptable for the basic bearer service operation (i.e. no supplementary services) to enable only the echo control on the called side.

Echo control on the calling side and A/μ–law conversion are required to ease supplementary services operation (see Appendix 1).

c) Allow the call to interwork with the PSTN, progress the call as a speech or 3.1 kHz audio call, and send to the calling user the interworking indication that would have been sent-if a speech or 3.1 kHz audio call interworks with the PSTN.

d) Offer the call to the called terminal on an ISDN with the same combination of BCs, and accept a BC in the CONNECT message when the called terminal answers. A BC in the CONNECT message would indicate the BC selected by the called terminal. If the called terminal answers without selecting a BC, the network would assume that the call is answered on the first BC (speech or 3.1 kHz audio) and provide interworking.

e) The network should indicate the selected BC to the calling terminal in the CONNECT message.

Detailed network interworking requirements for ISDN-ISDN and ISDN-PSTN interworking for Multi-use bearer service are described in Recommendations I.520 and I.530 respectively.

Appendix I

(to Recommendation I.501)

A/μ law conversion and supplementary services

(This appendix does not form an integral parte of this Recommendation)

I.1 7 kHz audio terminals

Recommendations G.725 and H.242 recommend that, for inter-regional communication, 7 kHz audio terminals should be able to encode speech to G.711 to both A -and μ-laws. This will avoid the need for provision of network-based A/μ-law conversion in μ-law countries when 7 kHz terminals operate in normal PCM mode (mode 0 in G.725), since any kind of in-band conversion would affect the in-band H.221 framing required to change to 7 kHz operation (Recommendation G.722). With this assumption, this appendix provides explanatory information on A/μ-law conversion requirements for 7 kHz audio communications.

The example given below is intended to clarify how having both G.711 encoding laws in a 7 kHz terminal overcomes the need for A/μ-law conversion in a normal call, once the connection is established, but why it may be required in the case of transferring the call to another terminal. In Figure I.1, a user in an A-law country having a 7 kHz terminal makes a call which terminates in a μ-law country on an ISDN speech terminal. While echo control is required towards the speech[6] terminal, A/μ-law conversion is not. Since the 7 kHz terminal supports both coding laws, it is able to use a compatible coding law (μ-law), and thus, conversation can proceed normally.

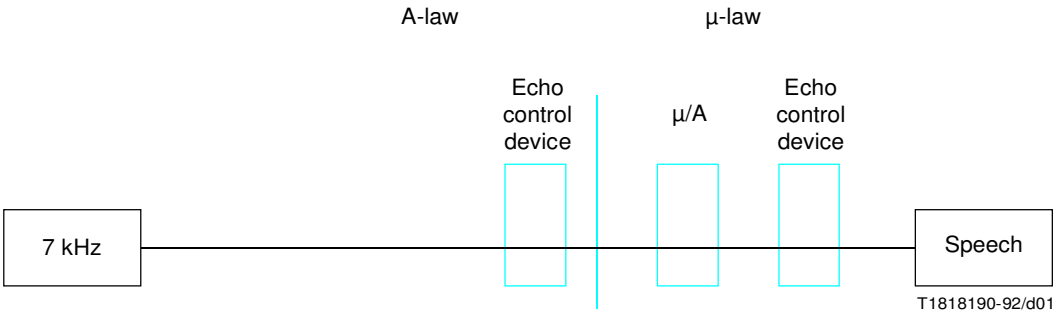

FIGURE I.1/I.501

Communication example between a 7 kHz terminal and a speech terminal

Assume that call transfer is invoked from the 7 kHz terminal to a Speech terminal (see Figure I-2/1.501).

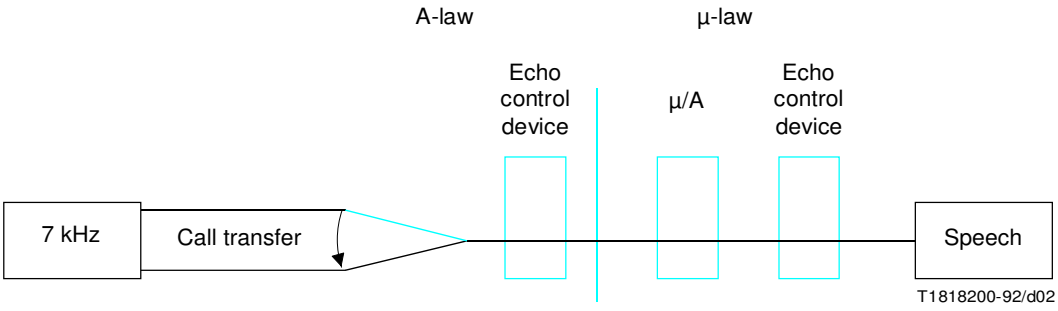

FIGURE I.2/I.501

Resulting communication after call transfer

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6) Note that echo control is required (where required by delay considerations) towards a speech terminal whether it is an ISDN or PSTN terminal because ISDN terminals may be a PSTN-type 2-wire phone connected to hte ISDN by a terminal adapter, incorporating a 2-wire/4-wire hybrid. In this case electrical echo would be introduced by the hybrid, requiring echo control.

In this situation, the μ-law encoded speech from the speech terminal located in the μ-law country is received by the Speech terminal in the A-law country with severe distortion. Note that the network capabilities needed to activate A/μ-law conversion would require additional inter-exchange signalling and switching exchange software. A further problem arises as a result of the need for echo control to be introduced towards the Speech terminal to which the call was transferred.

If the network capability to support a supplementary service request (such as Call transfer) is not available, then the supplementary service request will be rejected.

1.2 Data/facsimile terminals

It is anticipated that ISDN 3.1 kHz audio terminal adaptors associated with modems may also have the capability of operating in both encoding laws. Because most (not all) modems do not require echo control to be active (i.e. they disable echo control devices if they are present) and invocation of supplementary services, such as call transfer, is unusual with data services, initial implementations of fallback for support of data/facsimile could be provided without supporting all attributes of the 3.1 kHz audio bearer (i.e. echo control or A/μ-law conversion).