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INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

INTERNETWORK INTERFACES

INTERWORKING BETWEEN ISDN AND NETWORKS WHICH OPERATE AT BIT RATES OF LESS THAN 64 kbit/s

ITU-T Recommendation I.525

(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.525 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 Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.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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CONTENTS

Page

1 General 1

2 Scope 1

3 Principles 1

4 Interworking configuration 1

5 Examples of applications 1

Annex A – Network interworking between an ISDN and an integrated digital network at a basic rate of 32 kbit/s (IDN-32) 2

A.1 General 2

A.2 Scope 2

A.3 Interworking configuration and network characteristics 2

Appendix I – Integrated digital network at a basic rate of 32 kbit/s (IDN-32) 6

Annex B – Network interworking between an ISDN and a digital public land mobile network (D-PLMN) 6

B.1 General 6

B.2 Scope 7

B.3 Interworking configuration and network characteristics 7

Appendix I – D-PLMN 10

Recommendation I.525

INTERWORKING BETWEEN ISDN AND NETWORKS WHICH OPERATE AT BIT RATES OF LESS THAN 64 kbit/s

(Helsinki, 1993)

1 General

Along with the adoption of ISDN, there is an increasing number of public digital networks being established which rely on bit rates of less than 64 kbit/s. Though some of these may be national options or specialized applications, in many cases these networks will require to interwork with public ISDNs.

2 Scope

The purpose of this Recommendation is to describe the interworking arrangements between ISDN and networks operating at bit rates less than 64 kbit/s. Examples of such digital networks include:

- local public networks provided as a national option, for example, a digital network based on a rate of 32 kbit/s (IDN-32);
- mobile networks, including cellular networks;
- personal communication networks (PCN);
- private networks.

3 Principles

Networks operating at less than 64 kbit/s and interworking with ISDN shall follow internationally agreed 64 kbit/s based ISDN interface standards for interconnecting with ISDN. In particular, they shall ensure time slot sequence integrity of the information conveyed in a 64 kbit/s channel at the interworking point. Any adaption and interworking functions to standard ISDN interfaces will be provided within the specialized network (i.e. networks with rates less than 64 kbit/s).

Principles and objectives for end-to-end service quality, compatibility, and essential service support are for further study.

If both ends of a call terminate on similar networks which operate at less than 64 kbit/s, it would be desirable if interworking functions such as speech transcoders were disabled. In such cases, the ISDN could for example, provide a 64 kbit/s transparent path to interconnect the two sub-rate networks. The mechanism to achieve this is for further study.

4 Interworking configuration

Figure 1 shows the reference configuration.

5 Examples of applications

5.1 Annex A describes an example of interworking of IDN-32 with ISDN.

5.2 Annex B describes an example of interworking of a digital public land mobile network (D-PLMN) with ISDN.

5.3 Interworking arrangements of other networks operating at less than 64 kbit/s with ISDNs are for further study.

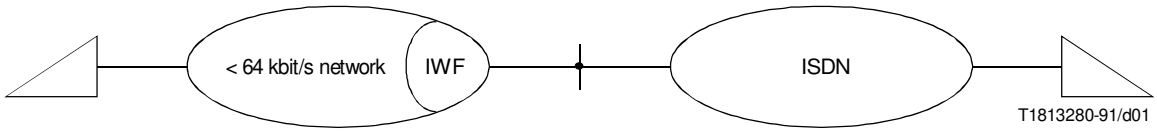

FIGURE 1/I.525

General configuration for interworking between ISDN and networks which operate at bit rates of less than 64 kbit/s

Annex A

(to Recommendation I.525)

Network interworking between an ISDN and an integrated digital network at a basic rate of 32 kbit/s (IDN-32)

(This annex forms an integral part of this Recommendation)

A.1 General

In the integrated digital network at a basic rate of 32 kbit/s, users are provided with a digital user network access at 32 kbit/s (see Appendix I to Annex A). Furthermore, some users of the IDN-32 can be provided with a digital user network access at 64 kbit/s as well as ISDN basic and primary rate accesses. Furthermore, all users of IDN-32 can communicate with telephone users of any other network.

A.2 Scope

The purpose of this annex is to describe the general arrangements for interworking between an IDN-32 and the ISDN.

A.3 Interworking configuration and network characteristics

A.3.1 Interworking configuration

See Figure A.1.

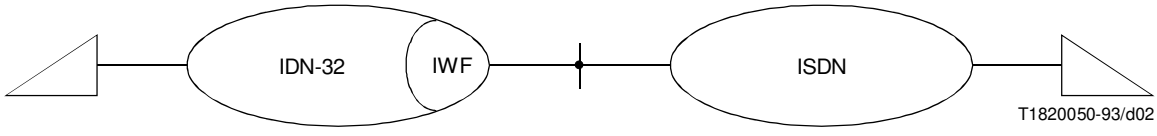

FIGURE A.1/I.525

General configuration for interworking between ISDN and IDN-32

A.3.2 Key IDN-32 and ISDN characteristics and related interworking functions

Table A.1 identifies the key characteristics of an IDN-32 and an ISDN, indicating possible interworking functions to accommodate dissimilar characteristics.

TABLE A.1/I.525

Key IDN-32 and ISDN characteristics[a)]

	IDN-32	ISDN	Interworking functions included in IDN-32
Subscriber interface	Digital	Digital	Note 1
User network signalling	In-band	Out-band	Note 2
User terminal equipment supported	Digital TE (DTS, DTE, etc.)	TE1 or TE2 + TA	Note 3
Inter-exchange signalling	SS No. 7 ISUP	SS No. 7 ISUP	
Transmission facilities	Digital	Digital	Note 1
Information transfer mode	Circuit	Circuit/packet	Note 4
Information transfer capability	Voice/voice-band data, unrestricted 32 kbit/s digital	Speech, 3.1 kHz audio, unrestricted 64 kbit/s digital video, etc.	Note 4

a) A brief description of IDN-32 is provided in Appendix I.

NOTES

Interworking functions:

1 32 to 64 kbit/s and 64 to 32 kbit/s digital conversion of transmitted signals.

2 Mapping between IDN-32 signals in the subscriber access and I.451 messages.

3 Support of communication between DTEs (without modem).

4 Further study required.

A.3.2.1 Location of interworking functions

Interworking functions are to be located within IDN-32. The location of interworking functions is dependent on the configuration of the national telephone network.

The optimum location of each interworking function may be specific per interworking function and depends on the usage of the service, network topology, etc.

A.3.3 Services suitable for IDN-32 - ISDN interworking

This subclause considers the subject of services suitable for IDN-32 - ISDN interworking. The discussions dealing with IDN-32 to/from ISDN direction are addressed in individual subclauses.

A.3.3.1 Services suitable for IDN-32 - ISDN interworking (circuit mode)

Currently, there are two identified services that could be subject to IDN-32 - ISDN interworking. These are:

i) circuit-mode 32 kbit/s, 8 kHz structured service, usable for voice or voice-band data;

ii) circuit-mode 32 kbit/s, 8 kHz structured service, usable for unrestricted 32 kbit/s.

NOTE – IDN-32 - ISDN interworking means interworking both ways between IDN-32 and ISDN, while IDN-32 to ISDN refers to a call initiated in the IDN-32 and terminated in the ISDN, and ISDN to IDN-32 refers to a call initiated in the ISDN and terminated in the IDN-32.

A.3.3.2 ISDN bearer services suitable for ISDN to IDN-32 interworking (circuit mode)

Currently there are two identified bearer services that could be used within ISDN to IDN-32 interworking. These are:

i) circuit-mode 64 kbit/s, 8 kHz structured bearer service, usable for speech information transfer;

ii) circuit-mode 64 kbit/s 8 kHz structured bearer service, usable for 3.1 kHz audio information transfer.

Bearer services similar to those used within the IDN-32 to ISDN interworking can be used within the ISDN to IDN-32 interworking:

i) circuit-mode 64 kbit/s, 8 kHz structured bearer service, usable for speech information transfer;

ii) circuit-mode 64 kbit/s, 8 kHz structured bearer service, usable for 3.1 kHz audio information transfer (see Note 1);

iii) circuit-mode 64 kbit/s unrestricted, 8 kHz structured bearer service (see Note 2).

NOTES

1 Transmission of 9600 bit/s voice-band data is for further study.

2 For further study.

Since one of these services - the 64 kbit/s unrestricted bearer services - can only be provided for individual IDN-32 users, during the setting up of a call, the ISDN call progress indicator will only recognize those users who can be provided with this bearer service.

A.3.3.3 ISDN bearer services suitable for IDN-32 - ISDN interworking (packet mode)

For further study.

A.3.3.4 ISDN bearer services suitable for ISDN to IDN-32 interworking (packet mode)

For further study.

A.3.4 Connection types suitable for IDN-32 - ISDN interworking

This subclause identifies the mapping of ISDN bearer services and possible connection types for IDN-32 - ISDN interworking. Depending on the specific ISDN bearer service being considered, more than one ISDN connection type may be applicable. However, in some cases the connection type may not be fully compatible with requested bearer service, thereby leading to downgrading of services.

The ISDN bearer services and possible connection types for four IDN-32 - ISDN interworking cases are given in Table A.2.

Refer to Recommendation I.335 for more details regarding the mapping between ISDN bearer services and ISDN connection types.

A.3.5 Functional requirements for IDN-32 - ISDN interworking

A.3.5.1 Interworking between signalling systems

Since IDN-32 uses SS No. 7 ISUP, no new interworking requirements are identified.

A.3.5.2 Provision of interworking indications

An interworking indication is required for the ISDN local exchange to know that interworking has occurred. ISUP Q.761 to Q.764 and I.451/Q.931 protocols have the ability to identify this interworking situation to the ISDN local exchange and the ISDN terminal (call progress indicator).

The ISDN terminal would be informed in every case that interworking has occurred. Procedures are for further study.

TABLE A.2/I.525

ISDN bearer services and connection types suitable for IDN-32 - ISDN interworking

Interworking	ISDN bearer services categories	ISDN connection types			
		64 kbit/s unrestricted	Speech	3.1 kHz audio	Packet
IDN-32 to ISDN (circuit)	64 kbit/s unrestricted 3.1 kHz audio	Y R	N For further study	N Y	N N
ISDN to IDN-32 (circuit)	64 kbit/s unrestricted speech 3.1 kHz audio	Y R R	N Y For further study	N Y Y	N N N
IDN-32 to ISDN (packet)	Virtual call and permanent virtual circuit	For further study			
ISDN to IDN-32 (packet)	Virtual call and permanent virtual circuit	For further study			

Y YES - Can be used (some interworking scenarios may require further study).

N NO - Cannot be used

R Can be used except when A/μ-law conversion and echo-control may be required.

NOTES

1 It is recognized that ISDN-32 services interworking with ISDN must use currently defined ISDN bearer services.

2 It is possible that the service obtained on each of the bearer services for IDN-32 to ISDN interworking may not be the same as that obtained for ISDN to ISDN configurations.

3 Refer to Recommendation I.231 for the service definition for 64 kbit/s interworking. Various mechanisms for ISDN - other networks interworking supporting Y-series terminals connected to the ISDN using the 64 kbit/s unrestricted bearer service are contained in Recommendation I.515. Procedures require further study.

4 Other ISDN bearer services and connection types that may be applicable for IDN-32-ISDN interworking are for further study.

A.3.5.3 Failure indication

Failure indication, when carried by the I.451 and ISUP signalling messages, should be meaningful and give a clear indication of the reason.

A.3.6 Handling of non-voice calls between IDN-32 and ISDN subscribers

For some cases of IDN-32 - ISDN interworking the capability to interconnect DTEs used as terminal equipments should be provided. The need for the transfer of data signals via a 32/64 kbit/s converter should be taken into consideration.

Appendix I

(to Recommendation I.525)

Integrated digital network at a basic rate of 32 kbit/s (IDN-32)

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

I.A.1 General

The integrated digital network at a basic bit rate of 32 kbit/s (IDN-32) is based on the following principles:

- the digitalization of the user network access for each user, which allows establishment of an all-digital network and permits integration of a number of services within this network;
- the use of 32 kbit/s as a basic rate for transmission and switching facilities;
- the provision of digital four-wire connections between terminals of this network.

I.A.2 Scope

The purpose of this appendix is to describe the main features of IDN-32, which are needed for the interworking functions specification.

I.A.3 Principles

IDN-32 consists of digital subscriber network and digital switching exchanges. This allows to establish the digital connections from user to user.

IDN-32 is created using the following equipments:

- digital subscriber network using remote subscriber multiplexers;
- digital switching equipments (subscriber switching modules, remote subscriber switching modules and transit switching modules);
- digital transmission systems;
- interworking units (see Note);
- operation and maintenance module.

NOTE – Interworking units provide the interfaces with ISDN, PSTN, etc.

Users can be provided with a 64 kbit/s channel obtained by combining two 32 kbit/s channels. A primary rate access can be obtained by using the whole digital transmission capacity.

I.A.4 Access configuration

The digital terminals are connected to remote subscriber multiplexers.

The remote subscriber multiplexers are connected to subscriber switching modules by digital transmission systems.

All subscriber switching modules are connected to transit switching modules.

Operating and maintenance modules support all the facilities mentioned above.

Annex B

(to Recommendation I.525)

Network interworking between an ISDN and a digital public land mobile network (D-PLMN)

(This annex forms an integral part of this Recommendation)

B.1 General

In a D-PLMN users are typically provided with digital user network access capabilities at significantly less than 64 kbit/s for efficient radio frequency use, which may be different for speech and data, and a separate low bit rate signalling access. Different D-PLMNs can operate at different bit rates.

B.2 Scope

The purpose of this annex is to describe the general arrangements for interworking between a D-PLMN and the ISDN.

B.3 Interworking configuration and network characteristics

B.3.1 Interworking configuration

See Figure 1.

B.3.2 Key D-PLMN and ISDN characteristics and related interworking functions

Table B.1 identifies the key characteristics of a D-PLMN and an ISDN, indicating possible interworking functions to accommodate dissimilar characteristics.

TABLE B.1/I.525

Key D-PLMN and ISDN characteristics and possible interworking functions required

	D-PLMN	IWF	ISDN
Subscriber interface	Digital	–	Digital
User-network signalling	Out-band	Signal mapping	Out-band
Inter-exchange signalling	SS No. 7 ISUP	Signal mapping	SS No. 7 ISUP
	MAP		MAP
Information transfer mode	Circuit	Circuit connection based on 64 kbit/s	Circuit
	Packet	For further study	Packet
Information transfer capability	Low rate speech	Transcoding echo control	Speech based on 64 kbit/s PCM
	3.1 kHz audio	Modem pool	3.1 kHz audio
	Low bit-rate data	Rate adapting	64 kbit/s UDI
Additional services	ISDN services	–	ISDN services
	Mobile specific services	For further study	–
	(Note)	–	
NOTE – This may be a “short message” – to be confirmed			

B.3.3 Services suitable for D-PLMN-ISDN interworking

B.3.3.1 Services suitable for calls initiated in a D-PLMN and terminated in ISDN

i) circuit mode service usable for speech information transfer;

ii) circuit mode service, usable for data;

iii) packet mode service, usable for data.

B.3.3.2 ISDN bearer services suitable for calls initiated in ISDN and terminated in a D-PLMN

i) circuit mode 64 kbit/s, 8 kHz structured bearer service, usable for speech information transfer;

ii) circuit-mode 64 kbit/s, 8 kHz structured bearer service, usable for 3.1 kHz audio information transfer;

iii) packet-mode up to the capacity of the interface.

B.3.4 Functional requirements for D-PLMN-ISDN interworking

B.3.4.1 Interworking between signalling systems

When the D-PLMN uses ISUP, no extra interworking functions are required.

B.3.4.2 Interworking for speech

The IWF in a D-PLMN has a transcoder to convert between the low bit-rate speech coding in D-PLMN and the standard 64 kbit/s coding in ISDN (see Figure B.1). The low bit-rate speech coding in D-PLMN may have a processing delay sufficiently long to require an echo canceller to cancel the echo from the ISDN side.

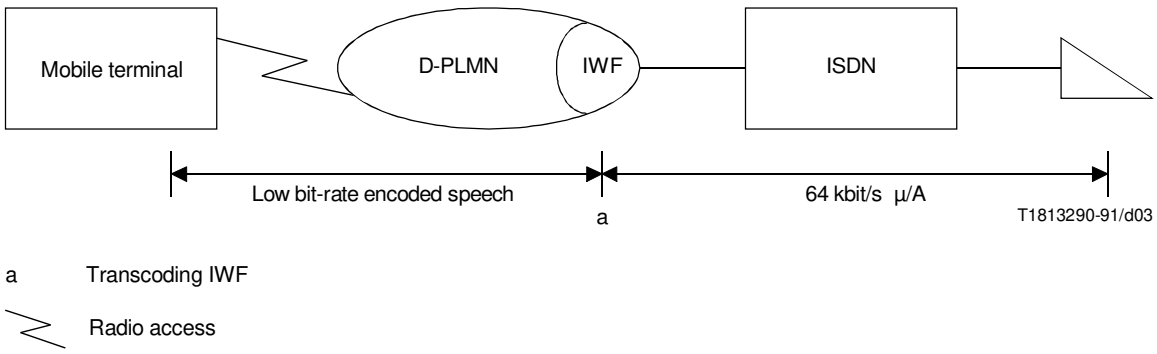

FIGURE B.1/I.525

General configuration for interworking between ISDN and D-PLMN showing transcoding IWF

In the case where there is D-PLMN access at both ends of a connection, and both D-PLMNs are of the same type, it would be desirable if the speech transcoders were disabled (see Clause 3), for optimum performance. This case is illustrated in Figure B.2.

It is possible that this scenario could include an ISDN connection long enough to require its own echo control, resulting in cascaded echo cancellers. In this case, it would be desirable for signalling information to be conveyed from the D-PLMNs such that the ISDN echo cancellers were disabled.

B.3.4.3 Interworking for data

Since the complex voice coding of D-PLMNs cannot pass voice-band data, when data transmission is required, the voice codec must be bypassed. One mechanism for transmission across the ISDN would be for the low bit rate of the D-PLMN (e.g. 8 kbit/s) to be rate-adapted to 64 kbit/s by the IWF. This is illustrated in Figure B.3.

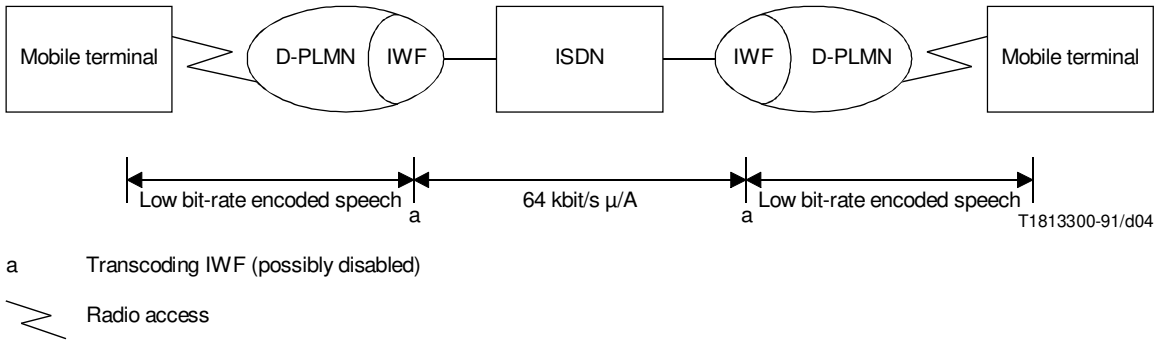

FIGURE B.2/I.525

General configuration for interworking between ISDN and D-PLMNs at both ends of the connection

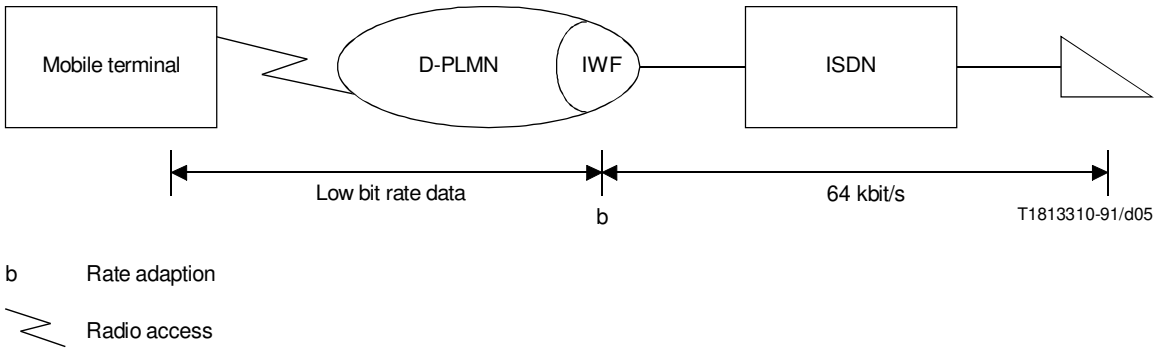

FIGURE B.3/I.525

General configuration for interworking between ISDN and D-PLMN for data

B.3.4.4 Supplementary service interworking

A D-PLMN may be provided with similar or identical supplementary services to those in the ISDN, but with some differences resulting from:

- moving from one mobile switching exchange area to another;
- roaming to another country offering the same D-PLMN capability;
- a connection to the D-PLMN only on an on-demand basis.

Frequently, the supplementary services will be required to operate across networks, and interworking between a D-PLMN and the ISDN requires interworking of signalling, notification and indications. Additionally, procedure compatibility may sometimes need to be assured before interworking of a supplementary service can be allowed.

Appendix I

(to Annex B of Recommendation I.525)

D-PLMN

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

I.B.1 General

A D-PLMN is based on the following principles:

- the digitalization of the user network access for each user, allowing the establishment of an all-digital network;
- the provision of a single low bit-rate communication channel and a single low bit-rate signalling channel to and from terminals of this network.

I.B.2 Scope

The purpose of this appendix is to describe the main features of a D-PLMN which are needed for, and affect, the interworking functions specification.

I.B.3 Principles

A D-PLMN consists of a digital switching network connected to and serving digital radio transceiver stations which can be connected by radio links on an on-demand basis to mobile terminals within their radio-coverage areas.

Because of the nature of the radio links, only relatively low bit rates may be available for the transport of speech or data, and for speech, complex encoding is required. Additionally, error correction coding and other techniques are needed to overcome excessive bit error rates during fades and close to the edge of the radio-coverage area. These result in transmission delays sufficient to require echo control within the D-PLMN for speech. Speech encoding used by D-PLMN is not suitable for conveying voice-band data. For data, echo control is removed.

A D-PLMN is constructed using the following equipment:

- digital radio transceiver stations, incorporating digital multiplexers;
- digital transcoders (for radio path to standard PCM transcoding);
- digital switching equipment (mobile subscriber switching modules and transit switching modules);
- echo controllers;
- digital transmission systems;
- interworking units (see Note);
- operation and maintenance modules.

NOTE – Interworking units provide the interfaces to ISDN, PSTN, etc.