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01	Dec. 19, 1997	Established
02	July 31, 1998	64 kbit/s unrestricted data bearer service is added

B-IW3.00-02-TS

Public Personal Handy-Phone System:
Interworking Between a Public PHS network and
a Public Switched Telephone Network (PSTN)

< Summary >

1. Relationship with International Standards

This specification specifies network interworking between a public PHS network and a public switched telephone network based on ITU-T Recommendation I.530 which specifies ISDN-PSTN interworking arrangements.

2. Differences to/from International Recommendations

(1) Network model and terminology
ITU-T Recommendation I.530 specifies interworking where interworking networks are ISDN and PSTN. This specification changes this model to specify interworkig between a public PHS network and a PSTN. The differences of model and terminology from ITU-T Recommendation I.530 are summarized in Table Summary-1/B-IW3.00.

(2) Specifications
The differences of specifications from ITU-T Recommendation I.530 are summarized in Table Summary-2/B-IW3.00.

The following specifications have been deleted from ITU-T Recommendation I.530:
- Packet mode interworking;
- Multi-use information transfer;

3. Reference

ITU-T Recommendation : I.5xx series
PHS MoU Documents : B-IF2.xx, B-IF3.xx, B-Ifx.xx series

4. Item for Further Study

None

Table Summary-1/B-IW3.00 Differences of model and Terminology from ITU-T Recommendation I.530

Item	I.530	This specifications
Interworking network model	Interworking networks are ISDN and PSTN.	Interworking networks are public PHS network and PSTN.
Network configuration figure	Networks are ISDN and PSTN.	Networks are public PHS natwork and PSTN
Terminology	ISDN – in a context of service	public PHS network
	64kbit/s unrestricted	32kbit/s unrestricted and 64kbit/s unrestricted
	ISDN user	public PS
	Kx	IF3 (Kx)
Reference	ITU-T Recommendations	PHS MoU Documents
	Q.699	B-IW1.02
	Q.931	B-IF2.02
	Q.761	B-IF3.31
	Q.762	B-IF3.32
	Q.763	B-IF3.33
	Q.764	B-IF3.34
	I.520	B-IW2.00
	I.441	B-IF2.03
	I.451	B-IF2.02

(2) B-IW3.00-02-TS

Table Summary-2/B-IW3.00 Differences of specifications from ITU-T Recommendation I.530

Section	Differences
5. Public PHS network bearer services suitable for public PHS network – PSTN interworking	-Descriptions including Table/I.530 relating to packet mode are deleted. -Description relating to multi-use are deleted.
5.1 Public PHS network bearer services suitable for public PHS network to PSTN interworking (circuit)	-Description relating to multi-use are deleted.
5.3 Public PHS network bearer service suitable for public PHS network to PSTN interworking (packet)	-This section relating to packet mode is not included
5.4 Public PHS network bearer service suitable for PSTN to public PHS network interworking (packet)	-This section relating to packet mode is not included.
6. Connection type suitable for public PHS network-PSTN interworking	-Descriptions including Table2/I.530 relating to packet mode are detected.
6.5 Control of speech processing and echo control devices	-Description relating to multi-use are deleted.
7.6 A/• law encoding	-Description relating to multi-use are deleted.
8. Handling of packet mode calls between public PSH network and PSTN subscribers	-This section relating to packet mode is not included.
Annex A GLOSSARY and ABBREVIATIONS	-Annex A is added.

Public Personal Handy-Phone System:
Network Interworking between a Public PHS network and
a Public Switched Telephone Network (PSTN)

Contents

1. General

In many countries, digitization of the existing PSTN has been ongoing over a number of years through the implementation of digital switching and transmission facilities.
However, it is foreseen that digitization will be a long transition period for some networks. Thus, the public PHS network using existing ISDN is necessary to introduce of interconnecting between existing PSTN and existing ISDN.

The purpose of this document is to identify the interworking funcitons and requirements to support interworking between a public PHS network and a PSTN.

2. Scope

The purpose of this document is to describe the general arrangements for interworking between a public PHS network and a PSTN. Both the provision of public PHS network voice transmission and data transmission services are within the scope of this document.

3. Interworking configuration and network characteristics

3.1 Interworking configuraitons

See Figure 3-1/B-IW3.00.

a) Interexchange scenario

b) Intra-exchange scenario

NOTES

1. In part a) refer to PHS MoU document B-IW0.01 for the definition of IF3(Kx) reference point.

2. Part b) illustrates the case where no clear division exists between public PHS network and PSTN network components.

Figure 3-1/B-IW3.00 Interworking configurations

3.2 Key public PHS network and PSTN characteristics and related interworking functions

Table 4-1/B-IW3.00 identifies the key characteristics of a public PHS network and a PSTN, indicating possible interworking functions to accommodate dissimilar characteristics.

3.2.1 Location of interworking functions

Given that the transition period from a PSTN to an ISDN may occur over a long period of time, there will be an ongoing requirement for public PHS network-PSTN interworking. In such a situation, it is likely that interworking functions will be required at not just one but several locations. As the transition to ISDN continues, interworking points will come into existence and later may not be required.

Points where interworking may exist are
  - within the local exchange;
  - at transit exchange;
  - at international gateway offices.
    NOTE – The optimum location of each interworking function may be specific per interworking
              function and dependent on the usage of the service, network topology, etc.

4. Public PHS network bearer services suitable for public PHS network-PSTN interworking

This clause considers the subject of public PHS network services suitable for public PHS network-PSTN interworking. The discussions dealing with the public PHS network to/from PSTN direction are addressed in individual subclasses, as is the subject of circuit mode.

Table 4-1/B-IW3.00 Key public PHS network and PSTN characteristics

	Public PHS network	PSTN	Interworking functions
Subscriber interface	Digital	Analogue	a
User network signalling	Out-band (B-IF2.03, B-IF2.02)	Mainly in-band (e.g. DTMF)	b, e
User terminal equipment supported	Digital TE (public PHS network NT,TE1 or TE2 + TA)	Analogue TE (e.g. dial pulse telephones, PABXs, modem-equipment DTEs)	c
Interexchange signalling	SS No. 7 ISDN user part (ISUP)	In-band (e.g. R1, R2 or; No. 4, No. 5) or out-band (e.g. SS No. 6, SS No. 7 TUP)	d, e
Transmission facilities	Digital	Analogue/digital	a
Information transfer mode	Circuit	Circuit	f
Information transfer Capability	Speech, digital unrestricted, 3.1 kHz audio, etc.	3.1 kHz audio (voice/voice-band data)	f

Interworking functions

a. Analogue-to-digital and digital-to-analogue conversion on transmission facilities.

b. Mapping between PSTN signals in the subscriber access and B-IF2.02 message for intra-exchange calls.

c. Support of communication between modem-equipped PSTN DTEs and public PHS network terminals.

d. Conversion between the PSTN signalling system and Signaling System No. 7 ISDN user part.

e. Mapping between signals in the public PHS network subscriber (B-IF2.03, B-IF2.02) access and PSTN in-band interexchange signalling (e.g. R1).

f. Further study required.

4.1 Public PHS network bearer services suitable for public PHS network to PSTN interworking (circuit)

Currently, there are three identified bearer services that could be used within the public PHS network for public PHS network to PSTN interworking. These are (refer to Recommendation I.231)

i)   circuit mode 64 kbit/s, 8 kHz structured bearer services, usable for speech information transfer (Note 1);

ii) circuit-mode 64 kbit/s, 8 kHz structured bearer services, usable for 3.1 kHz audio information transfer (Note 2);

iii) circuit-mode 64 kbit/s unrestricted, 8 kHz structured bearer service (Note 3).

It is recognized that the communication characteristics obtained for each of these three bearer services on a public PHS network to PSTN basis may not be the same as that obtained for public PHS network to public PHS network configurations/

NOTES

1   This bearer service is used for the public PHS network to PSTN-interworking for the purpose of speech

information transfer.

2   This bearer service is used for the public PHS network to PSTN interworking for the purpose of 3.1 kHz audio information transfer. For PSTN to public PHS network interworking, this bearer service will be selected at the boundary of the PSTN to the public PHS network for the purpose of speech information transfer *and* for 3.1 kHz audio information transfer.

3   This bearer service may be required for public PHS network PSTN interworking. Refer to Recommendation I.231 for the 64 kbit/s interworking service requirements. If 32 kbit/s unrestricted bearer is selected, the user rate and intermediate rate shall be less than or equal to 32 kbit/s.

4   Public PHS network-PSTN interworking means interworking both ways between public PHS network and PSTN, while public PHS network to PSTN refers to a call initiated in the public PHS network and terminated in the PSTN, and PSTN to public PHS network refers to a call initiated in the PSTN and terminated in public PHS network.

4.2 Public PHS network bearer services suitable for PSTN to public PHS network interworking (circuit)

Currently, there is no internationally recognized method of service differentiation between voice and non-voice calls originating in the PSTN. However, the "ciruit-mode 64 kbit/s, 8 kHz structured bearer service for 3.1 kHz audio information transfer" provides for the capability equivalent to PSTN. (see recommendation I.231.) Therefore, PSTN calls may interwork to this service in public PHS network.

The call progress indicator within ISUP will identify when interworking between public PHS network and PSTN occurs. This indicator will enable the public PHS network to select a connection that would support 3.1 kHz audio. A V-Series terminal connected to the public PHS network via a terminal adaptor and using the 32 kbit/s unrestricted or 64 kbit/s unrestricted bearer service requires the use of an IWF (including a modem) for calls from PSTN users. To effect the connection, a 64 kbit/s connection to the IWF would need to be used.

5. Connection type suitable for public PHS network-PSTN interworking

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

The public PHS network bearer services and possible connection types that may be used are summarized in Table 5-1/B-IW3.00, under the four possible interworking cases. Refer to Recommendation I.335 for more details regarding the mapping between public PHS network bearer services and public PHS network connection types.

Table 5-1/B-IW3.00   Public PHS network bearer services and connection types suitable for Public PHS network-PSTN interworking

Interworking	Public PHS network bearer services categories	Public PHS network conneciton types		
		64 kbit/s unrestricted	Speech	3.1 kHz audio
Public PHS network to PSTN (circuit)	32 kbit/s unrestricted	Y	N	N
	64 kbit/s unrestricted	Y	N	N
	Speech	R(1)	Y	Y
	3.1 kHz audio	R(1)	N	Y
PSTN to public PHS network (circuit)	32 kbit/s unrestricted	Y	N	N
	64 kbit/s unrestricted	Y	N	N
	3.1 kHz audio	R(1)	N	Y

Y: Yes Can be used (some interworking scenarios may require further study).

N: No Cannot be used.

R(1) Can be used except when A/• -law conversion and/or echo control may be required.

NOTES

1.   It is recognized that existing PSTN services must be supported by public PHS network using currently defined public PHS network bearer services.

2.   It is possible that the service obtained on each of the bearer services for public PHS network to PSTN interworking may not be the same as that obtained for public PHS network to public PHS network configurations.

3.   Refer to Recommendation I.231 for the service requirements for 64 kbit/s interworking. Various mechanisms for public PHS network-PSTN interworking supporting V-Series terminals connected to the public PHS network using the 32 kbit/s unrestricted or 64 kbit/s unrestricted bearer service are contained in Recommendation I.515. Procedures require further study.

4.   Other public PHS network bearer services and connection types that may be applicable for public PHS network-PSTN interworking are for further study.

6. Functional requirements for public PHS network-PSTN interworking

6.1 Interworking between signalling systems

Interworking between signalling systems, specifically for interexchange calls between the PSTN signalling system (which may be in-band) and Signaling System No. 7 (ISDN UP) on a public PHS network, may be required. The interworking procedures are specified in PHS MoU Document B-IW1.02.

For intra-exchange calls between the public PHS network and PSTN subscriber, interworking between B-IF2.02 messages and signals in the PSTN subscriber access may also be required.

6.2 Provision of interworking indications

An interworking indicaiton is required for the public PHS network local exchange (LE) to know that public PHS network-PSTN interworking has occurred. ISUP B-IF3.31 – B-IF3.34 and B-IF2.02 protocols have the ability to identify this interworking situation to the public PHS network LE and the public PHS network terminal (call progress indicator).

The public PHS network terminal would be informed in every case that public PHS network interworking has occurred. This information is required to satisfy as a minimum the requirement to:

- tell the terminal to connect the B-channel so that in-band tones and announcements can be received when public PHS network-to-PSTN calls are originated;
- tell the public PHS network terminal that some or all of service selection information and address may be unavailable – the terminal may then be required to accept the call without out-band compatibility checking;
- tell data terminal equipment to anticipate in-band handshaking signals for public PHS network calls.

The following interworking scenarios have been recognized:

a) a public PHS network-PSTN call which uses a Signaling System No. 7 ISUP connection between the originating and terminating local exchanges;
b) a public PHS network-PSTN call which uses a non-Signaling System No. 7 ISUP connection (e.g. R1, Signaling System No. 7 TUP) between the originating and terminating local exchanges;
c) a public PHS network-PSTN call which involves a combination of Signaling System No. 7 ISUP and non-Signaling System No. 7 ISUP interexchange signalling connections between the originating and terminating local exchanges;
d) a public PHS network-PSTN call within the same local exchange (i.e. no interexchange signalling).

6.2.1 Network indication of modification of communication characteristics

The network will always provide an indication to the user of modification of communication characteristics. The modification of communication characteristics may be due to the following reasons:

- interworking with another network;
- resource constraints in the network

In addition to providing an indication, the network may solicit user acceptance of the modification of communication characteristics in certain cases. Examples are:

- downgrading of service;
- upgrading of service.

For most interworking cases, user acceptance is not applicable.

There may be a requirement for the resolution of information transfer capability requests other than speech and 3.1 kHz audio on public PHS network-to-PSTN calls. The choices of rejection (which a suitable cause indication) or negotiation (involving parameter exchange) are possible (Recommendation I.515).

There may also be requirement for the rejection of supplementary service requests available on an public PHS network, but not supported on the PSTN. However, negotiation for supplementary services may be possible as well.

The principles for call negotiation in an public PHS network-PSTN interworking situation are for further study.

6.2.2 Failure indication

Failure indication, when carried by the B-IF2.02 and ISUP signalling messages, should be meaningful and give a clear indication of the reason.
The network failure indication should be able to identify the network where congestion occurred. This may be of user in networks allowing ROA selection.

6.3 Generation of in-band tones and announcements

In-band tones and announcements are provided for all speech and 3.1 kHz audio bearer service calls between an public PHS network and a PSTN (reference Recommendation E.180. Within public PHS network, in-band tones and announcements, with the exception of ring-back tone, should be provided at a point as close as possible to the calling user (i.e. network, PABX, or terminal). Whenever possible, out-band messages should also be used within the public PHS network and the local access.

The network (Public PHS network or PSTN) must be capable of generating in-band tones and announcements. However, for public PHS network-to-PSTN interworking cases, the public PHS network terminals will receive the in-band tones and announcements whenever the tones are generated within the PSTN, i.e. beyond the interworking point. Nevertheless, this does not preclude the terminal from providing its own tones and announcements.

In-band ring-back tone should be generated by the terminating exchange (or terminating PABX).

Furthermore, two call scenarios exist:

 a) the call is unsuccessful (user busy, network congestion, etc.);
 b) the call is delivered successfully.

Regardless of the call type, the same in-band tones and announcements (depending on the call scenario) should be provided to the calling user.

6.3.1 Call type 1: PSTN-to-public PHS network

6.3.1.1 Unsuccessful call delivery

When the point of call failure (i.e. the point at which the call cannot proceed further) is within the PSTN or at the PSTN user, normal PSTN procedures apply.

When the point of call failure is within the public PHS network or at the public PS, the public PHS network should send the appropriate out-band clearing message as far back towards the gateway exchange as possible.

- If the out-band message can be sent all the way through to the gateway exchange, then the gateway exchange should pass the information to the PSTN using the PSTN's normal procedures (i.e. out-band if the PSTN supports the out-band message, otherwise in-band).
- If the message cannot be sent out-band all the way to the gateway exchange, then the appropriate in-band tone or announcement should be provided by the public PHS network at the point where out-band signalling is no longer capable of handling the message.

For the above cases, the clearing message should not be sent prior to the completion of the announcement.

6.3.1.2 Successful call delivery

If the call is delivered successfully to the public PS, then the terminating public PHS network exchange should generate in-band ring-back tone towards the PSTN user.

6.3.2 Call type 2: Public PHS network-to-PSTN

6.3.2.1 Unsuccessful call delivery

When the point of call failure is within the public PHS network, the call should be handled as a public PHS network-to-public PHS network call (see PHS MoU Document B-IW2.00).

When the point of call failure is within the PSTN, the PSTN's procedures apply. For instance, if the PSTN supports out-band signalling to the gateway exchange, then the gateway exchange should map the message to the appropriate out-band public PHS network clearing message (i.e. the gateway exchange handles the call as a public PHS network-to-public PHS network call). If the PSTN does not support out-band signalling, then it will generate the appropriate in-band tone or announcement.

The public PHS network terminal should be alerted to the fact that interworking has occurred so that the user can be prepared to receive the appropriate in-band tone or announcement. The intermediate interworking point will provide the interworking message which will suppress, when necessary, tone generation in the public PHS network terminal, and pass through any in-band tones.

For the above cases, the clearing message should not be sent prior to the completion of the announcement.

6.3.2.2 Successful call delivery

If the call is delivered successfully to the PSTN user, then the terminating PSTN exchange will provide in-band ring-back tone. The public PHS network terminal should be alerted to the fact that interworking has occurred so the user can be prepared to receive the in-band ring-back tone.

6.4 Handling of non-voice calls between public PHS network and PSTN subscribers

There may be an interworking requirement for the capability to interconnect modem-equipped terminals on the PSTN and compatible terminals on a public PHS network access. This may in the future include a means for compatibility checking and the provision of a modem pool to perform A/D conversion and rate adaptation (Recommendation I.515)

There are in principle two alternative approaches to provide data communication between a public PHS network customer and a PSTN customer:

i)   The data terminal of the public PHS network customer is connected to a modem which in turn is connected to an A/D converter (PCM). A call will be handled as for telephony. Further study is required to determine what interworking functions are required in this case.

ii) The data terminal of the public PHS network customer is connected to a public PS, i.e. the data flow is rate adapted to 64 kbit/s. At a suitable interworking point, the original data flow (e.g. 1.2 kbit/s) is extracted and converted to "analogue" form by a modem for further transfer to the remote data terminal (i.e. the usage of modem pools). Mechanisms for modem interworking are contained in Recommendation I.515.

To handle non-voice calls in a public PHS network-PSTN interworking situation, the following interworking functions may be required.

a)   capability to distinguish a data call and its relevant parameters when the call is coming from a PSTN;

b)   capability to distinguish a data call and its relevant parameters when the call is going to a PSTN;

c)   special routing algorithms for inclusion of proper IWFs as detected in a) and b);

d)   IWFs for protocol conversion as detected in a) and b).

For interworking between public PHS network and PSTN, the need for in-band parameter exchange is recognized as necessary, with the understanding that out-band parameter exchange should be used whenever possible (refer to Recommendation I.515).

> NOTE – When public PHS network-PSTN interworking, using a modem pool in conjunction with the 32 kbit/s unrestricted or 64 kbit/s unrestricted bearer service, it may not be possible to extend PSTN supervisory tones to the public PS. The interworking implications of this in the public PHS network are for further study.

6.5 Control of speech processing and echo control devices

Connections provided for public PHS network/PSTN interworking may use speech processing techniques as long as these do not restrict the required information transfer. Restrictive devices should be functionally modified or removed using, for example, the 2.1 kHz in-band [ECD (echo control device) disabling] tone.

Digital circuit multiplication equipment (DCME) for example is designed to be compatible with the 3.1 kHz audio transfer capability. Echo control devices and their use in the PSTN are recommended in Recommendation G.131.

Similar Recommendations should apply to the public PHS network/PSTN interworking case. In particular, both echo suppressers and echo chancellors must be located within a range limitation of the four-wire/two-wire interface. These limits are mentioned in 2.2/G131, 1.1.3/G164 and 3.2/G.165. If echo control devices are included in the public PHS network connection, they will need to have the capability of being disabled by the 2.1kHz echo control disabling tone generated by modems as is the current practice in the PSTN. While echo suppressers should respond to a 2100 Hz tone (Recommendation G.164), echo chancellors should only respond if the tone includes phase reversals as specified in Recommendation G.165. It is recommended that the 2.1 kHz tone should not be converted into a public PHS network signalling message and vice-versa.

6.6 A/μ law encoding

The treatment of A/μ law encoding and translation in public PHS network/PSTN interworking can be based on the continuation of existing procedures whereby appropriate A/μ law translation is performed by the μ-law network when crossing international boundaries. Terminals would encode speech and 3.1 kHz audio using the G.711 law appropriate to the resident network. Unrestricted 32 kbit/s or unrestricted 64 kbit/s services bit streams would not be manipulated in any way by the public PHS network: terminals would be free to use any encoding (including G.711 or G721) as deemed appropriate between themselves when unrestricted 32 kbit/s or unrestricted 64 kbit/s capability is requested.

AnnexA GLOSSARY and ABBREVIATIONS

This annex forms an integral part of this document

GLOSSARY

A
B
C
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I

IF3(Kx)   **PHS MoU**
The network interworking reference point is the IF3(Kx) reference point when the network directly interconnected to the public PHS network is a non-ISDN

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ABBREVIATIONS

DCME	Digital circuit multiplication equipment	**ITU-T**
DTE	Data terminal equipment	**ITU-T**
DTMF	Dual-tone multi-frequency	**ITU-T**
IDN	Integrated digital network	**ITU-T**
ISDN	Integrated Service Digital Network	**ITU-T**
ISUP	ISDN user part	**ITU-T**
IWF	Interworking function	**ITU-T**
LE	Local exchange	**ITU-T**
NT	Network termination	**ITU-T**
PABX	Private Automatic Branch Exchange	**ITU-T**
PCM	Pulse code modulation	**ITU-T**
PSTN	Public switched telephone network	**ITU-T**
SS No.7	Signaling System No. 7	**ITU-T**
TE	Terminal equipment	**ITU-T**
TA	Terminal adaptor	**ITU-T**
TUP	Telephone user part.	**ITU-T**