

Title: Public Personal Handy-Phone System : Definitions and General Principles for Public PHS Network

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History of Revised Versions

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**Public Personal Handy-Phone System:
Definitions And General Principles For Public PHS Network
Interworking/Internetworking**

< Summary >

1. Relationship with International Standards

This specification specifies definitions and general principles for public PHS network interworking/internetworking based on ITU-T Recommendation I.510 which specifies definitions and general principles for ISDN interworking/internetworking.

2. Differences to /from International Recommendations

(1) Network model and terminology

ITU-T Recommendation I.510 specifies general principle for interworking between ISDNs, between ISDNs and other networks, and internal to an ISDN. This specification changes this model such that one of the interworking networks is a public PHS network and the other network is a public PHS network or an ISDN or an PSTN. The differences of model and terminology from ITU-T Recommendation I.510 are summarized in Table Summary-1/B-IW0.01.

(2) Specifications

The differences of specifications from ITU-T Recommendation I.510 are summarized in Table Summary -2/B-IW0.01.

The following specifications have been deleted from ITU-T Recommendation I.510.

- Packet mode bearer services;
- Telex and Teletex teleservices;
- Multi-use bearer services.

3. References

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

4. Items for Further Study

None.

Table Summary-1/B-IW0.01**Differences of model and Terminology from ITU-T Recommendation I.510**

Item	I.510	This specification
Interworking network model	Both side are ISDNs, ISDN and other network, internal to an ISDN	One of the interworking networks is a public PHS network, and the other one is other network (ISDN or PSTN).
Network configuration figure	ISDN and ISDN/other network.	Public PHS network and Public PHS network/other network.
Terminology	ISDN - in a context of service TE Kx, Nx	public PHS network public PS IF3(Kx), IF3(Nx)
Reference	ITU-T Recommendations I.510 I.520	PHS MoU Documents B-IW0.01 B-IW2.00

Table Summary-2/B-IW0.01**Differences of specifications from ITU-T Recommendation I.510**

Section	Differences
5. Network support of telecommunication service	Interworking to CSPDN and PSPDN is deleted in table 5-1
6.2.2 Connection types for interworking between public PHS networks	Items relating to packet mode are deleted.
6.3.2 Connection types for interworking between public PHS network and other network	Items for interworking to CSPDN, PSPDN, telex and private networks are deleted. Items for interworking between public PHS network and PSTN is added.
6.5.3 Connection types for interworking in network concatenation configurations	Items for interworking to CSPDN, PSPDN and telex are deleted.

**Public Personal Handy-Phone System:
Definitions And General Principles For Public PHS Network
Interworking/Internetworking**

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**Definitions And General Principles For Public PHS Network
Interworking/Internetworking**

1 Introduction

This document sets forth the general principles for interworking between public PHS networks, between public PHS networks and other networks, and internal to a public PHS network. The need for interworking stems from the coexistence of existing dedicated networks with public PHS networks and from the use of different, yet compatible, bearer services or teleservices for the provision of an end-to-end telecommunication service. When public PHS networks are introduced, it is to be expected that most users will need to interwork with the users of other networks, especially public switched telephone networks (PSTNs), and public land mobile networks (PLMNs) and dedicated data networks.

Normally, each instance of communication within a public PHS network will take place between the users of services with identical attribute values. However, communication may also take place between users of services with non-identical attribute values. In these cases interworking functions (IWFs) will be required. In general, when an public PHS network user communicates with the user of another network, if the service perceived by the user of that other network were to be defined by the attribute method, the values would not be identical to those of the public PHS network user.

The purpose of interworking is to enable the users of “different” services on an public PHS network to establish a useful communication or for an public PHS network user to establish a useful communication with a user of another network and vice-versa. The term “service” in this document implies a telecommunication service as defined in Recommendation I.210.

To permit interworking, interworking capabilities, making use of IWFs, may be required in one or more of the following:

- the public PHS network;
- any other network involved;
- customer equipment.

2 Scope

This document contains the definitions and general principles to be applied in instances of ISDN interworking, which include interworking between public PHS networks, between public PHS network and other networks, and internal to a public PHS network.

The public PHS network interworking configurations to be considered within the scope of this document include the interconnection of two networks where at least one network is a public PHS network, the concatenation of more than two networks where a public PHS network interconnects other networks (as a transit network), or the interconnection of two public PHS network by one or more other networks.

Public PHS network interworking, as defined in this document, is considered to take place whenever end-to-end communication has to be provided

- a) between different networks where at least one network is a public PHS network; or

- b) between telecommunication services with different lower or higher layer attributes or both, where at least one of the interworking telecommunication service is supported by the public PHS network; or
- c) between different networks and between telecommunication services with different lower or higher layer service attributes, or both.

Public PHS network interworking, as defined in this document, is intended to cover both voice and non-voice applications

NOTE – Interworking at layers above layer 3 of the OSI model is not generally specified within this and is for further study.

3 Definitions

3.1 Definitions related to services and network capabilities

The definitions which follow are related to services and to network capabilities. In those instances where terms already are defined in other PHS MoU documents and ITU-T Recommendations, appropriate references are made to such documents and Recommendations.

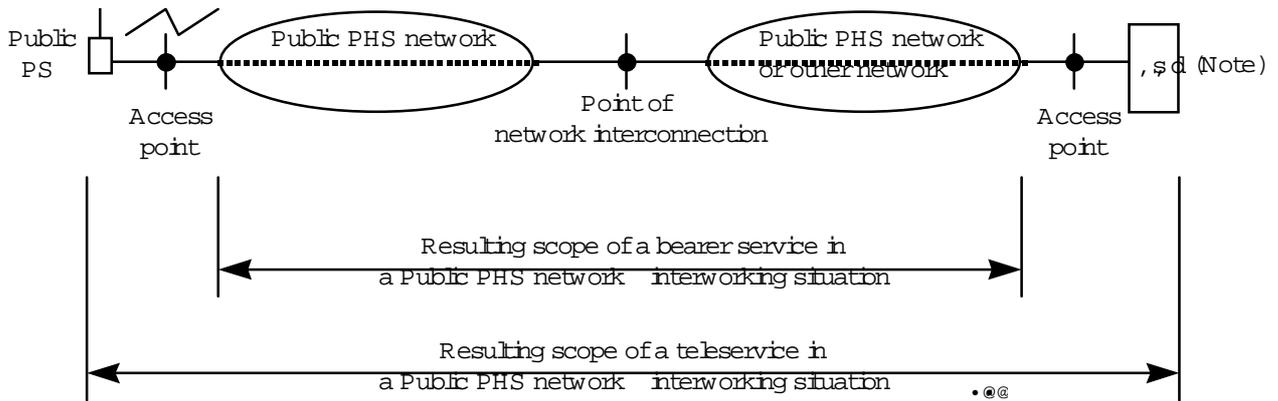
The following definitions apply to public PHS network interworking:

- *Telecommunication service*, as defined in Recommendation I.210.
- *Bearer service in the ISDN*, as defined in Recommendation I.210 and in the I.230-Series Recommendations.
- *Teleservice*, as defined in Recommendation I.210 and in the I.240-Series Recommendations, provides the full capacity for communication through terminal and network lower and higher layer functions.
- **bearer service in dedicated networks** – The term *bearer service* in dedicated networks is characterized by a set of lower layer attributes (e.g. data transmission services, as defined in Recommendation X.1, for use in public data networks) and corresponds to the term *bearer service* in an ISDN. Examples of *bearer services* in dedicated networks are data transmission over a data network and data transmission over the telephone network.
- *Supplementary service*, as defined in Recommendation I.210 and in the I.250 Series Recommendations.
- *Bearer capability*, as defined in Recommendation I.210, specifies the technical features of a *bearer service* in an ISDN as these appear to a user at the access point (S- or T-reference point). The term *bearer capability* also may be used with respect to dedicated networks. A *bearer capability* does not include any terminal functions.

3.2 Definitions related to general public PHS network interworking configurations

This subclause provides concepts and definitions of terms relevant to the general public PHS network

interworking configuration. Figure 3-1/B-IW0.01 depicts the scope of application of several key terms.



NOTE • The TE is used to refer to either a TE1 or a TE2 plus a terminal adaptor when the network to which it is connected is an SDN.

Figure 3-1 / B-IW0.01
**Scope of a bearer service and a teleservice
 in a Public PHS Network**

In accordance with Figure 3-1/B-IW0.01, the following terms are defined:

interworking: Within the scope the I.500-Series of Recommendations, the term *interworking* is used to express interactions between networks, between end systems, or between parts thereof, with the aim of providing a functional entity capable of supporting an end-to-end communication. The interactions required to provide a functional entity rely on functions and on the means to select these functions.

interworking functions (IWFs): These functions are referred to in the Interworking definition above, which include the conversion of physical and electrical states and the mapping of protocols. An IWF may be implemented in the public PHS network, in the other network(s), at the user's premises, through a third-party service provider, or in some combination of these.

The IWFs needed as a result of a service requirement for interworking are categorized as connection-dependent IWFs or communication-dependent IWFs. The relationships among these terms and definitions for connection-dependent IWFs and for communication-dependent IWFs are contained in Figure 4-1/B-IW0.01.

4 Telecommunication services to be supported by public PHS network interworking configurations

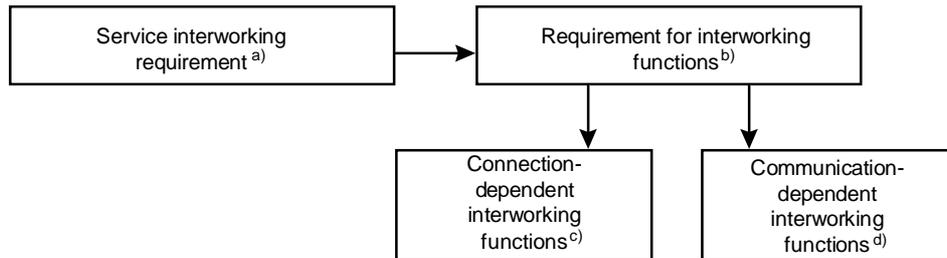
This clause contains a list of telecommunication services that are supported by interconnections between public PHS network and between public PHS network and other networks and defines the types of interworking functions required. The concept of 5 take into account:

- a) the definitions as outlined in 4;
- b) existing networks to be interconnected with public PHS network (public PHS networks, ISDNs, PSTNs, others);

- c) services to be offered with the public PHS network and through interworking with public PHS network.

End-to-end communication may require:

- i) interworking at lower layers;
- ii) interworking at higher layers;
- iii) interworking at both lower and higher layers.



- a) Service interworking requirements arise from the service definitions specified in the I.200-Series Recommendations.
- b) IWFs are needed as a result of any service requirement for interworking.
- c) Connection-dependent IWFs are those functions needed in order to interconnect ISDNs or ISDN and other networks.
- d) Communication-dependent IWFs are those functions in addition to connection-dependent IWFs needed in order to establish a specific end-to-end communication and which may differ from application to application.

FIGURE 4-1 / B-IW0.01

Telecommunication services to be supported by ISDN interworking configurations

Table 4-1/B-IW0.01 displays the networks that support telecommunication services which are also supported by an public PHS network and which are candidates, therefore, for interworking with an public PHS network in the provision of one of those telecommunication services. Furthermore, Table 4-1/B-IW0.01 depicts the type of interworking functions that may be required for each interworking configuration. Note that the table does not indicate the possibility for interworking between different telecommunication services.

TABLE 4-1/B-IW0.01 Network support of telecommunication services

Telecommunication services supported by the public PHS network	public PHS network interconnected with			
	public PHS network	PSTN	ISDN	Other dedicated networks
Telephony	0	N	N	N
Data transmission (Note 2)	(L)	N, L	N,L	N, (L)
Facsimile	0	N, L	N,L	N, L

0 No interworking functions foreseen
N Connection-dependent interworking needed
L Lower layer communication-dependent interworking needed
H Higher layer communication-dependent interworking needed
() N/L/H may be needed

NOTES

1 The list of services in Table 4-1/B-IW0.01 is not exhaustive and is therefore for further study. In particular, bearer services must be included.

2 See Recommendation X.1 for a description of data transmission services.

3 It is assumed for Table 4-1/B-IW0.01 that, for the cases of public PHS network to public PHS network interworking, the telecommunication services listed above are supported in both public PHS networks by the same bearer, no interworking functions are therefore required. public PHS network to public PHS network interworking situations that involve different bearers, as an extension of Table 4-1/B-IW0.01, are for further study.

5 Public PHS network interworking configurations

This section contains the general interworking reference configurations that form the basis of all possible public PHS network interworking configurations covered by the PHS MoU documents B-IWx.xx series .

The configurations are entirely functional and do not serve any aspect of the interworking function(s) needed in any specific instance of interworking. The complexities of specific cases are considered in the that deal at a scenario level of detail with the individual types of networks with which a public PHS network may be interconnected, i.e. PHS MoU documents B-IW2.00, B-IW3.00 etc.

The network interworking reference point is the IF3(K_x) or IF3(N_x) reference point when the network directly interconnected to the public PHS network is a non-ISDN or an ISDN, respectively.

5.1 Reference points for network interconnections

The protocol reference model for public PHS network interworking is outlined in 5 of ITU-T Recommendation I.320.

The reference points IF3(K_x) and IF3(N_x) for network interconnections are defined in this clause .

According to Note 1 to Figure 5-1/B-IW0.01 the value x = 1 signifies that interworking functions exist in the public PHS network. The value x = 2 signifies that no interworking functions are required in the public PHS network. No assumption is made regarding interworking functions outside the public PHS network. Regardless of the value of x, the possibility of interworking functions in the other networks, between the networks, or of some combination of these situations, is kept open. The case of IF3(N₁)

covers the situation when interworking functions are split between the two public PHS networks involved.

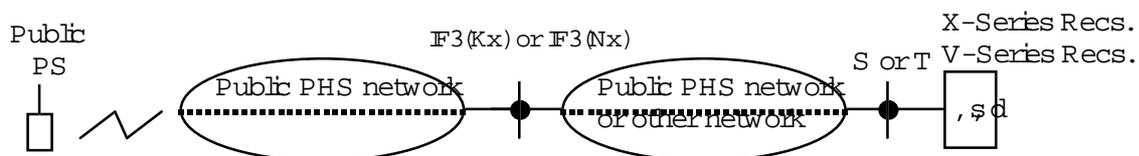
5.1.1 Interworking using one-stage selection (one-stage interworking)

Interworking using one-stage selection is possible when the interconnection of networks takes place by interconnecting trunk lines. It is also possible when the networks are physically inseparable [for example, see b) of Figure 5-4/B-IW0.01, and associated text]. In this type of interworking, each of the terminals involved in a communication has assigned to it a directory number from the numbering plan of the network to which it is connected. For call establishment, one-stage selection is assumed.

For interworking by one-stage selection, the interconnection of networks takes place at reference points IF3(K_X) or IF3(N_X) (see Figure 5-1/B-IW0.01).

The application of existing interfaces and the specification of new interfaces at the IF3(K_X) and IF3(N_X) reference points for interworking by one-stage selection needs further study.

NOTE – In Recommendation X.300 this category of interworking is defined as “interworking by call control mapping” (see 6.2.1/X.300).



5.1.2 Interworking using two-stage selection (two-stage interworking)

Interworking using two-stage selection is sometimes required, e.g. access to a ISDN through a public PHS network. In this example, each of the terminals involved in a communication has assigned to it a directory number from the numbering plan of the ISDN. For call establishment, two-stage selection is assumed: first, a connection is established through the public PHS network to the appropriate ISDN port; second, a connection is established through the ISDN to the called terminal.

The logical appearance of interworking by two-stage selection at reference point IF3(K₂) (see Note 1) may be that of a customer access (see Figure 5-2/B-IW0.01).

The application of existing interfaces and the specification of new interfaces at the IF3(K₂) reference point for interworking by two-stage selection is for further study.

NOTES1 Since, in the case of interworking using two-stage selection depicted in Figure 5-2/B-IW0.01, no IWFs are required in the public PHS network, only reference point IF3(K₂) is relevant.

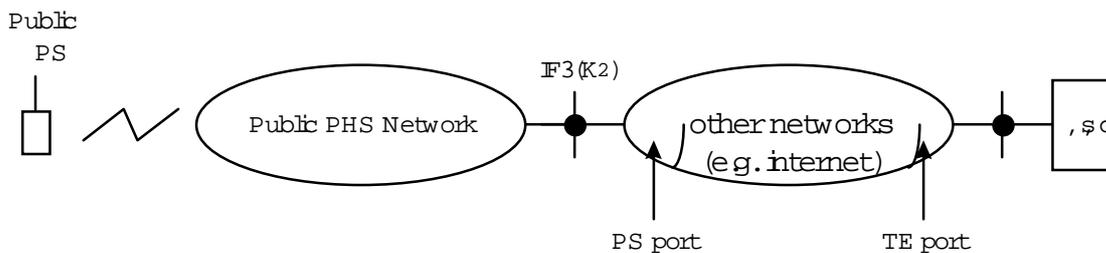


FIGURE 5- 2/ B- IW0.01
Interworking by two-stage selection at reference point IF3(K2)

5.2 Public PHS network to public PHS network interconnection

5.2.1 Reference configuration

With regard to public PHS network to public PHS network interworking in the context of the I.500-Series Recommendations, the functionality required for bearer service interworking is contained in public PHS network to public PHS network internetwork interfaces.

Figure 5-3/B-IW0.01 shows a reference configuration for public PHS network to public PHS network interworking. The services offered at the endpoints may be different.

public PHS network to public PHS network interworking may involve the functionality required for interworking to take place between public PHS networks operated by, for instance, different Administrations.

5.2.2 Connection types

Applicable PHS MoU document: B-IW2.00

ISDN circuit mode – ISDN circuit mode (both public PHS network supporting a circuit-switched bearer service)

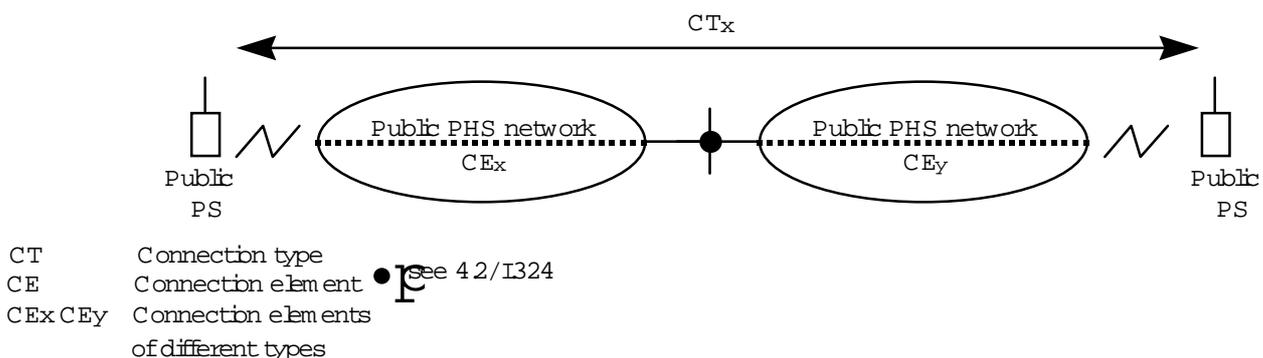


FIGURE 5- 3 / B- IW0.01
Reference configuration where Public PHS Network to Public PHS Network interworking is required

5.3 Interworking between public PHS networks and other networks

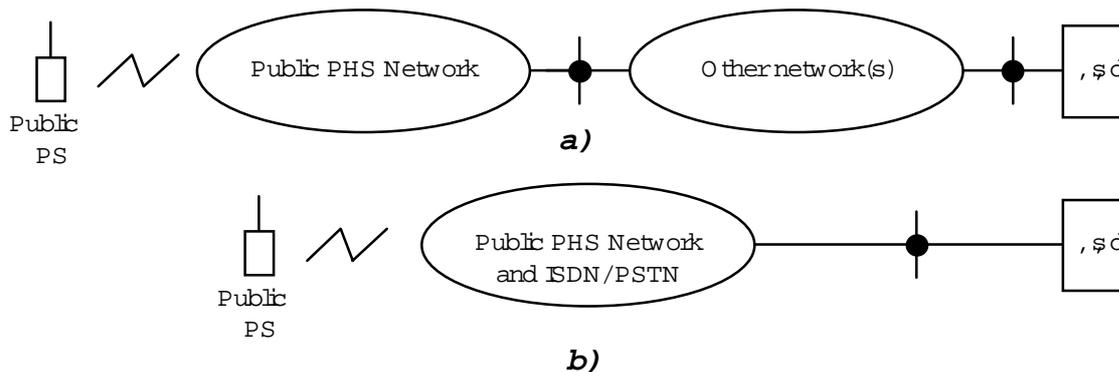
5.3.1 Reference configurations

Network interworking is required whenever a public PHS network and other networks are interconnected to provide an end-to-end connection.

Network interworking functions typically would contain the functionality needed for conversion of physical and electrical interface characteristics and for mapping of layer 2 and layer 3 network protocols. Examples of such network interworking functions are: signalling conversions, information transfer, protocol conversions, analogue-to-digital (and *vice versa*) conversions, and interworking between different numbering and charging plans.

Two reference configurations for network interworking are shown in Figure 5-4/B-IW0.01. The services offered at the endpoints may be different.

The separation between a public PHS network and an other network may not always be obvious. A local exchange may, for example, support both traditional telephony service and ISDN services. The physical network components supporting these services may be inseparable. From a functional perspective, such a case might be covered by a) of Figure 5-4/B-IW0.01, while b) of this Figure might be more appropriate from an implementation point of view.



NOTE- Case *b*) illustrates the situation when no clear division exists between physical components supporting Public PHS Network and physical components supporting other network

FIGURE 5-4 / B- IW0.01

Some examples of reference configurations where network interworking is required

5.3.2 Connection types

5.3.2.1 Public PHS network-PSTN

Applicable PHS MoU document: B-IW3.00

ISDN circuit mode-PSTN

- speech;
- 3.1 kHz;
- 64 kbit/s unrestricted

5.4 Public PHS network internal interworking

Internal public PHS network interworking involves the capabilities required for interworking between different connection elements within a public PHS network, as well as the capabilities required to support other interworking requirements within a public PHS network.

A reference configuration is given in Figure 5-5/B-IW0.01. The services offered at the endpoints may be different.

Not all aspects of internal public PHS network interworking may be subject to standardization. The existence and functionality of such interworking, however, may have an impact on the required functionality of network interworking of public PHS network to public PHS network interworking.

5.5 Network concatenation configurations

NOTE – The impact of network concatenation configurations (i.e. cascaded networks) on public PHS network and existing networks and on the mechanisms and functionalities for the realization of these networks is for further study.

5.5.1 Reference configurations

See Figure 5-6/B-IW0.01

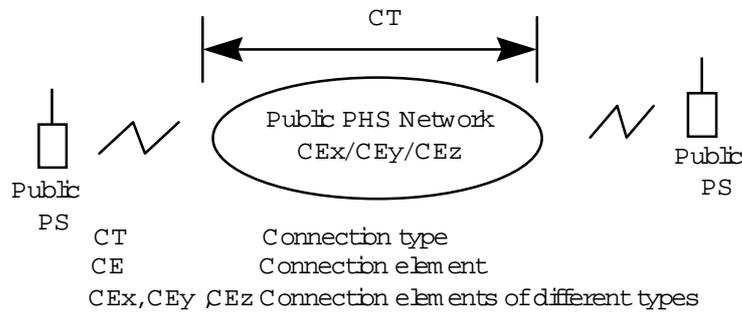
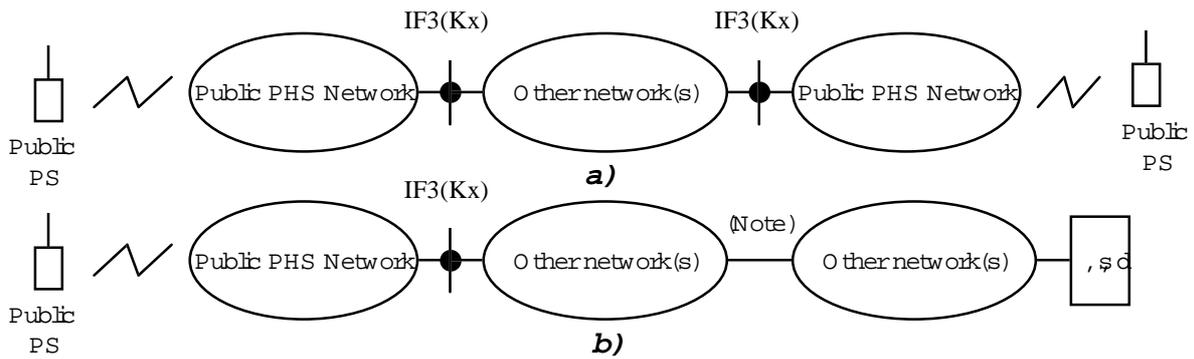


FIGURE 5-5 / B-IW0.01
Reference configuration where internal/ Public PHS Network interworking is required



NOTE- In the case of cascaded(concatenated) networks other than Public PHS networks, a requirement may exist for interworking functions between pairs of such networks.

FIGURE 5- 6 / B-IW0.01
 Network concatenation reference configurations

5.5.2 Connection types

5.5.2.1 Public PHS network-ISDN-public PHS network

Applicable alternatives at reference points IF3(Nx) are described in 5.3.2.1 and in PHS MoU document B-IW2.00.

5.5.2.2 Public PHS network-PSTN-public PHS network

Applicable alternatives at reference points IF3(Kx) are described in 5.3.2.2 and in PHS MoU document B-IW3.00 .

6 Interworking functional requirements – General aspects

6.1 Categories of interworking functions

The following network-related characteristics and protocols depend on the network type (ISDN circuit-switched, PSTN, etc.) and may be identified at the point of network interworking for conversion or mapping:

- network characteristics related to the connection type, such as interface characteristics, switching mode, bit rate, transfer mode, etc., and non-protocol conversion-related characteristics such as numbering plan and special routing;
- network-to-network protocols used for call establishment interexchange signalling, such as SS No. 7, etc. (e.g. SS No. 7 ISUP to another User Part of SS No. 7, SS No.7 to non-ISDN signalling system, D-channel signalling to non-ISDN user access signalling systems based on national standards);
- protocols used for the support of those supplementary services and service signals which have network-to-network relevance, as in the case, for example, of the closed user group facility;
- signals due to network operation and maintenance;

- e) inband protocol conversion IWFs such as rate adaption, modem pools, and generation of inband tones and announcements.

The definition of the conversion or mapping functions is the subject of specific interworking Recommendations which address ISDN interworking at a functional level of detail (see PHS MoU document B-IW0.00).

Interworking functions must take into account the mapping of protocols (protocol elements) dedicated to the support of OSI network layer service characteristics. These requirements should be formulated with the recognition that the networks involved in ISDN interworking may support the OSI network layer service as defined in Recommendation X.213 in different ways and to different extents (see 6/X.300).

6.2 Mapping principles

Interworking implies the transfer of information between two different entities across an interface. This transfer may imply the need to map different protocols with respect to coding, sequencing, and timing. Ideally, no information content should be lost in mapping. This objective may not be achievable in all circumstances. Three different cases are identified:

- a) one-to-one mapping, where the information is transferred across the interface without any loss;
- b) mapping with degraded information transfer, where parts of information are lost when crossing the interface;
- c) no meaningful mapping possible, due to the fact that crucial parts of one protocol cannot be represented in the other protocol.

In these cases, appropriate actions have to be taken at the interworking point with respect to one or both of the communicating entities.

6.3 Guidelines on the description of mapping functions

For further study.

6.4 Functional requirements for lower layer service interworking

(For example, mapping of layer 2 and layer 3 protocols by end systems in support of end-to-end communication).

For further study.

6.5 Functional requirements for higher layer service interworking

For further study.

7 General aspects of selection mechanisms for interworking functions

Public PHS network interworking will involve sets of different functional elements dedicated to the

various cases of network interworking. For each call where interworking is required, specific interworking functions have to be selected (see Figure 7-1/B-IW0.01).

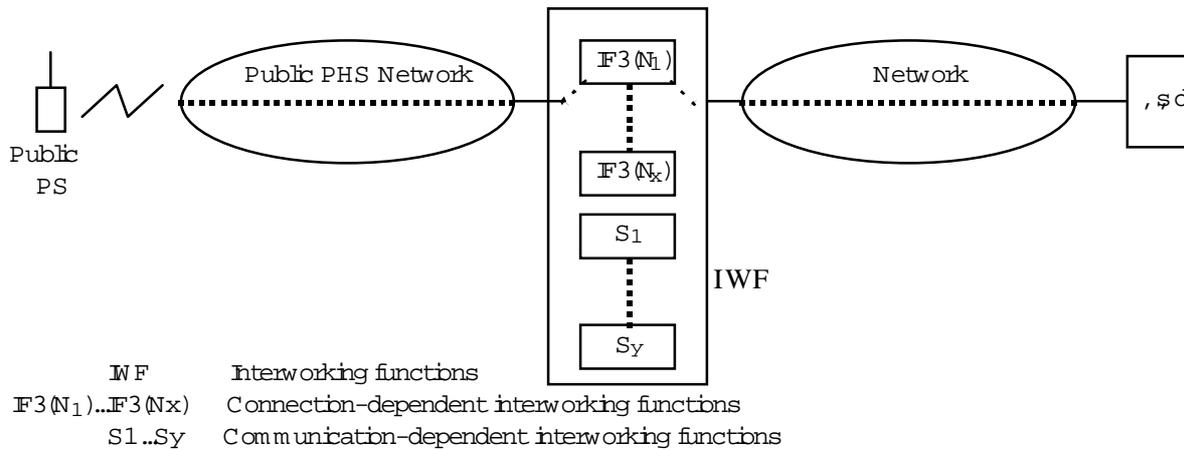


FIGURE 7- 1 / B- IW0.01
Selection of interworking functions, where a Public PHS Network is interconnected with another network (communication-dependent interworking functions may or may not be required)

When the IWF is not an addressed entity, the following concept for the selection of interworking functions is therefore defined:

- a) Connection-dependent interworking functions are selected by evaluation of user-network and network-network signalling information. Relevant information includes:
 - bearer capability;
 - low layer compatibility;
 - service indication;
 - routing information (address information, transit network information);
 - information on supplementary services (facilities), if applicable.
- b) Network-provided communication-dependent interworking functions are selected by evaluation of user-network and network-network signalling information. Relevant information includes:
 - service indication;
 - lower and higher layer compatibility information;
 - information on supplementary services (facilities), if applicable.
- c) End-system-provided communication-dependent interworking functions, if available, are activated by one of the following approaches:
 - by evaluation of user-network signalling information during the call establishment phase (service indication and lower/higher compatibility information);
 - by evaluation of user-to-user compatibility information during the parameter exchange phase.

NOTE – Examination of these information elements requires further study.

Annex A GLOSSARY and ABBREVLATIONS

GLOSSARY

*****A*****

*****B*****

*****C*****

*****D*****

*****E*****

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*****G*****

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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.

IF3(Nx)

PHS MoU

The network interworking reference point is the IF3(Nx) reference point when the network directly interconnected to the public PHS network is a public PHS network or an ISDN.

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Abbreviations

CE	Connection element
CS	Cell station
CSPDN	Circuit switched public data network
DTE	Data terminal equipment
ISDN	Integrated services digital network
IWF	Interworking function
OSI	Open Systems Interconnection
PDN	Public data network
PLMN	Public land mobile network
PS	Personal station
PSPDN	Packet switched public data network
PSTN	Public switched telephone network
SS No.7	Signalling System No. 7
TA	Terminal adaptor
TE	Terminal equipment