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Configurations

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# PHS MoU Group

## History of Revised Versions

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| 01 | 17 April 1996 | Established as follows.<br> Document No. : NW1.00<br> Document Title : System Configuration<br>of Personal Handy-Phone System |
| 02 | 17 Dec. 1996 | This version is the overall revised version of the above-mentioned NW1.00. |
| 03 | 11 July 1997 | Sub-clause 3.1 is chnanged. |
| 04 | 19 Dec. 1997 | Glossary and abbreviations are aligned with A-GN1.00 (Glossary and Abbreviations) |
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**Public Personal Handy-Phone System :
Network and System Configurations**

**Contents**

## 1. General

### 1.1 Objectives of this document

This document specifies the public PHS network model based on the scope defined by B-NW0.00. The model is described by means of functional architecture and physical architecture according to the ITU-T Recommendations related to the IN CS-2, including the definition of interface reference points to be specified by B-IFx.xx series documents of PHS MoU Group.

The objective of this specification is to provide the reference model of public PHS network to meet service requirements and network requirements. The reference model serves as basis for interface specification for public PHS network by allocating the functionality and identifying the interface reference points.

This document also shows the application of the public PHS network model to integration with other networks and internetworking with other networks. Furthermore, this document explains how the model works as explanatory purpose.

### 1.2 Scope of this document

This document specifies the public PHS network model, defines the interface reference points and provides the explanatory sequence of how the model works. This document also specifies the following cases based on the public PHS network as defined by B-NW0.00.

– basic public PHS network
– public PHS network integrated with non-IN structured PSTN/ISDN
– Internetworking with other networks including PLMN
– Internetworking between public PHS networks

This document includes the description relating to the public PHS network attached to the PLMN as one example of PHS applications in Appendix.

## 2. Basic functional architecture for public PHS network

### 2.1 Explanation of diagram

Figure 2-1/B-NW1.00 and 2-2/B-NW1.00 identify the basic functional models for public PHS network. These diagrams depict the functional entities and relationships applicable to public PHS network. Figure 2-1/B-NW1.00 shows the basic functional model for internetworking with other IN-structured Network. Figure 2-2/B-NW1.00 shows the basic functional model for internetworking with other non-IN structured Network. These models include a single public PHS network, public PHS network integrated with PSTN/ISDN network.



Legend
CCAF    Call Control Agent Function
CCF     Call Control Function
CUSF    Call Unrelated Service Function
SCF     Service Control Function
SCUAF   Service Control User Agent Function
SDF     Service Data Function
SRF     Specialized Resource Function
SSF     Service Switching Function

*1 : Necessity of these relationships is for further study.
*2 : Public PHS network, existing PSTN, ISDN, etc. can be considered.

**Figure 2-1/B-NW1.00  Basic Functional Model for Public PHS Network 1/2**

network boundary

to other SDFs

SDF

to other SCFs

SCF

to IAFs [*1]

to IAFs [*1]

SRF

SCUAF

CUSF          SSF

CCAF          CCF

CCF

Public PHS Network

Other non-IN structured Network[*2]

Legend
CCAF      Call Control Agent Function
CCF       Call Control Function
CUSF      Call Unrelated Service Function
IAF       Intelligent Access Function
SCF       Service Control Function
SCUAF     Service Control User Agent Function
SDF       Service Data Function
SRF       Specialized Resource Function
SSF       Service Switching Function

............... IN Service Control
————— Bearer Connection Control
----------- Non-Call, Non-Bearer
          Associated IN Service Control
·-··-··-·· Interworking Relationship

*1 : Note that the location of the IAF is for further study from the view point of call unrelated internetworking with non-IN structured network.

*2 : Existing PSTN, ISDN, PLMN, etc. can be considered.

**Figure 2-2/B-NW1.00  Basic Functional Model for Public PHS Network 2/2**

## 2.2 Definition of Functional Entities

The CCAF is the call control agent (CCA) function that provides access for users. It is the interface between user and network call control functions.

The CCF is the call control (CC) function in the network that provides call/connection processing and control.

The SSF is the service switching (SS) function, which, associated with the CCF, provides the set of functions required for interaction between the CCF and a service control function (SCF).

The SCF is a function that commands call control functions in the processing of IN provided and/or custom service requests. The SCF may interact with other functional entities to access additional logic or to obtain information (service or user data) required to process a call/service logic instance.

The SDF contains customer and network data for real time access by the SCF in the execution of an IN provided service.

The SRF provides the specialized resources required for the execution of IN provided services (e.g. digit receivers, announcements, conference bridges, etc.).

The IAF is the intelligent access (IA) function, which provides access between the SCF of an IN-structured network and an entity which is not an IN-structured network. This latter entity may be other networks (PSTN, ISDN, PLMN...) or customers (private network, simple databases network used for instance in the Customized Call Routing service, terminals, PABXs...).

The CUSF is the call-unrelated service (CUS) function, which, associated with the CCF and the SSF, provides a set of call unrelated service functions required for out-channel interaction with a SCUAF. It also provides the set of functions required for interaction between the SCUAF and a SCF.

The SCUAF is the service control user agent (SCUA) function that provides access for users. It is the interface between a user and the call-unrelated service function (CUSF).

**2.3 Functional Entity models**

Refer to ITU-T Recommendation Q.1224 for the explanation of the each Functional Entity (FE) model shown in the Figure 2-1/B-NW1.00 and Figure 2-2/B-NW1.00.

Table 2-1/B-NW1.00 shows functions required for the public PHS network. Item no. N-1 through N-13 in Table2-1/B-NW1.00 are functions required for communications, and item no. N-14 through N-18 are functions required for network operation and management. The mapping of these functions to the FEs of public PHS network is described as follows.

The Call Control Function(CCF) includes following functions.
1. CS Connection (N-1)
2. Line Connection Control (N-2)
3. Paging (N-3)
4. Handover (N-4)
5. Information Transfer (N-12)

The Service Control Function (SCF) Model includes following functions.
1. Location Registration (N-5)
2. Authentication (N-7)
3. Supplementary Service Function (N-9)
4. Gateway (N-11)
5. Operator Identification (N-13)

The Service Data Function (SDF) includes following functions.
1. Location Information Control (N-6)
2. Authentication Information Control (N-8)
3. Roaming (N-10)

The mapping of the other functions to FEs of public PHS network is for further study.

Table 2-2/B-NW1.00 shows functions required for wireless system. The mapping of the functions required for the wireless system in Table 2-2/B-NW1.00 to the FEs of public PHS network is described as follows.

The Call Control Function(CCF) includes following functions.
1. Wireless Access (R-2)
2. Interference Detection Function (R-3)
3. Interference Averting Function (R-4)
4. User Scrambling (R-5)

The Call Control Agent Function (CCAF) includes following functions.
1. Voice Coding (R-1)
2. Wireless Access (R-2)
3. User Scrambling (R-5)

**Table 2-1/B-NW1.00  Functions Required for Public PHS Network**

| Item No. | Function | Description |
|---|---|---|
| N-1 | CS Connection | Function to connect the network and Public CS |
| N-2 | Line Connection Control | Function to connect a line between a Public CS supporting Public PSs and Public PS communicating user with Public PS. |
| N-3 | Paging | Function to notify idle Public PSs that a service has been activated |
| N-4 | Handover | Function to enable a Public PS to continue to communicate over different wireless zones |
| N-5 | Location Registration | Function for registration of the associated relationships between the telephone number assigned to a Public PS and the connection point for routing an incoming call |
| N-6 | Location Information Control | Function for control of the associated relationships between the telephone number assigned to a Public PS registered by the location registration function and the connection point |
| N-7 | Authentication | Function to enable either or both of a Public PS identified by a telephone number and the network to check for the validity of the Public PS |
| N-8 | Authentication Information Control | Function to control information required for the authentication function |
| N-9 | Supplementary Service Function | Function to provide supplementary service |
| N-10 | Roaming | Function to enable a Public PS to communicate via the Public CS of multiple operators |
| N-11 | Gateway | Function to receive inter-network defined signalling from another network and convert them into local network signalling, and function to convert the local network signalling into inter-network defined signalling and send them to another network |
| N-12 | Information Transfer | Function to transfer information between the network elements |
| N-13 | Operator Identification | Function to identify the operator associated with the telephone number assigned to a Public PS |
| N-14 | CS Maintenance | Function for operation, maintenance and maintenance control of Public CS |
| N-15 | Customer Information Control | Function for control of information on users using Public PSs |
| N-16 | Charging | Function for acquired and recording information necessary for billing |
| N-17 | Billing | Function to prepare bills for users based on the information acquired and recorded by the charging function, issue the bills, and collect and control the revenue |
| N-18 | Settlement | Function necessary for settlement of accounts with other operators |

**Table 2-2/B-NW1.00  Functions Required for Wireless System**

| Item No. | Function | Description |
|---|---|---|
| R-1 | Voice Coding | Function to code Voice (analog signals) into digital signals or integrate the coded digital signals |
| R-2 | Wireless Access | Function to configure many communications channels through use of a given frequency band and gain access to one of the communications channels |
| R-3 | Interference Detection Function | Function to let a Public CS or Public PS attempting to start communications search for an idle channel and communicate by itself |
| R-4 | Interference Averting Function | Function to monitor the condition of interference by another Public PS, and if an interference occurs, avert the interference by automatically changing channels |
| R-5 | User Scrambling | Function to perform scramble processing of the original signals to prevent tapping |

## 3. Basic Physical Architecture for Public PHS Network

This clause describes basic physical architecture for public PHS network. Public PHS network is based on the Intelligent Network (IN) architecture, and detailed IN physical plane information is contained in ITU-T Recommendation Q. 1205.

The implementation of physical entity (PE) and deployment to the network shown in this clause may differ product by product or network by network. For example, if the some optional functional entities (FEs) for a PE is implemented in this PE, interface between FEs internal to this PE can be proprietary. Allocation of optional FEs to PE allows flexible physical implementation. Furthermore, the PEs described in this clause are for illustrative purposes only, and do not imply the only possible mapping of functionality.

### 3.1 Types of Public Public CSs

Public PHS network has the capability for several Public CS types to be implemented in each public PHS Network. Functional Entities (FEs) and Physical Entities (PEs) mapping shall be optimized for public PHS network planning. This subclause explains the characteristics of two popular Public CS types which are described as CS type 1 and CS type 2 in PHS MoU documents and the characteristics of Public CS types, using the information related issue for service control.

CS Type 1 has the only interface to the SSP (see Figure 3-2/B-NW1.00). Every information is transferred on this interface. Every information is one of the information being used for call control, the information being used for service control and also user information itself (Speech, 3.1kHz audio, 32kbit/s unrestricted data, etc.). This CS type 1 is always under the control of the SSP/SCP co-working PEs by way of the SSP. In general, the public PHS network using the CS type 1 requires fewer additions of functionalities for functional expansions, since fewer PEs in the PHS network will be affected by them.

On the other hand, CS type 2 has two interfaces connected to the SSP and the SCP-A (see Figure3-4/B-NW1.00). The interface between Public CS and the SSP transfers the information being used for call control, the location registration information and also user information. The other information is transferred on the interface between Public CS and the SCP directly. Public CSs interact with the SCP-A and the SSP independently. In this case, the functional expansions which are independent from the SSP functions require the additions of functionalities only in the Public CS and the SCP-A. For the reason, if the operator A who owns the public PHS access part including Public CS and the SCP-A and the operator B who owns the public PHS ISDN part including the SSP-L are different, the operator A can expand functions by itself in a short development period.
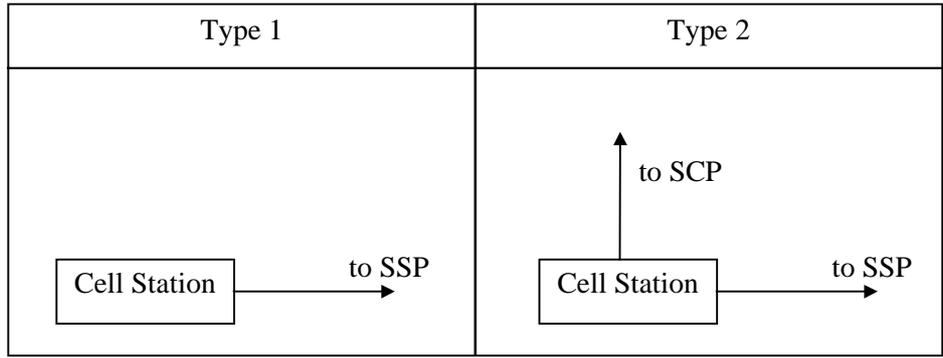
| Type 1 | Type 2 |
|---|---|
| Cell Station    to SSP → | to SCP ↑    Cell Station    to SSP → |

**Figure 3-1/B-NW1.00  Types of Public Public CS**

**3.2 Physical Entities (PEs)**

Physical entities supports PHS are shown as follows.

(1) Service Switching Point (SSP)

In addition to providing users with access to the network (if the SSP is a local switch ) and performing any necessary switching functionality, the SSP allows access to the set of IN capabilities. The SSP contains detection capability to detect requests for IN-based services. It also contains capabilities to communicate with other PE(s) containing a service control function (SCF), such as a service control point (SCP), and to respond to instructions from the other PE. Functionally, an SSP contains a call control function (CCF), and a service switching function (SSF). It also may optionally contain a service control function (SCF), a service data function (SDF), and/or a specialized resource function (SRF). The SSP may provide IN-based services to users connected to subtending Network Access Points. For the PHS service, SSP detects the call of PHS and access to IN capabilities for authentication, location registration, and routing for Public PS.

(2) Service Control Point (SCP)

The SCP contains the service logic processing programs (SLPs) and data that are used to provide IN-based services. The SCP is connected to SSPs by a signalling network. Multiple SCPs may contain the same SLPs and data to improve service reliability and to facilitate load sharing between SCPs. Functionally, an SCP contains an SCF and it may contain an SDF. The SCP can access data in an SDP either directly or through a signalling network. The SDP may be in the same network as the SCP, or in another network. The SCP can be connected to SSPs, and optionally to IPs, through the signalling network. SCP mainly executes Public PS authentication, location registration, routing for Public PS. There are 3 types SCP for public PHS network. They are SCP, SCP-A, and SCP-L. Authentication function is contained SCP-A, Location registration and routing for Public PS functions are contained SCP-L, and other functions are contained either SCP-A orSCP-L.

(3) Service Data Point (SDP)

The SDP contains the customer and network data which is accessed during the execution of a service. Functionally, the SDP contains an SDF.

(4) Network Access Point (NAP)

A NAP is a PE that contains only the CCF . It may also be present in the network. The NAP supports early and ubiquitous deployment of IN-based services. This NAP cannot communicate with an SCF, but it has the ability to determine whether a call is required IN processing. It shall send calls requiring IN processing to an SSP.

(5) Intelligent Peripheral (IP)

The IP provides resources such as customized and concatenated voice announcements, voice recognition equipment, and dual tone multi-frequencies (DTMF) digit receiver, and contains switch to connect users to these resources. The IP supports flexible information interactions between a user and the network. Functionally, the IP contains the SRF. The IP may directly connect to one or more SSPs, and/or may connect to the signalling network.
An SCP can request an SSP to connect a user to a resource located in an IP that is connected to the SSP from which the service request is detected. An SCP can also request the SSP to connect a user to a resource located in an IP that is connected to another SSP.

(6) Public Personal Station (Public PS)

Public PS is a user terminal for the PHS service which has the radio transmission capability for up link/down link with Public Public CSs . Public PS contains SCUAF and CCAF.

(7) Public Public CS (Public CS)

Public CS has the capability to terminate the radio section for the public PHS services. Public CS contains CUSF and CCF. There are two types of Public Public CSs.

(8) Intelligent Access Point (IAP)

The IAP is a PE which belongs to non-IN structured networks or customers (e.g. private networks, simple databases used in the customized call routing service). It contains the Intelligent Access Function, which provides access between an SCF of IN-structured networks and an entity of non-IN structured networks, and maps the information between the internal and external representation.

(9) Call Control Point (CCP)

A CCP is a PE that contains only the CCF . It may be present in the non IN-structured network. The CCP supports basic call processing. When the call that is connected to PHS is required, CCP routes the call to SSP in public PHS network.

(10) Mobile service Switching Center (MSC)

A MSC is a PE that contains only the MSCF . It may be present in the PLMN network. The MSC supports mobile service switching. When the call that is connected to PHS is required, MSC routes the call to SSP in public PHS network.

(11) Operating and Maintenance center (O&M)

O&M controls maintenance / operating of each element of the public PHS network.

(12) Billing Center (BC)

BC issues bill of subscribers

(13) Customer Service Center (CSC)

CSC controls registration, de-registration and modification of Public PS service profile.

## 3.3 Mapping of Functional Architecture to Physical Architecture

### 3.3.1 Mapping of Functional Entities to Physical Entities

Mapping of functional entities to IN physical entities.
This subclause gives a mapping of FEs into PEs and describes the reference points between the PEs. In so doing, an appropriate distribution of functionality is identified, and functional interfaces suitable for standardization are highlighted. The PEs described in this subclause are for illustrative purposes only, and do not imply the only possible mapping of functionality.
This subclause describes a flexible physical architecture made up of several PEs. Each PE contains one or more functional entities, which define its IN functionality. Typical scenarios of functional entity mapping to physical entity are shown in Table 3-1/B-NW1.00.

**Table 3-1/B-NW1.00  Typical scenarios of FE to PE mapping**

| PEs | FEs | | | | | | | | |
|-----|-----|-----|-----|------|-------|-----|------|-----|-----|
|     | SCF | SSF | CCF | CCAF | SCUAF | SDF | CUSF | SRF | IAF |
| SCP | C   | -   | -   | -    | -     | O   | -    | -   | -   |
| SSP | O   | C   | C   | -    | -     | O   | C    | O   | -   |
| SDP | -   | -   | -   | -    | -     | C   | -    | -   | -   |
| NAP | -   | -   | C   | -    | -     | -   | -    | -   | -   |
| IP  | -   | -   | -   | -    | -     | -   | -    | C   | -   |
| PS  | -   | -   | -   | C    | C     | -   | -    | -   | -   |
| CS  | -   | O   | C   | -    | -     | -   | C    | -   | -   |
| IAP | -   | -   | -   | -    | -     | -   | -    | -   | C   |
| CCP | -   | -   | C   | -    | -     | -   | -    | -   | -   |
| MSC | -   | -   | C   | -    | -     | -   | -    | -   | -   |

C: Core,  O: Optional,  - : Not allowed

Figure 3-2/B-NW1.00 shows basic physical architecture for public PHS network under cell station type 1 (case 1). In this case public PHS network is connected to other IN-structured network. This model includes single public PHS network that integrated with PSTN/ISDN. SCP can be used as home location register or visited location register when the roaming service is provided.
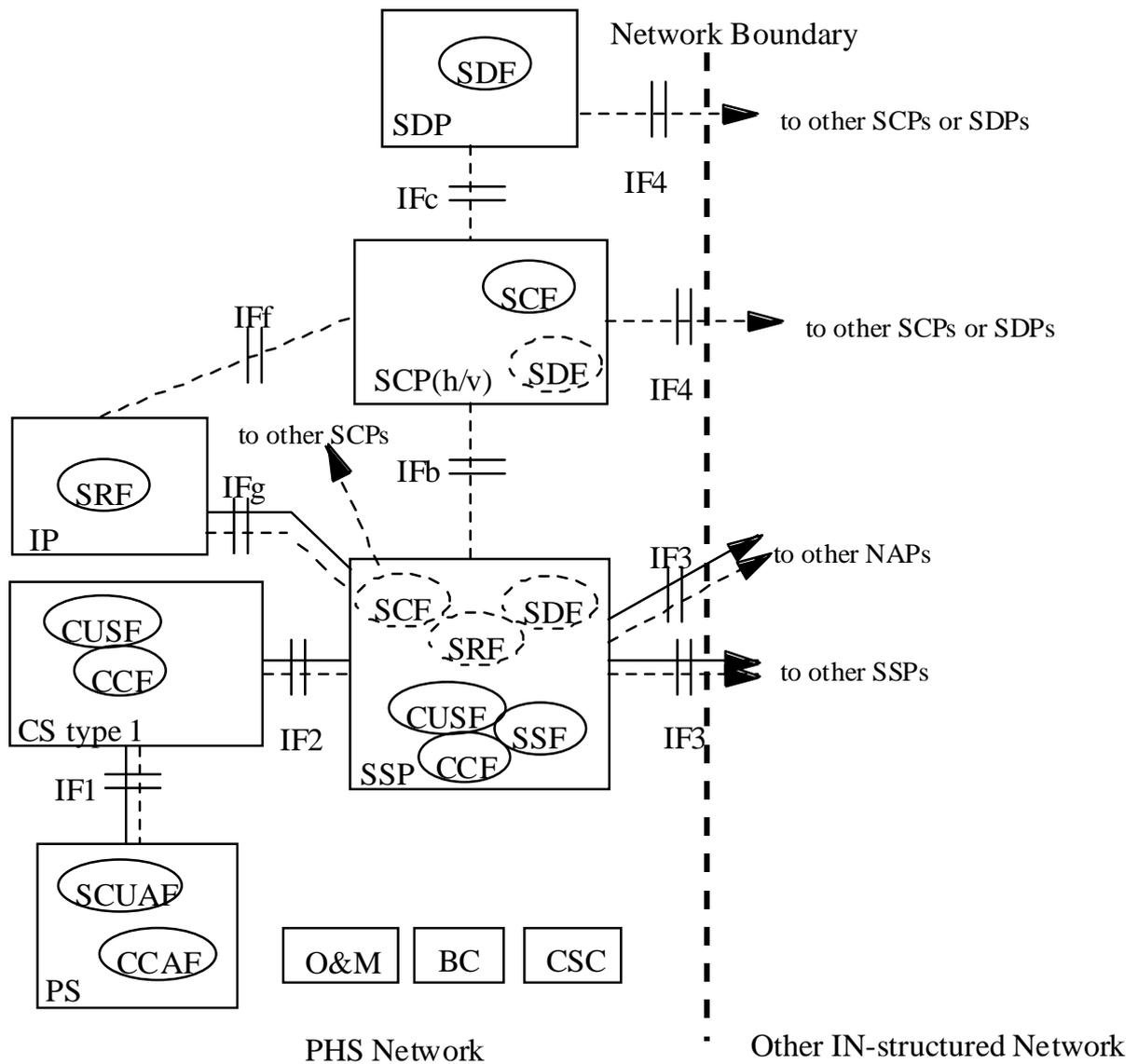
Figure 3-3/B-NW1.00 shows basic physical architecture for public PHS network under cell station type 1 (case 2). In this case public PHS network is connected to other non-IN structured network.

Figure 3-4/B-NW1.00 shows basic physical architecture for public PHS network under cell station type 2 (case 1). In this case public PHS network adopts SCP-A and SCP-L connects to other IN-structured Network. While public PHS network is connected to PLMN network, CCP is replaced to MSC in this figure. SCP-A and SCP-L can be used as home location registration or visited location registration when the roaming service is provided.

Figure 3-5/B-NW1.00 shows basic physical architecture for public PHS network under cell station type 2 (case 2). In this case public PHS network adopts SCP-A and SCP-L connects to other non-IN structured Network. While public PHS network is connected to PLMN network, CCP is replaced to MSC in this figure.

Figure 3-6/B-NW1.00 shows basic physical architecture for public PHS network under cell station type 2 (case 3). In this case public PHS network adopts SCP connects to other IN-structured Network. SCP can be used as home location register or visited location register when the roaming service is provided.

Figure 3-7/B-NW1.00 shows basic physical architecture for public PHS network under cell station type 2 (case 4). In this case public PHS network adopts SCP connects to other non-IN structured Network. While public PHS network is connected to PLMN network, CCP is replaced to MSC in this figure.

**Figure 3-2/B-NW1.00  Basic Physical Architecture for Public PHS Network
under Public Cell Station Type 1 (case 1)**

**Legend**

| | |
|---|---|
| CS type 1 | Cell Station type 1 |
| IP | Intelligent Peripheral |
| NAP | Network Access Point |
| PS | Personal Station |
| SCP | Service Control Point |
| SDP | Service Data Point |
| SSP | Service Switching Point |
| h/v | home location register /visited location register |
| O&M | Operating and Maintenance center |
| BC | Billing Center |
| CSC | Customer Service Center |

Transport ——————

Signalling*1 ··············

Optional FE

*1 Signals can transferred via
   information transfer network
   such as SS No.7 network

**Figure 3-3/B-NW1.00  Basic Physical Architecture for Public PHS Network
under Public Cell Station Type 1 (case 2)**

**Legend**

| | |
|---|---|
| CCP | Call Control Point |
| CS type 1 | Cell Station type 1 |
| IAP | Intelligent Access Point |
| IP | Intelligent Peripheral |
| NAP | Network Access Point |
| PS | Personal Station |
| SCP | Service Control Point |
| SDP | Service Data Point |
| SSP | Service Switching Point |

Transport ───────

Signalling*1 ·················

Optional FE

*1 Signals can transferred via
   information transfer network
   such as SS No.7 network

Note that it is open issue which SCP (i.e..., SCP-A or SCP-L) supports internetwork interface IF4.

**Legend**

| | |
|---|---|
| CS type 2 | Cell Station type 2 |
| IP | Intelligent Peripheral |
| NAP | Network Access Point |
| PS | Personal Station |
| SCP | Service Control Point |
| SDP | Service Data Point |
| SSP | Service Switching Point |
| h/v | home location register/visited location register |
| -A | Authentication |
| -L | Location |

Transport

Signalling*1

Optional FE

*1 Signals can transferred via information transfer network such as SS No.7 network

*2 These FEs support subset of capabilities

**Figure 3-4/B-NW1.00  Basic Physical Architecture for Public PHS Network under Public Cell Station Type 2 (case 1)**

**Legend**

| | |
|---|---|
| CCP | Call Control Point |
| CS type 2 | Cell Station type 2 |
| IAP | Intelligent Access Point |
| IP | Intelligent Peripheral |
| NAP | Network Access Point |
| PS | Personal Station |
| SCP | Service Control Point |
| SDP | Service Data Point |
| SSP | Service Switching Point |
| -A | Authentication |
| -L | Location |

Transport ————

Signalling*1 ················

Optional FE

*1 Signals can transferred via information transfer network such as SS No.7 network

*2 These FEs support subset of capabilities

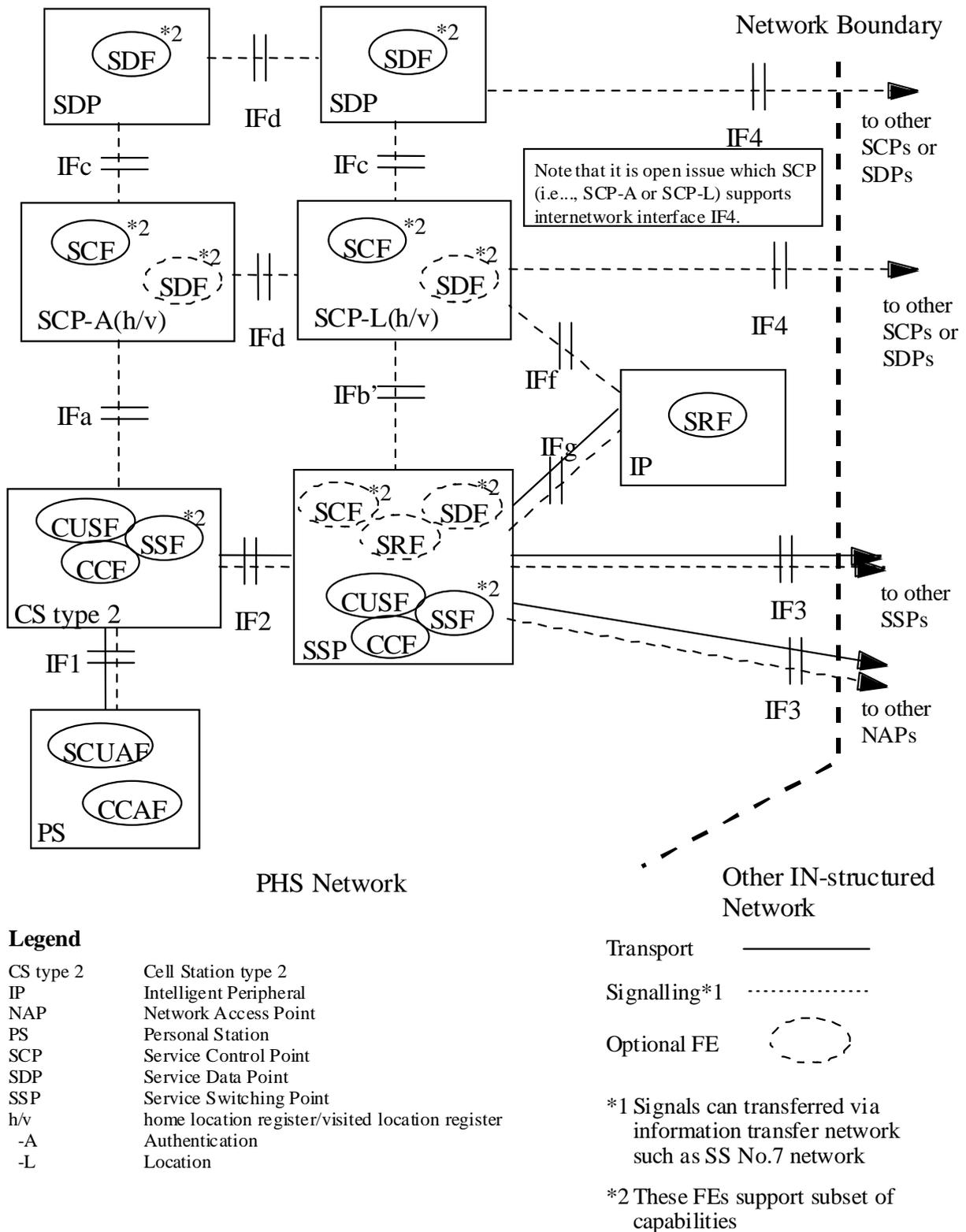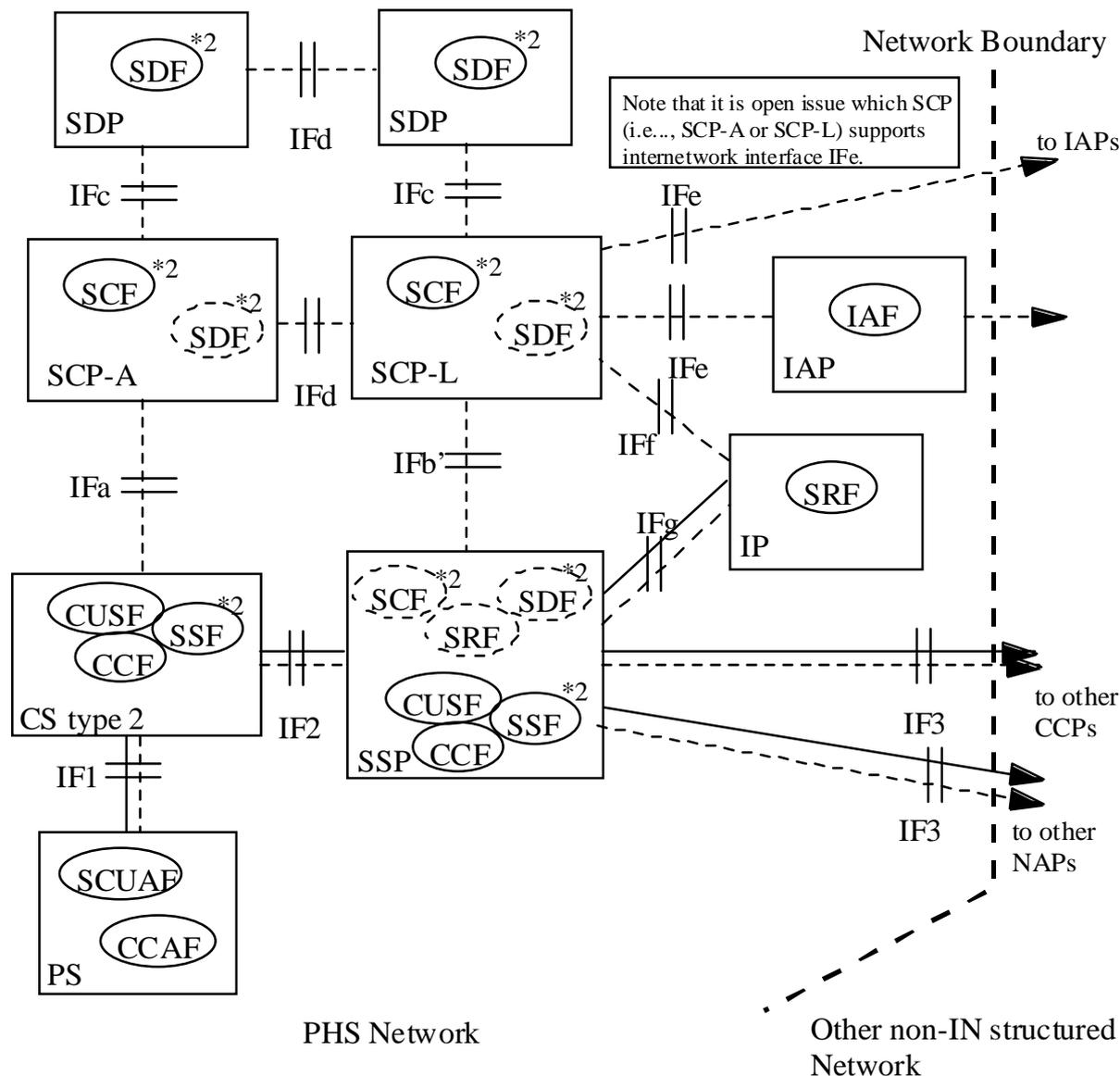Note that it is open issue which SCP (i.e..., SCP-A or SCP-L) supports internetwork interface IFe.

**Figure 3-5/B-NW1.00  Basic Physical Architecture for Public PHS Network under Public Cell Station Type 2 (case 2)**

**Legend**

| | |
|---|---|
| CS type 2 | Cell Station type 2 |
| IP | Intelligent Peripheral |
| NAP | Network Access Point |
| PS | Personal Station |
| SCP | Service Control Point |
| SDP | Service Data Point |
| SSP | Service Switching Point |
| h/v | home location register /visited location register |

Transport ————

Signalling*1 ················

Optional FE

*1 Signals can transferred via information transfer network such as SS No.7 network

*2 These FEs support subset of capabilities

**Figure 3-6/B-NW1.00  Basic Physical Architecture for Public PHS Network under Public Cell Station Type 2 (case 3)**

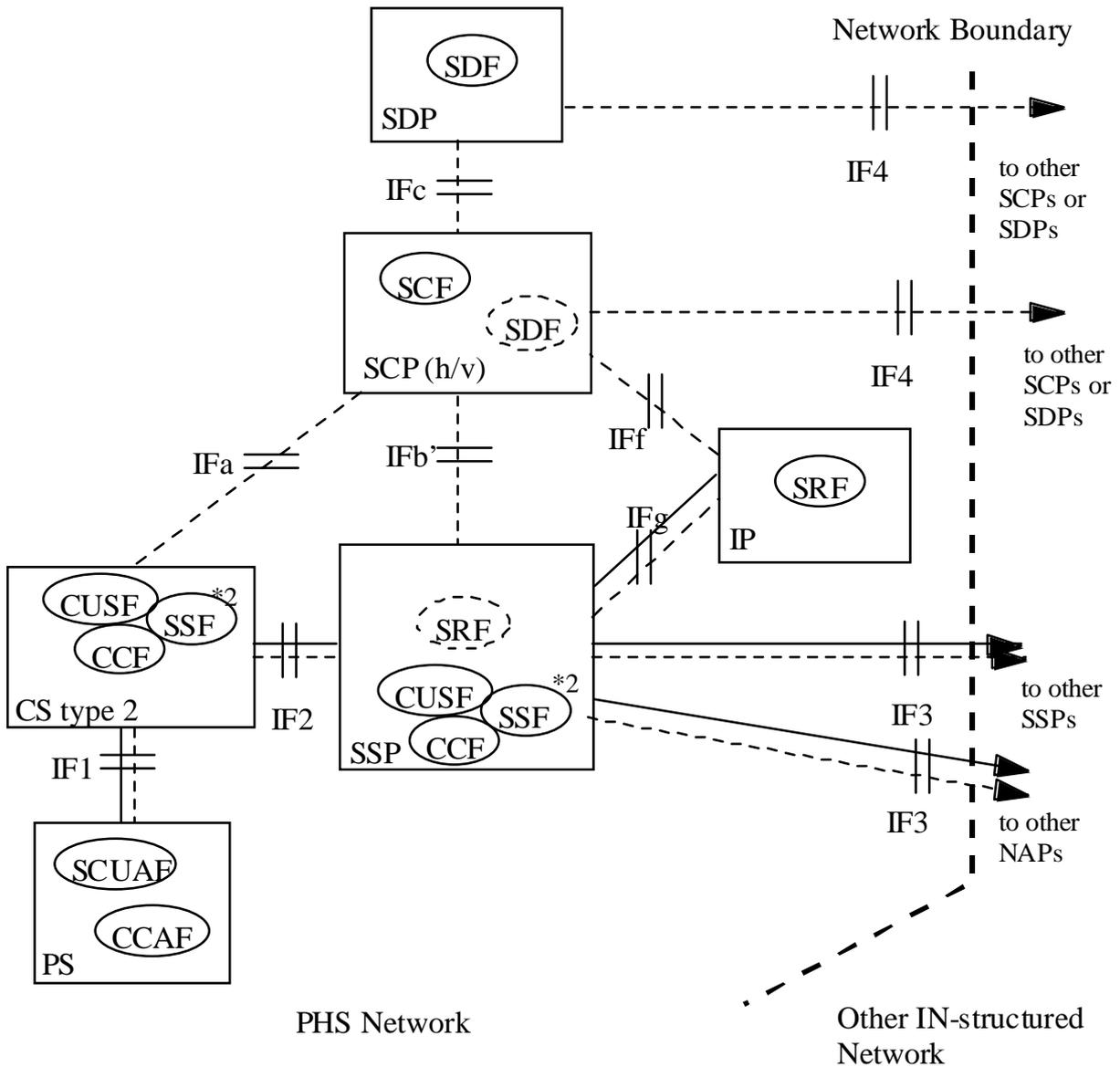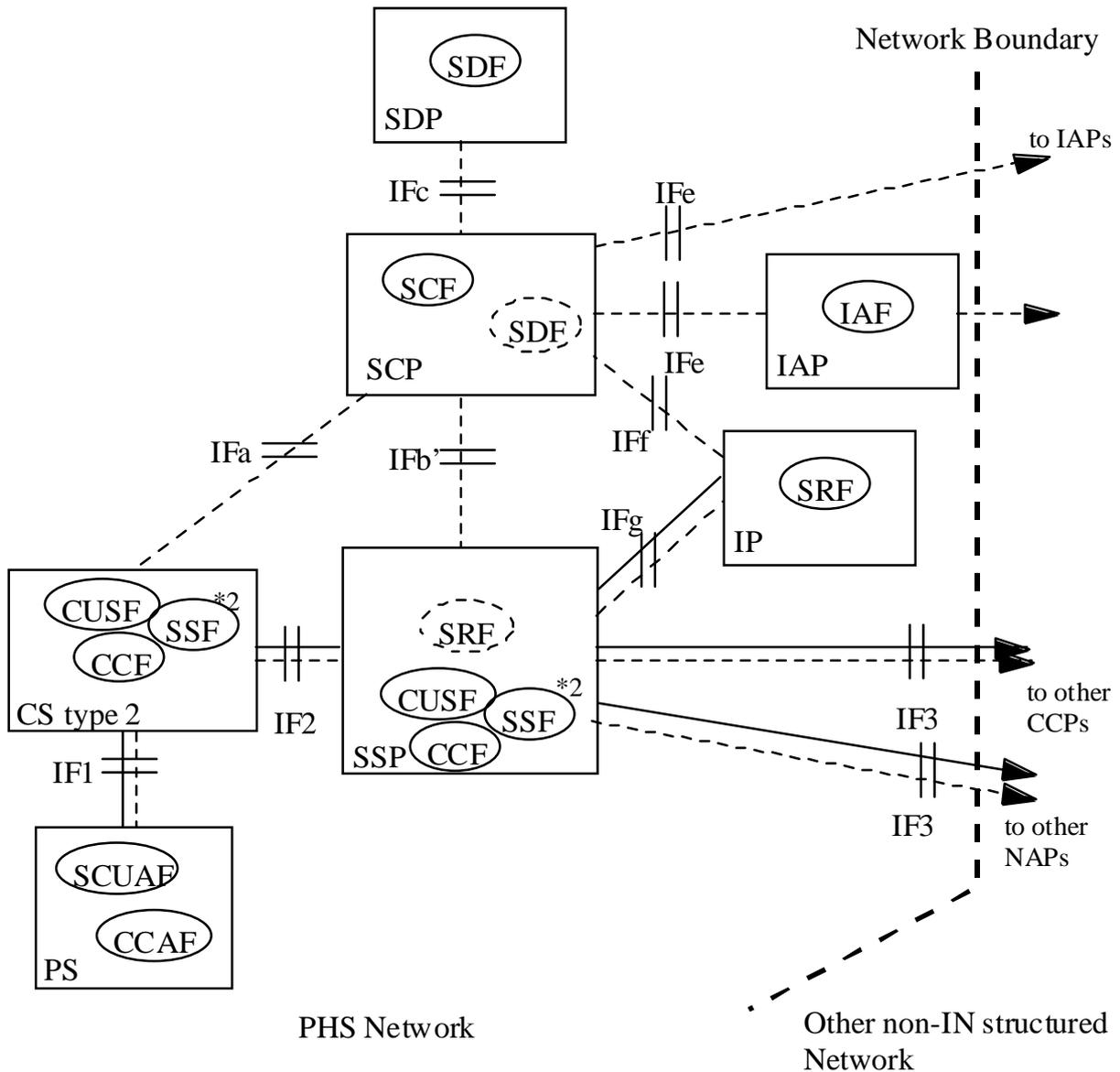**Figure 3-7/B-NW1.00  Basic Physical Architecture for Public PHS Network under Public Cell Station Type 2 (case 4)**

Network Boundary

to IAPs

SDF

SDP

IFc

IFe

IFe

SCF

SDF

SCP

IAF

IAP

IFf

IFa

IFb'

SRF

IP

IFg

CUSF

SSF

*2

CCF

SRF

CS type 2

IF2

CUSF

SSF

*2

SSP

CCF

to other CCPs

IF3

IF1

IF3

SCUAF

to other NAPs

CCAF

PS

PHS Network

Other non-IN structured Network

**Legend**

| | |
|---|---|
| CCP | Call Control Point |
| CS type 2 | Cell Station type 2 |
| IAP | Intelligent Access Point |
| IP | Intelligent Peripheral |
| NAP | Network Access Point |
| PS | Personal Station |
| SCP | Service Control Point |
| SDP | Service Data Point |
| SSP | Service Switching Point |

Transport

Signalling*1

Optional FE

*1 Signals can transferred via information transfer network such as SS No.7 network

*2 These FEs support subset of capabilities

### 3.3.2 Mapping of FE-FE Relationship to PE-PE Relationship

The FE-FE relationships used for PHS are as follows.

1) SSF-SCF
2) SCF-SDF
3) SCUAF-CUSF
4) CUSF-CUSF
5) SDF-SDF
6) SCF-SRF
7) CCF-CCF
8) SCF-IAF
9) SSF-SRF

All PE-PE interfaces of public PHS network model are shown in Figure 3-1/B-NW1.00 ~ Figure 3-6/B-NW1.00. Table 3-2/B-NW1.00 shows FE-FE relationships to PE-PE relationships for PHS.

**Table 3-2/B-NW1.00  FE-FE relationships to PE-PE relationships**

| FE-FE | PE-PE |
|---|---|
| SSF-SCF | SSP-SCP (IFb) |
| SCF-SDF | SCP-SDP (IFc) |
| | SSP-SCP (IFb) |
| | CS-SCP (IFa) |
| SCUAF-CUSF | PS-CS (IF1) |
| CUSF-SCF | SSP-SCP (IFb) |
| | CS-SCP (IFa) |
| CUSF-CUSF | CS-SSP (IF2) |
| SDF-SDF | SDP-SDP (IF4, IFd) |
| | SCP-SDP (IFd) |
| | SSP-SDP (IFb) |
| CCF-CCF | SSP-SSP (IF3) |
| | SSP-CCP (IF3) |
| | SSP-NAP (IF3) |
| SCF-IAF | SCP-IAP (IFe) |
| SCF-SRF | SCP-IP (IFf) |
| SSF-SRF | SSP-IP (IFg) |

Definitions of these interfaces are as follows.

(i)    IF1 is a radio interface between Public PS and Public CS.
(ii)   IF2 is the interface between the Public CS and the Service Switching Point (SSP).
(iii)  IF3 is the inter-network interface between SSPs or between SSP and Call Control Point (CCP).

(iv) IF4 is the inter-network interface between Service Data Functions(SDFs). Other interfaces such as between SCFs and between SCF and SDF are for further study. It is used for roaming services.

(v) IFa is the intra-network interface between the Public CS Type 2 and the SCP.

(vi) IFb is the intra-network interface between SSP and SCP.

(vii) IFb' is the intra-network interface between SSP and SCP.

(viii) IFc is the intra-network interface between SCP and SDP.

(ix) IFd is the intra-network interface between SCP-A and SCP-L and between SDPs.

(x) IFe is the inter-network interface between SCP and IAP.

(xi) IFf is the intra-network interface between SCP and IP

(xii) IFg is the intra-network interface between SSP aid IP

### 3.3.3 Selection of Protocols

(1) Interfaces between Public CS and SSP (IF2)

There are some interface types between Public CS and SSP according to the application method of PHS specific functions. In the case of public PHS network integrated with IN-structured PSTN/ISDN, specifications for existing ISDN interface is suitable for the functions.
The protocol model in the case of use of the specification for ISDN interface is shown in Figure 3-8/B-NW1.00. This approach is suitable for the case of IN-structured PSTN/ISDN. Mobility and radio resource controls are limited against in the case of the interface using in PLMN.

(2) Interface between networks (IF3, IF4, IFe)

There are some interface protocols between public PHS networks and the other networks. In the case of inter-connection between public PHS networks or between public PHS network and other IN-structured network, SS No.7 ISUP (IF3) and INAP (IF4) are suitable for bearer connections and IN based service provisions respectively. In the case of inter-connection between public PHS networks and other non IN-structured networks, SS No.7 ISUP is suitable for bearer connections (IF3) and INAP (IFe) is suitable for IN based service provisions. IFe is the same protocols structures as SCF-SCF interface.

(3) Interface internal public PHS network (IFa, IFb, IFb', IFc, IFd, IFf, IFg)

There are some interface protocols between PEs which are located in public PHS network (except Public CS-SSP interface). Protocols of IFa, IFb, IFb', IFc, IFd, and IFf are all suitable for INAP based on IN CS2. Protocol of IFg is suitable for SS No.7 ISUP.

IFa supports authentication for registration between the CUSF and the SCF, and for call related service provision between the SSF and the SCF. IFb supports I) CUSF-SCF interface for location registration and authentication for this, and ii) SCF-SSF interface for authentication for call related service provision and routing for PS. It also supports SCF-SDF and SDF-SDF interfaces when SSP contains SCF and SDF respectively. IFb' supports location registration between the CUSF and the SCF, and routing for PS between the SSF and the SCF. It also supports SCF-SDF and SDF-SDF interfaces when SSP contains SCF and SDF respectively. IFc supports management of the service data such as authentication information and location information. IFd is used for supporting roaming service with IF4. IFf is used by SCF to control SRF for the purpose of collecting DTMF or providing

voice announcement. IFg is used for connect user to IP.

Personal Station
(PS)

Cell Station
(CS)

Switching Network
(SSP)

| | | | |
|---|---|---|---|
| L3 | CC | CC | |
| | MM | MM | CC |
| | RT | RT | |
| L2 | L2 | L2 | L2 | L2 |
| L1 | L1 | L1 | L1 | L1 |

PS-CS Interface
(Radio)

CS-NW Interface

CC: Call Control
MM: Mobility Management
RT: Radio frequency Transmission management
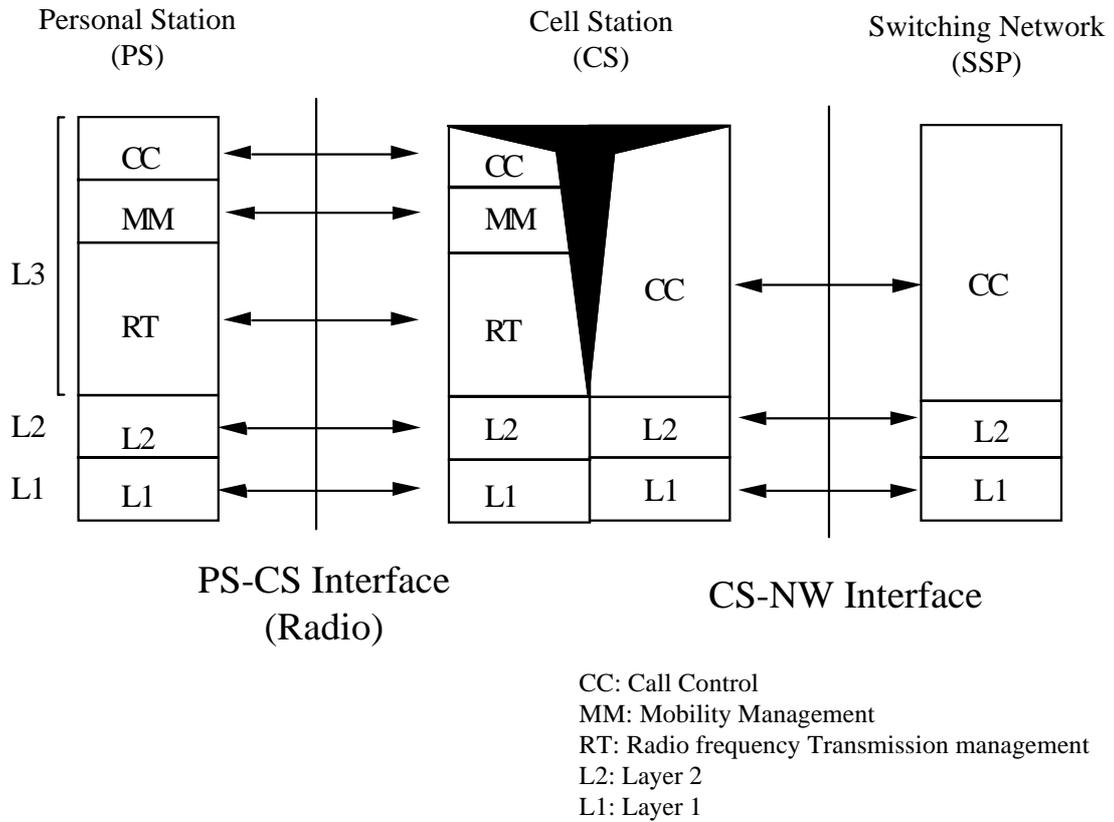L2: Layer 2
L1: Layer 1

**Figure 3-8/B-NW1.00  Protocol model (use of the specification for ISDN interfaces)**

## 4. Application of Basic Public PHS Network

This clause provides abstract explanations about integration and internetworking of public PHS network as examples of applications of basic models of public PHS network. Another public PHS network, PSTN/ISDN and PLMN are considered as interworking networks. Two types of PSTN/ISDN, namely IN-structured and non-IN structured, are considered. In this clause, the following cases are considered;

(Integration)
  – IN-structured PSTN/ISDN                          (4.1)
  – Non-IN structured PSTN/ISDN                       (4.2)

(Internetworking with other networks)
  – PSTN/ISDN                                         (4.3.2.1)
  – PLMN                                              (4.3.2.2)

(Internetworking between public PHS networks)        (4.3.3)

The description of this clause is based on the basic physical architecture for public PHS network under CS Type 1. Though discussions about network models for CS Type 2 might be similar, detailed review is left for further study. Also, the description is focused on integration and internetworking of public PHS network. Therefore, supplementary items such as SRF etc. are not considered in discussions of this clause.

### 4.1 Integration with IN-Structured Network

### 4.1.1 General

This sub-clause provides the basic explanations of public PHS network integrated with IN-structured network.

In the case that some IN-structured PSTN/ISDNs are available, the public PHS network may be realized by modifying or adding some functions related to PHS service, such as location registration, authentication, and handover etc. In this case, major modifications/additions related to PHS specific functions are mainly applied to access-provision and service-controlling portions in IN architecture.

### 4.1.2 Functional Model for Public PHS Network Integrated with IN-Structured PSTN/ISDN

Figure 4-1/B-NW1.00 depicts functional model for public PHS network which is integrated with IN-structured PSTN/ISDN. In this figure, functions which are added or modified to IN-structured PSTN/ISDN are expressed by bold-lines bubbles or doubled-line bubbles, respectively.
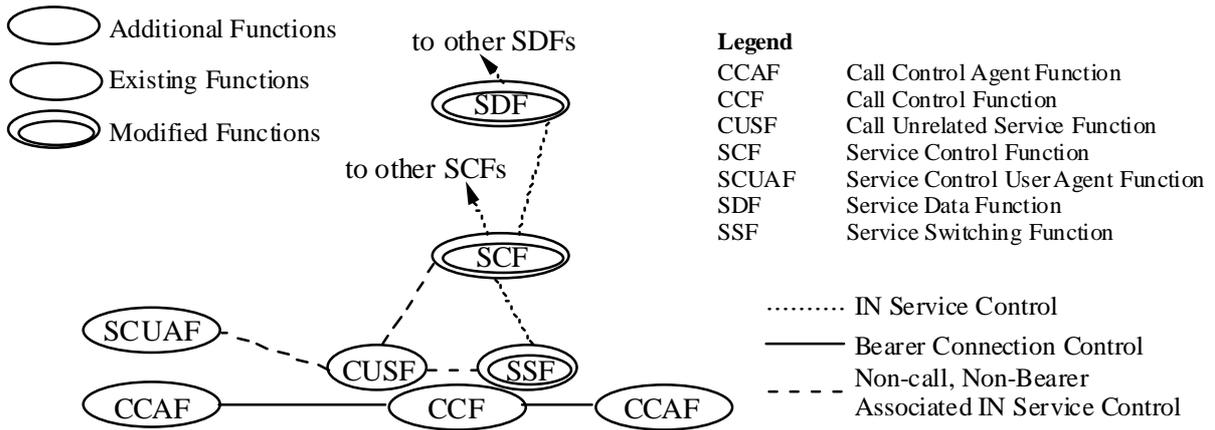
**Figure 4-1/B-NW1.00 Functional Model for Public PHS Network Integrated with IN-Structured PSTN/ISDN**

In this case, SCUAF and CCAF are attached for providing wireless access functions in PS. Also, CUSF is attached to CCF for interfacing purpose with SCUAF, SCF and SSF. SSF, SCF, SRF and SDF are modified in such way that these functions provides mobility related functions such as location-registration, authentication and hand-over.

### 4.1.3 Physical Architecture for Public PHS Network Integrated with IN-Structured PSTN/ISDN

Figure 4-2/B-NW1.00 depicts physical architecture for public PHS network which is integrated with IN-structured PSTN/ISDN. In this figure, allocation of functions are shown. Functions which are described in dotted lines mean that those functions may be optional.
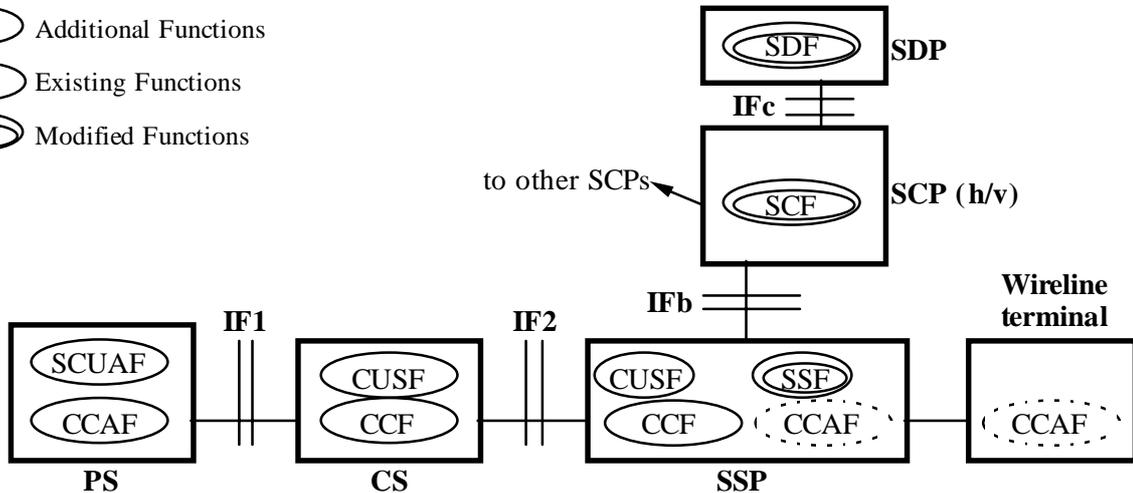
**Figure 4-2/B-NW1.00  Physical Architecture for Public PHS Network Integrated with IN-Structured PSTN/ISDN**

## 4.2 Integration with Non-IN Structured PSTN/ISDN

### 4.2.1 General

Public PHS Networks may also integrated with non-IN structured PSTN/ISDN. Additional network functions serve as overlay public PHS network for existing non-IN structured PSTN/ISDN as well as access part of public PHS network (i.e., SSP serves as toll switch in the PSTN/ISDN).

### 4.2.2 Functional Model for Public PHS Network Integrated with Non-IN Structured PSTN/ISDN

Figure 4-3/B-NW1.00 depicts functional model for public PHS network which is integrated with non-IN structured PSTN/ISDN. In this figure, functions which are added or modified to IN-structured PSTN/ISDN are expressed by bold-lines bubbles or doubled-line bubbles, respectively.
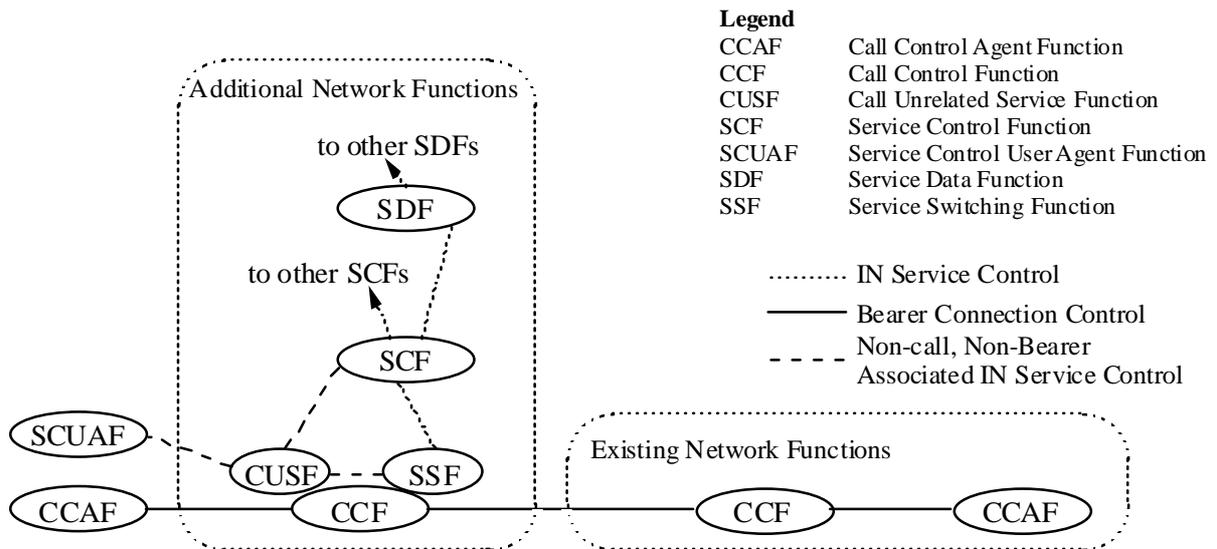
**Legend**
CCAF      Call Control Agent Function
CCF      Call Control Function
CUSF      Call Unrelated Service Function
SCF      Service Control Function
SCUAF      Service Control User Agent Function
SDF      Service Data Function
SSF      Service Switching Function

·········· IN Service Control
———— Bearer Connection Control
– – – – Non-call, Non-Bearer Associated IN Service Control

**Figure 4-3/B-NW1.00   Functional Model for Public PHS Network Integrated with Non-IN Structured PSTN/ISDN**

In this case, CUSF, SSF, CCF, SRF SCF and SDF are attached to existing network functions as overlay network functions. These functional entities provides mobility related functions such as location-registration, authentication and hand-over.

### 4.2.3 Physical Architecture for Public PHS Network Integrated with Non-IN Structured PSTN/ISDN

Figure 4-4/B-NW1.00 depicts physical architecture for public PHS network which is integrated with non-IN structured PSTN/ISDN. In this figure, allocation of functions are shown. Functions which are described in dotted lines mean that those functions may be optional.

In this case, Public CS, SSP and SDP are attached to existing non-IN structured PSTN/ISDN in such that these physical entities work as overlay network for existing non-IN PSTN/ISDN.
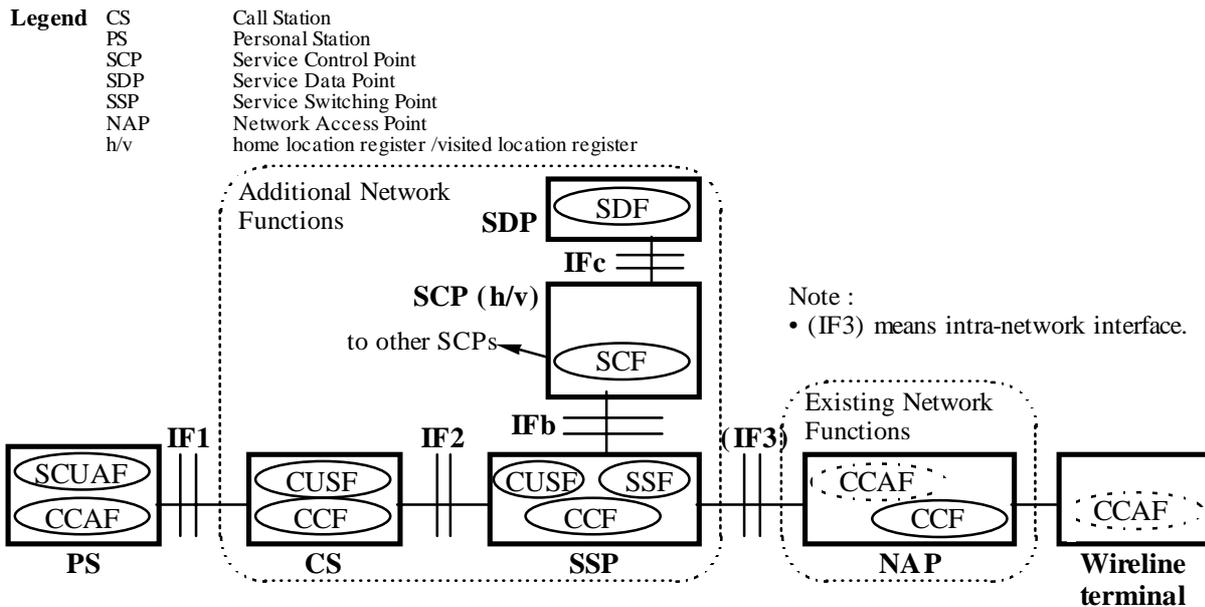
**Figure 4-4/B-NW1.00  Physical Architecture for Public PHS Network Integrated
with Non-IN Structured PSTN/ISDN**


## 4.3 Internetworking

### 4.3.1 General

This clause shows some models for applying the public PHS network for providing call connection to/from other network or roaming service, and also provides prose description and definition.

### 4.3.2 Internetworking with Other Networks

In this sub-clause, explanations about functional model and physical architecture is provided.

#### 4.3.2.1 Internetworking with PSTN/ISDN

#### 4.3.2.1.1 Functional Model for Public PHS Network Internetworking with PSTN/ISDN

In this case, only normal call connection is considered. Therefore, call related relationships between the public PHS network and PSTN/ISDN is used.

Figure 4-5/B-NW1.00 depicts a functional model for public PHS network which is Internetworking with PSTN/ISDN. CCF of both networks are connected through interface for call connection. Definition about other applications, which requires call unrelated relationships are left for further study.

**Figure 4-5/B-NW1.00  Functional Model for Public PHS Network
Internetworking with PSTN/ISDN**

### 4.3.2.1.2 Physical Architecture for Public PHS Network Internetworking with PSTN/ISDN

Figure 4-6/B-NW1.00 depicts physical architecture for public PHS network Internetworking with PSTN/ISDN. In this figure, allocation of functions are shown. Functions which are described in dotted lines mean that those functions may be optional.



**Figure 4-6/B-NW1.00  Physical Architecture for Public PHS Network
Internetworking with PSTN/ISDN**

SSP of public PHS network and CCP of PSTN/ISDN is connected through ISUP etc..

## 4.3.2.2 Internetworking with PLMN

As for application of internetworking between public PHS network and PLMN, roaming service provision by means of dual mode terminal etc. is considered currently. Though other applications may be provided by this internetworking, clarification of those applications is for further study.
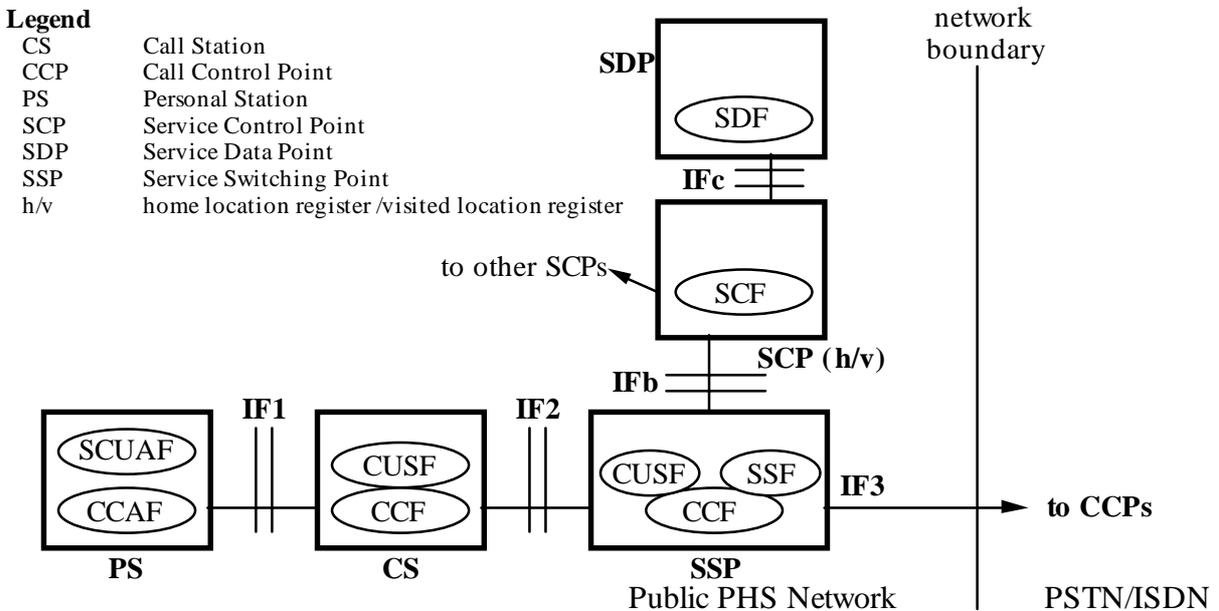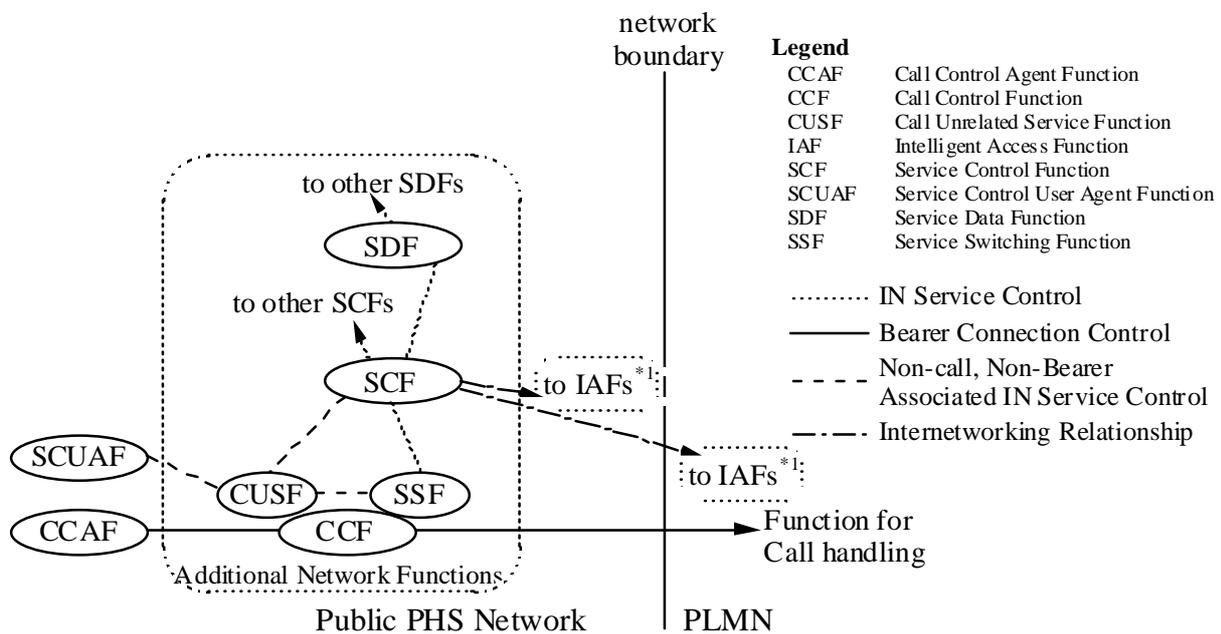
### 4.3.2.2.1 Functional Model for Public PHS Network Internetworking with PLMN

Figure 4-7/B-NW1.00 depicts a functional model for public PHS network which is internetworking with PLMN.



*1) The location of the IAF and relationship between the SCF and the IAF is for further study considering the roaming between public PHS network and PLMN for dual mode terminal by means of IN based call unrelated internetworking relationship.

**Figure 4-7/B-NW1.00  Functional Model for Public PHS Network
Internetworking with PLMN**

CCF and functions for call handling in MSC are connected through interface for call connection. Call unrelated internetworking is made via IAF. The IAF may provide the internetworking functions such as;

(a)  retrieving subscriber profile information from home network
(b)  updating location information in home network
(c)  maintaining consistencies of subscriber profile between home and visitor
etc.

The location of the IAF and relationship between the SCF and the IAF is left for further study considering the concrete image of roaming service between public PHS network and PLMN (e.g. dual mode terminal etc.)

### 4.3.2.2.2 Physical Architecture for Public PHS Network Internetworking with PLMN

Figure 4-8/B-NW1.00 depicts physical architecture for public PHS network internetworking with PLMN.
In this figure, allocation of functions are shown. Functions which are described in dotted lines mean that those functions may be optional.



**Legend**
| | |
|---|---|
| CS | Call Station |
| IAP | Intelligent Access Point |
| PS | Personal Station |
| SCP | Service Control Point |
| SDP | Service Data Point |
| SSP | Service Switching Point |
| h/v | home location register /visited location register |
| MSC | Mobile Service Switching Centre |

*1) The location and necessity of IAP and IFe is for further study considering the roaming between public PHS network and PLMN for dual mode terminal by means of IN based internetworking relationship.

**Figure 4-8/B-NW1.00  Physical Architecture for Public PHS Network Internetworking with PLMN**

In this case, SCUAF and CCAF are allocated in PHS Terminal (PS).
IAF is allocated in IAP.
Function for call handling is allocated in MSC in the PLMN.

The location and necessity of IAP and IFe is left for further study considering the detailed requirements for providing roaming service between public PHS network and PLMN.

### 4.3.3 Internetworking between Public PHS Networks

In this sub-clause, application of internetworking between public PHS network is explained.
Primary application is considered to be roaming between public PHS network.

Functional requirements for providing roaming service includes;

(a) retrieving subscriber data from home network
(b) holding visitor's service profile information
(c) removing information at the network from which the subscriber moved out
(d) routing the incoming call of roamed PS to visited public PHS network
(e) authorize to originate/receive calls from/to roamed PS in the visited network

As for roaming, internetworking procedures includes;

(a) Location Registration
(b) Call Termination

In order to realize these procedures, INAP is considered. An example of abstract procedures for roaming is as follows;

(Location Registration)
(a) Roamed PS send location registration request signal to visited network through IF1 and IF2.
(b) The visited network requests the subscribers information to the home network through IF4 and authenticate the roamed terminal.
(c) After complete authentication, the visited network save the retrieved subscribers information in its SDF.

(Call Termination)
(a) A user makes a call to the roamed PS and the call is routed to the PS's home public PHS network.
(b) The home public PHS network route the call to the visited network through IF3.
(c) The visited network search location of the PS through IFb and IFc and broadcast the paging signal for registered Public CS s through IF2 and IF1.
(d) After receiving the reply from the terminal the SSP of the visited public PHS network connect the call

In the rest of this clause, functional model and physical architecture for internetworking between public PHS networks are explained.

## 4.3.3.1 Functional Model for Internetworking between Public PHS Networks

Figure 4-9/B-NW1.00 depicts a functional model for internetworking between public PHS networks.

Each relationship between SCFs and SDFs is based on INAP. Though, SDF and SCF of public PHS networks has relationships with SCF and SDF of opposed network, necessity of relationships except SDF-SDF are for further study.
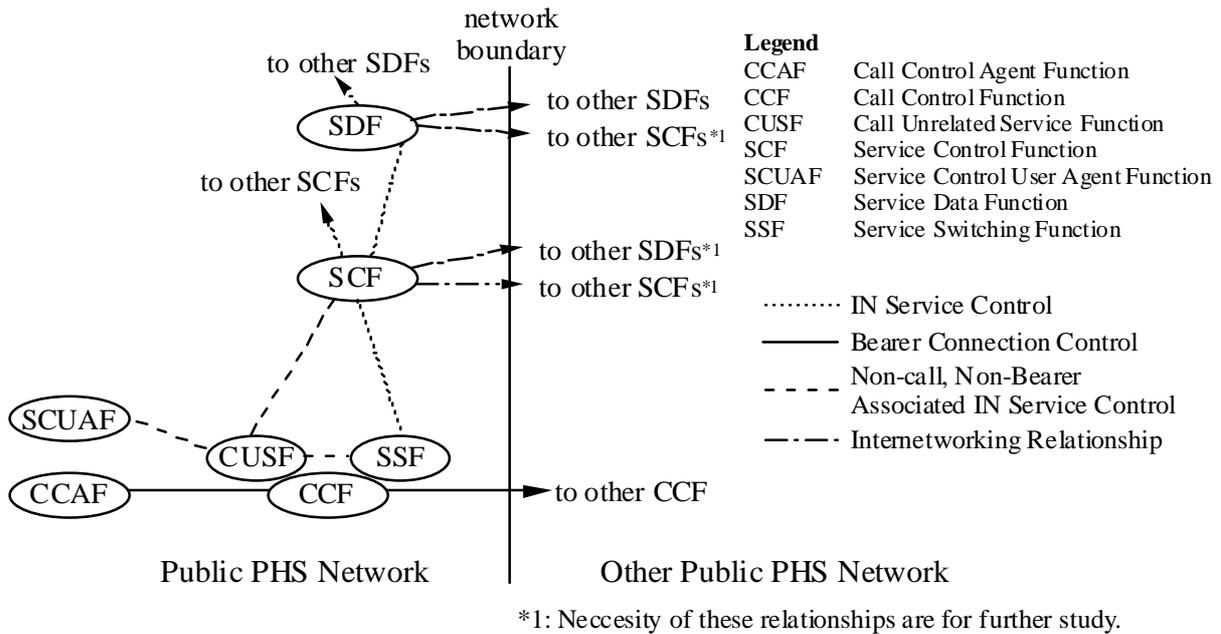CCF of both networks are connected through interface for call connection.

Figure 4-9/B-NW1.00  Functional Model for Internetworking between Public PHS Networks

## 4.3.3.2 Physical Architecture for Internetworking between Public PHS Networks

Figure 4-10/B-NW1.00 depicts physical architecture for internetworking between public PHS networks. In this figure, allocation of functions are shown. Functions which are described in dotted lines mean that those functions may be optional.



*1 IF4 specifies only SDF-SDF relationship for the time being.
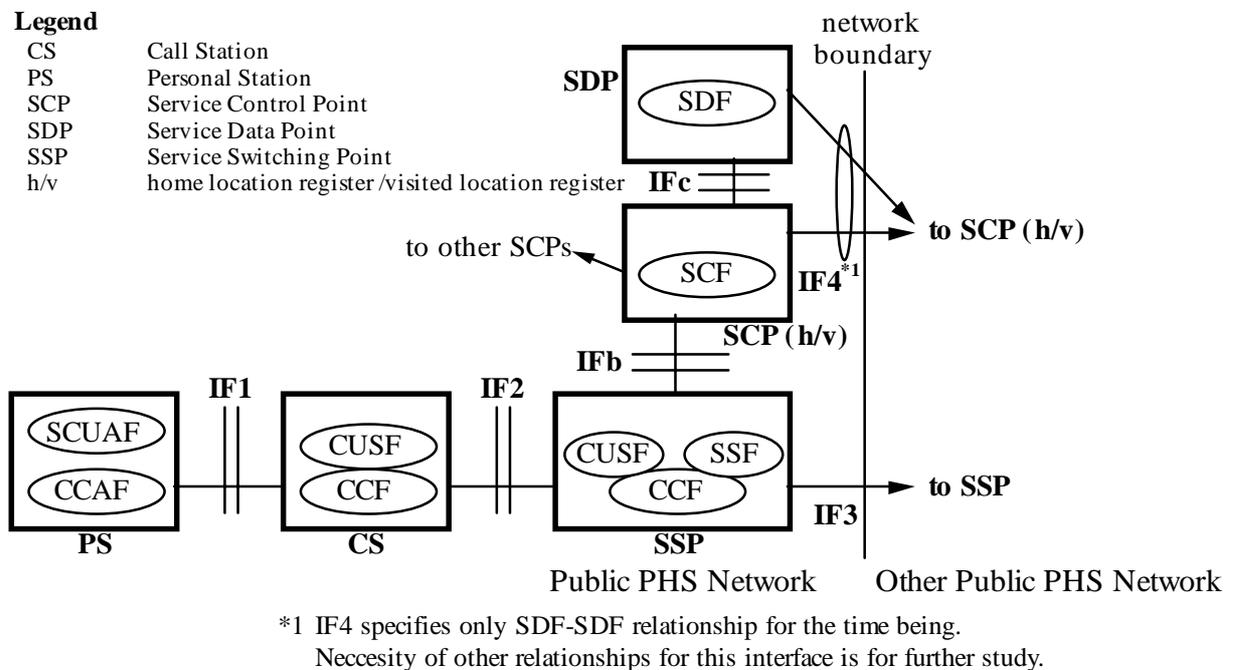Neccesity of other relationships for this interface is for further study.

Figure 4-10/B-NW1.00  Physical Architecture for Internetworking between
Public PHS Networks

SCPs of each network are connected through IF4.

IF4 specifies only SDF-SDF relationship for the time being. Necessity of other relationships for this interface is for further study.

**5. Future evolution**

**5.1 Application of IN CS-3 Modelling**

The application of IN CS-3 modelling such as the alignment of public PHS network modelling with IN CS-3, which supports IMT2000 requirements, and the relation to IMT2000 are subjects for further study. The ITU-T Recommendations relating to the IN CS-3 for IMT2000 are planned to be frozen by the end of 1998.

**Annex A Glossary and ABBREVIATIONS**
**(Normative)**

**GLOSSARY**

**\*\*\*A\*\*\***

**authentication** ARIB

This is the function that acknowledges that the personal station carrying out communication is the correct personal station.It carries out call reception,call sending ,location registration,etc.

**\*\*\*B\*\*\***

**\*\*\*C\*\*\***

**Call Control (CC)** ITU-T

The set of functions used to process a call (e.g. provide service features and establish, supervise, maintain and release connections ).

**Call Control Function(CCF)** ITU-T

The network intelligence that provide call/connection processing and control. Functional entities which cooperate with each other to provide network call processing functions.

**Signalling System No.7 (SS No.7)** ITU-T

A method of signaling in which signaling information relating to a multiplicity of circuits or functions or for network management, is conveyed over a single channel by addressed messages.   No.7 is the seventh signaling system specified in ITU-T recommendation.

**Customer Service Center (CSC)** PHS MoU

CSC controls registration of subscribers and charge of service menu, etc. by giving a service order. For the PHS service, registers and stops PSs.

**\*\*\*D\*\*\***

**\*\*\*E\*\*\***

**entity** PHS MoU

A part device,sub-system,functional unit,equipment or system that can be individually considered.In ISDN the term is used to refer to particular system or sub-system such as a user terminal or a digital exchange.It is also used to refer to a set of functions of a particular system at a location,e.g.the layer 2 functions of a signaling system at a user terminal.

**\*\*\*F\*\*\***

**Functional Entity  (FE)** ITU-T

An entity that comprises a specific set of functions at a given location.

**\*\*\*G\*\*\***

**gateway**                                                              **ITU-T**
Functions to receive inter-network defined signals from another network and convert them into local
network signals, and functions to convert the local network signals into inter-network defined signals
and send them to another network

**\*\*\*H\*\*\***

**handover**                                                              **ITU-T**
Handover is the action of switching a call in progress from one cell to another (or between radio
channels in the same cell).  It is used to allow established calls to continue when PS moves from one
cell to another.

**Home Location Register (HLR)**                                          **ITU-T**
Register where the current location and all subscriber profile for PS are permanently stored.

**home network**                                                         **ITU-T**
The geographical area of network where the user normally resides,or the service provider associated
with.

**\*\*\*I\*\*\***

**IF1**                                                                   **PHS MoU**
IF1 is a radio interface between PS and CS.

**IF2**                                                                   **PHS MoU**
IF2 is the interface between CS andPSC

**IF3**                                                                   **PHS MoU**
IF3 is the CCF-CCF interface between networks.

**IF4**                                                                   **PHS MoU**
IF4 is the SDF-SDF interface between public PHS networks.

**Initial Address Message (IAM)**                                        **ITU-T**
A type of message sent in the forward direction at call set-up.It contains address information and
other information relating to the routing and handling of the call.

**Intelligent Network (IN)**                                             **ITU-T**
A telecommunications network architecture that provides flexibility for facilitating the introduction of
mew capabilities and services,including those under customer control.

**Intelligent Network Application Part (INAP)**                          **ITU-T**
A protocol for intelligent network applications contained in layer 7 (application of the OSI model). ;
Note that INAP is also called as Intelligent Network Application Protocol.

**InterWorking Unit (IWU)**                                            **ITU-T**
A part device,sub-system, functional unit, equipment or system which connects different networks.

**ISDN User Part (ISUP)**                                       **ITU-T**
The signalling system No.7 protocol which provides the signalling functions required to support basic bearer services and supplementary services for voice and non-voice applications in an integrated services digital network.

**\*\*\*J\*\*\***

**\*\*\*K\*\*\***

**\*\*\*L\*\*\***

**layer**                                                   **ITU-T**
A conceptual region that embodies one or more functions between an upper and a lower logical boundary within a hierarchy of functions.

**Layer 1 (L1)**                                              **ITU-T**
The layer 1 provides the mechanical, electrical, functional and procedural means to activate, maintain,and de-activate physical-connections for bit transmission between the data-link-entities. A physical-connection may involve intermediate open system, each relaying bit transmission within the Layer 1.Its entities are interconnected by means of a physical medium.

**Layer 2 (L2)**                                              **ITU-T**
The Layer2 provides functional and procedural means for connectionless-mode among network-entities,  and for connection-mode for the establishment, maintenance, and release data-link-connections among network-entities and for the transfer of data-link-service-units. A data-link-connection is built upon one or several physical-connections. It detects and possibly corrects errors which may occur in the Layer 1. In addition, it enables the Layer 3 to control the interconnection of data-circuits within the Layer 1.

**Later3 (L3)**                                               **ITU-T**
The layer 3 provides the functional and procedural means for conectionless-mode or connection-mode transmission among transport-entities and therfore,provides to the transport-entities independence of routing and relay considerations.It provides the means to establish,mantain,and terminate network-connections between open systems containing communicating application-entities and the functional and procedural means to exchange network-service-data-units between transport-entities over network-communications.It provides to the transport-entities independence from routing and relay consideration associated with the establishment and operation of a given network-connection.This includes the case where several subnetworks are used in tandem or in pararell.It marks invisible to transport-entities how underlying resources.such as data-link-connections are used to provide network-connections.•A any relay functions and hop-by-hop service enhancement protocols used to support the network-service between the OSI end systems are below the Layer 2,ie.within the Layer 3 or below .

**Location Information (LI)**                                     **TTC**
This information contains one of following types of information depending on the status of personal

station:-personal station is roaming to other public PHS network and roaming number assigned by visited network for roaming personal station to route a call to visited network.-existence of roaming personal station from other network and location of roaming personal station to be used for routing within the visited network ,and-location of personal station to be used for routing within the home network.

**location registration**                                                                                  **TTC**

The location registration carries out registration of location information regarding PS via public cell station.The information of a Public Cell Station received the location registration request is the location information.For PHS-WLL case the location identify of WSU/WPS is registered in WAC.

**location registration area**                                                                          **ARIB**

This is composed of plural cell zones. When PS is moved to other location registration area, the procedure of location registration is activated.

**location registration procedure**                                                            **ARIB**

This procedure includes holding location information of PS and updating the location information.

**\*\*\*M\*\*\***

**Mobility Management (MM)**                                                                    **ARIB**

This is the layer 3 entity that performs the location registration and authentication functions.

**\*\*\*N\*\*\***

**Network Access Point (NAP)**                                                                 **ITU-T**

A physical entity that provides network access for users.It contains the call control agent function and may include the call control function.

**\*\*\*O\*\*\***

**Operation and Maintenance center (O&M)**                                         **PHS MoU**

O&M controls maintenance/operating of each constituent element of public PHS network.

**\*\*\*P\*\*\***

**PHS Number (PSN)**                                                                              **TTC**

It indicate number to identify PHS service and PS.

**PHS Switching Center (PSC)**                                                            **PHS MoU**

This physical entity provides the switching function for all personal stations. It may support a part of authentication and location registration function. It may also support subscribers other than personal stations.

**PHS roaming number**                                                                          **PHS MoU**

It is a number that the visited public PHS network assigns to a PS which is roaming in that public PHS
network. PHS roaming number is based on E.164.

**public Cell Station (public CS)** ARIB

The public cell station carries out mobile communication with personal station on land using public standard.

**Public Land Mobile Network (PLMN)** ITU-T

PLMN is established and operated by an administration or RPOA (Recognized private operating agency) for the specific purpose of providing land mobile telecommunication services to the public.A PLMN may be regarded as an extension of a fixed network (e.g.PSTN) or as an integral part of the PSTN.In the first case,it can be considered as a collection of mobile services switching center (MSC) area within a common numbering plan (e.g. service access codes) and a common routing plan (e.g.definition of crossover point) ; in this case the MSCs are the functional interfaces between the fixed network and a PLMN for call set-up. In the second case, it can be considered as an assemblage of special logic in existing of future PSTN/ISDN stored program controlled digital local exchanges, conceptually integrated within a common numbering and routing plan.

**public Personal Station (public PS)** ARIB

The personal station, as a subscriber communication terminal ,is used to make land mobile radio communications to either personal station or Public Cell Station.

**public PHS ISDN part** PHS MoU

A part of the public PHS network including SCP and PSC, having IF2 for the connection with a public PHS wireless access part.

**Public Switched Telephony Network (PSTN)** ITU-T

A telecommunications network set up (and administered by an "Administration") to perform telephonic services for the public subscribers.

**\*\*\*Q\*\*\***

**\*\*\*R\*\*\***

**Radio frequency Transmission management (RT)** ARIB

This layer 3 entity controls radio channel set up, holding, switching, etc.

**redirection** ITU-T

The mechanism that can be used by an exchange that decides that the call should be set-up to called number other than that identified in the received called Party Number parameter.

**relationship** ITU-T

The complete set of information flow , where they exist , between two functional entities.

**roaming** TTC

Indicate PHS user's action to access originating/terminating service when he moved from a network with his PHS roaming service subscription to another network.

**\*\*\*S\*\*\***

**Service Control Function (SCF)**                            **ITU-T**

The application of service logic to control functional entities in providing intelligent network services.

**Service Control Point (SCP)**                              **ITU-T**

An entity in the intelligent network that implements a service control function.

**service data**                                        **ITU-T**

Customer and/or network information required for the proper functioning of a service.

**Service Data Function (SDF)**                              **ITU-T**

The set of functions that provides for the management of service data in accordance with a service data template.

**Service Data Point (SDP)**                                **ITU-T**

A physical entity that implements a service data function.

**Service Switching Function (SSF)**                          **ITU-T**

The set of processes that provide for interaction between a call control function and a service control function.

**Service Switching Point (SSP)**                            **ITU-T**

A physical entity that implements a service switching function.

**signalling network**                                    **ITU-T**

A network used for signalling by one or more users and consisting of signalling points and connecting signalling links.

**Signalling Transfer Point (STP)**                           **ITU-T**

A signalling point with the function of transferring signalling messages from one signalling link to another and considered exclusively from the viewpoint of transfer.

**Special Resource Function (SRF)**                          **ITU-T**

The set of functions that provide for the control and access to resources used in providing services in the intelligent network.

**Subscriberdata**     **ITU-T**

All information concerning a specific PS which is required for service provisions, identification, authentication, routing, call handling, charging, operation and maintenance purposes. Some subscriber data are refered to as permanent subscriber data, i.e. they can only be changed by administrative means. Other data are temporary subscriber data which may change as a result of normal operation of the system. Some data are referred to as flexible length data, i.e. further values then those listed may be required in the future.

**supplementary service**                                 **ITU-T**

Any services provided by a network in addition to its basic service or services.

**\*\*\*T\*\*\***

**Transit Switch (TS)**
Transit switch is the relay switching system in the network. It has the Tandem Switch function within the network and the Gateway function for connection with other network.

**\*\*\*U\*\*\***

**UPT**                                                          **ITU-T**
Enables access to telecommunication services while allowing Universal Personal Mobility. It enables each UPT user to participate in a User-defined set of subscribed services and to initiate and receive calls on the basis of a personal, network-transparent UPT Number across multiple networks at any terminal, fixed or mobile, irrespective of geographic location, limited only by terminal and network capabilities and restrictions imposed by the network operator.

**User Scrambling**                                         **ARIB**
Functions to perform scramble processing of the original signals to prevent tapping.

**\*\*\*V\*\*\***

**Visitor Location Register (VLR)**                           **ITU-T**
The location register, other than the home location register used by an PSC to retrieve, for instance, subscriber profile for handing of calls to or a roaming PS, currently located in its area.

**visited network**                                          **TTC**
The network , other than the home network that is visited by PS in roaming state.

**\*\*\*W\*\*\***

**\*\*\*X\*\*\***

**\*\*\*Y\*\*\***

**\*\*\*Z\*\*\***

**ABBREVIATIONS**

| | |
|---|---|
| BC | Billing Center |
| CC | Call Control |
| CCAF | Call Control Agent Function |
| CCF | Call Control Function |
| Public CS | Public Cell Station |
| CS | Capability Set |
| CS2 | Capability Set 2 |
| CSC | Customer Service Center |
| CUSF | Call Unrelated Service Function |
| | |
| DTMF | Dual-Tone Multi-Frequency signaling |
| FE | Functional Entity |
| HLR | Home Location Register |
| | |
| IAM | Initial Address Message |
| IAF | Intelligent Access Function |
| IAP | Intelligent Access Point |
| IMT2000 | International Mobile Telecommunication 2000 |
| IN | Intelligent Network |
| INAP | Intelligent Network Application Part |
| INAP | Intelligent Network Application Protocol |
| IP | Intelligent Peripheral |
| ISDN | Integrated Services Digital Network |
| ISUP | ISDN User Part |
| ITU-T | International Telecommunication Union Telecommunication Standardization |
| IWU | Inter Working Unit |
| L1 | Layer 1 |
| L2 | Layer 2 |
| | |
| NAP | Network Access Point |
| MM | Mobility Management |
| MSC | Mobile Service Switching Center |
| O&M | Operation and Maintenance Center |
| OSI | Open Systems Interconnection |
| PABX | Private Automatic Branch eXchange |
| | |
| PE | Physical Entity |
| PHS | Personal Handy-Phone System |
| PLMN | Public Land Mobile Network |
| Public PS Station | Public Personal |
| PSC | PHS Switching Center |
| PSTN | Public Switched Telephone Network |

PSN          PHS Number

RT           Radio frequency Transmission management
SCF          Service Control Function
SCP          Service Control Point

SCUAF        Service Control User Agent Function
SDF          Service Data Function
SDP          Service Data Point
SLPService Logic processing Program
SRF          Specialized Resource Function
SS No.7      Signalling System No.7
SSF          Service Switching Function
SSP          Service Switching Point
STP          Signalling Transfer Point
TDMA         Time Division Multiple Access
TTC          The Telecommunication Technology Committee

**Appendix I Intra-network Process**
**(informative)**

## I.1 Introduction

This appendix explains the processes in closed public PHS network. These processes are as follows:

1) Location Registration (Appendix I.2)
2) Call Connection (Appendix I.3)
3) Handover (Appendix I.4)

In Public PHS network, there are few specified common knowledges. These are Public CS zone, Location registration area (same means as Paging Area) and Paging Function. The descriptions in following section help understanding.

### I.1.1 Public CS Zone

Public PHS Cell Station (Public CS) always transmits the control channel for Public PS synchronization and information broadcasting. Control channel is placed on one slot of 4 time slots PHS TDMA frame on the air interface. Basically, this control channel covers area is in few-hundreds meters radiation. This covered area is called as Public CS zone or only Zone or Cell instead. In PHS, this area is the smallest fundamental area.



SCP

PSC

CS : Cell Station

CS Zone

**Figure I-1/B-NW1.00  Public CS Zone (Cell)**

### I.1.2 Location Registration Area (Paging Area)

Public PHS uses the Paging function (see I.1.3 Paging Function) to offer incoming call to the Public PS in the aggregated Public CS zones. Public PS is usually moving amongPublic CS zones. The size

of paging area which is composed of aggregated Public CS zones can be optimized to catch the Public PS certainly. Some public PHS may have larger paging area to improve the efficiency of network resources. Request of location registration from the individual Public PS is transferred via Public CS to the PSC with Public PS number. The PSC access Location register as one of database in SCP to store and retrieve location information. This area, is managed and covered by one PSC, is also called Location Registration area.



**Figure I-2/B-NW1.00  Location Registration Area (Paging Area)**

### I.1.3 Paging Function

The relationship between location registration area (paging area) and Public CS zone is explained in previous subclause. In this subclause, Paging in public PHS network is explained. Public PHS network uses Paging method for Call control process. The paging method uses multi-Public CSs to reach target Public PS. The paging broadcasts the same paging message to multi-Public CSs in same paging area. If a Public CS receive the reply from target Public PS,  the PSC stop the paging from other Public CSs. On the other hand, if no Public CS receive reply before the expiration of specific timer, Paging function is stopped.

The PSC refers to location register to know where the target Public PS is. Location register refers the Public PS location from Public PS number. The PSCs route a call for targeted Public PS using latest registered location. Destination PSC executes the paging message to all Public CSs, in a paging area, and then Public CSs also execute the paging to targeted Public PS.

SCP

PSC

**Paging**

CS

Location Registration Area
(Paging Area)

**Figure I-3/B-NW1.00  Paging Function**

After Public CSs execute the paging, if targeted Public PS replies for the paging to one of Public CSs, This Public CS assigns a frequency and time slot to Public PS, by same method of origination,. Public PS transmit the call control message on assigned frequency and time slot with authentication. Public PS starts communication after authentication is successfully done. If targeted Public PS can't reply for the paging, public PHS network executes some actions according to contract with the subscriber of targeted Public PS. For example, public PHS network transfers a call to another terminal which is Pager, Cellular phone, voice message storing system or fixed phone etc..

### I.2 Location Registration

Location registration makes public PHS network recognize where Public PS is. If location registration is not executed correctly, the Public PS will never receive the call. Location registration is one of key processes to implement fully two way, call origination and termination, telecommunication service in Personal Handy-Phone System.

Location registration function includes holding the location information and updating the location information. "Area Number" is used as location information. The purpose of the location registration is to inform the location information to the SCP when Public PS moves to other location registration area.
Figure I-4/B-NW1.00 shows an example of location registration process.

(1)  Public PS recognizes change of location registration area by information from the Public CS.
(2)  The location registration request is transferred from Public PS. The message reaches to the SCP after authentication process is executed.
(3)  The location information is updated in the SCP.

(4) The complete message of the location registration is transferred from the SCP to Public PS through the PSC and Public CS.



Figure I-4/B-NW1.00  Location Registration

Location registration is executed at PS's power on and/or Public PS moves over location registration areas (Paging areas). Location registration is always initiated from Public PS. Public PS receives new correct control channel first. Public PS sends the location registration request to the Public CS, using traffic channel assigned by that Public CS using control channel. During this process, Public PS communicates some informations with Public CS. These informations include zone information , voice scrambling information, authentication method information and Location registration Area information etc.

Public PHS network (including Public CS) has to check the Public PS with subscriber's profiles. Public PHS network judges the subscription conditions of that Public PS, network allows connection or not. If public PHS network judgment is not-allowed for the subscriber, location registration is canceled and connected air interface is released.

Location registration is executed by public PHS network after Public PS authentication process is successfully done for subscriber. Public PHS network sends the location registration acknowledge with area information and/or paging group assignment information, if needed. Location registration processing is completed by the disconnection air channel normally.

After Public PS executed location registration once, Public PS has to hold the given area information. Public PS has to re-initiate the Location registration when Public PS receives the difference area information from previous one, in the received broadcast informations on the control channel.

Public PHS network routes all call to targeted Public PS and then Public CSs, in same paging area, execute paging. Public PHS network holds the latest registered area of the Public PS, even if Public PS was moved without location registration, before successful location registration of the Public PS.

## I.3 Call Control Process

The general flow of call connection is shown in Figure I-5/B-NW1.00. This Figure shows an example of the originating and terminating connection in public PHS network.

(1) User dial PHS number in originating terminal.
(2) Setup message is transferred to the PSC.
(3) The authentication process id execute in the PSC.
(4) The PSC queries the location information of the terminating Public PS to the SCP.
(5) The SCP searches the location registration from PHS number
(6) The location information is returned back to The PSC.
(7) The connection is established to the terminating PSC based on the location information.
(8) The PSC pages the terminating Public PS.
(9) The authentication of the terminating Public PS is executed.



Figure I-5/B-NW1.00  Call Control

Key issue in this process is authentication.
Authentication protects the illegal accesses from irregular subscribers.

In the case of call origination or termination after location registration, Public PS requests the frequency and TDMA time slot without interference for voice communication to Public CS, using

control channel. Public CS searches a frequency and time slot not used. Public CS assigns the found frequency and time slot to Public PS as request's grant. In this process, public PHS network , include Public CS itself, executes the authentication to confirm the Public PS access is allowed or not. Public CS allows the Public PS to voice communication only when Public PS is correct. After authentication and frequency & time slot assignment, Public CS accesses to switch to establish the communication path by call control. This authentication is based on subscriber's profile in the SCP.

## I.4 Handover Process

Handover process enables Public PS to change cells during active state of the call. It is useful when Public PS moves to other cell. The Public PS or Public CS collects information related to the quality of the air channel, then the collected  information is used to select a new cell for handover.

There are the following two cases for handover process.

(1)  Public PS moves between Public CSs.
(2)  Public PS moves between PSCs.

In public PHS network, Handover process basically uses re-initiating call type of handover. It's means that Public PS executes re-initiation of call with handover request in new Public CS zone from previously.

Public PS or Public CS request the handover process when Public PS or Public CS detects the quality degration of that air channel. Public PS requests the channel assignment to new Public CS. After channel assignment, Public PS starts the process by sending setup message. The PSC finds out target call by searching existing calls in the PSC, using location register and Public PS number after receiving handover request from the Public PS via new Public CS. PSC finds new communication path and then the PSC switches the communication path from previous path to new one. Public PS is continuously able to communicate at moving between cells. About authentication in this process, Public PS sends handover request with the latest authentication calculated result. The PSC is able to check Public PS only with that latest result. PSC holds the  authentication calculated results of all communicating Public PS in each PSC. By such simplified authentication canceled method, public PHS network reduce the time of re-initiating call in handover process.

In the case of (1), the PSC setup a new link to the new Public CS which supports cell where the Public PS moved. As for the case (2), a new link is set up to the new PSC where the Public PS moved.

Figure I-6/B-NW1.00 shows an example of the handover process in the case of (1).

(1)  Public PS recognizes that the quality of the air channel becomes lower by information from the Public CS.
(2)  New Setup message including the handover request is transferred from Public PS to the Public CS which has the higher quality of the air channel than quality of the current air channel.
(3)  New Setup message including the handover request is transferred from Public CS to the PSC. The authentication process is executed.
(4)  The PSC creates the new link and route the call on this link.
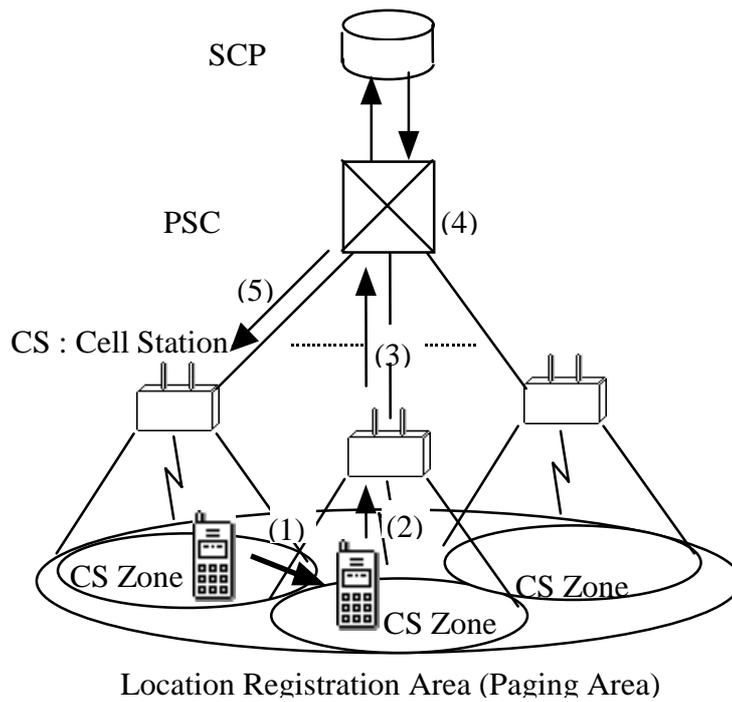(5)  The PSC releases the unused link.

Location Registration Area (Paging Area)

**Figure I-6/B-NW1.00  Handover**

**Appendix II Inter-network process**
**(Informative)**

**II.1 Internetwork bearer connection process**

The process is based on Q.760 series of ITU-T Recommendations which specify. ISUP.

When a Public PS is registered in a visited network, service profile of the terminal is transferred from the home network to the visited network. A set of authentication data is included in the transferred service profile and each piece of the data is utilized for each authentication process in the visited network. This enables service provision in the visited network efficient, since interactions between the networks are not necessary for each call processing. When the set of authentication data is almostly used up, additional set of the data is transferred from the home network on the request of the visited network.

The main internetworking processes are as follows;
1) Location registration (moving from the home network; II.2)
2) Location registration (moving back to the home network; II.3)
3) Subsequent service profile transfer (additional inquiry of authentication data; II.4)
4) Paging to roaming terminal (II.5)
5) Outgoing call from roaming terminal (II.6)

**II.2 Location registration (moving from the home network)**

Location registration process when the terminal roams from the home network is illustrated in Figure II-1/B-NW1.00 as an example.

(1) Public PS moves from the home network to the visited network.
(2) Location registration request is transferred from Public PS to the SCP through the Public CS and the PSC.
(3) The SCP in the visited network which acts as VLR, requests PHS service profile to SCP in the home network which acts as HLR through SS No.7 network.
(4) The HLR responds with PHS service profile to the request of the VLR through SS No.7 network.
(5) The VLR requests internetwork location registration to the HLR through SS No.7 network.
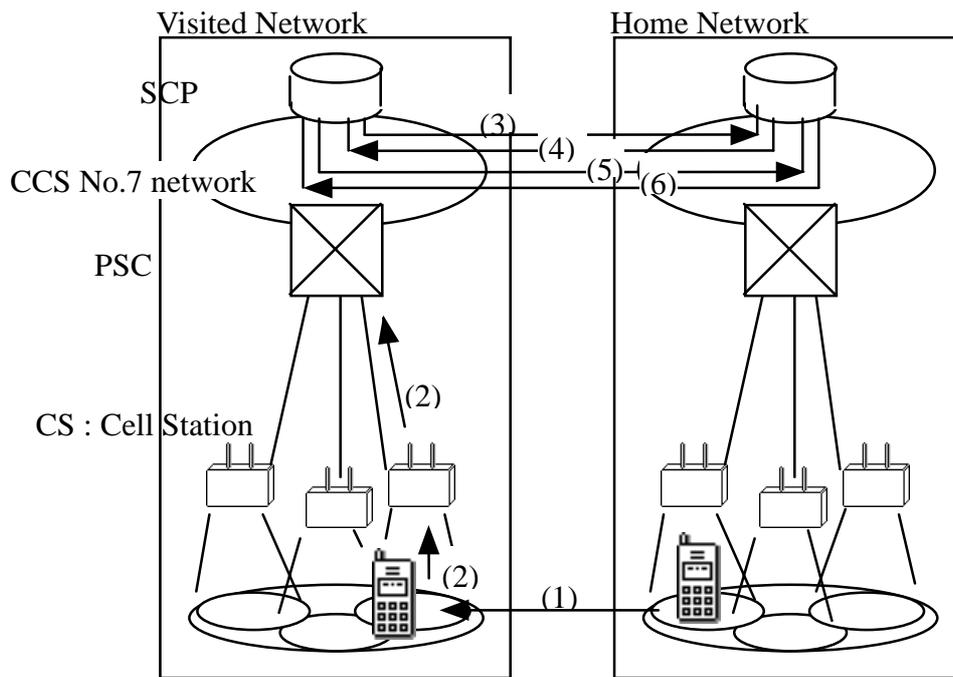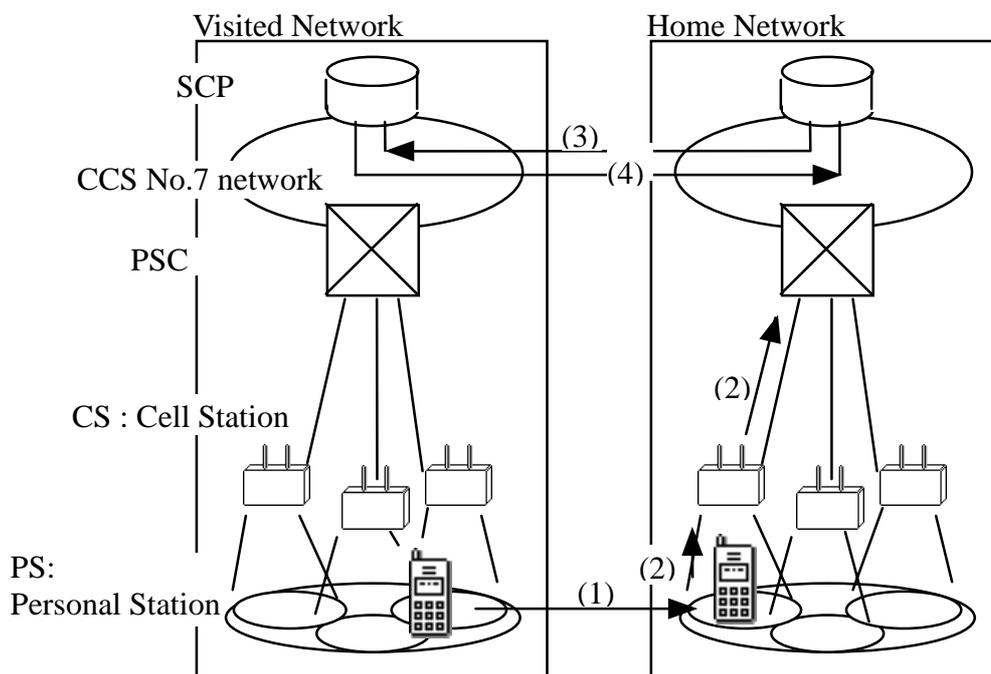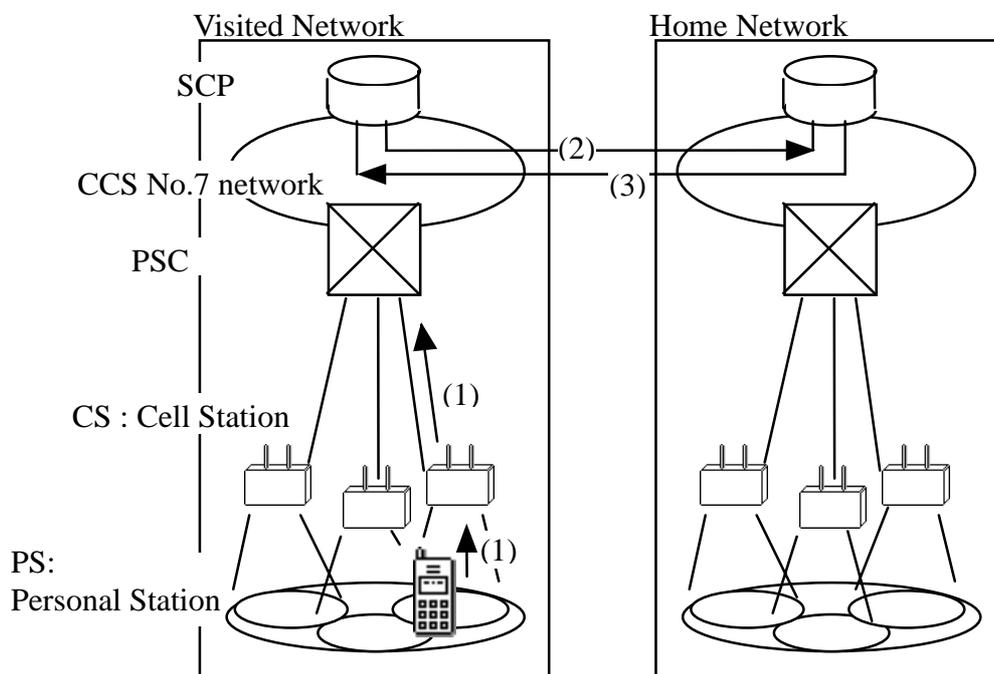(6) The HLR responds with result of registration to the request of the VLR through SS No.7 network.

**Figure II-1/B-NW1/00  Location registration (moving from the home network)**

## II.3 Location registration (moving back to the home network)

Location registration process when Public PS moves back to the home network is illustrated in Figure II-2/B-NW1.00 as an example.

(1) Public PS moves from the visited network to the home network.
(2) Location registration request is transferred from Public PS to the SCP through the Public CS and the PSC..
(3) The SCP in the home network which acts as HLR requests the SCP in the visited network which acts as VLR to delete PHS Service profile through SS No.7 network.
(4) The VLR responds with result to the request of the HLR through SS No.7 network.

**Figure II-2/B-NW1.00  Location registration (moving back to the home network)**

## II.4 Subsequent service profile transfer (additional inquiry of authentication data)

Subsequent service profile transfer process with inquiry of additional authentication data is illustrated in Figure II-3/B-NW1.00 as an example.

(1)  Location registration request is transferred from Public PS to the SCP through the Public CS and the PSC.
(2)  When SCP in the visited network which acts as VLR recognizes the set of authentication data is almostly used up, it requests additional set of authentication data from SCP in the home network which acts as HLR through SS No.7 network.
(3)  The HLR responds with additional set of authentication data to the request of the VLR through SS No.7 network.



**Figure II-3/B-NW1.00  Subsequent service profile transfer
(additional inquiry of authentication data)**

## II.5 Paging to roaming terminal

In the case of Paging to roaming terminal, public PHS network can support several call routing methods. This subclause explains about two methods. one is called "Through Home Network" method, another is called "Redirection method".

### II.5.1 Through Home Network

This method is indicated by that name itself. Call originating network routes all calls to Home PHS network, and then home network gives the PHS roaming number to that call. That call is routed to visited network with given PHS roaming number and target PHS number. Visited network pages to offer a call to the target Public PS, using received PHS number. All calls have to be routed through home network. As the result, established communication path is indicated in Figure II-4/B-NW1.00.



**Figure II-4/B-NW1.00  Routing by "Through Home Network"**

## II.5.2 Redirection

In this method, a call has not to be routed through home network. A call is directly directed to target visited network, if the originating network have the capability of Redirection. Home network reply with indication to execution of Redirection and then home network release the path. Home network send this reply with PHS roaming number. The call originating network executes Redirection using the given PHS roaming number and PHS number to route the call to destination network (visited network). The visited network execute paging, using received PHS number. As the result, established communication path is indicated in Figure II-5/B-NW1.00.



**Figure II-5/B-NW1.00  Routing by "Redirection"**

## II.5.3 Paging to Roaming Terminal

Paging process to the roaming terminal is illustrated in Figure II-6/B-NW1.00 as an example.

(1)   A call to the roaming terminal is initiated in the originating PSTN.
(2)   The call is routed to the home network based on dialed PHS number.
(3)   In the home network, database (HLR) that knows which network the terminal is located and it informs the switch of roaming number to route the call to the visited network.
(4)   The call is further routed to the visited network based on roaming number included in Initial Address Message (IAM) of ISUP.
(5)   Public PS Number is also included in IAM by which the SCP in the visited network (VLR) decides the appropriate PSC to which the call is finally routed.
(6)   The terminal is paged at the PSC. Authentication is accomplished in the visited network based on the information held in the VLR.
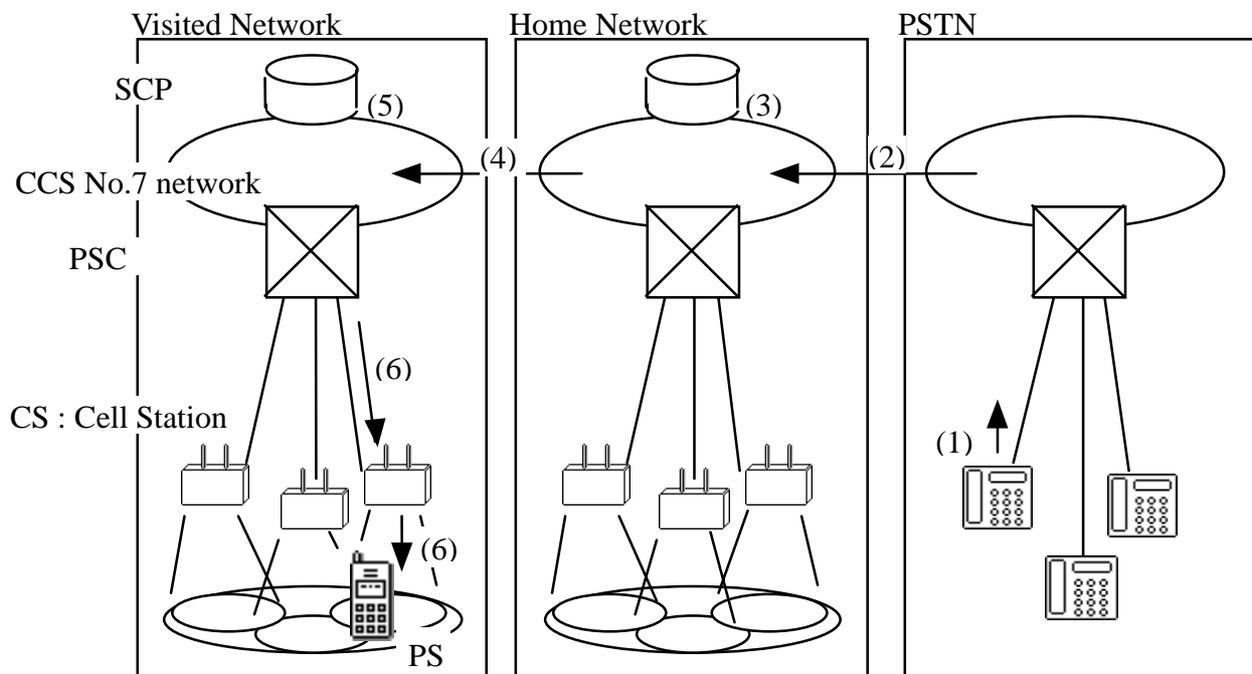


**Figure II-6/B-NW1.00  Paging to roaming terminal**

## II.6 Outgoing call from roaming terminal

Call originating process from the roaming terminal is illustrated in Figure II-7/B-NW1.00 as an example.

(1)   A call from the roaming terminal is initiated in the visited network.
(2)   Authentication is accomplished in the visited network based on the information held in the SCP which acts as VLR.
(3)   The call is routed to the PSTN based on the dialed number.
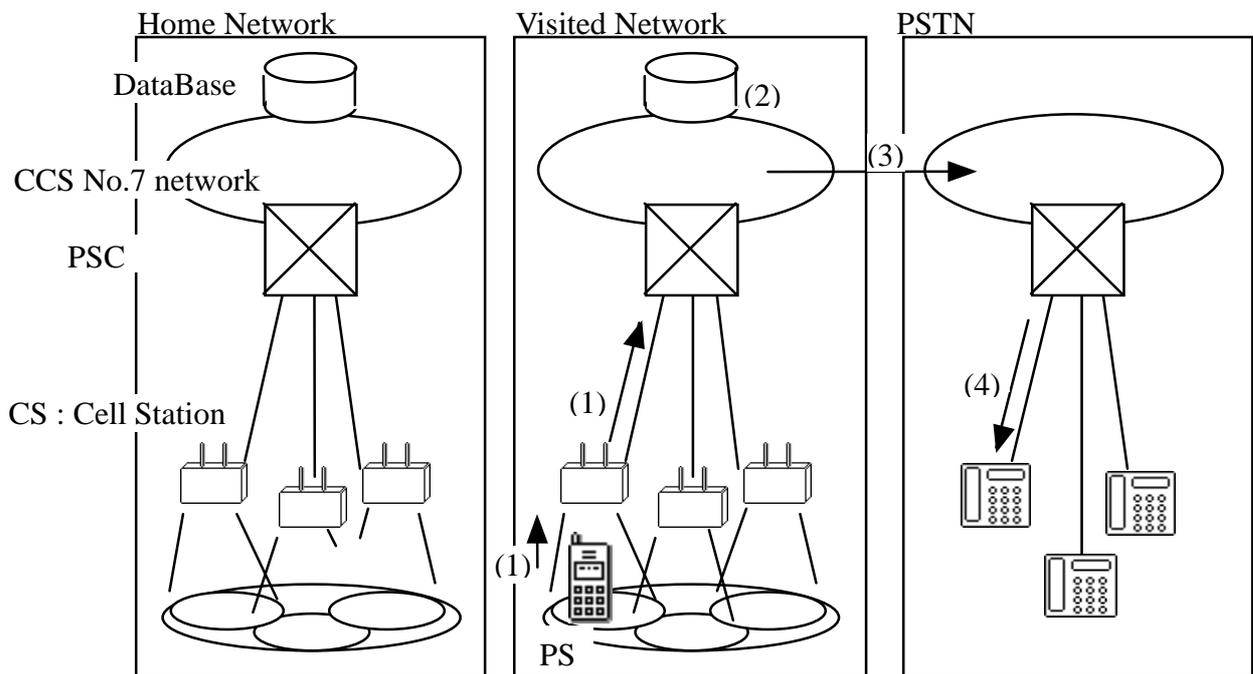(4)   In the PSTN, the call is processed as ordinary incoming call and connected to the destination terminal.



**Figure II-7/B-NW1.00  Outgoing call from roaming terminal**

**Appendix III Public PHS network attached to the PLMN**
**(Informative)**

Note :   This appendix III is described as one example of PHS applications, more detail informations will be described in other document in future.

### III.1 Scope

This appendix includes only the case that public PHS network is attached PLMN. It's means that PHS air interface is used as access to the PLMN instead of PLMN standard air interface. Reference point IF2 of public PHS network is used instead of the interface between Base Station and Switch of PLMN. The PLMN can use both PLMN standard air interface and PHS's one.

### III.2 IWU Requirements

The PLMN normally supports PLMN standard interface. The public PHS network requires PHS standard interface. This application requires the functionality to handle above differences in InterWorking Unit (IWU). Required IWU functions are as follows:

1)   Interworking between PHS signalling and PLMN signalling.
2)   IWU supports same services of PLMN to PHS.
3)   PLMN must have functions the handling the PHS subscriber's profile via IWU.
4)   PLMN executes the authentication for PHS subscribers via IWU. etc.............

### III.3 Functional Model for public PHS network attached to PLMN

Functional Model for public PHS network attached to PLMN is depicted in Figure III-1/B-NW1.00. In this figure, MSCF is instantly used and named as general common naming for any types of PLMN. This MSCF includes similar functionalities of CCF, SSF, CUSF, SCF, SDF and other functions general PLMN has to have. BSF and MTF is also named instantly as such functions. BSF include CCF, CUSF and other functions PLMN Base Station has to have. MTF include PLMN Mobile Terminal's ones. In this application, IWU is the function entity to communicate with attached CCF&CUSF and MSCF.  IWU supports all functions of "Attached Network Functions" to support PHS air interface in PLMN environment.
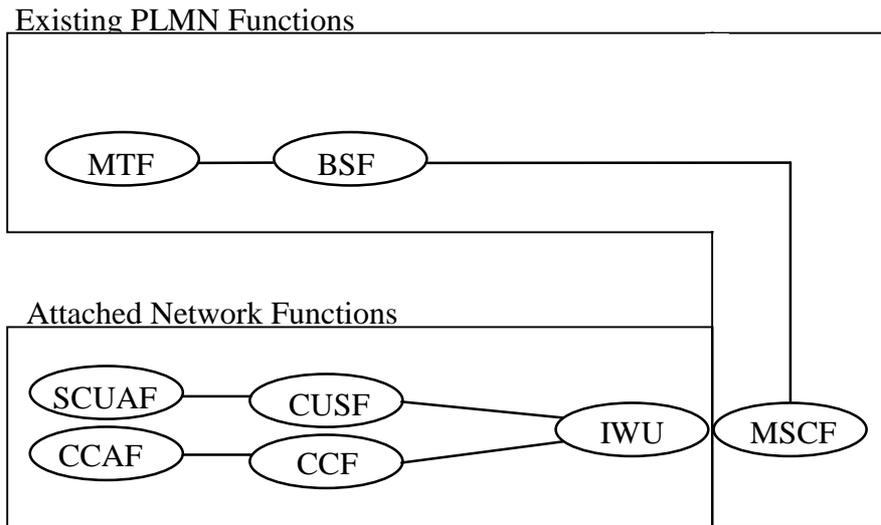
Existing PLMN Functions

MTF ── BSF ─────────────────────┐

Attached Network Functions

SCUAF ── CUSF ──┐
                IWU ── MSCF
CCAF ── CCF ────┘

**Figure III-1/B-NW1.00  Functional Model**

### III.4 Physical Architecture for Public PHS network attached to PLMN

Physical architecture of this application is depicted in Figure III-2/B-NW1.00. Figure III-2/B-NW1.00 indicate only Base station, PHS Public CS and the MSC in the network. It's means that this figure doesn't indicate the Location register, the SCPs include subscriber profile and other peripheral physical equipments which PLMN can also have. This application requires InterWorking Unit (IWU) to attach PHS network to PLMN. IWU handles the interworking of the messages between PHS Public CS and PLMN SSP. Key issues are same one such as Location Registration, authentication of Public PS or Mobile station, and Call Control. There are few differences between PHS network and PLMN in these issues. IWU has to translate the messages from/to PHS Public CS to/from PLMN SSP for bi-directional communication. PLMN services are offered to PHS Public PS by IWU.
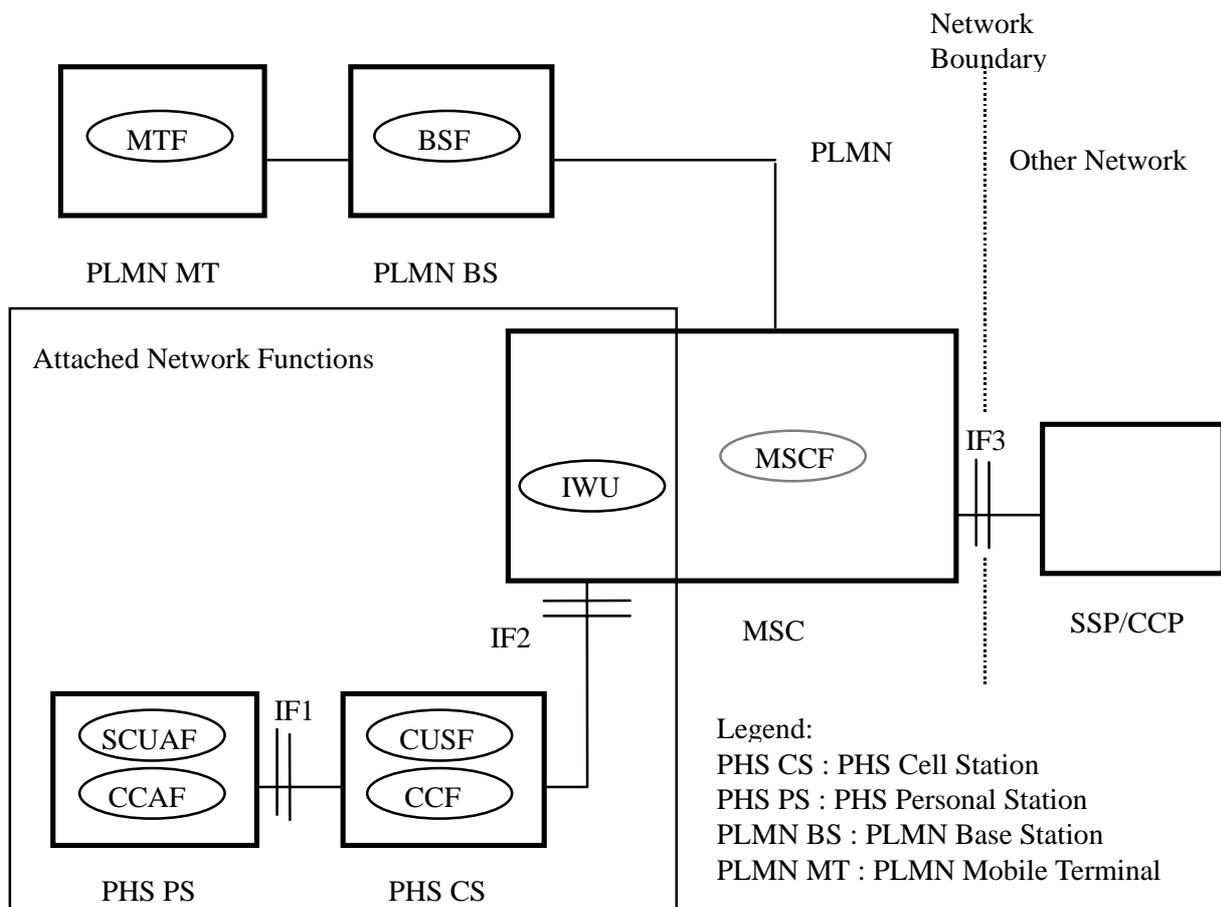


**Figure III-2/B-NW1.00  Physical Architecture**