



Network Reference Model for cdma2000 Spread Spectrum Systems

Revision: A

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CONTENTS

CONTENTS.....	ii
LIST OF FIGURES.....	iii
PREFACE.....	iii
REVISION HISTORY	iii
1. PURPOSE AND SCOPE	1
1.1 References	1
2. REFERENCE MODELS	2
2.1 3GPP2 Wireless Network Reference Model	2
2.1.1 Network Entities	4
2.1.2 Reference Points	10

LIST OF FIGURES

Figure 2.1	3GPP2 Wireless Network Reference Model	3
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PREFACE

This 3GPP2 Wireless Network Reference Model depicts circuit-mode and packet mode operations.

REVISION HISTORY

Revision	Date	Description
0	June 1999	Initial publication
A	December 1999	<ul style="list-style-type: none"> • Update OAM&P elements to agree with PN-4108 • Added packet data network elements, rearranged several network elements • updated ME&MS elements to agree with definitions in PN-4582

1. PURPOSE AND SCOPE

This document recommends the basic 3GPP2 Wireless Network Reference Model.

1.1 References

ANSI-41

- ANSI/TIA/EIA-41-D, *Cellular Radiotelecommunications Intersystem Operations*, December, 1997.

ANSI-95

- TIA/EIA/IS-95-A, *Mobile Station – Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular Systems*; Telecommunications Industry Association; May 1995.
- TSB74, *Support for 14.4 kbps Data Rates and PCS Interaction for Wideband Spread Spectrum Cellular Systems*, December, 1995.
- ANSI J-STD-008, *Personal Station - Base Station Compatibility Requirements for 1.8 to 2.0 Ghz Code Division Multiple Access (CDMA) Personal Communications Systems*.

IS-124

- TIA/EIA/IS-124-A, *Cellular Radio Telecommunications Intersystem Non-Signaling Data Communications (DMH)*; Telecommunications Industry Association; October 1997.

ANSI-136

- TIA/EIA IS-136.1-A, *TDMA Cellular/PCS - Radio Interface - Mobile Station — Base Station Compatibility - Digital Control Channel, Rev. A*, October 1996.
- TIA/EIA IS-136.2-A, *TDMA Cellular/PCS - Radio Interface - Mobile Station — Base Station Compatibility - Traffic Channels and FSK Control Channel, Rev. A*, October 1996.

ANSI-553

- EIA/TIA/IS-553, *Mobile Station - Land Station Compatibility Specification*; September 1989.

IS-634

- TIA/EIA/IS-634, *MSC - BS Interface for Public Mobile 800 MHz*, December 1995.
- TIA/EIA/IS-634-A, *MSC - BS Interface for Public Wireless Communications Systems*, (to be published tbd).
- TSB80, *MSC - BS Interface for Public 800 MHz*, October 1996.

IS-658

- TIA/EIA/IS-658, *Data Services Interworking Function Interface for Wideband Spread Spectrum Systems*, 1996.
- TIA/EIA/IS-737, *IS-41-C Enhancements to Support Circuit Mode Services*, (approved for publication).

IS-725

- TIA/EIA/IS-683-A, *Over-The-Air Service Provisioning of Mobile Stations in Spread Spectrum Systems*, February 1997.
- TIA/EIA/IS-725, *Over-The-Air Service Provisioning*, June 1997.

2. REFERENCE MODELS

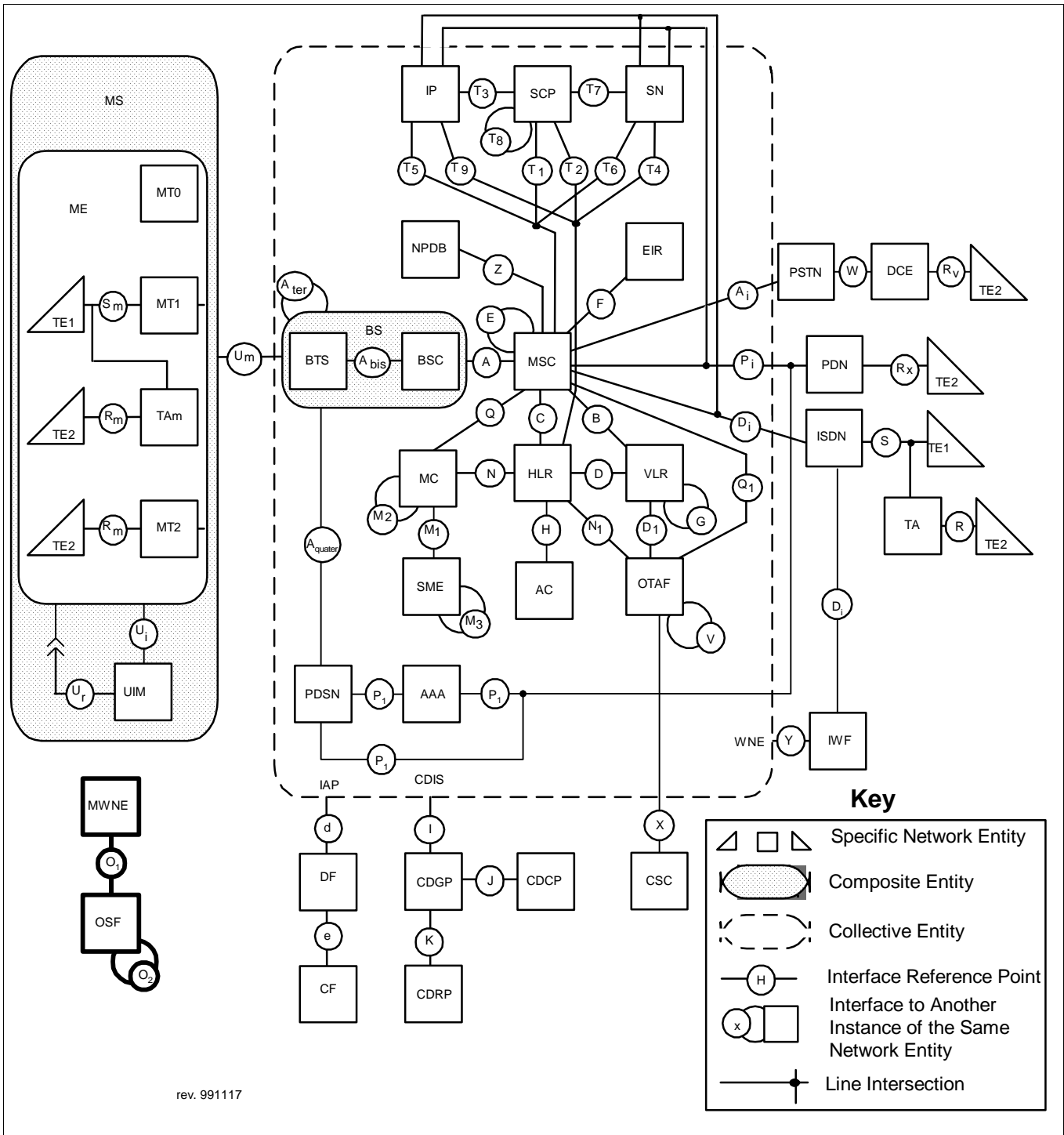
Reference models are a graphical tool used to visualize, structure, and describe certain complex subjects. A few such models are widely used in the 3GPP2 wireless recommendations.

2.1 3GPP2 Wireless Network Reference Model

Figure 2.1 presents the network entities and associated reference points that comprise a wireless network. The network entities are represented by squares, triangles and rounded corner rectangles; the reference points are represented by circles. The network reference model in this document is the compilation of several reference models currently in use in 3GPP2 wireless recommendations.

Note the following:

- **The network reference model is a functional block diagram.**
- **A network entity represents a group of functions, not a physical device. For example, a Mobile Switching Center (MSC) is a physical device; it comprises frames, shelves, circuit packs, etc. The physical device may comprise a single network entity such as the MSC, or it may comprise some combination such as the MSC, the Visitor Location Register (VLR), the Home Location Register (HLR), and the Authentication Center (AC). The physical realization is an implementation issue; a manufacturer may choose any physical implementation of network entities, either individually or in combination, as long as the implementation meets the functional requirements. Sometimes, for practical reasons, the functional network entity is a physical device. The Mobile Station (MS) is an excellent example.**
- **A reference point is a conceptual point that divides two groups of functions. It is not necessarily a physical interface. A reference point only becomes a physical interface when the network entities on either side of it are contained in different physical devices.**
- **A “Collective Entity” contains encompassed network entities that are an instance of the collective.**
- **A “Composite Entity” contains encompassed network entities that are part of the composite.**



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Figure 2.1 3GPP2 Wireless Network Reference Model

AAA	Authentication, Authorization, and Accounting	MWNE	Managed Wireless Network Entity
AC	Authentication Center	MC	Message Center
BS	Base Station	MS	Mobile Station
BSC	Base Station Controller	MSC	Mobile Switching Center
BTS	Base Transceiver System	MT	Mobile Terminal
CDCP	Call Data Collection Point	NPDB	Number Portability DataBase
CDGP	Call Data Generation Point	OSF	Operations System Function
CDIS	Call Data Information Source	OTAF	Over-The-Air Service Provisioning Function
CDRP	Call Data Rating Point	PDN	Packet Data Network
CF	Collection Function	PDSN	Packet Data Serving Node
CSC	Customer Service Center	PSTN	Public Switched Telephone Network
DCE	Data Circuit Equipment	SCP	Service Control Point
DF	Delivery Function	SN	Service Node
EIR	Equipment Identity Register	SME	Short Message Entity
HLR	Home Location Register	TA	Terminal Adapter
ISDN	Integrated Services Digital Network	TE	Terminal Equipment
IP	Intelligent Peripheral	UIM	User Identity Module
IAP	Intercept Access Point	VLR	Visitor Location Register
IWF	Interworking Function	WNE	Wireless Network Entity

2.1.1 Network Entities

The only network entity that is by definition a physical device is the MS. Each of the others may be a physical device, it may form part of a physical device, or it may be distributed over a number of physical devices.

Authentication, Authorization and Accounting

The AAA is an entity that provides Internet Protocol functionality to support the functions of Authentication, Authorization, and Accounting. These IP functions are defined in Internet Engineering Task Force documents. The AAA interacts with the PDSN to perform AAA functions in support of the PDSN for requesting Mobile Stations. The AAA interacts with other AAA entities to perform AAA functions where the Home AAA is outside the serving mobile network.

Authentication Center (AC)

The AC is an entity that manages the authentication information related to the MS. The AC may, or may not be located within, and be indistinguishable from an HLR. An AC may serve more than one HLR.

Base Station (BS)

A BS is an entity that provides the means for MSs to access network services using radio. It includes a BSC and a BTS.

Base Station Controller (BSC)

The BSC is an entity that provides control and management for one or more BTSs. The BSC exchanges messages with both the BTS and the MSC. Traffic and signaling concerned with call control, mobility management, and MS management may pass transparently through the BSC.

Base Transceiver System (BTS)

The BTS is an entity that provides transmission capabilities across the U_m reference point. The BTS consists of radio devices, antenna and equipment.

Call Data Collection Point (CDCP)

The CDCP is the entity that collects the *IS-124* format call detail information.

Call Data Generation Point (CDGP)

The CDGP is an entity which provides call detail information to the CDCP in *IS-124* format. This may be the entity which converts call detail information from a proprietary format into the *IS-124* format. All information from the CDGP to the CDCP must be in *IS-124* format.

Call Data Information Source (CDIS)

The CDIS is an entity that can be the source of call detail information. This information may be in proprietary format. It is not required to be in *IS-124* format.

Call Data Rating Point (CDRP)

The CDRP is the entity that takes the unrated *IS-124* format call detail information and applies the applicable charge and tax related information. The charge and tax information is added using *IS-124* format.

Collection Function (CF) - [Intercept]

The CF is an entity that is responsible for collecting intercepted communications for a lawfully authorized law enforcement agency.

The CFs typically include:

- the ability to receive and process call contents information for each intercept subject.
- the ability to receive information regarding each intercept subject (e.g., call associated or non-call associated) from the Delivery function and process it.

Customer Service Center (CSC)

The CSC is an entity where service provider representatives receive telephone calls from customers wishing to subscribe to initial wireless service or request a change in the customer's existing service. The CSC interfaces proprietarily with the OTAF to perform network and MS related changes necessary to complete the service provisioning request.

Data Circuit Equipment (DCE)

A termination that provides a non-ISDN user-network interface (e.g., ITU-T [CCITT] V series, ITU-T [CCITT] X series).

Delivery Function (DF) - [Intercept]

The DF is an entity that is responsible for delivering intercepted communications to one or more collection functions.

The DFs typically include:

- the ability to accept call contents for each intercept subject over one or more channels from each Access function.
- the ability to deliver call contents for each intercept subject over one or more channels to a Collection function as authorized for each law enforcement agency.
- the ability to accept information over one or more data channels and combine that information into a single data flow for each intercept subject.
- the ability to filter or select information on an intercept subject before delivery to a Collection function as authorized for a particular law enforcement agency.
- the optional ability to detect audio in-band DTMF digits for translation and delivery to a Collection function as authorized for a particular law enforcement agency.
- the ability to duplicate and deliver information on the intercept subject to one or more Collection functions as authorized for each law enforcement agency.
- the ability to provide security to restrict access.

Equipment Identity Register (EIR)

The EIR is an entity that is the register to which user equipment identity may be assigned for record purposes. The nature, purpose, and utilization of this information is an area for further study.

Home Location Register (HLR)

The HLR is the location register to which a user identity is assigned for record purposes such as subscriber information (e.g. Electronic Serial Number (ESN), Mobile Directory Number (MDN), Profile Information, Current Location, Authorization Period).

Integrated Services Digital Network (ISDN)

The ISDN is defined in accordance with the appropriate *ANSI T1* Standards.

Intelligent Peripheral (IP)

The IP is an entity that performs specialized resource functions such as playing announcements, collecting digits, performing speech-to-text or text-to-speech conversion, recording and storing voice messages, facsimile services, data services, etc.

Intercept Access Point (IAP)

The IAP is an entity that provides access to the communications to, or from, the equipment, facilities, or services of an intercept subject.

Interworking Function (IWF)

The IWF is an entity that provides information conversion for one or more WNEs. An IWF may have an interface to a single WNE providing conversion services. An IWF may augment an identified interface between two WNEs, providing conversion services to both WNEs.

Managed Wireless Network Entity (MWNE)

A wireless Entity within the Collective Entity or any specific Network Entity having OS wireless management needs, including another OS.

Message Center (MC)

The MC is an entity that stores and forwards short messages. The MC may also provide supplementary services for Short Message Service (SMS).

Mobile Station (MS)

A wireless terminal used by subscribers to access network services over a radio interface. MSs include portable units (e.g., hand-held units), units installed in vehicles, and somewhat paradoxically, fixed location MSs. The MS is the interface equipment used to terminate the radio path at the subscriber.

Mobile Switching Center (MSC)

The MSC switches MS originated or MS terminated traffic. An MSC is usually connected to at least one BS. It may connect to the other public networks (PSTN, ISDN, etc.), other MSCs in the same network, or MSCs in different networks. The MSC may store information to support these capabilities.

Mobile Terminal 0 (MT0)

A self-contained data capable MS termination that does not support an external interface.

Mobile Terminal 1 (MT1)

A MS termination that provides an ISDN user-network interface.

Mobile Terminal 2 (MT2)

A MS termination that provides a non-ISDN user-network interface (e.g., ITU-T [CCITT] V series, ITU-T [CCITT] X series).

Number Portability DataBase (NPDB)

The NPDB is an entity which provides portability information for portable Directory Numbers.

Operations Systems Function (OSF)

The OSF is defined by the Telecommunications Management Network (TMN) OSF. These functions include Element Management Layer (EML), Network Management Layer (NML), Service Management Layer (SML), and Business Management Layer (BML) functions spanning across all operations systems functions (e.g., Fault Management, Performance Management, Configuration management, Accounting management and Security Management).

Over-The-Air Service Provisioning Function (OTAF)

The OTAF is an entity that interfaces proprietarily to CSCs to support service provisioning activities. The OTAF interfaces with the MSC to send MS orders necessary to complete service provisioning requests.

Packet Data Serving Node (PDSN)

The PDSN is an entity that provides Internet Protocol functionality to the mobile network. A PDSN establishes, maintains and terminates link layer sessions to the Mobile Station. A PDSN routes IP datagrams to the PDN. A PDSN may act as a Mobile IP Foreign Agent in the mobile network. A PDSN may have interface to one or more Base Stations to provide the link layer session. A PDSN interacts with the AAA to provide IP authentication, authorization, and accounting support. A PDSN may interface to one or more IP networks either public or Intranet to provide IP network access.

Packet Data Network (PDN)

A PDN, such as the Internet, provides a packet data transport mechanism between processing network entities capable of using such services.

Public Switched Telephone Network (PSTN)

The PSTN is defined in accordance with the appropriate *ANSI T1* Standards.

Service Control Point (SCP)

The SCP is an entity that acts as a real-time database and transaction processing system that provides service control and service data functionality.

Service Node (SN)

The SN is an entity that provides service control, service data, specialized resources and call control functions to support bearer-related services.

Short Message Entity (SME)

The SME is an entity that composes and decomposes short messages. A SME may, or may not be located within, and be indistinguishable from, an HLR, MC, VLR, MS, or MSC.

Terminal Adapter (TA)

An entity that converts signaling and user data between a non-ISDN and an ISDN interface.

Terminal Adapter m (TAm)

An entity that converts signaling and user data between a non-ISDN and an ISDN interface.

Terminal Equipment 1 (TE1)

A data terminal that provides an ISDN user-network interface.

Terminal Equipment 2 (TE2)

A data terminal that provides a non-ISDN user-network interface (e.g., ITU-T [CCITT] V series, ITU-T [CCITT] X series).

User Identity Module (UIM)

The UIM contains subscription information such as the NAM and may contain subscription feature information. The UIM can be integrated into any mobile terminal or it may be removable.

Visitor Location Register (VLR)

The VLR is the location register other than the HLR used by an MSC to retrieve information for handling of calls to or from a visiting subscriber. The VLR may, or may not be located within, and be indistinguishable from an MSC. The VLR may serve more than one MSC.

Wireless Network Entity (WNE)

A Network Entity in the wireless Collective Entity

2.1.2 Reference Points

The U_m reference point is the only reference point that is by definition a physical interface. The other reference points will be physical interfaces if network entities on either side them are contained in different physical devices.

An interface exists when two Network Entities are interconnected through exactly one Reference Point.

Reference Point A

Reference Point A is the interface between the BSC and the MSC.

Reference Point A_i

Reference Point A_i is the interface between the IP and the PSTN, plus the interface between the MSC and the PSTN, plus the interface between the SN and the PSTN.

Reference Point A_{bis}

Reference Point A_{bis} is the interface between the BSC and the BTS.

Reference Point A_{ter}

Reference Point A_{ter} is the BS to BS interface.

Reference Point A_{quater}

Reference Point A_{quater} is the interface between the PDSN and the BS.

Reference Point B

Reference Point B is the interface between the MSC and the VLR.

Reference Point C

Reference Point C is the interface between the MSC and the HLR.

Reference Point D

Reference Point D is the interface between the VLR and the HLR.

Reference Point d

Reference Point d is the interface between an IAP and the DF.

Reference Point D₁

Reference Point D₁ is the interface between the OTAF and the VLR.

Reference Point D_i

Reference Point D_i is the interface between the IP and the ISDN, the IWF and the ISDN, the interface between the MSC and the ISDN, plus the interface between the SN and the ISDN.

Reference Point E

Reference Point E is the interface between the MSC and the MSC.

Reference Point e

Reference Point e is the interface between the CF and the DF.

Reference Point F

Reference Point F is the interface between the MSC and the EIR.

Reference Point G

Reference Point G is the interface between the VLR and the VLR.

Reference Point H

Reference Point H is the interface between the HLR and the AC.

Reference Point I

Reference Point I is the interface between the CDIS and the CDGP. The operations supported by this interface are described in *IS-124*.

Reference Point J

Reference Point J is the interface between the CDGP and the CDCP. The operations supported by this interface are described in *IS-124*.

Reference Point K

Reference Point K is the interface between the CDGP and the CDRP. The operations supported by this interface are described in *IS-124*.

Reference Point L

Reserved.

Reference Point M₁

Reference Point M₁ is the interface between the SME and the MC.

Reference Point M₂

Reference Point M₂ is the MC to MC interface.

Reference Point M₃

Reference Point M₃ is the SME to SME interface.

Reference Point N

Reference Point N is the interface between the HLR and the MC.

Reference Point N₁

Reference Point N₁ is the interface between the HLR and the OTAF.

Reference Point O₁

Reference Point O₁ is the interface between an MWNE and the OSF.

Reference Point O₂

Reference Point O₂ is the interface between two Operations Systems Functions (OSF's).

Reference Point P_i

Reference Point P_i is the interface between the MSC, the IWF, the PDSN, the AAA, and the PDN . This reference point is also the interface between the PDSN and the AAA.

Reference Point Q

Reference Point Q is the interface between the MC and the MSC.

Reference Point Q₁

Reference Point Q₁ is the interface between the MSC and the OTAF.

Reference Point R

Reference Point R is the interface between the TA and the TE2.

Reference Point R_m

Reference Point R_m is the interface between the TE2 and the TA_m plus the interface between the TE2 and the MT2.

Reference Point R_v

Reference Point R_v is the interface between the DCE and the TE2.

Reference Point R_x

Reference Point R_x is the interface between the PPDN and the TE2.

Reference Point S

Reference Point S is the interface between the ISDN and the TE1.

Reference Point S_m

Reference Point S_m is the interface between the TE1 and the MT1 plus the interface between the TE1 and the TA_m.

Reference Point T₁

Reference Point T₁ is the interface between the MSC and the SCP.

Reference Point T₂

Reference Point T₂ is the interface between the HLR and the SCP.

Reference Point T₃

Reference Point T₃ is the interface between the IP and the SCP.

Reference Point T₄

Reference Point T₄ is the interface between the HLR and the SN.

Reference Point T₅

Reference Point T₅ is the interface between the IP and the MSC.

Reference Point T₆

Reference Point T₆ is the interface between the MSC and the SN.

Reference Point T₇

Reference Point T₇ is the interface between the SCP and the SN.

Reference Point T₈

Reference Point T₈ is the interface between the SCP and the SCP.

Reference Point T₉

Reference Point T₉ is the interface between the HLR and the IP.

Reference Point U_i

Reference Point U_i is the interface between the integrated UIM and a MT.

Reference Point U_m

Reference Point U_m is the interface between the BS and the MS, which corresponds to the air interface.

Reference Point U_r

Reference Point U_r is the interface between the Removable-UIM and a MT.

Reference Point V

Reference Point V is the interface between the OTAF and the OTAF.

Reference Point W

Reference Point W is the interface between the DCE and the PSTN.

Reference Point X

Reference Point X is the interface between the CSC and the OTAF.

Reference Point Y

Reference Point Y is the interface between a Wireless Network Entity (WNE) and the IWF. See *IS-634* or *IS-658*.

Reference Point Z

Reference Point Z is the interface between the MSC and the NPDB.