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3RD GENERATION
PARTNERSHIP
PROJECT 2
"3GPP2"

Network Architecture Model for cdma2000 Femtocell Enabled Systems

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REVISION HISTORY

Revision	Description of Changes	Date
Rev 0 v1.0	Initial publication	April 2010

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Foreword

This foreword is not part of this specification.

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1 OVERVIEW

This document provides the 3rd Generation Partnership Project 2 (3GPP2) Network Architecture Model (NAM) for cdma2000[®]¹ systems that include femtocell network entities. The cdma2000 Femtocell NAM supports the requirements in S.R0126 [19].

1.1 Scope

This document describes the entity names and reference point for cdma2000 Femtocell enabled systems. Items that are outside the scope of this document include functional operation of the network entities, protocols of the interfaces, and requirements.

1.2 References

1.2.1 Informative References

References are either specific (i.e. identified by date of publication, revision identifier and/or version number) or non-specific. For specific references, earlier or later versions may not apply. For non-specific references, the latest revision applies.

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- [2] 3GPP2 A.S0009-C v2.0, *Interoperability Specification (IOS) for High Rate Packet Data (HRPD) Radio Access Network Interfaces with Session Control in the Packet Control Function*, January 2009.
- [3] 3GPP2 A.S0011-D v2.0, *Interoperability Specification (IOS) for cdma2000 Access Network Interfaces — Part 1 Overview (3G-IOS v5.1.1)*, August 2009.
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- [5] 3GPP2 A.S0013-D v2.0, *Interoperability Specification (IOS) for cdma2000 Access Network Interfaces — Part 3 Features (3G-IOS v5.1.1)*, August 2009.
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¹ cdma2000[®] is the trademark for the technical nomenclature for certain specifications and standards of the Organizational Partners (OPs) of 3GPP2. Geographically (and as of the date of publication), cdma2000[®] is a registered trademark of the Telecommunications Industry Association (TIA-USA) in the United States.

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- [11] 3GPP2 C.S0001-E v1.0, *Introduction to cdma2000 Standards for Spread Spectrum Systems*, September 2009.
- [12] 3GPP2 C.S0002-E v1.0, *Physical Layer Standard for cdma2000 Spread Spectrum Systems*, September, 2009.
- [13] 3GPP2 C.S0003-E v1.0, *Medium Access Control (MAC) Standard for cdma2000 Spread Spectrum Systems*, September 2009.
- [14] 3GPP2 C.S0004-E v1.0, *Signaling Link Access Control (LAC) Standard for cdma2000 Spread Spectrum Systems*, June 2009.
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- [16] 3GPP2 C.S0024-B v3.0, *cdma2000 High Rate Packet Data Air Interface Specification*, September 2007.
- [17] 3GPP2 S.R0005-B v2.0, *Network Reference Model for CDMA2000 Spread Spectrum Systems*, May 2007.
- [18] 3GPP2 S.R0037-B v2.0, *IP Network Architecture Model for cdma2000 Spread Spectrum Systems*, June 2009.
- [19] 3GPP2 S.R0126-0 v1.0, *System Requirements for Femto Cell Systems*, 15 May, 2008.
- [20] 3GPP2 X.S0059-000-0 v1.0, *cdma2000 Femtocell Network: Overview*, January 2010.

1.3 Acronyms

3GPP2	3rd Generation Partnership Project 2
AAA	Authentication, Authorization and Accounting
AC	Authentication Center
AI	Air Interface
AN	Access Network
AN-AAA	Access Network Authentication, Authorization, and Accounting

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3	AP	Access Point
4	AT	Access Terminal
5	BS	Base Station
6	EMS	Element Management System
7	ESN	Electronic Serial Number
8	FA	Foreign Agent
9	FAP	Femtocell Access Point
10	FCS	Femtocell Convergence Server
11	FGW	Femtocell Gateway
12	FMS	Femtocell Management System
13	HA	Home Agent
14	HLR	Home Location Register
15	HRPD	High Rate Packet Data
16	IMS	IP Multimedia Subsystem
17	IOS	Interoperability Specification
18	IP	Internet Protocol
19	IPsec	IP Security
20	IPv6	Internet Protocol version 6
21	ISDN	Integrated Services Digital Network
22	LAC	Link Access Control
23	LIIWF	LMSD – IMS Interworking Function
24	LIPA	Local IP Access
25	LMA	Local Mobility Anchor
26	LMSD	Legacy MS Domain
27	MAC	Medium Access Control
28	MAG	Mobile Access Gateway
29	MAP	Mobile Application Part
30	MC	Message Center
31	MDN	Mobile Directory Number
32	MGCF	Media Gateway Control Function
33	MGW	Media Gateway
34	MIP	Mobile IP
35	MM	Mobility Management
36	MPC	Mobile Positioning Center
37	MS	Mobile Station
38	MSC	Mobile Switching Center
39	MSCe	Mobile Switching Center emulation
40	NAM	Network Architecture Model
41	OEP	Other End Point
42	OSF-EML	Operating System Function – Element Management Layer
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PCF	Packet Control Function
PCM	Pulse Code Modulation
PDE	Position Determining Entity
PDSN	Packet Data Serving Node
PMIP	Proxy Mobile IP
PPP	Point to Point Protocol
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
RAN	Radio Access Network
SC	Session Control
SeGW	Security Gateway
SIP	Session Initiation Protocol
SMS	Short Message Service
SS7	Signaling System 7
UDI	Unrestricted Digital Information

1.4 Definitions

1x cdma2000 1x. Refer to A.S0011 [3].

2 ARCHITECTURE MODEL

2.1 Architecture Diagram

The NAM is comprised of the network entities and reference points as shown in Figure 2.1-1. Some of the network entities are a collection of network entities that are defined in A.S0024 [10] and X.S0059 [20]. The NAM is a superset of possible reference points and entities. An implementation can implement a subset of the entities and reference points.

Entities and reference points specific to cdma2000 Femtocells are bolded.

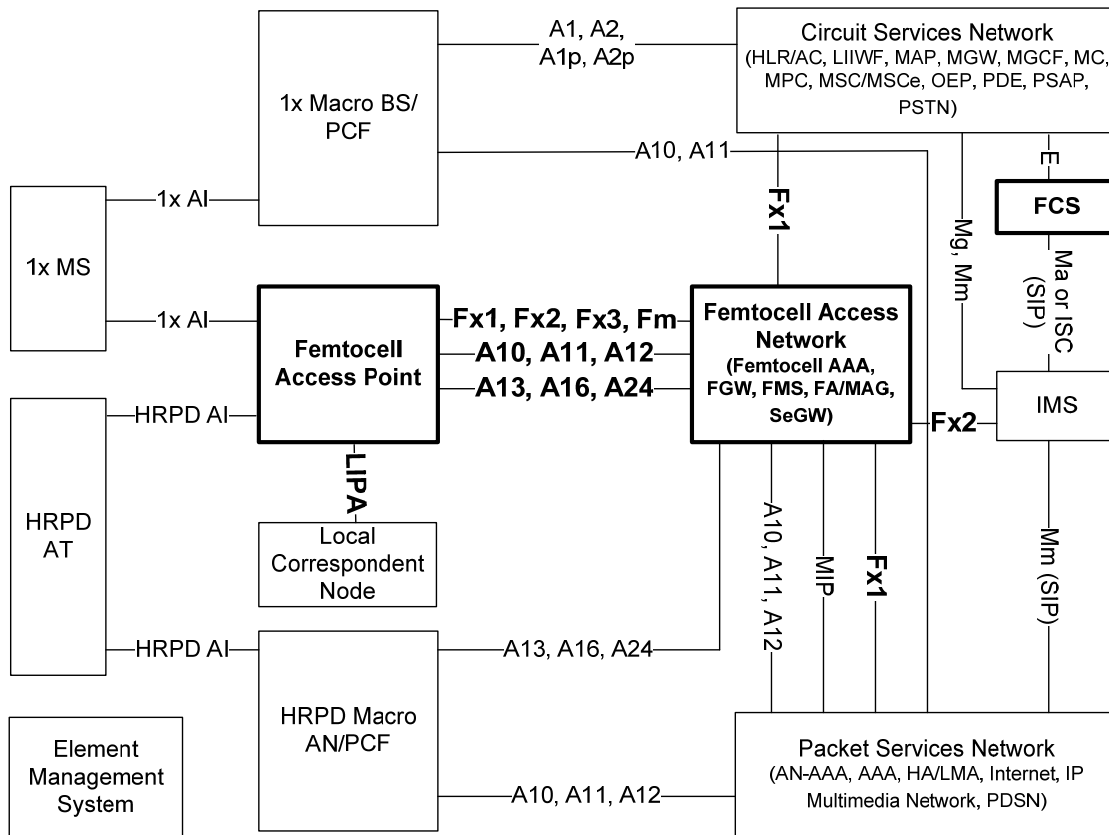


Figure 2.1-1 Network Architecture Model for cdma2000 Femtocell Enabled Systems

2.2 Network Entities

2.2.1 1x Macro BS/PCF

The 1x Macro Base Station (BS)/Packet Control Function (PCF) is an entity in the public radio telecommunications system used for radio telecommunications with MSs. The 1x Macro BS/PCF is defined in A.S0011 through A.S0017 [3][4][5][6][7][8][9].

2.2.2 1x Mobile Station (MS)

The 1x Mobile Station (1x MS) is an entity in the public cellular radio telecommunications service intended to be used while in motion or during halts at unspecified points. The 1x MS operates on the 1x air interface per C.S0001 through C.S0005 [11][12][13][14][15].

2.2.3 Circuit Services Network

The Circuit Services Network consists of entities primarily dealing with circuit switched services. Unless otherwise noted, refer to X.S0059 [20] for use in the context of how the entity supports cdma2000 Femtocells.

2.2.3.1 Home Location Register (HLR)/Authentication Center (AC)

The Home Location Register (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, and Authorization Period). The Authentication Center (AC) is an entity that manages the authentication information related to the 1x MS.

2.2.3.2 Legacy Mobile Station Domain – IMS – Interworking Function (LIWF)

The Legacy MS Domain (LMSD) - IMS - Interworking Function (LIWF) provides interworking between the Mobile Switching Center emulation (MSCe) and IP Multimedia Subsystem (IMS) by interworking LMSD Session Initiation Protocol (SIP) and IMS SIP.

2.2.3.3 Media Gateway (MGW)

The Media Gateway (MGW) provides an interface between the packet environment of the Core Network and the circuit switched environment of the Public Switched Telephone Network (PSTN) for bearer traffic, when equipped with circuit capabilities. The MGW provides vocoding and/or transcoding functions to the bearer traffic. The MGW also provides modem functions to convert digital byte streams to and from audio modem tones placed on circuits, and provides the capability to terminate Point-to-Point Protocol (PPP) connections. It also provides policy enforcement relative to its activities and resources. Refer to S.R0037 [18].

2.2.3.4 Media Gateway Control Function (MGCF)

The Media Gateway Control Function (MGCF) provides the ability to control a Media Gateway through standardized interfaces. Such control includes allocation and de-allocation of resources of the Media Gateway, as well as modification of the usage of those resources.

2.2.3.5 Message Center (MC)

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

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2.2.3.6 Mobile Application Part (MAP)

The Mobile Application Part (MAP) is a Signaling System 7 (SS7) protocol which provides an application layer for the various nodes in mobile core networks to communicate with each other in order to provide services to mobile phone users.

2.2.3.7 Mobile Positioning Center (MPC)

The Mobile Positioning Center (MPC) selects a Position Determining Entity (PDE) to determine the position of a mobile station. The MPC restricts access to position information (e.g., require that the 1x MS be engaged in an emergency call or only release position information to authorized network entities).

2.2.3.8 Mobile Switching Center (MSC)/Mobile Switching Center emulation (MSCe)

The MSC is either a circuit-switched MSC or an Internet Protocol (IP)-based MSCe and provides processing and control for calls and services.

2.2.3.9 Other End Point (OEP)

An Other End Point (OEP) is the communicating party with whom the 1x MS is communicating.

2.2.3.10 Position Determining Entity (PDE)

The PDE facilitates determination of the position or geographical location of a wireless terminal.

2.2.3.11 Public Safety Answering Point (PSAP)

A Public Safety Answering Point (PSAP) is a call center responsible for answering calls to an emergency telephone number for police, firefighting, and ambulance services.

2.2.3.12 Public Switched Telephone Network (PSTN)

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

2.2.4 Femtocell Access Network

The Femtocell Access Network consists of entities primarily dealing with cdma2000 Femtocells. Unless otherwise noted, refer to X.S0059 [20] for use in the context of how the entity supports cdma2000 Femtocells.

2.2.4.1 Femtocell Authentication, Authorization, and Accounting Server (Femtocell AAA)

The Femtocell AAA provides a Femtocell Access Point (FAP) authorization function.

2.2.4.2 Femtocell Gateway (FGW)

The Femtocell Gateway (FGW) is a network entity that resides in an operator's network and provides aggregation and proxy functions for the Femtocell Access Point to access services within the system operator's network.

2.2.4.3 Femtocell Management System (FMS)

The Femtocell Management System (FMS) is a network entity that resides in an operator's network and aids in the auto-configuration of the FAP before the 1x MS can access services through the FAP.

2.2.4.4 Foreign Agent/Mobile Access Gateway (FA/MAG)

The Foreign Agent (FA) de-tunnels and delivers data-grams to the mobile node that were tunneled by the mobile node's home agent. The Mobile Access Gateway (MAG) is a function on an access router that manages the mobility-related signaling for a mobile node that is attached to its access link.

2.2.4.5 Security Gateway (SeGW)

The Security Gateway (SeGW) is a network entity residing in an operator's network that provides secure access for the FAP to the operator's network

2.2.5 Femtocell Access Point (FAP)

The FAP is a wireless Access Point (AP) operating in licensed spectrum to connect a 1x MS and/or HRPD AT to the operator's network through the public Internet infrastructure. The FAP is defined in A.S0024 [10] and X.S0059 [20].

2.2.6 Femtocell Convergence Server (FCS)

The Femtocell Convergence Server (FCS) is an application server that provides interworking between the FAP that is supporting the 1x Mobile; the SIP environment of IMS; and the appropriate Mobile Application Part (MAP) network elements. The MAP contains elements such as the HLR, Message Center (MC), Mobile Positioning Center (MPC), and Mobile Switching Center (MSC).

2.2.7 IP Multimedia Subsystem (IMS)

The IMS is an architectural framework for delivering IP multimedia services. Refer to S.R0137 [18].

2.2.8 HRPD AT

The HRPD AT is a device providing data connectivity to a user. The HRPD AT uses the HRPD Air Interface (AI) as defined in C.S0024 [16].

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2.2.9 HRPD Macro AN/PCF

The HRPD Macro Access Network (AN)/PCF is defined in A.S0008 [1] and A.S0009 [2]. The HRPD Macro AN/PCF is a logical entity in the HRPD Radio Access Network (RAN) used for radio communications with the HRPD AT.

2.2.10 Local Correspondent Node

The Local Correspondent Node is generic IP based equipment that is outside the scope of this specification.

2.2.11 Element Management System

The Element Management System (EMS) provides the Operating System Function – Element Management Layer (OSF-EML) capabilities described in S.R0037 [18]. The EMS functions span across all operations systems functions (e.g., Fault Management, Accounting Management, Performance Management, Configuration Management and Security Management).

2.2.12 Packet Services Network

The Packet Services Network consists of entities primarily dealing with packet data services. Unless otherwise noted, refer to X.S0059 [20] for use in the context of how the entity supports cdma2000 Femtocells.

2.2.12.1 Access Network Authentication, Authorization, and Accounting (AN-AAA) Server

The AN Authentication, Authorization and Accounting server performs access authentication functions for the RAN.

2.2.12.2 Authentication, Authorization, and Accounting (AAA) Server

The Authentication, Authorization, and Accounting (AAA) server provides support for authentication, authorization, and accounting procedures.

2.2.12.3 Home Agent/Local Mobility Anchor (HA/LMA)

The Home Agent (HA) is the topological anchor point for the home network of the 1x MS and HRPD AT and is the entity that manages the reach-ability state of the 1x MS and HRPD AT. Local Mobility Anchor (LMA) is the home agent for the mobile node in a Proxy Mobile IP (PMIP) Version 6 (IPv6) domain.

2.2.12.4 Internet

The Internet is a global system of interconnected computer networks that uses a standardized internet protocol suite (e.g. TCP/IP).

2.2.12.5 IP Multimedia Network

The IP Multimedia Network is a collection of functions for delivering IP multimedia services.

2.2.12.6 Packet Data Serving Node (PDSN)

The Packet Data Serving Node (PDSN) is an entity that routes HRPD AT originated or HRPD AT terminated packet data traffic.

2.3 Reference Points

2.3.1 1x AI

The 1x Air Interface (AI) reference point is defined in C.S0001 through C.S0005 [11][12][13][14][15]. The 1x AI connects between a 1x MS and a 1x Macro BS/PCF and/or a FAP.

2.3.2 A1, A2, A1p, A2p

The A1, A2, A1p, A2p reference point is defined in A.S0011 [3], A.S0012 [4], A.S0013 [5], and A.S0014 [6].

- A1 This interface carries signaling information between the call control and mobility management functions of the circuit-switched MSC and the call control component of the macro BS.
- A1p This interface carries signaling information between the call control and mobility management functions of the MSCe and the call control component of the macro BS.
- A2 This interface is used to provide a path for user traffic. The A2 interface carries 64/56 kbps Pulse Code Modulation (PCM) information (for circuit-oriented voice) or 64 kbps Unrestricted Digital Information (UDI), for Integrated Services Digital Network (ISDN), between the circuit-switched MSC and the BS.
- A2p This interface provides a path for packet-based user traffic sessions. The A2p interface carries voice information via IP packets between the MGW and the BS.

2.3.3 A10, A11, A12

The A10, A11, A12 reference point is defined in various specifications depending on which entities are being connected.

The A10, A11 reference point between the 1x Macro BS/PCF and the Packet Services Network is defined in A.S0011 [3], A.S0012 [4], A.S0013 [5], and A.S0017 [9].

The A10, A11, A12 reference point between the FAP and the Femtocell Access Network is defined in A.S0024 [10].

The A10, A11, A12 reference point between the Femtocell Access Network and the Packet Services Network is defined in X.S0059 [20].

The A10, A11, A12 reference point between the HRPD Macro AN/PCF and the Packet Services Network is defined in A.S0008 [1] and A.S0009 [2].

A10 This interface carries user traffic between the FAP and the FGW or between the PCF and the PDSN.

A11 This interface carries signaling information between the FAP and the FGW or between the PCF and the PDSN.

A12 This interface carries signaling information related to access/terminal authentication between the FAP or the AN/PCF and the AN-AAA.

2.3.4 A13, A16, A24

The A13, A16, A24 reference point is defined in various specifications depending on which entities are being connected.

The A13, A16, A24 reference point between the FAP and the Femtocell Access Network is defined in A.S0024 [10].

The A13, A16, A24 reference point between the Femtocell Access Network and the HRPD Macro AN/PCF is defined in A.S0008 [1] and A.S0009 [2].

A13 This interface carries signaling information between the Session Control (SC)/Mobility Management (MM) function in the macro AN/PCF and the SC/MM function in the FAP for idle state session transfer and inter-AN/PCF paging when the HRPD AT is in idle state.

A16 This interface carries signaling information between the HRPD Macro AN/PCF and the FAP for HRPD inter-AN connected state session transfer (hard handoff).

A24 This interface carries buffered user data between the HRPD Macro AN/PCF and the FAP for an HRPD AT, during A13 session transfer.

2.3.5 E

The E reference point connects between FCS and MSC or MSCe. Refer to S.R0005 [17].

2.3.6 Fx1, Fx2, Fx3, Fm

The Fx1, Fx2, Fx3, Fm reference point is defined in X.S0059 [20].

Fx1 The Fx1 interface is the bearer interface between the FAP and the MGW. The FX1 interface is also the bearer interface between the FAP and the IP Multimedia Network.

Fx2 The Fx2 interface is the signaling interface between the FAP and the IMS.

Fx3 The Fx3 interface is an IP security (IPsec) tunnel between the FAP and the SeGW.

Fm The Fm interface enables auto-configuration of the FAP by the FMS.

2.3.7 HRPD AI

The HRPD AI is defined in C.S0024 [16]. The HRPD AI connects between an HRPD AT and a HRPD Macro AN/PCF and/or a FAP.

2.3.8 LIPA

Local IP Access (LIPA) is defined in A.S0024 [10].

2.3.9 Ma or ISC (SIP)

The Ma or ISC (SIP) reference point connects between the FCS and the IMS.

2.3.10 Mg, Mm (SIP)

The Mg reference point connects between the IMS and the MGCF and MGW.

The Mm (SIP) reference point connects between the IMS and the IP Multimedia Network. The Mm (SIP) reference point also connects between the IMS and the LIIWF.

2.3.11 Mobile IP (MIP)

The Mobile IP (MIP) reference point is defined in X.S0059 [20]. The MIP reference point connects between the Femtocell Access Network and the Packet Services Network.