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3GPP2 S.R0037-A v.1.0
Version Date: May, 2007
Version 1.0



3RD GENERATION
PARTNERSHIP
PROJECT 2
"3GPP2"

IP Network Architecture Model for cdma2000 Spread Spectrum Systems

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PREFACE

This 3GPP2 Wireless IP Network Architecture Model depicts packet mode operations and gateway information.

REVISION HISTORY

The “Revision” identifier is three characters “X.Y.Z”; each character is defined as:

“X” = published revision to which this enhancement applies.

“Y” = major technical enhancement number beyond “X”.

“Z” = editorial enhancement number beyond “Y”.

| Document | Date | Description | Source |
|----------------|------------------|--|----------------------------------|
| S.R0037-0 v1.0 | October 25, 2000 | Initial publication 1.0.0 | 3GPP2 All-IP AdHoc Group |
| S.R0037-0 v2.0 | May 14, 2002 | NAM Version 2.0.0 | 3GPP2 TSG-S (April 17th meeting) |
| S.R0037-0 v3.0 | August 21, 2003 | NAM Revision 3.0.0 text | SDO review comments incorporated |
| S.R0037-A v1.0 | May, 2007 | Renamed from S.R0037-0 v.4.0 to align with TIA TSB-151-A | Editor |

1. PURPOSE AND SCOPE

This document recommends the basic 3GPP2 Wireless IP Network Architecture Model.

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3GPP

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TIA/EIA-124

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TIA/EIA-553-A

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OTA

- TIA-683-C, *Over-The-Air Service Provisioning of Mobile Stations in Spread Spectrum Systems*, March 2003.

1.2 Terminology

This document uses the following “verbal forms” and “verbal form definitions”:

1. “should” and “should not” indicate items of interest that are highly desirable and particularly suitable, without identifying or excluding other items; or (in the negative form) indicate items of interest that are not desirable, are not particularly suitable, or are not recommended but not prohibited, and
2. “may” and “may not” indicate items of interest that are optional but permissible within the limits of this recommendation.

1.3 Assumptions

- a. The architecture described in this document assumes the following protocols:
 1. SIP (Session Initiation Protocol),
 2. RADIUS,
 3. DIAMETER, and
 4. MOBILE IP (i.e., IPv4 and/or IPv6).

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- b. The use, support, and interoperation of IPv4 and IPv6 in the All-IP network is currently assumed in this document, but whether IPv6 should be used exclusively needs to be strongly considered in ongoing work.
- c. There are known bearer paths not shown in Figure 2.1 (e.g., bearer paths between the Application Servers and the Border Router, the Application Servers and the Media Resource Function Processor). Some of these interfaces are shown in additional diagrams in this document, but not numerically labeled. (See Section 3)
- d. There are known signaling paths not shown in Figure 2.1 (e.g., signaling paths between two Call Session Control Functions (CSCFs), two AAAs, two AGWs, an external SIP entity beyond the Border Router and the CSCF). Some of these interfaces are shown in additional diagrams in this document, but not numerically labeled. (See Section 3)

1.4 Architectural Principles

The statements contained in this section should guide the development of the All-IP network architecture. While these statements are too general to be treated as specific requirements, they form a set of principles meant to govern the overall development of the All-IP network, they are:

- a. The All-IP network architecture should be independent of the underlying Layer 1 and Layer 2 protocols through the use of IP-based protocols.
- b. The All-IP core network should be independent of the access network. The core network should have the ability to support multiple access network technologies (e.g., cable, radio access technologies, wireless LAN, DSL).

The core network should have the ability to support access networks as they evolve and as new access technologies are identified. This implies that network functions such as call control and service control should be independent of access functions. How this independence is maintained for mobility management and location-based services (which may be dependent on access technology) is for further study.

- c. A phased migration of existing networks to the All-IP network should be possible.
- d. All pertinent interfaces in the All-IP network should be defined in an open manner.
- e. The All-IP network should promote efficient use of radio interface resources.
- f. The All-IP network should be capable of supporting reliability levels equal to or better than those found in legacy networks.
- g. The All-IP network should support capabilities for rapid service creation, including service creation by the user and by third parties as well as service profile customization by end users.
- h. The All-IP network should permit separate signaling and bearer paths.
- i. The All-IP network architecture and protocols should be scalable.
- j. The All-IP network architecture development process should aim to identify and reuse solutions from other initiatives within the IMT-2000 family (especially 3GPP), whenever possible and reasonable.
- k. The All-IP network should support Quality of Service equal to or better than that found in legacy networks.
- l. The All-IP network architecture should be defined in terms of separate functions and clear interfaces such that it is possible to separate bearer from signaling.
- m. The All-IP network should be functionally designed to allow and encourage reduced complexity and/or resource utilization.

- n. The All-IP network should support a range of terminal types (e.g., voice-only terminals, IP Multimedia terminals, laptop computers). Not all these terminals may be able to support end-to-end IP capabilities (e.g., 2G and 3G legacy terminals).
- o. The All-IP architecture should be designed in such a way that a migration from IPv4 to IPv6 is feasible and that IPv4 and IPv6 based All-IP networks may interoperate.

1.5 Legend

This section provides a definition of the different styles of lines and rectangles used in many figures within this recommendation, as:

| | |
|--------------------------|---|
| Dashed Line | Signaling interface, |
| Dashed Rectangle | Collective Network Entity and Composite Network Entity, |
| Heavy Dashed Line | Radio Link (air interface), |
| Solid Line | Circuit Bearer or Packet Bearer interface, and |
| Solid Rectangle | Network Entity. |

1.6 Definitions

This section provides definitions of some terms used within this document, as:

Quality of Service (QoS)

QoS refers to a set of capabilities that a network may provide to a communications session. These capabilities can be specified so that particular applications (e.g., voice, video, streaming audio) fulfill human factors or other requirements with respect to fidelity and performance.

QoS in a packet network consists of at least the following components:

- Bandwidth: Data rate (e.g., 64 kbps),
- Delay: End-to-end or roundtrip latency (e.g., 300 ms),
- Jitter: Inter-packet latency variation (e.g., 10 ms), and
- Loss: Rate at which packets are dropped (e.g., 3%).

Additionally, this QoS may be:

- unidirectional or bidirectional,
- guaranteed or statistical,
- end-to-end or limited to a particular domain or domains, and
- applied to all traffic or just to a particular session or sets of sessions.

Wireless Network Operator (WNO)

A network operator offering wireless services using the architecture defined by 3GPP2. This architecture may also support other access technologies.

1.7 Abbreviations

This section provides a definition of the abbreviations used within this recommendation, as:

| | | | |
|---------------|--|----------------|--|
| AAA | Authentication, Authorization and Accounting | MFRP | Media Resource Function Processor |
| API | Application Programming Interface | MS | Mobile Station |
| AGW | Access Gateway | MSC | Mobile Switching Center |
| AS | Application Server | NAI | Network Access Identifier |
| | | NML | Network Management Layer |
| BCMCS | Broadcast-Multicast Service | OSA | Open Service Access |
| BGCF | Breakout Gateway Control Function | OGF | OSA Gateway Function |
| BML | Business Management Layer | OSA-SCF | OSA - Service Capability Feature |
| BR | Border Router | OSF | Operations Systems Function |
| BSC | Base Station Controller | OSS | Operations Support System |
| BSN | Broadcast Serving Node | OTAF | Over the Air Activation Function |
| BTS | Base Transceiver System | PCF | Packet Control Function |
| CoA | Care of Address | P-CSCF | Proxy CSCF |
| CSCF | Call Session Control Function | PDE | Position Determining Entity |
| DB | Database | PDSN | Packet Data Service Node |
| DSI | Dynamic Subscriber Information | PDF | Policy Decision Function |
| EIR | Equipment Identity Register | PSTN | Public Switched Telephone Network |
| EML | Element Management Layer | QoS | Quality of Service |
| FA | Foreign Agent | RAN | Radio Access Network |
| HA | Home Agent | RNC | Radio Network Controller |
| HLR | Home Location Register | SCE | Service Creation Environment |
| HSS | Home Subscriber Server | SCP | Service Control Point |
| IMS | IP Multimedia Subsystem | SGW | Signaling Gateway |
| IP | Internet Protocol | SIBB | Service Independent Building Block |
| IPv4 | Internet Protocol Version 4 | SIP | Session Initiation Protocol |
| IPv6 | Internet Protocol Version 6 | | |
| I-CSCF | Interrogating CSCF | SLA | Service Level Agreement |
| ISUP | Integrated Services User Part | | |
| MAP | Mobile Application Part | SML | Service Management Layer |
| MC | Message Center | SMS | Service Management System |
| ME | Mobile Equipment | S-CSCF | Serving CSCF |
| MGW | Media Gateway | TE | Terminal Equipment |
| MGCF | Media Gateway Control Function | UIM | User Identity Module |
| MM | Mobility Manager | UTRAN | Universal Terrestrial Radio Access Network |
| | | WIN | Wireless Intelligent Network |
| MMD | Multimedia Domain | WLAN | Wireless Local Area Network |
| M-NE | Managed-Network Entity | WNO | Wireless Network Operator |
| MRFC | Media Resource Function Controller | | |

NOTE to the Reader: The NAM (Network Architecture Model) has made the following name and diagrammatical change after version 3.0: OSA Service Capability Server (OSA-SCS) has become the OSA Gateway Function (OGF).

2. ARCHITECTURE MODELS

Architecture 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 All-IP Network Architecture Model

Figure 2.1 presents the network entities and associated reference points that comprise a wireless All-IP network. The network entities are represented by squares and rectangles; the interfaces between network entities are reference points identified by numbers. The network architecture model in this document is the compilation of several architecture models currently in use in 3GPP2 wireless recommendations.

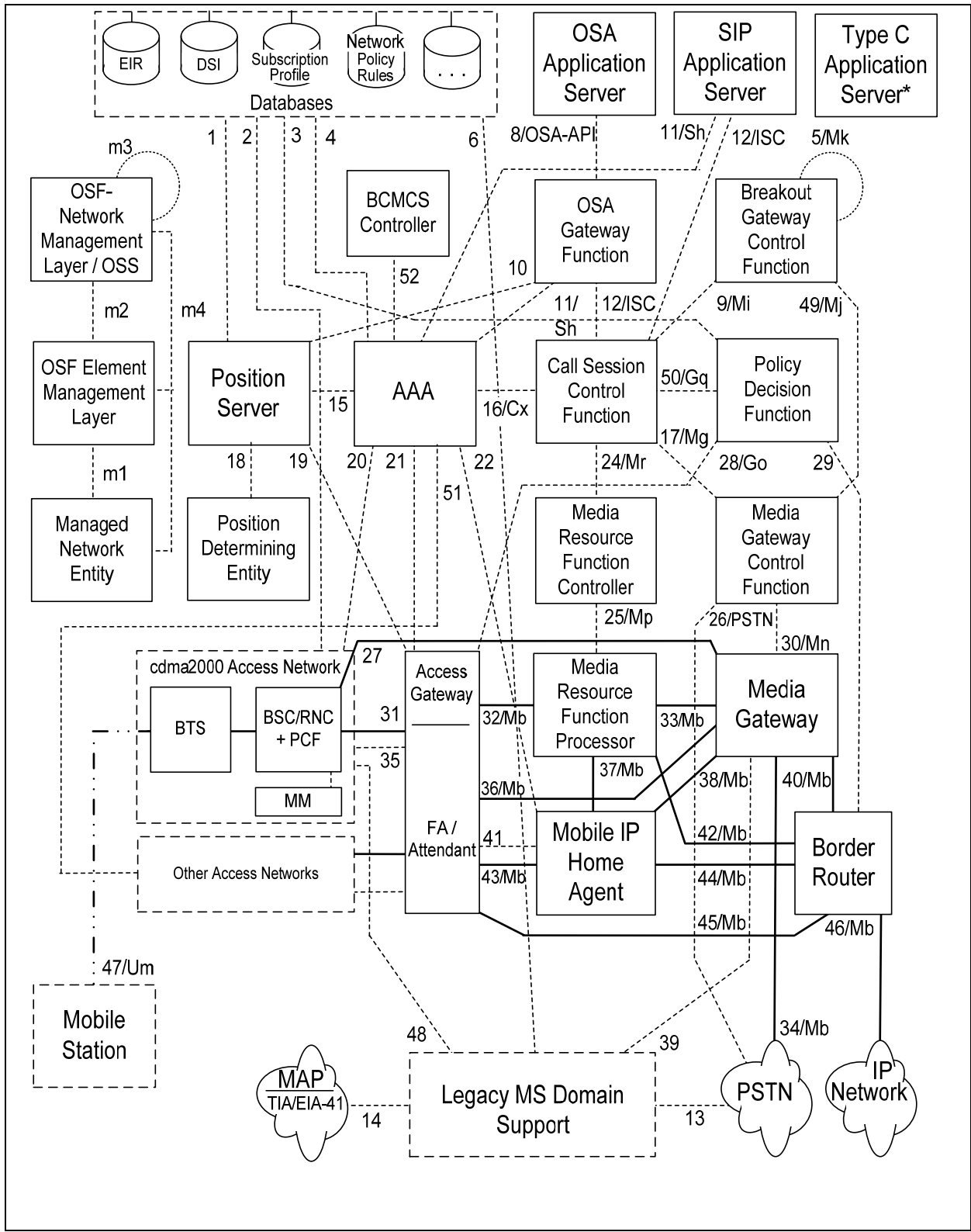
Note the following:

- a. **The network architecture model is a functional block diagram.**
- b. **A network entity represents a group of functions, not a physical device. 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.**
- c. **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. One or more interfaces may be defined to support each reference point.**
- d. **A reference point may or may not be standardized. This is a subject for further study, for each particular reference point.**
- e. **An interface is comprised of a standardized set of procedures, messages, and protocols. Interface specification is beyond the scope of this document.**
- f. **A “Collective Entity” contains encompassed network entities that are an instance of the collective (e.g., cdma2000^{®1} Access Network).**

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.

- g. A “Composite Entity” contains encompassed network entities that are part of the composite (e.g., Mobile Station).**

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* Reference points to Type C Application Servers are specified in the respective services specifications

Figure 2.1 3GPP2 Wireless All-IP Network Architecture Model

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2.1.1 Network Entities

Each network entity may be a physical device, it may form part of a physical device, or it may be distributed over a number of physical devices.

Access Gateway (AGW)

The AGW is a network component that should support the Multimedia and Legacy MS Domains, as well as BCMCS. The CDMA2000 Access Gateway (AGW) consists of the Packet Data Service Node (PDSN), the Broadcast Serving Node (BSN) and other logical functions required to interface the core network to the CDMA2000 Radio Access Network (RAN).

The AGW provides the Core Network (CN) with access to the resources of the Access Network. The AGW presents the CN with a common interface to the specific capabilities, configuration, and resources of the numerous Access Network technologies. An Access Gateway performs the following functions:

IP Multimedia Domain:

- a. supports inter-access gateway handoffs,
- b. provides Foreign Agent (IPv4) and/or Attendant (IPv6) functionality,
- c. includes the link layer peer function for link layer termination of the IP traffic from and to the Mobile Station (e.g., PPP [Point-to-Point Protocol]),
- d. provides the interface to access network functions (e.g., the PCF function of the BSC/RNC+PCF),
- e. transports bearer streams (containing both upper layer signaling and user traffic) between the mobile station and the core network,
- f. provides access to network level registration and authentication for the mobile station (e.g., Mobile IP registration),
- g. communicates with the AAA for user authentication, access authorization to the core network, and accounting,
- h. communicates with the Policy Decision Function (PDF) for management of QoS resources,
- i. supports link layer handoffs between homogeneous access networks supported by the same AGW,
- j. may support link layer handoffs among access networks of differing technologies when the Access Networks are supported by the same access gateway,
- k. maps Network Access Identifiers (NAIs) into mobile station identifiers,
- l. propagates appropriate policy decision information to the Access Network for enforcement within the Access Network,
- m. may intercept the QoS requests from the mobile station. QoS allocation requests may be forwarded to the Policy Decision Function (PDF) for authorization. If successfully authorized, the QoS allocation request may be forwarded toward the request's final destination,
- n. may mark packets from mobile station as per QoS profile,
- o. enforces policy decisions for authorized services, and
- p. gathers accounting information from the Access Network and forwards it to the Accounting Function along with accounting information maintained by the AGW.

Legacy MS Domain:

- a. Supports packet data services for cdma2000 legacy mobile stations.

The 3GPP2 AGW is one of numerous types of access gateways (e.g., CDMA2000 RAN, UTRAN, 802.11, wireline, etc.).

The AGW is connected via Reference Points (see Section 2.1.2):

- 19. Position Server (signaling [Multimedia Domain only]),
- 21. AAA (signaling),
- 28/Go. Policy Decision Function (signaling),
- 31. cdma2000 Access Network (bearer streams),
- 32/Mb. Media Resource Function Processor (bearer streams),
- 35. cdma2000 Access Network (signaling),
- 36/Mb. Media Gateway (bearer streams [Multimedia Domain only]),
- 41. Mobile IP Home Agent (signaling),
- 43/Mb. Mobile IP Home Agent (bearer streams),
- 45/Mb. Border Router (bearer streams),
- PP. PDSN in another Access Gateway (signaling and bearer [Multimedia Domain only]) – not shown in Fig. 2.1.

BCMCS:

- a. Communicates with the BSC/PCF to add and remove Multicast IP Flows;
- b. Employs IP multicast protocols to manage bearers supporting Multicast IP Flow between itself and the nearest router connecting to the BCMCS Content Server;
- c. Applies flow treatment received from the BCMCS Controller to the Multicast IP Flows.

Access Network

The Access Network is a network component that may support both the Multimedia and Legacy MS Domains.

The access network may perform mobility management functions for registering, authorizing, authenticating and paging IP based terminals, independent of circuit based terminals. The access network may perform handoffs within an access network and between access networks of the same technology and may support handoffs between access networks of differing technologies.

cdma2000 Access Network:

The cdma2000 Access Network contains:

Base Transceiver System (BTS)

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

Base Station Controller (BSC)

The BSC is an entity that provides control and management for one or more BTSs.

In support of the IP Multimedia Domain, the BSC/PCF interfaces to the Access Gateway to support bearer streams between the terminal and the IP Multimedia core network.

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In support of the Legacy MS Domain (LMSD), the BS may initiate the QoS allocation request. The QoS allocation request uses the address of the Media Gateway and QoS parameters provided by the LMSDS. Additionally, the BSC exchanges messages with the BTS, other BSCs, AGW, and the LMSDS. Signaling for call control, mobility management, and MS management as well as traffic may pass transparently through the BSC.

In support of Broadcast-Multicast Service (BCMCS), the BSC operates in conjunction with the PCF to perform signaling, and to establish and tear down bearer channels, between the BSN and the MSs.

Mobility Manager (MM)

The IP Multimedia Domain MM function's responsibilities include:

- a. Handling registration messages from the Mobile Station for the establishment of logical bearers through the IP Multimedia Domain core network,
- b. Communicating with the AAA for access network authentication, authorization of radio link access and accounting. Example of accesses that MM should authenticate and/or authorize with the AAA include multimedia registration, multimedia page response, inter-radio access network handoff, and
- c. Supporting hard handoff within and between access networks when possible.

NOTE: The functionality of the MM is under study.
The MM has a signaling relationship with the BSC/RNC + PCF.

Packet Control Function (PCF)

The PCF's responsibilities include:

- a. establish, maintain, and terminate layer-2 connection to the Access Gateway (AGW),
- b. interact with AGW to support dormant handoff,
- c. maintain knowledge of radio resource status (e.g., active, dormant),
- d. buffer packets arriving from the AGW when radio resources are not in place or are insufficient to support the flow from the AGW,
- e. relay packets to and from the AGW,
- f. map mobile station ID and connection reference to a unique layer-2 connection identifier used to communicate with the AGW,
- g. collect and send radio link (air interface) related accounting information to the AGW.

The cdma2000 Access Network is connected via Reference Points (see Section 2.1.2):

- 2. Databases (signaling),
- 20. AAA (signaling [Multimedia Domain only]),
- 27. Media Gateway (bearer streams [Legacy MS Domain only]),
- 31. Access Gateway (bearer streams),
- 35. Access Gateway (signaling),

47/Um. Mobile Station (Radio Link [air interface]), and

48. Legacy MS Domain Support (signaling [Legacy MS Domain only]).

Authentication, Authorization and Accounting (AAA)

The AAA is a network component that supports the Multimedia and Legacy MS Domains, and application services (e.g., BCMCS).

The AAA provides IP based Authentication, Authorization, and Accounting functions. The AAA maintains security associations with peer AAA entities to support intra- and/or inter-administrative domain AAA functions.

Authentication Function

The Authentication Function of the AAA provides Authentication of terminal devices and subscribers.

The Authentication Function:

- a. verifies an entity's identity for network access, QoS request, multimedia resource request, or service request, and
- b. provides authentication and/or encryption keys to establish dynamic security associations between network entities.

Authorization Function

The Authorization Function of the AAA provides authorization of requests for services and/or bandwidth, etc. and has access to the Policy Repository, the Directory Services, Subscriber Profiles, and the Device Register.

The Authorization Function provides the authorization decision for services, bandwidth, etc. The Authorization Function answers the question (yes or no) whether a user or device is authorized for a particular service, and to what levels that service may be used.

The service authorization request may come from the Call Session Control Function once the Call Session Control Function (in the case of a multimedia session) has determined the specific service to be provided.

An entity that requests authorization from the AAA entity may receive a set of information that allows it to make further decisions concerning services and/or bandwidth, etc.) without a new request to the AAA entity (i.e., the requesting entity may be able to cache authorization information from the AAA entity). Cached information may have an assigned expiration time. The AAA entity may send unsolicited messages containing policy decisions to appropriate entities.

Note: The OSA Gateway Function (OGF), in conjunction with AAA, is responsible for guaranteeing proper authorization for application access to all resources for all OSA Application Server requests. There are still outstanding concerns related to privacy applications and/or conditions that cannot be satisfied by an initial authorization from AAA which are not fully known at this time and must be further investigated by the applicable TSGs.

Accounting Function

The Accounting Function of the AAA gathers data concerning the services, QoS, and multimedia resources requested and used by individual subscribers.

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- a. records session details (e.g., requesting party, requested services, actual services used, date and time of requests, duration of usage, QoS used, terminal used),
- b. records mobility (e.g., administrative domain location, date and time of attach, date and time of detach),
- c. collects session details from various sources (e.g., CSCF, other Accounting Servers),
- d. allows session details to be retrieved for further processing, and
- e. provides accounting information to downstream OAM&P functions (e.g., Billing Management).

The AAA is connected via signaling Reference Points (see Section 2.1.2):

- 4. Databases [Network Policy Rules, Subscriber Profile],
- 11/Sh. OGF and SIP Application Server [Multimedia Domain only],
- 15. Position Server,
- 16/Cx. Call Session Control Function [Multimedia Domain only],
- 20. cdma2000 Access Network [Multimedia Domain only],
- 21. Access Gateway,
- 22. Mobile IP Home Agent,
- 51. Other Access Networks (e.g. WLAN),
- 52. BCMCS Controller
- between Local AAA and Home AAA servers (not shown in NAM Figure 2.1; see “gg” Section 3.1).

Application Server

The Application Servers are functional entities that may support both the Multimedia and Legacy MS Domains, and application services (e.g., BCMCS).

These services may be accessed via the OSA Gateway Function (OGF) or accessed directly from the user’s mobile station via other network entities. See section 3.1.4 for details on Application Server usage.

The OSA Application Server (OSA-AS), i.e., a Type A Application Server, is connected via signaling Reference Points (see Section 2.1.2):

- 8/OSA-API. OSA Gateway Function, and
- between the OSA Application Server and the IP Multimedia Client ([Multimedia Domain only], not shown in Figure 2.1; see “ii” Section 3.1.4).

The SIP Application Server (SIP AS), i.e., a Type B Application Server is connected via signaling Reference Points (see Section 2.1.2):

- 11/Sh. AAA [Multimedia Domain only],
- 12/ISC. CSCF [Multimedia Domain only], and
- between SIP AS and IP Multimedia Client ([Multimedia Domain only], not shown in Figure 2.1; see “ii” Section 3.1.4).

There also exist service-specific Type C Application Servers, an example of which is the BCMCS Content Server. The BCMCS Content Server is a core network function that makes BCMCS content available within an IP Multicast stream. The BCMCS Content Server in the serving network is not necessarily the creator or source of the content; it is the last application level entity to manipulate (e.g., reformat) the content prior to the content reaching the BSN. It may store and forward the content from the content provider, merge the content from the multiple content providers. The interface(s) required for the BCMCS Content Server is specified in X.S0022.

Notes:

The distribution of an Application Server may consist of any of the following combinations:

- a. all Application Servers may be hosted in a single server, or
- b. one Application Server may be hosted in a constellation of servers.

An Application Server refers to:

- a. a "Home Application Server" (i.e., owned and executed by the home service provider who may or may not be the home WNO),
- b. a "Third Party Application Server" (i.e., owned and executed by a third party, but uses the resources of the WNO network), and/or
- c. a "Local Application Server" (i.e., owned and executed by the visited WNO).

Application servers use their underlying MMD network resources through the following two interfacing categories.

- a. **SIP Application Servers:** SIP application servers providing service control interact directly with the network elements such as the S-CSCF, and the AAA. These servers include Multimedia Domain (MMD) in-house and trusted SIP-based multimedia application servers offering both service content and service control.
- b. **OSA Application Servers:** The OSA application servers interact indirectly with the network elements via the OSA Application Programming Interface (OSA API) to the OGF. This category of application servers provides all applications that are independent from their underlying core network technology, and are delivered via the use of an open standardized API. In this scheme, the OSA API open up access to core network capabilities and resources towards 3rd party application providers all the while ensuring network integrity.

This access to network capabilities is achieved by defining an abstracted set of network functionalities in terms of a series of generic Service Capability Features (SCFs), and by specifying an OSA-API interface between the application server (OSA-AS) and the OGF. This arrangement is to provide access to the network elements in order to build applications. After completion of authentication, authorization, discovery and service agreement signing functions using the Framework interfaces of the OGF, the OSA application is granted access to the OSA Service Capability Features. On the network side, the OGF interfaces with its underlying network protocols. In this way, applications and their service control protocols become independent from the underlying network technology. Functional description of the OGF is provided later in this section (Section 2.1.1).

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BCMCS Controller

This entity is a core network function that is responsible for managing and providing the BCMCS session information to the BSN function and the RAN (via the Serving AAA), the MS (via the PDSN function), and the BCMCS Content Server. It also performs authorization using the BCMCS user profile received from the Home AAA. The BCMCS Controller also can perform discovery operations to assist the MS to find desired content.

The BCMCS Controller is connected via signaling Reference Points (see Section 2.1.2):

52 AAA.

Border Router (BR)

The BR is a network component that should support both the Multimedia and Legacy MS Domains.

The BR connects the Core Network with peer networks (e.g., other service providers, corporate networks, Internet). The BR performs IP packet routing, exterior gateway routing protocols, and policing of incoming and outgoing traffic, ensuring traffic complies with defined Service Level Agreements established with peer networks. The BR may intercept any QoS allocation request, and issue a request to the Policy Decision Function (PDF), which should verify that the requested inbound and/or outbound QoS is available. A successful response from the PDF may cause the BR to forward the bandwidth allocation request to its final destination.

The BR is connected via Reference Points (see Section 2.1.2):

- 29. Policy Decision Function (signaling),
- 40/Mb. Media Gateway (bearer streams),
- 42/Mb. Media Resource Function Processor (bearer streams),
- 44/Mb. Mobile IP Home Agent (bearer streams),
- 45/Mb. Access Gateway (bearer streams), and
- 46/Mb. IP Network (bearer streams).

Breakout Gateway Control Function (BGCF)

The BGCF is a network component that applies only to the Multimedia Domain.

The BGCF selects the network in which PSTN breakout is to occur and, within the network where the breakout is to occur, selects the MGCF.

The BGCF is connected via signaling Reference Points (see Section 2.1.2):

- 9/Mi. S-CSCF,
- 49/Mj. MGCF, and
- 5/Mk. BGCF.

Call Session Control Function (CSCF)

The CSCF is a network component that applies only to the Multimedia Domain.

The CSCF establishes, monitors, supports, and releases Multimedia sessions and manages the user's service interactions. The CSCF is responsible for:

- a. managing the allocation of required resources such as announcement servers, multi-party bridges, etc.,
- b. maintaining knowledge of session states and user's service precedence,
- c. querying the AAA for authentication information and user profile information, and
- d. performing session processing tasks (e.g., network selection) required for session completion.

The CSCF entity in the home network is responsible for session control, as described above. The P-CSCF is used to proxy requests from the mobile station to an CSCF in the home network and to return responses from the home network to the mobile station.

The CSCF entity in the home network may be further divided into an Interrogating-Call Session Control Function (I-CSCF) and a Serving- Call Session Control Function (S-CSCF). The reason for this could be load sharing and/or hiding of the internal network structure, or for allocation of an S-CSCF close to the mobile station. The I-CSCF would in such a case be the entry point to the network, responsible for locating the S-CSCF serving the user, while the S-CSCF is the entity actually keeping the session state.

The communication between the CSCF and AAA may include the passing of addresses and security tokens necessary for the CSCF to communicate with other CSCF entities. Other techniques may also apply that allow an CSCF to determine the address of another CSCF entity.

The S-CSCF has access to Subscriber Profiles.

The CSCF uses information from various databases (e.g., subscriber profile) and invocation of various services applications to determine the exact service being requested.

The CSCF is connected via signaling Reference Points (see Section 2.1.2):

- 12/ISC. OSA Gateway Function or SIP Application Server,
- 16/Cx. AAA [Authorization Function],
- 17/Mg. Media Gateway Control Function,
- 24/Mr. Media Resource Function Controller,
- between P-CSCF and I-CSCF ([not shown in Figure 2.1; see "dd/Mw" Section 3.1.4]),
- between P-CSCF and S-CSCF ([not shown in Figure 2.1; see "dd/Mw" Section 3.1.4]),
- 9/Mi between BGCF and S-CSCF (also see Section 3.1.4),
- 50 between P-CSCF and PDF,
- between I-CSCF and S-CSCF [not shown in Figure 2.1; see "ff/Mw" Section 3.1.4]), and
- between IP Multimedia Client and P-CSCF [not shown in Figure 2.1; "hh/Gm" see Section 3.1.4]).

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Databases (DB)

The DB is a network component that may support both the Multimedia and Legacy MS Domains.

The information in the core network DBs may include HLR/AC, EIR, Dynamic Subscriber Information, Network Policy Rules and Subscriber Profile data.

EIR (Equipment Identity Register)

The EIR is a database of equipment information, including but not limited to a record of stolen equipment. The nature, purpose and utilization of the EIR information is for further study.

Dynamic Subscriber Information

The Dynamic Subscriber Information database contains the current session registration information (e.g., the serving Call Session Control Function address).

Network Policy Rules

The Network Policy Rules database provides the policy rules for subscription resource usage, expected QoS, valid times and routes, geographical service area definitions, policy rules for the applications serving a user, etc. The Network Policy Rules database also provides network wide policy rules specified by the operator to control the network.

The Network Policy Rules database is a data repository referenced by the Authorization Function of AAA, and the Policy Decision Function.

Subscriber Profile

The Subscriber Profile database contains subscriber specific information that identifies items as: authorized features, authorized services, authorized service area and credit worthiness.

The Databases are connected via signaling Reference Points (see Section 2.1.2):

1. Position Server [Multimedia Domain only],
2. cdma2000 Access Network,
3. Policy Decision Function,
4. AAA, and
6. Legacy MS Domain Support [Legacy MS Domain only].

Home Subscriber Server

The term "HSS" is used to represent the Home AAA entity plus the databases to which it interfaces. When used to define interfaces, the term HSS implies interfaces to the AAA component of the collective. The functions of the HSS collective and its interfaces are defined by the MMD specifications and their normative references. Other functions and interfaces supported by the AAA and Databases (e.g. Packet Data Subsystem Authentication, Authorization and Accounting) defined in other specifications are not changed by the use of the term HSS in the MMD series of specifications. Note that HSS as defined in the MMD series of specifications is used only for IMS.

IP Multimedia Client

The IP Multimedia Client is an IP application that resides in the MS and applies only to the Multimedia Domain.

The IP Multimedia Client communicates with Application Servers, P-CSCFs, and other IP Multimedia Clients.

The IP Multimedia Client is not shown in Figure 2.1, see Section 3.1.4.

The IP Multimedia Client is connected via signaling Reference Points (not shown in Figure 2.1; see Section 3.1.4):

- hh/Gm. Proxy-Call Session Control Function, and
- ii. Application Servers.

IP Network

The IP network is a network component that should support both the Multimedia and Legacy MS Domains.

The IP network corresponds to IP based packet data networks that provide a transport mechanism between the core network and external IP networks. IP Network represents packet networks connected to the core network including the public Internet, private IP backbone networks, and private IP networks such as a corporate Intranets.

The IP Network is connected via signaling and bearer streams Reference Points (see Section 2.1.2):

- 46/Mb. Border Router.

Legacy MS Domain Support (LMSDS)

The LMSDS is a network component that applies only to the Legacy MS Domain.

The LMSDS contains functional network components supporting the Legacy MS Domain; including:

- Home Location Register emulation (HLRe),
- Mobile Switching Center emulation (MSCe), and
- Service Control Point emulation (SCPe).

The SCPe component of LMSDS may also support the Multimedia Domain users' access to legacy features.

The LMSDS performs the call control, mobility management, and service management functions to provide support for non-IP (i.e., legacy) MSs. The LMSDS is responsible for the control of mobile originated and mobile terminated calls. The LMSDS terminates the user-network signaling and converts it into the appropriate network-network signaling. The LMSDS also controls the connections for bearer channels in a Media Gateway connected to a BSC in the Access Network.

Note: The LMSDS requires an authentication function capable of supporting legacy authentication methods. The placement of that authentication function is for further study. An interface to the HLRe should be necessary.

Note: The LMSDS requires a VLR type function. The placement of the VLR is for further study.

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Note: The LMSDS requires existing functionality (e.g., OTAF, MC) to support legacy capabilities. The placement of these functions is for further study. The sharing of these functions between the Legacy MS and Multimedia Domains is for further study.

The Legacy MS Domain Support contains network entities:

Home Location Register emulation (HLRe)

The HLRe is a network entity that supports non-IP Terminals (legacy MSs) in an IP network. The HLRe differs from an HLR in its interfaces and its functionality. The HLRe has IP signaling interfaces. For legacy and dual mode MSs (e.g., multimedia mode capable MSs and legacy mode capable MSs), the HLRe supports roaming to legacy networks and to Legacy MS Domains of IP networks.

The HLRe manages the subscriber profile for both voice services (e.g., Call Forwarding, Three Way Calling, Message Waiting Notification) and data services (e.g., Priority). Subscriber profile information may be accessed from the HLRe or may be downloaded to a serving system as needed.

The HLRe manages subscriber location and/or accessibility information. This includes updating the dynamic subscriber information database with current domain information (e.g., MSCe address) and with MS status information (e.g., SMS pending flag). The HLRe interacts with the location database to update or retrieve current location information.

Mobile Switching Center emulation (MSCe)

The MSCe provides processing and control for calls and services. The MSCe provides signaling capabilities comparable to those of a legacy MSC but has only bearer management capabilities. The MSCe:

- a. establishes, manages, and releases calls and connections (e.g., uses IP signaling to: setup calls between MSCes, control bearer resource allocation, control network resources such as tones and announcements),
- b. provides trigger mechanisms to access WIN and other service application functionality,
- c. modifies call and connection processing functions under the control of service logic, and
- d. provides interworking functions between TIA/EIA-41 and IP signaling protocols.

Service Control Point emulation (SCPe)

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

- a. interacts with the MSCe,
- b. contains the logic and processing capability required to handle Wireless Intelligent Network (WIN) provided service attempts,
- c. interacts with other SCPes and Application Servers for secured data acquisition and manipulation, distributed service control and unsolicited service notifications, if necessary, and
- d. interacts with the databases for data acquisition and manipulation.

The LMSDS is connected via signaling Reference Points (see Section 2.1.2):

- 6. Databases,
- 13. PSTN,
- 14. MAP (TIA/EIA-41),
- 39. Media Gateway,
- 48. cdma2000 Access Network,
- Position Server (not shown in Figure 2.1; see “jj” Section 3.4),
- OSA Gateway Function (not shown in Figure 2.1; see “kk” Section 3.4),
- Media Resource Function Processor (not shown in Figure 2.1; see “xx” Section 3.4 [Legacy MS Domain only]), and
- other LMSDSs (not shown in Figure 2.1; see “zz” Section 3.4 [Legacy MS Domain only]).

Managed Network Entity (M-NE)

A M-NE within the Collective Entity or any specific network entity (including databases) having OS management needs, including another OS.

IP Multimedia Domain:

- a. Supporting management capabilities as defined in S.S0028-A.

Legacy MS Domain:

- a. Supporting management capabilities as defined in S.S0028-A.

The M-NE is connected via Reference Points (see Section 2.1.2):

- m1. OSF-EML.

Managed Wireless Network Entity (MWNE)

A MWNE within the Collective Entity or any specific network entity having Operation Systems (OS) wireless management needs, including another OS.

Media Gateway (MGW)

The MGW is a network component that should support both the Multimedia and Legacy MS Domains.

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

Since the MGW has the ability to connect to the IP-based core network environment as well as the circuit-based PSTN environment, the resources provided by the MGW, including transcoding resources, can be used to support bearer channels that are contained entirely within the IP environment.

The MGW is connected via Reference Points (see Section 2.1.2):

- 27. BSC (bearer streams [Legacy MS Domain only]),
- 30/Mn. Media Gateway Control Function (signaling [Multimedia Domain only]),

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- 33/Mb. Media Resource Function Processor (bearer streams),
- 34/Mb. PSTN (bearer streams),
- 36/Mb. Access Gateway (bearer streams [Multimedia Domain only]),
- 38/Mb. Mobile IP Home Agent (bearer streams [Multimedia Domain only]),
- 39. Legacy MS Domain Support (signaling, [Legacy MS Domain only]),
- 40/Mb. Border Router (bearer streams), and
- other MGWs (bearer streams, not shown in Figure 2.1; see “yy” Section 3.4 [Legacy MS Domain only]).

Media Gateway Control Function (MGCF)

The MGCF is a network component that applies only to the Multimedia Domain.

The MGCF provides the ability to control a Media Gateway through standardized interfaces. Such control includes allocation and deallocation of resources of the Media Gateway, as well as modification of the usage of those resources.

The MGCF interfaces to the Media Gateway and to the Call Session Control Function. The MGCF interface to the Call Session Control Function is for communicating session control information (e.g., via a protocol like SIP). The MGCF interface to the PSTN is for communicating signaling information to the PSTN (e.g., ISUP signaling). The MGCF has the ability to translate between session based signaling within the All-IP core network and ISUP signaling.

The MGCF is connected via signaling Reference Points (see Section 2.1.2):

- 17/Mg. Call Session Control Function,
- 26/PSTN. PSTN,
- 30/Mn. Media Gateway, and
- 49/Mj. Breakout Gateway Control Function.

Media Resource Function Controller (MRFC)

The MRFC is a network component that applies only to the Multimedia Domain.

The MRFC, in conjunction with the MRFP, provides a set of resources within the core network that are useful in supporting services to subscribers. The MRFC, in conjunction with the MRFP, provides multi-way conference bridges, announcement playback services, tone playback services, etc.

The MRFC controls allocation, de-allocation, and modification of the usage of resources of the MRFP.

The MRFC is connected via signaling Reference Points (see Section 2.1.2):

- 24/Mr. Call Session Control Function, and
- 25/Mp. Media Resource Function Processor.

Media Resource Function Processor (MRFP)

The MRFP is a network component that may support both the Multimedia and Legacy MS Domains.

The MRFP, in conjunction with the controlling entity, provides multi-way conference bridges, announcement playback services, tone playback services, etc.

Bearer paths may go between the MRFP and network entities Access Gateway, Border Router, Media Gateway, and Mobile IP Home Agent.

The MRFP is connected via Reference Points (see Section 2.1.2):

- 25/Mp. Media Resource Function Controller (signaling [Multimedia Domain only]),
- 32/Mb. Access Gateway (bearer streams [Multimedia Domain only]),
- 33/Mb. Media Gateway (bearer streams),
- 37/Mb. Mobile IP Home Agent (bearer streams [Multimedia Domain only]),
- 42/Mb. Border Router (bearer streams), and
- Legacy MS Domain Support (not shown in Figure 2.1; see “xx” Section 3.4 [Legacy MS Domain only]).

Mobile IP Home Agent (HA)

The HA is a network component that should support both the Multimedia and Legacy MS Domains.

The HA provides two major functions: registering the current point of attachment of the user, and forwarding of IP packets to and from the current point of attachment (IPv4 Care of Address [CoA] and/or IPv6 Co-located CoA) of the user. The HA accepts registration requests using the Mobile IP protocol and uses the information in those requests to update internal information about the current point of attachment of the user, i.e., the current IP address to be used to transmit and receive IP packets to and from that user. The HA interacts with the AAA to process Mobile IP registration requests that have been authenticated, and to return Mobile IP registration responses. The HA also interacts with the Access Gateway to receive subsequent Mobile IP registration requests. The HA may interact with several network entities in performing its work of forwarding IP packets to the current point of attachment of the user.

The HA is connected via Reference Points (see Section 2.1.2):

- 22. AAA (signaling),
- 37/Mb. Media Resource Function Processor (bearer streams [Multimedia Domain only]),
- 38/Mb. Media Gateway (bearer streams [Multimedia Domain only]),
- 41. Access Gateway (signaling),
- 43/Mb. Access Gateway (bearer streams), and
- 44/Mb. Border Router (bearer streams).

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Mobile Station (MS)

The MS is a network component that may support both the Multimedia and Legacy MS Domains.

See Section 3.3 “Mobile Station View”.

The MS is connected via the Radio Link (air interface) Reference Point (see Section 2.1.2):
47/Um. Base Transceiver System.

Operations Systems Function (OSF)

The OSF is defined by the Telecommunications Management Network (TMN) OSF (see ITU M.3100). 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).

OSF – Element Management Layer (OSF-EML)

The OSF-EML covers Element Management Layer (EML) aspects and spanning across all operations systems functions.

IP Multimedia Domain:

- a. Supporting capabilities as defined in S.S0028-A.

Legacy MS Domain:

- a. Supporting capabilities as defined in S.S0028-A.

The OSF-EML is connected via Reference Points (see Section 2.1.2):

- m1. M-NE,
- m2. OSF-NML/OSS, and
- m4. Databases.

OSF – Network Management Layer (OSF-NML/OSS)

The OSF-NML/OSS (Operations Support System) includes Network Management Layer (NML), Service Management Layer (SML), and Business Management Layer (BML) functions and spanning across all operations systems functions..

IP Multimedia Domain:

- a. Supporting capabilities as defined in S.S0028-A.

Legacy MS Domain:

- a. Supporting capabilities as defined in S.S0028-A.

The OSF-NML/OSS is connected via Reference Points (see Section 2.1.2):

- m2. OSF-EML,
- m3. OSF-NML/OSS, and
- m4. Databases.

OSA Gateway Function (OGF)

The OSA Gateway Function (OGF) is a network functional entity that enables applications to make use of network capabilities and resources in the design and deployment of new

application services. This network functional entity is defined as a set of Service Capability Features (SCFs) and a Framework component in the OSA API. The OGF serves as a mediation function between 3rd-party Application Servers and mobile network entities, by providing controlled access to network resources required during service application execution. The OGF may support both the Multimedia and Legacy MS Domains. In relation to the Multimedia Domain (MMD), the OGF’s Framework component is primarily tasked to the execution of its basic mechanisms for ensuring secure and managed access to network capabilities for 3rd-party applications. Upon execution of these basic mechanisms, the OGF provides the application with SCFs the application is authorized to access. SCFs are abstractions from underlying network functionality.

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The OGF, in conjunction with AAA and the Position Server (for position related requests), is responsible for guaranteeing proper authorization for application access to resources. Note: There are still outstanding concerns related to privacy applications and/or conditions that cannot be satisfied by an initial authorization from AAA which are not fully known at this time and must be further investigated by the applicable TSGs.

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The OGF (for Legacy MS Domain Support) interfaces to Application Server and Legacy MS Domain Support network entities and relays service application information between these two network entities.

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The OGF is connected via signaling Reference Points (see Section 2.1.2):

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- 8/OSA-API. OSA Application Server,
- 10. Position Server,
- 11/Sh. AAA,
- 12/ISC. Call Session Control Function [Multimedia Domain only], and
- Legacy MS Domain Support [not shown in Figure 2.1; see “kk” Section 3.4, Legacy MS Domain only].

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Other Access Network:

For example WLAN (Wireless Local Area Network).

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Policy Decision Function (PDF)

The PDF is a network component that applies only to the IP Multimedia Domain.

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The PDF provides management of core network QoS resources within its own core network necessary to support services to network users. It communicates with the Access Gateway to provide authorization of resource allocations. The PDF makes policy decisions with regard to use of core network QoS resources within its own network, including consideration of Service Level Agreements (SLAs [Note, the maintenance of SLAs is for further study.]). QoS policy information for network resource utilization may be forwarded to and cached by the PDF.

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PDF manages resources of the Border Router and Access Gateway that handle traffic between low-speed networks (e.g., radio access network) and the high-speed backbone core network.

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Additionally, the PDF makes policy decisions based on information obtained from P-CSCF.

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The PDF is connected via signaling Reference Points (see Section 2.1.2):

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- 3. Database [Network Policy Rules],
- 28/Go. Access Gateway,

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- 29. Border Router, and
- 50. P-CSCF.

Position Determining Entity (PDE)

The PDE is a network component that may support both the Multimedia and Legacy MS Domains.

The PDE communicates with the Position Server to determine the precise geographic position of the MS based on input data provided by the Position Server.

The PDE is connected via signaling Reference Point (see Section 2.1.2):

- 18. Position Server.

Position Server

The Position Server is a network component that may support both the Multimedia and Legacy MS Domains.

The Position Server provides geographic position information to requesting entities.

The Access Gateway chooses a Position Server and requests registration for a particular terminal. The Position Server is responsible for granting such registrations, forwarding registration information to a proxy Position Server in the same network, if such a proxy exists, and interfacing with the Access Gateway to obtain necessary information to respond to position information requests. The Position Server selects a Position Determining Equipment (PDE) based on the positioning capabilities of the MS (as received from the Access Gateway). The (Proxy) Position Server interacts with the AAA to authenticate and authorize position service requests. The Position Server may cache the MS position.

The Position Server may simultaneously provide Proxy Position Server capabilities. In that capacity, the Position Server may also interface to other Proxy Position Servers.

The Position Server is connected via signaling Reference Points (see Section 2.1.2):

- 1. Databases (DSI [Multimedia Domain only]),
- 10. OSA Gateway Function [Multimedia Domain only],
- 15. AAA,
- 18. Position Determining Entity (PDE),
- 19. Access Gateway [Multimedia Domain only], and
- Legacy MS Domain Support (not shown in Figure 2.1; see “jj” Section 3.4 [Legacy MS Domain only]).

Public Switched Telephone Network (PSTN)

The PSTN is a network component that may support both the Multimedia and Legacy MS Domains (see Section 3.5 and Section 3.4, respectively).

The PSTN is defined in accordance with the appropriate applicable national and regional standards.

The PSTN is connected via Reference Points (see Section 2.1.2):

- 13. Legacy MS Domain Support (signaling [Legacy MS Domain only]),

26/PSTN. Media Gateway Control Function (signaling [Multimedia Domain only]),
and
34/Mb. Media Gateway (bearer streams).

Signaling Gateway (SGW)

The SGW is a network component that may support both the Multimedia and Legacy MS Domains.

The SGW function interconnects between the IP transport layer and the SS7 transport layer for signaling. The SGW function is not shown in Figure 2.1. The SGW function may reside within another entity or be a standalone entity.

2.1.2 Reference Points

An interface exists when two Network Entities are interconnected through exactly one signaling or bearer stream Reference Point. The Reference Points and their associated Network Entities are:

Reference Point 1

Reference Point 1 is the signaling interface between the Databases and the Position Server [Multimedia Domain only].

Reference Point 2

Reference Point 2 is the signaling interface between the Databases and the cdma2000 Access Network.

Reference Point 3

Reference Point 3 is the signaling interface between the Databases and the Policy Decision Function [Multimedia Domain only].

Reference Point 4

Reference Point 4 is the signaling interface between the Databases (e.g., the HLR) and the AAA.

Reference Point 5/Mk

Reference Point 5/Mk is the signaling interface between Breakout Gateway Control Functions [Multimedia Domain only].

Reference Point 6

Reference Point 6 is the signaling interface between the Databases and the Legacy MS Domain Support [Legacy MS Domain only].

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Reference Point 7

Reserved.

Reference Point 8/OSA-API

Reference Point 8/OSA-API is the signaling interface between the OSA Application Server and the OSA Gateway Function. Reference Point 8/OSA-API may employ interfacing techniques that support a wide spectrum of capabilities, ranging from secure (e.g., application programming interfaces such as Parlay, used for un-trusted parties) to non-secure (e.g., used for trusted parties).

Reference Point 9/Mi

Reference Point 9/Mi is the signaling interface between the BGCF and the Serving-CSCF [also see Figures 3.1.4b and 3.1.4c, Multimedia Domain only].

Reference Point 10

Reference Point 10 is the signaling interface between the Position Server and the OSA Gateway Function [Multimedia Domain only].

Reference Point 11/Sh

Reference Point 11/Sh is the signaling interface between the SIP Application Server and the AAA and between the OSA Gateway Function and the AAA, for user's service authentication and/or authorization, and for retrieving information from the MMD database [Multimedia Domain only].

Reference Point 12/ISC

Reference Point 12/ISC is the signaling interface between the SIP Application Server and Call Session Control Function and between the OSA Gateway Function and the Call Session Control Function for service control [Multimedia Domain only].

Reference Point 13

Reference Point 13 is the signaling interface between the Legacy MS Domain Support and the PSTN [Legacy MS Domain only].

Reference Point 14

Reference Point 14 is the signaling interface between the Legacy MS Domain Support and the MAP (TIA/EIA-41) [Legacy MS Domain only].

Reference Point 15

Reference Point 15 is the signaling interface between the Position Server and AAA.

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Reference Point 16/Cx

Reference Point 16/Cx is the signaling interface between the AAA and the Call Session Control Function [Multimedia Domain only].

Reference Point 17/Mg

Reference Point 17/Mg is the signaling interface between the Call Session Control Function and the Media Gateway Control Function [Multimedia Domain only].

Reference Point 18

Reference Point 18 is the signaling interface between the Position Server and the Position Determining Entity.

Reference Point 19

Reference Point 19 is the signaling interface between the Position Server and the Access Gateway [Multimedia Domain only].

Reference Point 20

Reference Point 20 is the signaling interface between the AAA and the cdma2000 Access Network [Multimedia Domain only].

Reference Point 21

Reference Point 21 is the signaling interface between the AAA and Access Gateway.

Reference Point 22

Reference Point 22 is the signaling interface between the AAA and the Mobile IP Home Agent.

Reference Point 23

Reserved.

Reference Point 24/Mr

Reference Point 24/Mr is the signaling interface between the Call Session Control Function and the Media Resource Function Controller [Multimedia Domain only].

Reference Point 25/Mp

Reference Point 25/Mp is the signaling interface between the Media Resource Function Controller and the Media Resource Function Processor.

Reference Point 26/PSTN

Reference Point 26/PSTN is the signaling interface between the Media Gateway Control Function and the PSTN [Multimedia Domain only].

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Reference Point 27

Reference Point 27 is the bearer stream interface between the cdma2000 Access Network and the Media Gateway [Legacy MS Domain only].

Reference Point 28/Go

Reference Point 28/Go is the signaling interface between the Policy Decision Function and Access Gateway.

Reference Point 29

Reference Point 29 is the signaling interface between Policy Decision Function and the Border Router.

Reference Point 30/Mn

Reference Point 30/Mn is the signaling interface between the Media Gateway Control Function and the Media Gateway [Multimedia Domain only].

Reference Point 31

Reference Point 31 is the bearer stream interface between cdma2000 Access Network and the Access Gateway.

Reference Point 32/Mb

Reference Point 32/Mb is the bearer stream interface between the Access Gateway and the Media Resource Function Processor .

Reference Point 33/Mb

Reference Point 33/Mb is the bearer stream interface between the Media Resource Function Processor and the Media Gateway.

Reference Point 34/Mb

Reference Point 34/Mb is the bearer stream interface between the Media Gateway and the PSTN.

Reference Point 35

Reference Point 35 is the signaling interface between the cdma2000 Access Network and the Access Gateway.

Reference Point 36/Mb

Reference Point 36/Mb is the bearer stream interface between the Access Gateway and the Media Gateway.

Reference Point 37/Mb

Reference Point 37/Mb is the bearer stream interface between the Media Resource Function Processor and the Mobile IP Home Agent.

Reference Point 38/Mb

Reference Point 38/Mb is the bearer stream interface between the Media Gateway and the Mobile IP Home Agent [Multimedia Domain only].

Reference Point 39

Reference Point 39 is the signaling interface between the Media Gateway and the Legacy MS Domain Support [Legacy MS Domain only].

Reference Point 40/Mb

Reference Point 40/Mb is the bearer streams interface between the Media Gateway and the Border Router.

Reference Point 41

Reference Point 41 is the signaling interface between the Access Gateway and the Mobile IP Home Agent.

Reference Point 42/Mb

Reference Point 42/Mb is the bearer streams interface between the Media Resource Function Processor and the Border Router.

Reference Point 43/Mb

Reference Point 43/Mb is the bearer streams interface between the Access Gateway and the Mobile IP Home Agent.

Reference Point 44/Mb

Reference Point 44/Mb is the bearer stream interface between the Mobile IP Home Agent and the Border Router.

Reference Point 45/Mb

Reference Point 45/Mb is the bearer stream interface between the Access Gateway and the Border Router.

Reference Point 46/Mb

Reference Point 46/Mb is the bearer stream interface between the Border Router and the IP Network.

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Reference Point 47/Um

Reference Point 47/Um is the Radio Link (air interface) between the Mobile Station and the cdma2000 Access Network.

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Reference Point 48

Reference Point 48 is the signaling interface between the cdma2000 Access Network and the Legacy MS Domain Support [Legacy MS Domain only].

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Reference Point 49/Mj

Reference Point 49/Mj is the signaling interface between the Breakout Gateway Control Function and the Media Gateway Control Function [Multimedia Domain only].

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Reference Point 50/Gq

Reference Point 50/Gq is the signaling interface between the Policy Decision Function and the P-CSCF [Multimedia Domain only].

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Reference Point 51

Reference Point 51 is the signaling interface between Other Access Networks (e.g., WLAN) and the AAA.

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Reference Point 52

Reference Point 52 is the signaling interface between the BCMCS Controller and the AAA.

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Reference Point aa

Reference Point aa is the bearer stream interface between the MS's IP Multimedia Client and the Home or Visited Network's Peer Mobile Station [not shown in Figure 2.1 (see Figure 3.1.3), Multimedia Domain only].

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Reference Point bb

Reference Point bb is the bearer stream interface between the MS's IP Multimedia Client and the Home or Visited Network's Media Resource Function Processor [not shown in Figure 2.1 (see Figure 3.1.3), Multimedia Domain only].

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Reference Point cc

Reference Point cc is the bearer stream interface between the MS's IP Multimedia Client and the Home or Visited Network's Media Gateway [not shown in Figure 2.1 (see Figure 3.1.3), Multimedia Domain only].

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Reference Point dd/Mw

Reference Point dd/Mw represents several signaling interfaces. Reference Point dd/Mw exists between the Proxy-CSCF and the Serving-CSCF, and between the Visited Network's

Proxy-CSCF and the Home Service Network's Interrogating-CSCF [not shown in Figure 2.1 (see Figure 3.1.4b), Multimedia Domain only].

Reference Point ff/Mw

Reference Point ff/Mw is the signaling interface between the Home Service Network's Interrogating-CSCF and the Home Service Network's Serving-CSCF [not shown in Figure 2.1 (see Figures 3.1.4b and 3.1.4c), Multimedia Domain only].

Reference Point gg

Reference Point gg is the signaling interface between the Visited Network's Local-AAA and the Home Network's Home-AAA [not shown in Figure 2.1 (see Figures 3.1.1 and 3.1.2)].

Reference Point hh/Gm

Reference Point hh/Gm is the signaling interface between the MS's IP Multimedia Client and the Visited Network's Proxy-CSCF [not shown in Figure 2.1 (see Figure 3.1.4b), Multimedia Domain only].

Reference Point ii

Reference Point ii is the signaling interface between the MS's IP Multimedia Client and the Home Service Network's Application Server [not shown in Figure 2.1 (see Figure 3.1.4c), Multimedia Domain only].

Reference Point jj

Reference Point jj is the signaling interface between the Position Server and the Legacy MS Domain Support [not shown in Figure 2.1 (see Figure 3.4), Legacy MS Domain only].

Reference Point kk

Reference Point kk is the signaling interface between the OSA Gateway Function and the Legacy MS Domain Support [not shown in Figure 2.1 (see Figure 3.4), Legacy MS Domain only].

Reference Point m1

Reference Point m1 is the management interface between an M-NE and an OSF-EML (applicable definitions provided by S.S0028-A).

Reference Point m2

Reference Point m2 is the management interface between an OSF-EML and an OSF-NML/OSS; this reference point is equivalent to the 3GPP Itf-N interface (applicable definitions provided by S.S0028-A).

Reference Point m3

Reference Point m3 is the management interface between an OSF-NML/OSS and another OSF-NML/OSS (applicable definitions provided by S.S0028-A).

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Reference Point m4

Reference Point m4 is the management interface between OSF-EML / OSF-NML/OSS and 3GPP2 NAM Databases, such as Network Policy Rules and Subscriber Profile (applicable definitions provided by S.S0028-A).

Reference Point O1

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

Reference Point O2

Reference Point O2 is the OSF to OSF interface.

Reference Point PP

Reference Point PP is the interface between the PDSN entities of the Serving and Target Access Gateways.

Reference Point xx

Reference Point xx is the signaling interface between the Media Resource Function Processor and the Legacy MS Domain Support [not shown in Figure 2.1 (see Figure 3.4)].

Reference Point yy

Reference Point yy is the bearer stream interface between two Media Gateways [not shown in Figure 2.1 (see Figure 3.4)].

Reference Point zz

Reference Point zz is the signaling interface between two Legacy MS Domain Supports [not shown in Figure 2.1 (see Figure 3.4)].

3. ALL-IP NAM DETAILED VIEWS

3.1 Planar Views

There are several different drivers for having a planar view of the architecture showing:

- a. the separation of access specific functions from access independent functions,
- b. how IP transparency is used to facilitate communication between functions in the mobile station and on the network side,
- c. how the concepts of different home networks in different planes apply to the architecture, and
- d. the concepts of separation between transport and signaling wherever they apply.

3.1.1 Access Plane

The purpose of the access plane is to hide anything access specific from the upper planes (network, multimedia bearer, multimedia control). The access plane should receive QoS

requests through the network plane, and the access plane functions should translate these requests to resource requests that are applicable to that specific access technology.

The access plane contains functions specific to an access network such as access technology specific authentication and authorization (also known as L2 functions). The access plane should provide all the infrastructure needed for this task, even though some of the functions may be physically implemented in the same entity as functions of the other planes.

In the access plane, the concept of a “Home Access Network” is introduced. In the case of cdma2000 networks, the home network is the network of the service provider providing the subscription to the wireless access. The “Home Access Network” is logically different from the concepts of Home Network of the Network plane and in the Multimedia Control plane, even though they in many cases physically would be the same network.

The access plane contains the following components:

- a. Mobile Station (TE part, link layer, air interface signaling etc.),
- b. RAN (BSC/RNC+PCF, BTS, MM),
- c. Access Gateway, and
- d. AAA (for L2 AAA functions).

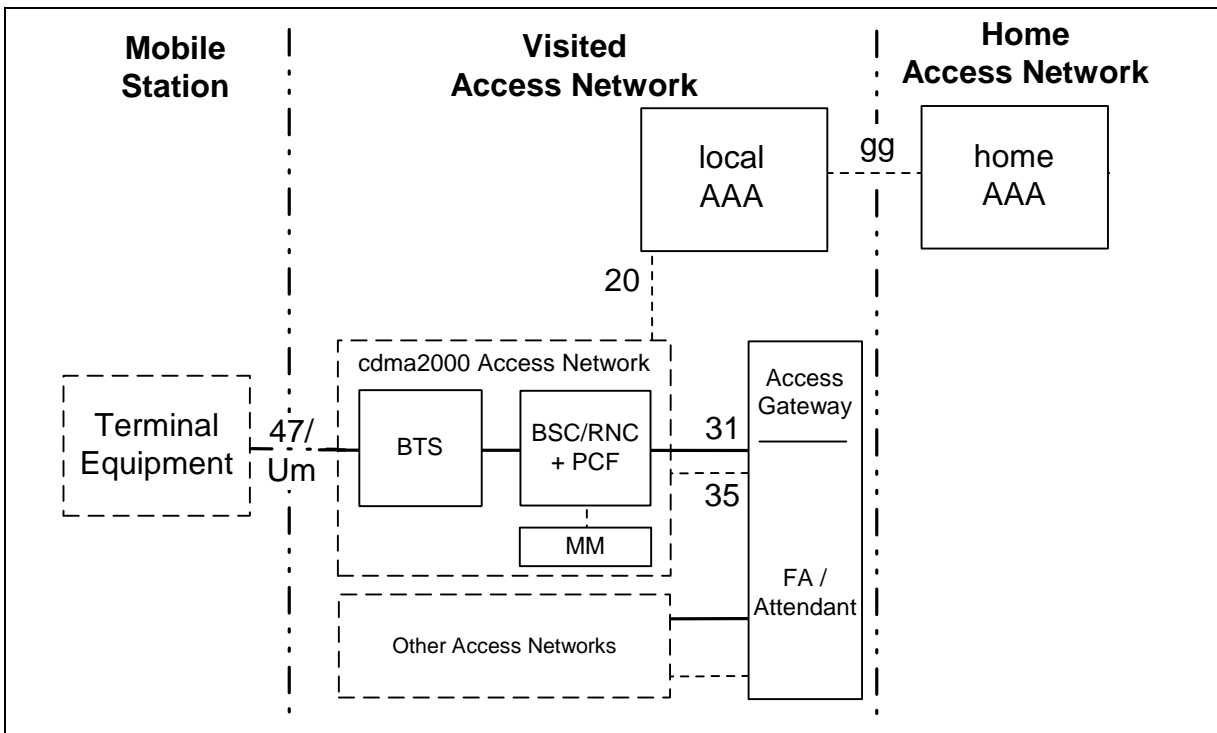


Figure 3.1.1 Access Plane

3.1.2 Network Plane

The purpose of the network plane is to provide end-to-end IP connectivity between the mobile station (including devices connected to it) and other IP entities. Other IP entities may include nodes in the multimedia control or bearer planes.

The network plane interacts with the access plane, which to the network plane appears as a link layer, controlling it through means such as DiffServ, RSVP, and an Access Gateway-Policy Decision Function interface.

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The interaction with the multimedia bearer or control planes should be through generic and transparent interfaces, so that the applications executing either on the network side or on the mobile station side may request QoS resources without any direct knowledge of the access currently in use.

In the network plane, the concept of “Home IP network” is introduced. This concept has the same meaning as in P.S0001-B. The home IP network may be the same as the wireless home (access) network. The home IP network could be an ISP network or it could be a corporate network.

The network plane contains the following components:

- a. Mobile Station (IP capabilities, MIP Client, QoS client),
- b. Home Agent,
- c. Policy Decision Function, and
- d. AAA (for Layer-3 AAA functions).

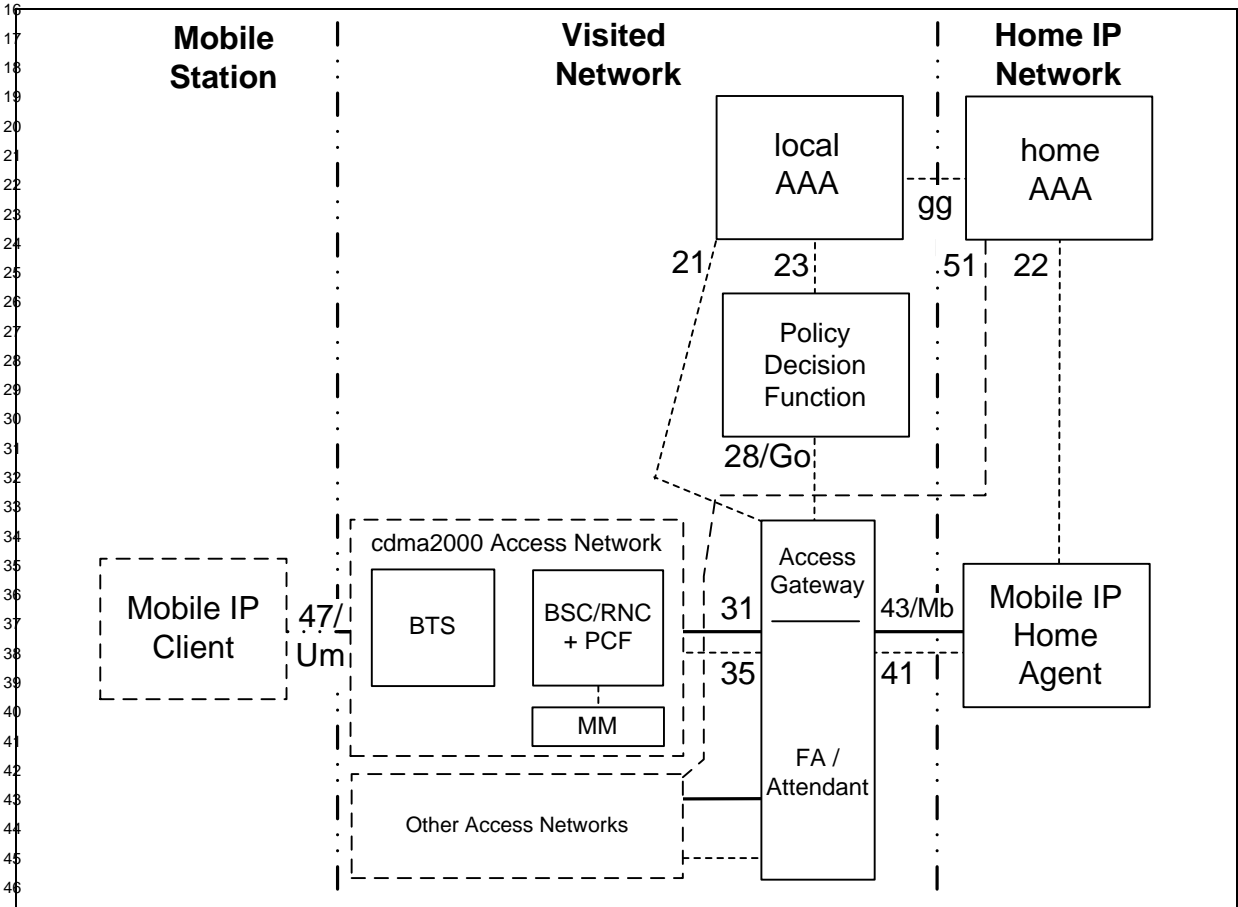


Figure 3.1.2 Network Plane

3.1.3 Multimedia Bearer Plane

The purpose of the multimedia bearer plane is to transport the user data (bearers) between the network entities involved in multimedia sessions or calls. This includes network entities such as the mobile station, Media Gateways, Media Resource Function Processors and entities on the Internet.

The multimedia bearer plane is an abstraction above the network plane. The network plane provides end-to-end IP connectivity to the multimedia bearer plane, so that these network entities may communicate directly. If, for example, a bearer path is to be established between the mobile station and a Media Gateway, the mobile station would need to:

- a. Obtain the IP address of the Media Gateway from the multimedia control plane,
- b. Request the necessary QoS from the network layer, and
- c. Start sending IP packets to the Media Gateway.

The purpose of the underlying planes is to make sure that the necessary QoS is available through all parts of the network (including over the air interface) and to make sure that the packets are routed correctly.

The multimedia bearer plane contains the following components:

- a. Mobile station (Multimedia client or applications),
- b. Media Resource Function Processor,
- c. Media Gateway, and
- d. Internet (peer entity on the Internet).

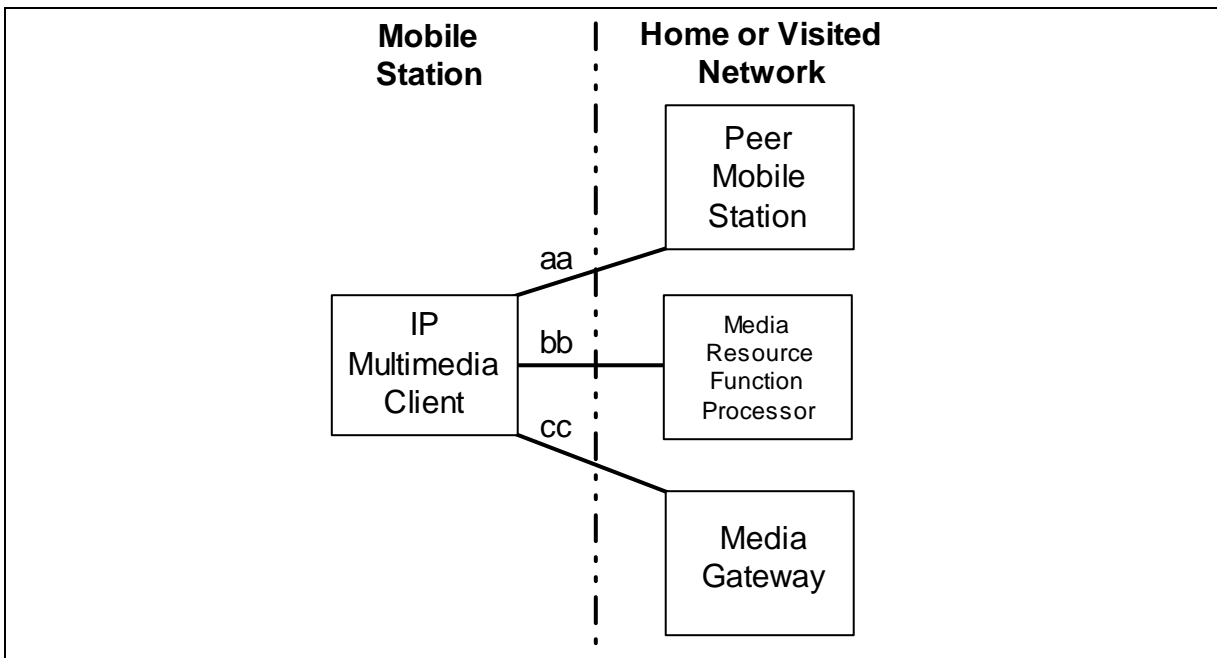


Figure 3.1.3 Multimedia Bearer Plane

3.1.4 Multimedia Application Server Control Plane

The multimedia application server control plane implements all the call control and services or applications that makes up the multimedia services of the All-IP domain. The multimedia application server control plane functions are access independent, except in generic terms such as available QoS etc.

The multimedia application server control plane is an abstraction above the network plane. The network plane provides end-to-end IP connectivity to the multimedia control plane, so that these entities may communicate directly. Assuming the lower planes ensure IP packets are routed correctly, and the necessary QoS is available, the entities of the multimedia application server control plane may communicate directly with each other and with entities in the multimedia bearer plane. For example a SIP Client in the mobile station may

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1 communicate with SIP Servers (CSCFs) in the network, assuming the SIP Client has
2 obtained knowledge about the IP address to use.

3 The multimedia application server control plane contains the following components:

- 4 a. Mobile Station (Multimedia client and/or applications),
- 5 b. OSA Gateway Function,
- 6 c. Call Session Control Function,
- 7 d. AAA (for application level AAA),
- 8 e. Application Servers, and
- 9 f. Databases.

10 The S-CSCF chooses a particular service control application server using user profile
11 information it has received from the AAA. No choice of protocol needs to be made to access
12 a particular service control application server since the same IP multimedia service control
13 interface is used between the S-CSCF and each of these service control application servers.

14 Figure 3.1.4a shows the variety of application server configurations that may be supported in
15 the Multimedia Application Server Control Plane. These configurations include:

- 16 a. application servers that reside inside or outside of the WNO network (i.e.,
17 Application Servers A to C),
- 18 b. application servers that access network resources (e.g., Call Session Control
19 Function, AAA, Position Server) for functionality needed during service logic
20 execution using either the OSA API and the OSA Gateway Function (i.e., Type-A
21 Application Server) or direct interfaces such as Reference Point “11/Sh” (i.e.,
22 Type-B Application Server), and
- 23 c. applications that do not use network resources other than for bearer management
24 (i.e., Type-C Application Server).

25 In each of the configurations shown:

- 26 a. a bearer relationship may be established between the mobile station and the
27 application server,
- 28 b. application server management may be performed by the WNO, the service
29 provider, or a third party, and
- 30 c. the information provided by Reference Point 8 to a Type-A Application Server and
31 or by Reference Points 11/Sh and 12/ISC to a Type-B Application Server may vary
32 by the level-of-trust afforded by the WNO.

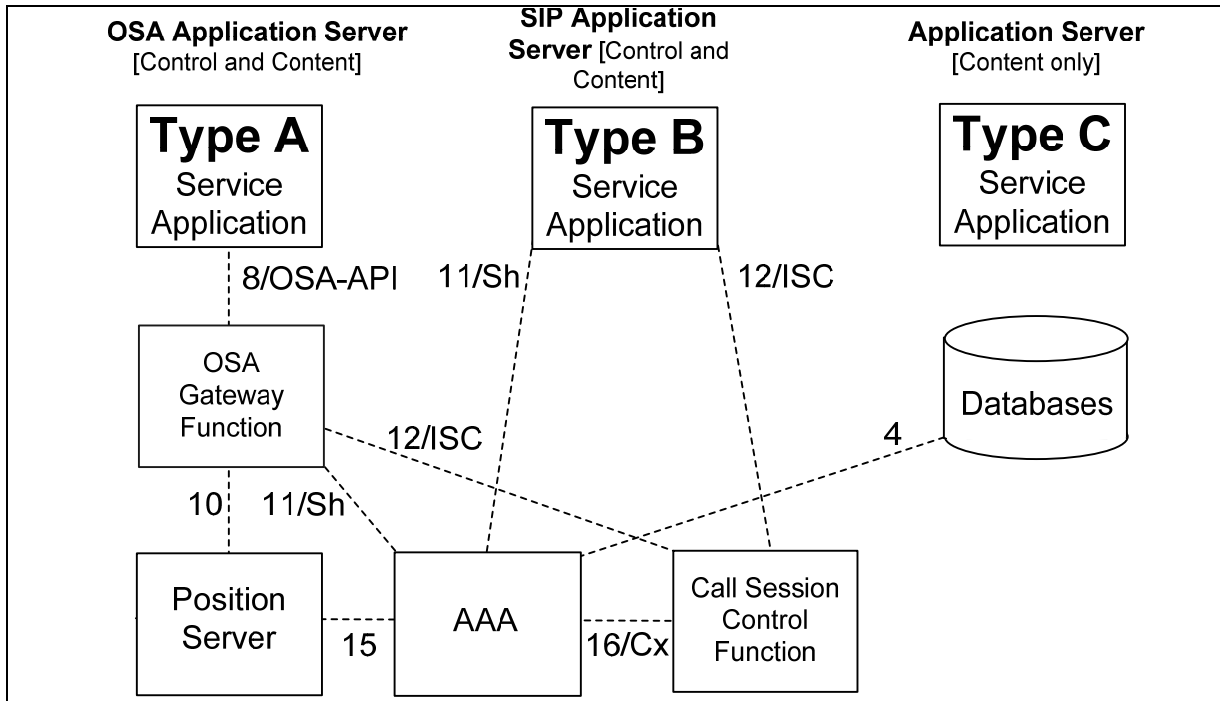


Figure 3.1.4a Multimedia Application Server Control Plane

Figure 3.1.4a illustrates the following three application server signaling configurations:

- A:** Type A Application Servers are hosted on equipment in the Wireless Network Operator's (WNO) network, in the Internet or in a private network. These application servers use standard APIs (e.g., OSA API) supported by the OSA Gateway Function. The APIs allow access to application servers during SIP sessions and allow applications to access resources in the network (e.g., Position Server, CSCF, AAA) as required for service logic execution.

While accessing functionality in the WNO network (e.g., AAA, CSCF, Position Server), Type A Application Servers may also access private databases, SIP or http servers, and other functionality on equipment provided by a third party.

Type A Application Servers may have bearer access using the WNO intranet, allowing a higher QoS than public Internet.

- B:** Type B Application Servers are hosted on equipment in the WNO network, in the Internet or in a private network capable of communication in SIP and offering both service control and content. These application servers require signaling access to functionality provided in the WNO network in addition to the signaling needed for bearer management.

Type B Application Servers may have bearer access using the WNO intranet, allowing a higher QoS than public Internet.

- C:** Type C Application Servers are hosted on equipment in the Internet or in the WNO network offering content applications only. These application servers do not require signaling access to the WNO network other than as needed for bearer management. An example of the Type C Application Server is the BCMCS Content Server.

Figure 3.1.4b depicts the functional entities involved in providing service applications to SIP based sessions. The applications are invoked from the Call Session Control Function either directly or via the OSA Gateway Function and may request use of network resources via the OSA Gateway Function. Figure 3.1.4b also illustrates how the CSCF functionality is distributed between the visited and home networks. After a SIP client in the mobile station has registered through a Proxy-CSCF (P-CSCF) in the visited/home network, all further communication between the SIP client and the home network passes through the P-CSCF.

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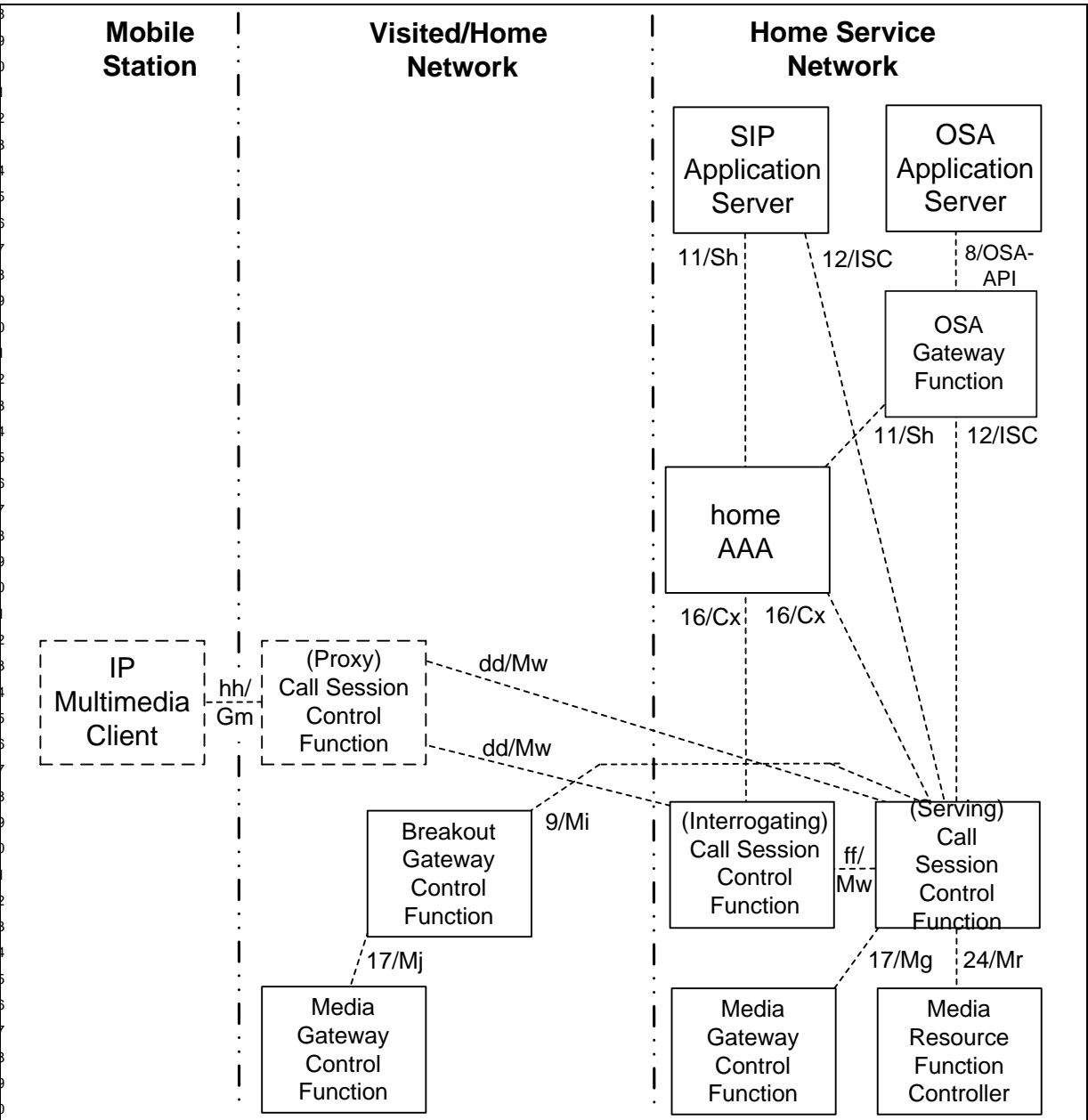


Figure 3.1.4b Multimedia SIP Services Control Plane

Figure 3.1.4c depicts the functional entities involved in providing service applications to data sessions. The applications are invoked from the mobile station after the application server has provided the service addresses. Depending on the connectivity scenario, the application server may request use of network resources either directly or via the OSA Gateway Function.

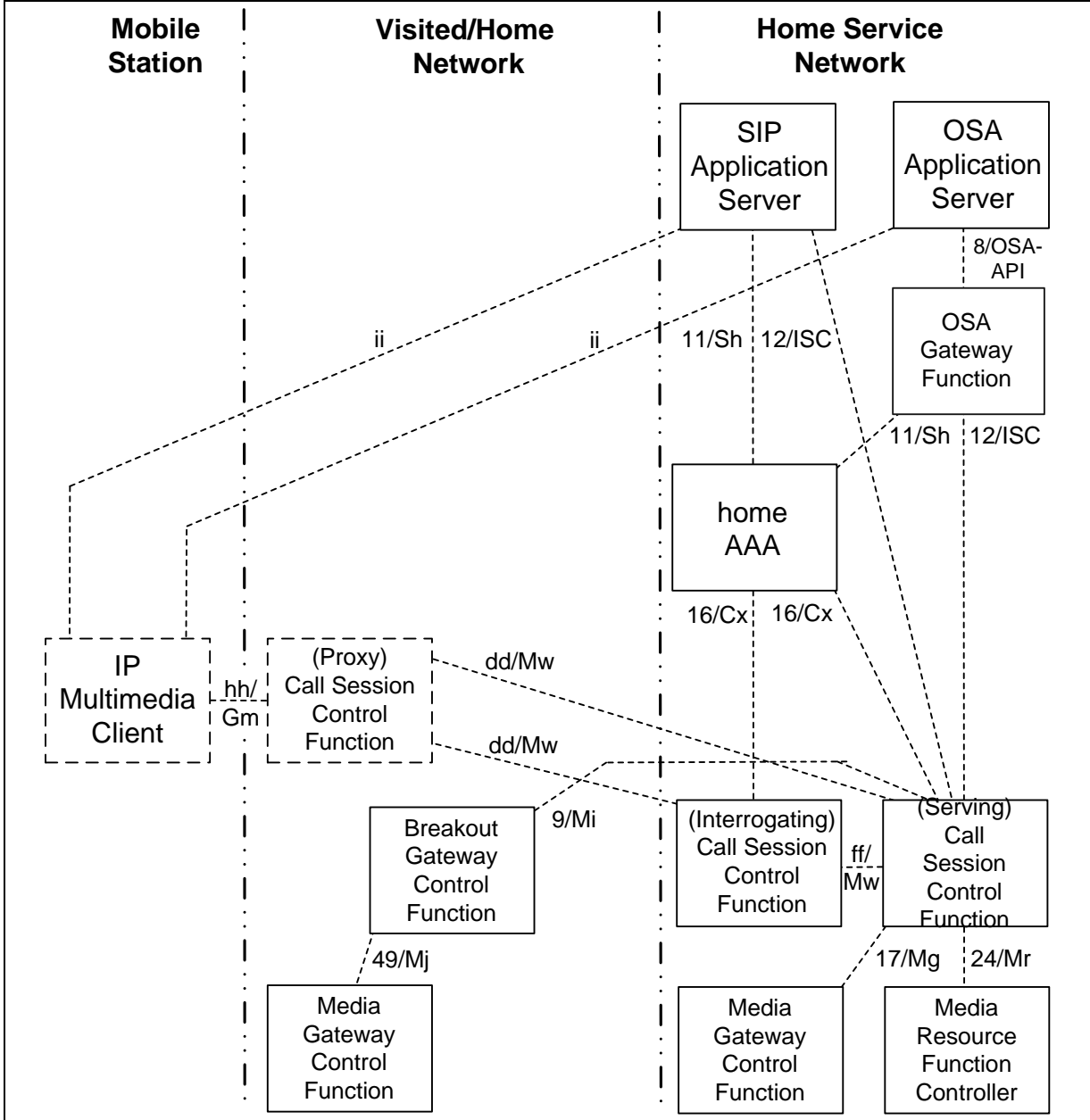


Figure 3.1.4c Multimedia Data Services Control Plane

3.2 Authentication and Authorization View

Authentication and authorization are performed at different times and may employ different network elements in order to support wireless access network IP-based and circuit-based service requests, see Figure 3.2.

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Permission for IP-based access and services is authorized and authenticated at various levels. In the IP model, user initiated MS service requests may employ additional levels of authorization and authentication processes based on the service application or multimedia feature being accessed. The purpose of the architecture is to allow the configuration of authorization and/or authentication interaction paths (i.e., “a”, “b”, “c” and “d”) necessary to support network based or independent approval authorities or a combination of these processes. Services-specific authentication and authorization mechanisms are described in the corresponding 3GPP2 services specifications (e.g., X.S0017 – OSA API, and X.S0022 – BCMCS in cdma2000 Wireless IP Network).

Permission for existing circuit-based access and services is authorized and authenticated using specific procedures for the *TIA/EIA-41* wireless network. The interaction paths (i.e., “e”) extend from the Mobile Station to the Legacy MS Domain Support that contains several logical network entities (i.e., “HLRe”, “MSCe” and “SCPe”).

Further definitions of these authorization and authentication interaction paths are:

- “a” Multimedia Layer-2 access permission is sought from the serving wireless access provider and involves interaction with the subscriber's home wireless access provider for final approval, this action is initiated by a MS access request.
- “b” Simple IP or Mobile IP Layer-3 access permission is sought from the IP service provider, which may be the same provider as the wireless access network or in the case of IP access to a private network, the IP Access provider may be different.
TIA/EIA-41 packet data service Simple IP or Mobile IP access permission is sought from the IP service provider, this action is initiated by a Legacy MS Domain packet data service access request.
- “c” multimedia services access permission is requested from the multimedia service provider, access for each user is requested by the Call Session Control Function.
- “d” services within the multimedia domain are approved for each user by Application Server via the OSA Gateway Function. In each of these cases, the necessary authentication and/or authorization approval may be different for each service authority or all service levels may employ one and the same AAA.
- “e” Layer-2 and Layer-3 *TIA/EIA-41* access permission is sought from the serving Legacy MS Domain Support wireless access provider and may involve interaction with the subscriber's home *TIA/EIA-41* wireless access provider for final approval, this action is initiated by a Legacy MS Domain access request.

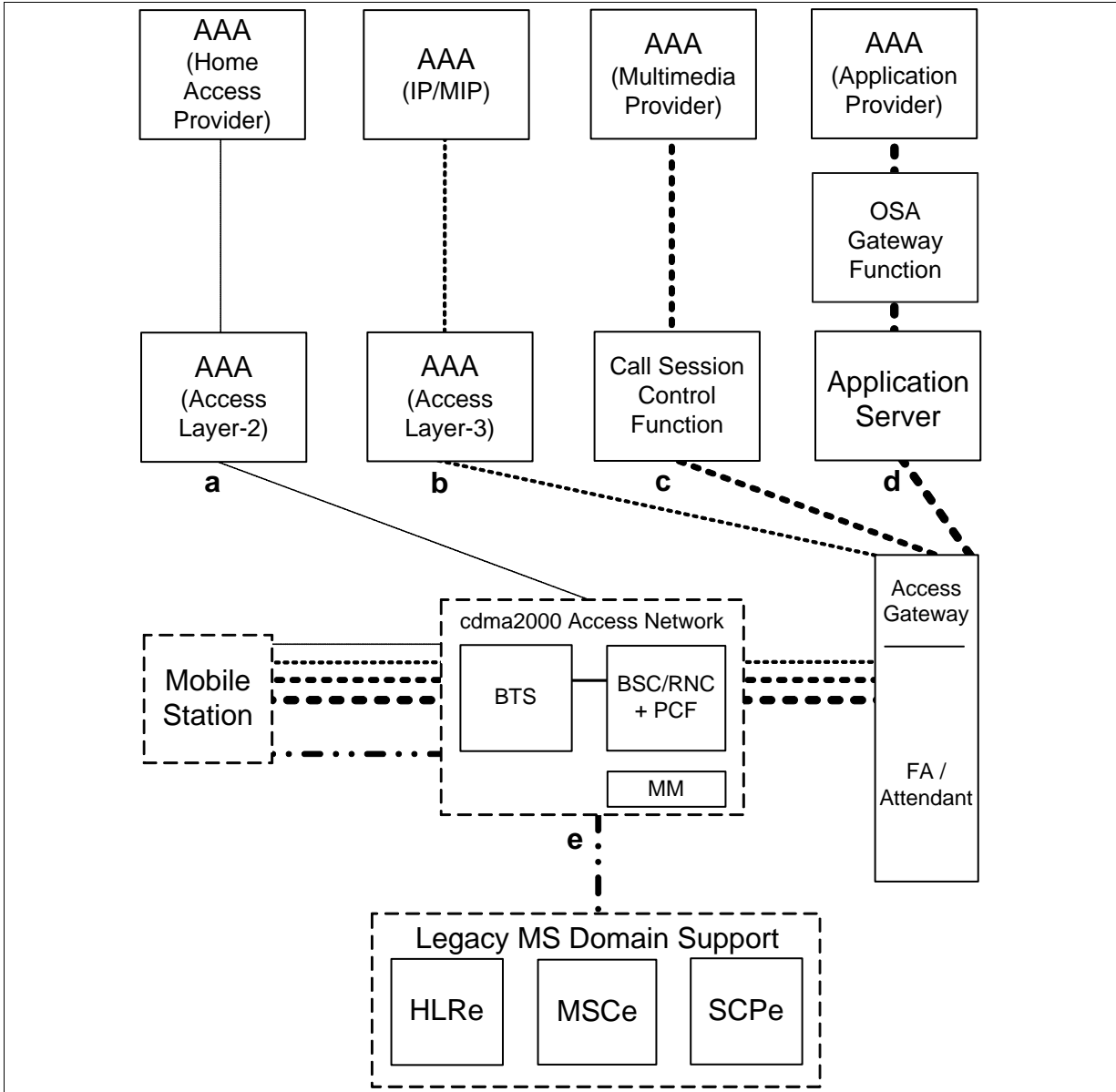


Figure 3.2. Authentication and Authorization View

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3.3 Mobile Station (MS) View

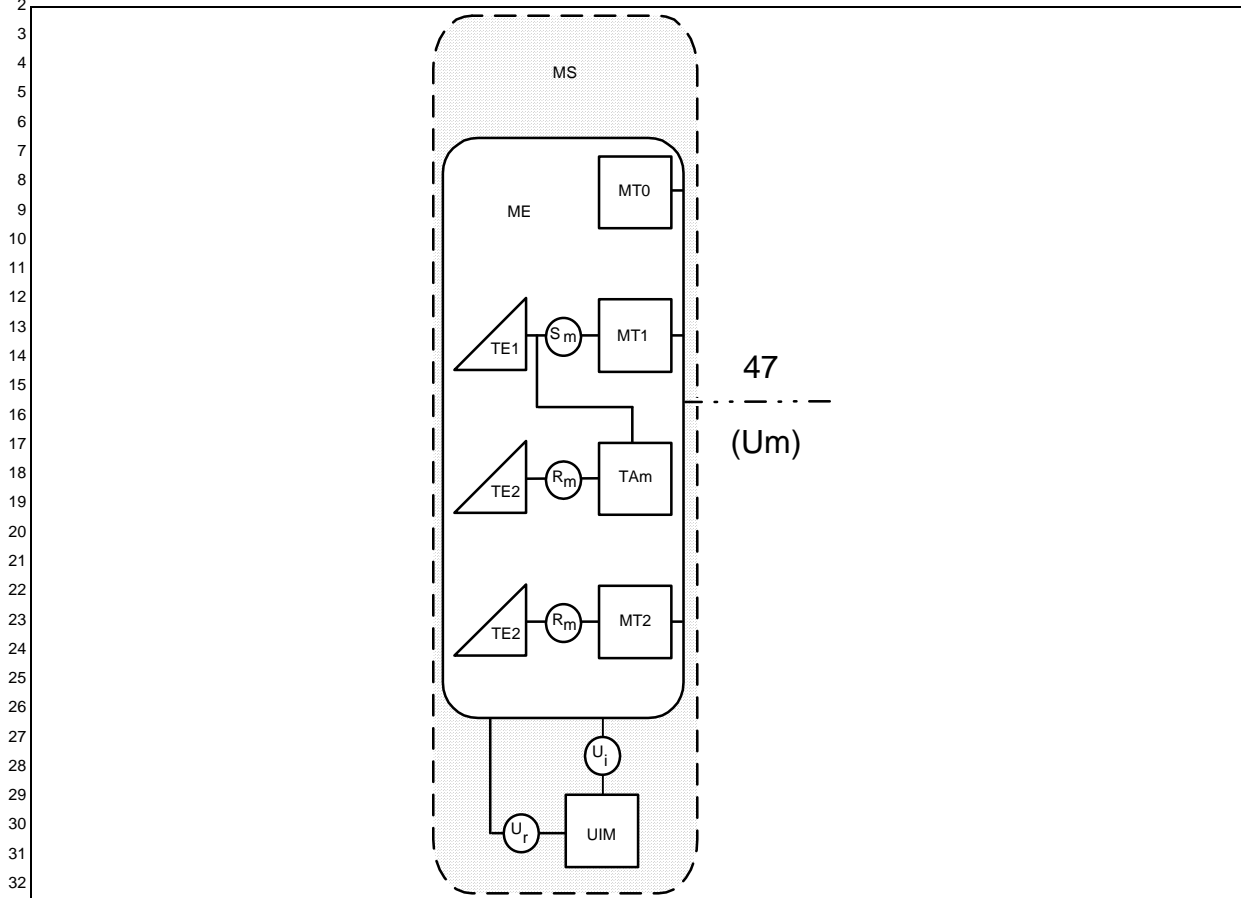


Figure 3.3 Mobile Station (MS) View

The Mobile Station Plane contains the following entities and reference points:

Mobile Equipment (ME)

The ME is the MS without a UIM. The ME is only capable of accessing the network per locally defined service configuration (e.g., emergency services, service center, etc).

Mobile Station (MS)

The MS is a wireless terminal used by subscribers to access the Legacy MS Domain or the IP Multimedia Domain 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. A MS is a ME with a programmed UIM.

Mobile Terminal 0 (MT0)

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

Mobile Terminal 1 (MT1)

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

Mobile Terminal 2 (MT2)

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

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 equipment or it may be removable.

Reference Point R_m

Reference Point R_m is the interface between TE2 and the TAm and the interface between TE2 and the MT2.

Reference Point S_m

Reference Point S_m is the interface between the TE1 and a MT1.

Reference Point U_i

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

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 ME.

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3.4 Legacy MS Domain Control and Bearer View

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The Legacy MS Domain provides support for existing MSs (e.g., analog, IS-95-A, IS-95-B, cdma2000) in an IP core network environment. This domain supports the features and capabilities provided in a legacy network in a manner transparent to the user. New features and capabilities supported by the IP core network may be made available to subscribers where they are supported by the MS capabilities.

The Media Gateway provides conversion between IP bearers and circuit bearers (e.g., ISDN, Feature Group D, CAMA).

Figure 3.4 provides a detailed view of the Legacy MS Domain. It includes an expansion of the Legacy MS Domain Support entity shown in Figure 2.1 as well as other IP network elements required to support legacy MSs (NOTE: except those not shown such as OTAF, MC, etc.).

Within Figure 3.4 there are several items of interest, as:

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- a. the bearer path from the BSC to the MGW is used to support voice and circuit data services,
- b. the bearer path for packet data from the BSC to the Access Gateway continues through the Border Router to the IP Network,
- c. the LMSDS has signaling relationships with the cdma2000 Access Network, MGW, and MRFP. The LMSDS also has a signaling relationship with TIA/EIA-41 networks that allows interworking between the LMSD and other TIA/EIA-41 based systems. The relationship with the MGW allows control of the bearer paths to and from the PSTN,
- d. services supported on the SCP make use of information stored in the Databases component of the core network, including subscriber information, and may interact with service applications, and
- e. the HLRe uses information that may be stored commonly in the Databases. This may allow the Databases to service both the Legacy MS Domain and the IP Multimedia Domain.

3.5 Multimedia Domain Control and Bearer View

The Multimedia Domain provides support for SIP capable mobile stations in an IP core network environment. This domain supports new multimedia features and capabilities and also supports the features and capabilities provided in a legacy network in a manner transparent to the user.

The Multimedia Domain supports multimedia sessions to and from SIP-capable mobile stations.

The Multimedia Domain supports interconnectivity with the PSTN for circuit switched sessions to and from SIP-capable mobile stations.

Figure 3.5 provides a detailed view of the Multimedia Domain.

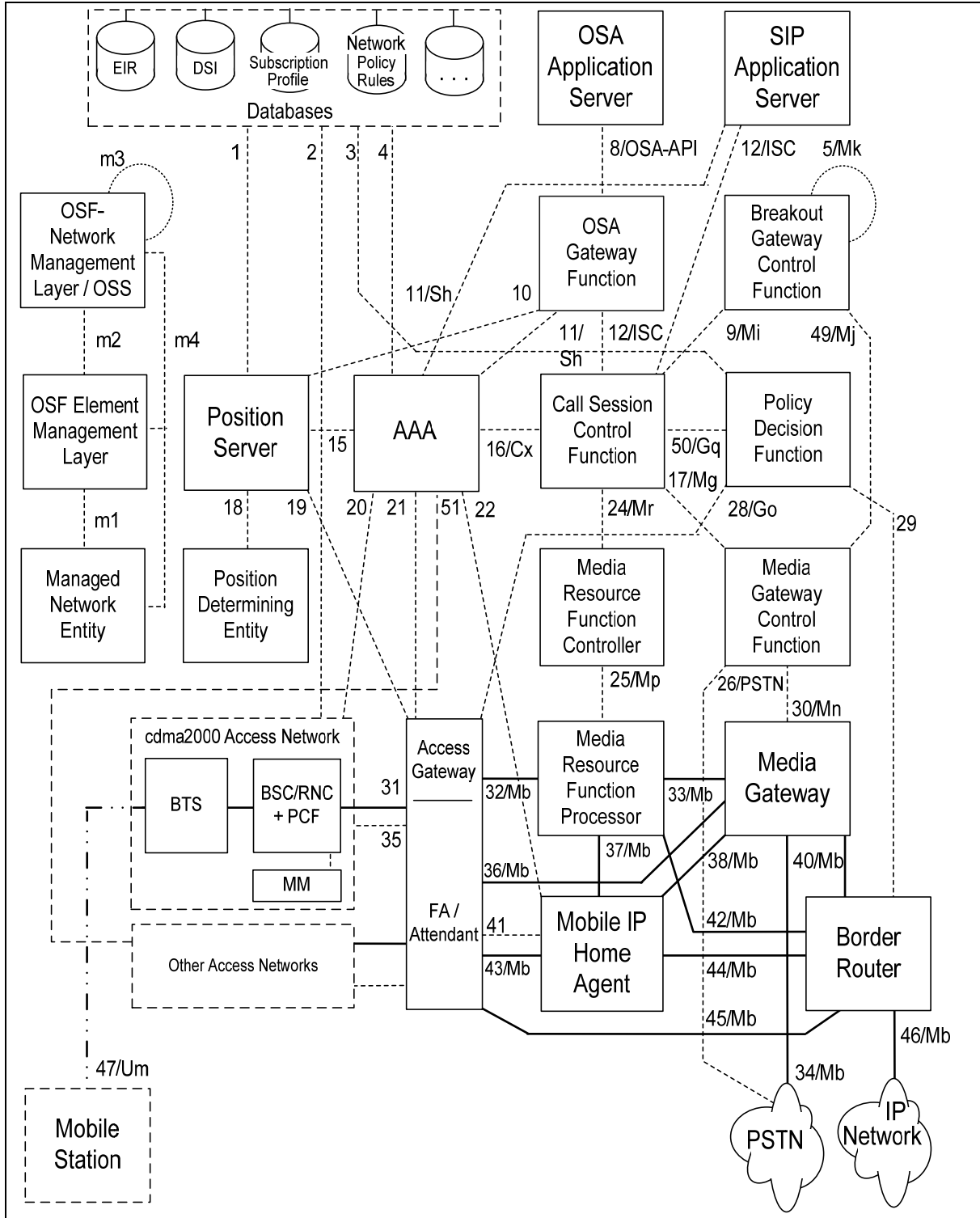


Figure 3.5 Multimedia Domain Control and Bearer View

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4. SERVICE CREATION AND MANAGEMENT

4.1 Service Creation Environment (SCE)

The SCE is a non-real time development environment for creating service applications. Service providers and third party application developers may use different versions (e.g., flavors) of the SCE. The technology used to create applications may be a function of technological choices (e.g., SIBBs), or vendor preferences. Its implementation should, ideally be protocol independent, but could as well be technology specific (e.g., SIP). The SCE could allow for version and configuration management control of existing and being developed services.

The SCE is connected via signaling Reference Point (see Figure 4.1):

A Service Management System.

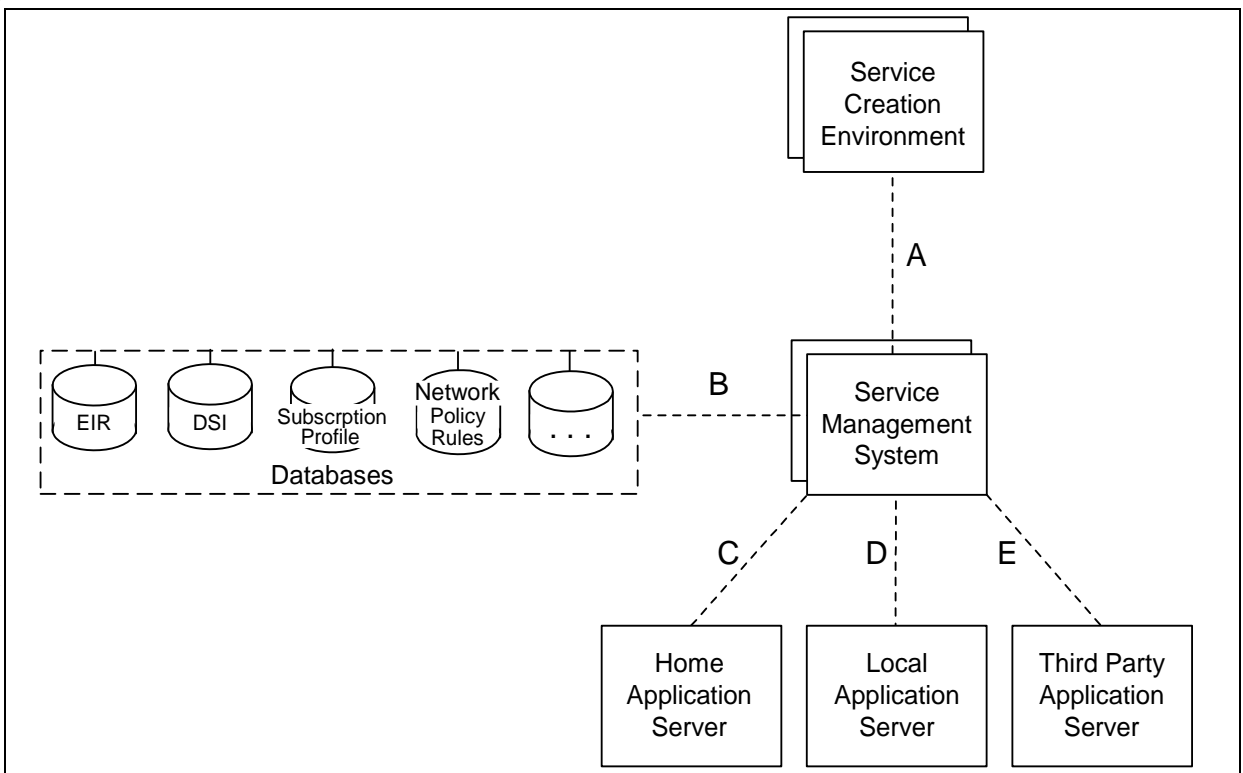


Figure 4.1 Service Creation and Management

4.2 Service Management System (SMS)

The Service Management System (SMS) provides overall service management functionality for the network. Service providers and third party application developers may use different versions (e.g., flavors) of the SMS. The SMS interacts with the SCE and other entities to perform service provisioning, monitoring, testing, deployment, and subscriber data management functions.

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The Service Management System is connected via signaling Reference Points (see Figure 4.1):

- A. Service Creation Environment,
- B. Databases,
- C. Home Service Applications,
- D. Local Service Applications, and
- E. Third Party Service Applications.

Note that a particular SCE and SMS pair may have access only to those databases and application servers operated and authorized by a service provider. For example, an SCE and SMS pair owned by service provider A may have access to databases and application servers also owned by provider A, but may not have access to databases owned by service provider B. The specification of Reference Points A, B, C, D and E is beyond the scope of this document.

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