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This is not an IEEE Draft Standard.

Draft Amendment to IEEE Standard for
Local and metropolitan area networks

Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems

Amendment to IEEE Standard for Local and Metropolitan Area Networks - Management Plane Procedures and Services

Sponsor
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Abstract: This document defines Management Procedures as enhancements to the IEEE 802.16 air interface standard for fixed and mobile broadband wireless systems. It specifies the management functions, interfaces and protocol procedures.

Keywords: fixed broadband wireless access network, mobile broadband wireless access network, metropolitan area network, microwave, millimeter wave, management, WirelessMAN™ standards

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Management Plane Procedures and Services

NOTE-The editing instructions contained in this amendment define how to merge the material contained herein into the existing base standard IEEE Std 802.16-2004.

The editing instructions are shown ***bold italic***. Four editing instructions are used: ***change***, ***delete***, ***insert***, and ***replace***. ***Change*** is used to make small corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using strike through (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

1. Introduction

Scope: This document provides enhancements to the MAC and PHY management entities of IEEE Standard 802.16-2004, as amended by P802.16e, to create standardized procedures and interfaces for the management of conformant 802.16 devices.

Purpose: The purpose of this project is to provide conformant 802.16 equipment with procedures and services to enable interoperable and efficient management of network resources, mobility, and spectrum, and to standardize management plane behavior in 802.16 fixed and mobile devices.

2. References

This standard shall be used in conjunction with the following publications. When the following specifications are superseded by an approved revision, the revision shall apply.

IEEE 802.16-2004, "IEEE Standard for Local and Metropolitan area networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems", October, 2004

IEEE P802.16e-D12, "Draft IEEE Standard for Local and Metropolitan area networks - Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems", October, 2005

IEEE P802.16f-D6, "Draft Amendment to IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems - Management Information Base"

IEEE P802.16-2004/Cor1 - "Draft Corrigendum to IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems"

3. Definitions

[Insert the following definitions as specified below]

U Interface - The management and control interface that exists between the SS and the BS over the air interface.

4. Abbreviations and acronyms

[Insert the following abbreviations and acronyms into the the text as specified below]

GPCS - Generic Packet Convergence Sublayer

IRP - Integration Reference Point

NRM - Network Reference Model

MIB - Management Information Base

RRM - Radio Resource Management

RRC - Radio Resource Controller

RRA - Radio Resource Agent

5. Service-Specific CS

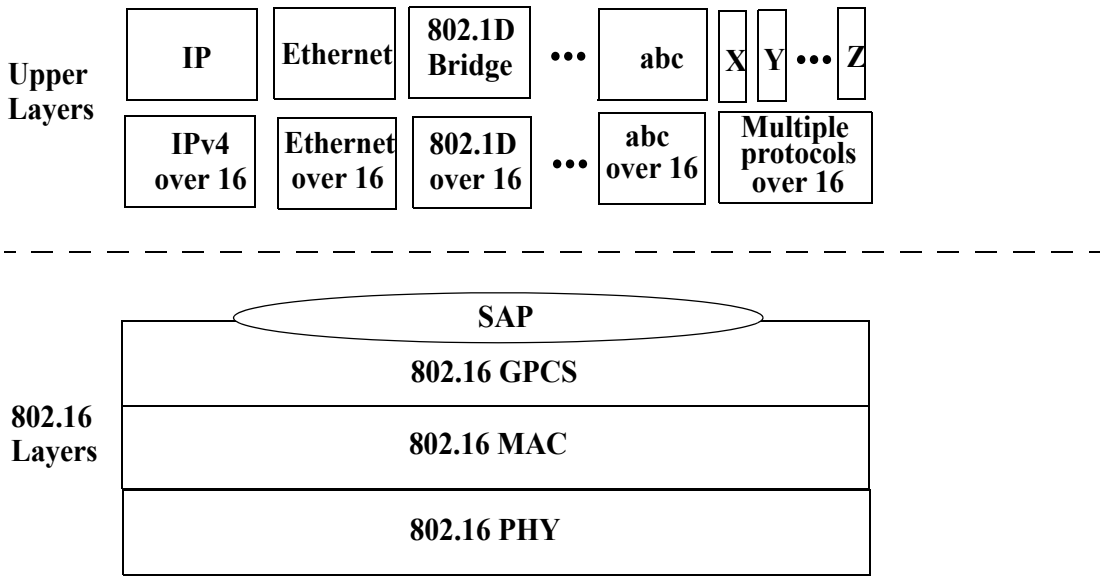
5.2 Packet CS

[insert new subclause 5.2.8 and subsequent test below]

5.2.8 Generic Packet Convergence Sublayer (GPCS)

The Generic Packet CS (GPCS) is a upper layer protocol-independent packet convergence sublayer that supports multiple protocols over 802.16 air interface. It is defined as follows:

- GPCS provides a generic packet convergence layer. This layer uses the MAC SAP and exposes a SAP to GPCS applications
- GPCS does not re-define or replace other convergence sublayers. Instead, it provides a SAP that is not protocol specific
- With GPCS, packet parsing happens "above" GPCS. The results of packet parsing are classification parameters given to the GPCS SAP for "parameterized classification," but upper layer packet parsing is left to the GPCS application
- GPCS defines a set of SAP parameters as the result of upper layer packet parsing. These are passed from upper layer to the GPCS in addition to the data packet. Each is defined in section 5.2.8.1.
  - •LOGICAL_FLOW_ID
  - •PROTOCOL_TYPE
- GPCS provides an optional way to multiplex multiple layer protocol types (e.g., IPv4, IPv6, Ethernet) over the same 802.16 connection. A TLV parameter, MULTIPROTOCOL_ENABLE, is defined in the DSx messages to enable/disable this feature. . The capability of supporting this feature is indicated in a TLV parameter of the REG messages.
- For interoperability, each upper layer protocol type needs an interface specification (e.g., IPv4 over 802.16, or Ethernet over 802.16). Such a standard specification is out of scope of the GPCS.



Protocol structure with the Generic Packet Convergence Sub Layer (GPCS)

Figure 17c—GPCS Layering Model

5.2.8.1 GPCS Service Access Point (SAP) Parameters

The GPCS SAP parameters enable the upper layer protocols to generically pass information to the GPCS so that the GPCS does not need to interpret upper layer protocol headers in order to mapping the upper layer data packets into proper 802.16 MAC connections. Since the SAP parameters are explicit, the parsing portion of the classification process is the responsibility of the upper layer. The parameters are relevant for SAP data path primitives, GPCS_DATA.request and GPCS_DATA.indication as described in sections 5.2.8.1.2 and 5.2.8.1.3, respectively.

PROTOCOL_TYPE:
The protocol type field identifies the upper layer protocol that is immediately above the 802.16 protocols. The PROTOCOL_TYPE is included in GPCS_DATA.request and GPCS_DATA.indication as defined in sections 5.2.8.1.2 and 5.2.8.1.3 respectively. If MULTI_PROTOCOL_ENABLE is activated, the PROTOCOL_TYPE shall be also carried over-the-air in every SDU, so the 802.16 receiver can demultiplex an SDU and invoke the appropriate upper layer protocol. If MULTIPROTOCOL_ENABLE is not activated, an 802.16 connection can carry only one protocol type, and the PROTOCOL_TYPE field shall be included in ASF.indication primitive and DSx messages during connection establishment. The PROTOCOL_TYPE values are the same as the value of the GPCS PROTOCOL_TYPE encoding as defined in section 11.13.19.3.4.3.

LOGICAL_FLOW_ID:
This parameter is a locally-assigned number, unique within a GPCS implementation. A GPCS implementation shall map this parameter directly to a service flow. During service flow establishment, the 802.16 control plane function shall allocate a LOGICAL_FLOW_ID and return it to the upper layer in the Add_Service_Flow.response as defined in section 14.5.6.4.4.2.

MULTI_PROTOCOL_ENABLE :
This parameter is not shown in Figure 17d. A local system can optionally choose to enable/disable multiple PROTOCOL_TYPEs to be carried over a single CID. MULTI_PROTOCOL_ENABLE is useful for devices that are constrained to implement a small number of CIDs yet need to carry a variety of protocols using the same 802.16 scheduling service type. For instance, a single best-effort (BE) connection could carry statistically multiplexed packets of IPv6, IPv6-ROHC and Ethernet PROTOCOL_TYPEs.

DATA:
SDU data reference to a number of bytes delivered by the GPCS upper layer to GPCS, or by GPCS to the upper layer.

LENGTH:
Number of bytes in DATA.

5.2.8.2 GPCS_DATA.request

5.2.8.2.1 Function

This primitive defines the transfer of data from the upper-layer, GPCS application, to the GPCS SAP.

5.2.8.2.2 Semantics of the Service Primitive

The parameters of the primitive are as follows:

GPCS_DATA.request

```
(
    PROTOCOL_TYPE,
    LOGICAL_FLOW_ID,
    length,
    data
)
```

The **PROTOCOL_TYPE** specifies the protocol function of the upper layer, as defined in section 11.13.19.3.4.3.

LOGICAL_FLOW_ID is a locally-assigned number, unique within a GPCS implementation. A GPCS implementation shall map this parameter directly to a service flow. During service flow establishment, the 802.16 control plane function shall allocate a LOGICAL_FLOW_ID and return it to the upper layer in the Add_Service_Flow.response as defined in section 14.5.6.4.4.2. Furthermore, a LOGICAL_FLOW_ID is mapped to exactly one 802.16 service flow identified by an SFID.

The **length** parameter specifies the length of the SDU in bytes. Note if MULTIPROTOCOL_ENABLE is active, the length does not include the PROTOCOL_TYPE which GPCS will prepend to the SDU before sending to the MAC SAP.

The **data** parameter specifies the SDU as received by the GPCS SAP from the upper layer protocol.

5.2.8.2.3 When Generated

This primitive is generated by an upper layer protocol when a GPCS SDU is to be transferred to a peer entity or entities.

5.2.8.2.4 Effect of Receipt

The receipt of this primitive causes GPCS to map the LOGICAL_FLOW_ID to a service flow and thereby a connection. GPCS invokes MAC functions, for example the MAC SAP (an example MAC SAP definition is provided in Annex C) to effect transfer of the SDU to the MAC layer. If MULTIPROTOCOL_ENABLE is activated as defined in sections 11.8.13 and 11.13.19.3.4.19, then GPCS will insert the PROTOCOL_TYPE at byte number 0 of the SDU prior to delivering the SDU to the MAC layer.

5.2.8.3 GPCS_DATA.indication

5.2.8.3.1 Function

This primitive defines the transfer of data from the GPCS to an upper layer protocol.

5.2.8.3.2 Semantics of the Service Primitive

The parameters of the primitive are as follows:

```
GPCS_DATA.indication
(
    PROTOCOL_TYPE,
    length,
    data
)
```

The **PROTOCOL_TYPE** identifies the specific upper layer protocol, as defined in section 11.13.19.2.1. GPCS formulates the PROTOCOL_TYPE in one of 2 ways:

> If MULTIPROTOCOL_ENABLE is activated as defined in sections 11.13.19.2 and 11.13.19.2.2, then GPCS locates PROTOCOL_TYPE starting at byte number 0 in the SDU.
>
> If MULTIPROTOCOL_ENABLE is not activated (the default condition), GPCS obtains PROTOCOL_TYPE from the CID context since it was established in a DSx message when the corresponding 802.16 service flow was established.

The **length** parameter specifies the length of the SDU in bytes. Note if MULTIPROTOCOL_ENABLE is active, the length does not include the PROTOCOL_TYPE which GPCS will remove from the SDU before sending to the upper layer.

The **data** parameter specifies the SDU as received by the GPCS SAP from the MAC.

Note: The GPCS_DATA.indication does not have a LOGICAL_FLOW_ID parameter because LOGICAL_FLOW_ID is not transferred over the 802.16 air interface.

5.2.8.3.3 When Generated

This primitive is generated by GPCS whenever a GPCS SDU is to be delivered to an upper layer protocol resulting from receipt of a MAC SDU by GPCS.

5.2.8.3.4 Effect of Receipt

The effect of receipt of this primitive by the upper layer protocol entity is dependent on the validity and content of the SDU. The choice of upper layer protocol entity is identified by PROTOCOL_TYPE.

5.2.8.4 GPCS PDU Format

There are two different formats of the GPCS PDU depending on the parameter value of MULTIPROTOCOL_ENABLE, as shown in Figure 17e. PROTOCOL_TYPE indicates the outermost protocol of the SDU. It is 16-bit number assigned from a set of possible values of the PPP data link (DL) layer protocol numbers. This space of numbers is maintained by the IANA. It shall be communicated to the MAC receiver in every SDU if MULTIPROTOCOL_ENABLE is enabled for a CID.

(a) GPCS PDU format with MULTIPROTOCOL_ENABLE Disabled

(b) GPCS PDU format with MULTIPROTOCOL_ENABLE Enabled

Figure 17e—GPCS PDU formats Sent to the MAC SAP from the GPCS

6. MAC common part sublayer

6.3 Data/Control plane

6.3.2 MAC PDU formats

6.3.2.3 MAC Management messages

[Insert new subclauses 6.3.2.3.62 MOB_MSMIH-REQ, 6.3.2.3.63 MOB_MSMIH-RSP, 6.3.2.3.64 MOB_BSMIH-REQ, 6.3.2.3.65 MOB_BSMIH-RSP]

6.3.2.3.62 MOB_MSMIH-REQ

The MS may transmit MOB_MSMIH-REQ message to BS in order to send handover imminent messages, or control and management message related to MIH. Parameters encoded to TLV tuple shall be differentiated according to data which MIH delivers as primitive.

The message shall be transmitted on basic CID.

Table 108aa—MOB_MSMIH-REQ message format

Syntax	Length	Description
MOB_MSMIH-REQ_Message_Format( ) {		
Management Message Type = 67	8 bits	
TLV Encoded Information	variable	Specific TLV
}		

6.3.2.3.63 MOB_MSMIH-RSP

The BS shall respond with an MOB_MSMIH-RSP message upon reception of MOB_MSMIH-REQ message.

The message shall be transmitted on basic CID.

Table 108bb—MOB_MSMIH-RSP message format

Syntax	Length	Description
MOB_MSMIH-RES_Message_Format( ) {		
Management Message Type = 68	8 bits	
TLV Encoded Information	variable	Specific TLV
}		

6.3.2.3.64 MOB_BSMIH-REQ

The BS may transmit MOB_BSMIH-REQ message to MS in order to send handover imminent messages, or control and management message related to MIH.

Parameters encoded to TLV tuple shall be differentiated according to data which MIH delivers as primitive.

The message shall be transmitted on basic CID.

Table 108cc—MOB_BSMIH-REQ message format

Syntax	Length	Description
MOB_BSMIH-REQ_Message_Format( ) {		
Management Message Type = 69	8 bits	
TLV Encoded Information	variable	Specific TLV
}		

6.3.2.3.65 MOB_BSMIH-RSP

The MS shall respond with an MOB_BSMIH-RSP message upon reception of MOB_BSMIH-REQ message.

The message shall be transmitted on basic CID.

Table 108dd—MOB_BSMIH-RSP message format

Syntax	Length	Description
MOB_BSMIH-RSP_Message_Format( ) {		
Management Message Type = 70	8 bits	
TLV Encoded Information	variable	Specific TLV
}		

<editors note>

[Add MIH_Capability_IE in 8.4.5.3.2.2, page 3, line 51, Modify]:

8.4.5.3.2.2.2 DL-MAP extended-2 IE format

Table 277b—OFDMA DL-MAP extended-2 IE format

Extended-2 DIUC (hexadecimal)	Usage
00	MBS_MAP_IE
01	HO_Anchor_Active_DL_MAP_IE
02	HO_Active_Anchor_DL_MAP_IE
03	HO_CID_Translation_MAP_IE
04	MIMO_in_another_BS_IE
05	Macro-MIMO_DL_Basic_IE
06	Skip_IE
07	HARQ DL MAP IE
08	HARQ ACK IE
09	Enhanced DL MAP IE
0A	Closed-loop MIMO DL Enhanced IE
0B	MIH_Capabilty_IE
0C-0D	*Reserved*
0E	AAS_SDMA_DL_IE
0F	*Reserved*

[Add 8.4.5.3.27 MIH_Capability_IE , page 3, line 51, Add]:

8.4.5.3.27 MIH_Capability_IE format

Table 286y—MIH_Capability_IE

Syntax	Size (bits)	Notes
MIH_Capability_IE() {		
Extended-2 DIUC	4 bits	MIH_Capability_IE = 0B
Length	4 bits	Length = 0x01
MIH Capability	1 bit	0 : MIH Not Supported 1 : MIH Supported
}		

[In Section 8.4.10.3, Expand the Table 334 with the following entries]:

Table 334a—Normalized C/N per modulation

Modulation/ FEC Rate	Normalized C/N Target BER e1-6	Normalized C/N Target BER e1-4	Normalized C/N Target BER e1-5	Normalized C/N Target BER e1-7
Fast_Feedback IE	0	0	0	0
CDMA Code	3	3	3	3
QPSK 1/2	6	TBD	TBD	TBD
QPSK 3/4	9	TBD	TBD	TBD
16QAM 1/2	12	TBD	TBD	TBD
16QAM 3/4	15	TBD	TBD	TBD
64QAM 1/2	18	TBD	TBD	TBD
64QAM 2/3	20	TBD	TBD	TBD
64QAM 3/4	21	TBD	TBD	TBD
64QAM 5/6	23	TBD	TBD	TBD

11. TLV Encodings

[Insert new subclause 11.7.4]

11.7.4 Multiprotocol over GPCS Support

This basic capability parameter indicates whether or not the multiprotocol over GPCS is supported. If multiprotocol is supported, a BS or SS may send MULTIPROTOCOL_ENABLE (section 11.13.19.2.2) in a DSx message.

Type	Length	Value	Scope
45	1	Bit#0: 0=multiprotocol not supported (default) 1=supported Bit#1 to Bit#7: reserved	REG-REQ REG-RSP

[Insert new subclause 11.8.9]

11.8.9 Service Information Query (SIQ) TLV

Service Information Query is included by MS in SBC-REQ to request the Service Network Provider Identifiers supported by the Operator Network that includes the current BS.

Name	Type	Length	Value	Scope
SIQ	4	1	bit 0: indicates that SS/MS queries the mapping relation between 24-bit format NSP ID and NSP realm; bit 1: indicates thatSS/MS queries the Service Network Provider Identifiers supported by the Operator Network that includes the current BS; bit 2 -7: reserved	SBC-REQ

[Insert new subclause 11.8.10]

11.8.10 NSP List TLV

NSP LIST TLV is a compound TLV that contains one or more Network Service Provider Identifiers, and it may be included in a SBC_RSP message. When an SBC_REQ message with an SIQ TLV is received, the BS should respond with an SBC_RSP message with an NSP LIST TLV

.

Name	Type	Length	Value	Scope
NSP List TLV	5	3*n	Including n, 24 bit Network Service Provider IDs, n is greater than or equal to 1.	SBC-RSP

[Insert new subclause 11.8.11]

11.8.11 NSP Count TLV

NSP Count TLV is an optional TLV that indicate the change of the NSP list. It will be increased by one (modulo 256) by the Operator Network whenever the NSP list changes. NSP Count TLV should be sent with NSP List TLV in the SBC-RSP message.

Name	Type	Length	Value	Scope
NSP Count TLV	6	1	Increment by one (modulo 256) by the Operator Network whenever the list of the NSP changes.	SBC-RSP

[Insert new subclause 11.8.12]

11.8.12 NSP Mapping List TLV

NSP Mapping List is an optional compound TLV that contains one or more mapping relations between 24-bit format NSP Identifier(s) and NSP realm(s), and it may be included in a SBC-RSP message.

Name	Type	Length	Value	Scope

NSP Mapping List TLV	7	variable	Compound (the compound field contains sub-attributes as defined in Table 449)	SBC-RSP, SII-ADV

Table 449—NSP mapping List sub-attributes field

Type	Length	Value
NSP Identifier	3	24-bit format NSP identifier
NSP realm	variable	NSP realm, the fully qualified domain name

[In section 11.13, insert the following entries to Table 383]

Table 383—Service flow encodings

Type	Parameter
47	PER

[Insert new subclause 11.13.19]

11.13.19 CS specific service flow encodings

[Insert new subclause 11.13.19.1]

11.13.19.1 CS specification

Type	Length	Value

[145/146].28	1	0: ~~No CS~~ GPCS (Generic Packet Convergence Sublayer) 1: Packet, IPv4 2: Packet, IPv6 3: Packet, 802.3/Ethernet 4: Packet, 802.1Q VLAN 5: Packet, IPv4 over 802.3/Ethernet 6: Packet, IPv6 over 802.3/Ethernet 7: Packet, IPv4 over 802.1Q VLAN 8: Packet, IPv6 over 802.1Q VLAN 9: ATM 10: Packet, 802.3/etherneta with ROHC header compression 11: Packet, 802.3/ethernetb with ECRTP header compression 12: Packet, IP2 with ROHC header compression 13: Packet, IP2 with ECRTP header compression 14~255: reserved

[Insert new subclause 11.13.19.2]

11.13.19.2 CS Parameter encoding rules

CST	CS
98	~~No CS~~ GPCS (Generic Packet Convergence Sublayer)
99	ATM
100	Packet, IPv4
101	Packet, IPv6
102	Packet, 802.3/Ethernet
103	Packet, 802.1Q VLAN
104	Packet, IPv4 over 802.3/Ethernet
105	Packet, IPv6 over 802.3/Ethernet
106	Packet, IPv4 over 802.1Q VLAN
107	Packet, IPv6 over 802.1Q VLAN
108	Packet, IPv4 with header compression (ROHC)
109	Packet, IPv4 with header compression (ECRTP)
110	Packet, IPv6 with header compression (ROHC)

111	Packet, IPv6 with header compression (ECRTP)

11.13.19.2.1 GPCS PROTOCOL_TYPE Encoding

The encoding of the value field is that defined in an Internet Assigned Numbers Authority (IANA) registry. <TBD: insert reference to registry here>. The protocol type is defined as one byte.

Type	Length	Value	Scope
[145/146].cst.3.21	1	One byte 802.16 protocol number	DSx-REQ, DSx-RSP

For a connection using Generic Packet CS, this TLV shall be used to indicate the protocol carried over the connection when the MULTIPROTOCOL_ENABLE is disabled. For other packet CS types, PROTOCOL_TYPE is not used.

11.13.19.2.2 MULTIPROTOCOL_ENABLE Encoding

This parameter is used to indicate whether or not multiple upper layer protocol data packets are allowed to be transported over the same connection when the Generic Packet Convergence sublayer (GPCS) is used. This parameter only applies to GPCS.

If enabled, the connection can carry multiple upper layer protocols and the PROTOCOL_TYPE field must be prepended to each upper layer data packets for the corresponding CID. See section 5.2.8.2 for the GPCS PDU format. If disabled, a connection must establish the single PROTOCOL_TYPE in use by exchanging the PROTOCOL_TYPE TLV in the DSx messages as specified in section 11.13.19.2.1.

Type	Length	Value	Scope
[145/146].cst.3.20	1	0: MULTIPROTOCOL_ENABLE is disabled, default value. 1: MULTIPROTOCOL_ENABLE is enabled, SDU is prepended with PROTOCOL_TYPE value described in section 11.13.19.2.1 2-255: Reserved for future use	DSx-REQ, DSx-RSP

[Insert new subclause 11.13.38]

11.13.38 Packet Error Rate (PER)

This TLV indicates the target packet error rate (PER) for the service flow as defined below. This PER could either be the PER as seen by the application (post ARQ and/or HARQ processing) or as seen on the airlink (before the application of ARQ and/or HARQ). The particular use of this TLV is left open to implementations and vendor differentiations. Some usage scenarios, however could be: to determine whether to enable HARQ or not; to determine whether to enable ARQ or not; to choose a more aggressive or more robust burst profile etc. Support for setting the PER using this TLV is optional for both BS and MS.

Type	Length	Value	Scope
[145/146].47	1	MSB (bit 7): 0 – PER measured by the application 1 – PER measured on the airlink **Bit 6**: 0 – Interpret bits 0-5 as an integer % 1 – Interpret bits 0-5 as negative exponent of 10 **LSB 6 bits (bits 0-5):** PER value If bit 6 =0, [0 to 63%] PER If bit 6 =1, [1e-63 to 1] PER	DSA-REQ/RSP, DSC-REQ/ RSP

[Insert new subclause 11.18.2]

11.18.2 NSP List TLV

NSP List is an optional compound TLV that contains one or more Network Service Provider Identifiers, and it may be included in a MAC message transmitted on a broadcast CID.

Name	Type	Length	Value	Scope
NSP List	6	3*n	Including n, 24 bit Network Service Provider IDs, n is greater than or equal to 1.	SII-ADV Message

[Insert new subclause 11.18.3]

11.18.3 NSP Count TLV

NSP Count TLV is an optional TLV that indicate the change of the NSP list. It will be increased by one (modulo 256) by the Operator Network whenever the NSP list changes. NSP Count TLV should be sent in a more frequent manner than NSP List TLV.

Name	Type	Length	Value	Scope
NSP Count	7	1	Increment by one (modulo 256) by the Operator Network whenever the list of the NSP changes.	SII-ADV Message

[Insert new subclause 11.18.4]

11.18.4 DL Available Radio Resource

Available Radio Resource indicator shall indicate the average percentage of available physical radio resources for DL where averaging shall take place over a time interval which shall be defined by configuration. Available physical radio resources shall be defined as the set of subchannels and symbols within a radio frame, which are not used by any non-best-effort service flow class.

Table 384—DL Available Radio Resource

Type	Length (Bytes)	Value	Scope
23	1	0x00 : 0% 0x01 : 1%, ..., 0x64 : 100% 0x65 - 0xFE : reserved, 0xFF indicates no information available	OFDMA

[Insert new subclause 11.18.5]

11.18.5 UL Available Radio Resource

Available Radio Resource indicator shall indicate the average percentage of available physical radio resources for UL where averaging shall take place over a time interval which shall be defined by configuration. Available physical radio resources shall be defined as the set of subchannels and symbols within a radio frame, which are not used by any non-best-effort service flow class.

Table 385—UL Available Radio Resource

Type	Length (Bytes)	Value	Scope
24	1	0x00 : 0% 0x01 : 1%, ..., 0x64 : 100% 0x65 - 0xFE : reserved, 0xFF indicates no information available	OFDMA

[Insert a new chapter 14 and then insert the text specified below]

14. Management Interfaces and Procedures

14.1 Overview

The 802.16 devices within the purview of this specification can include 802.16-2004 subscriber stations (SS) or 802.16e mobile subscriber stations (MS) or base stations (BS). As the 802.16 devices may be part of a larger network and therefore would require interfacing with entities for management and control purposes, this document assumes a Network Control and Management System (NCMS) abstraction that interfaces with the base stations. The NCMS abstraction allows the PHY/MAC/CS layers specified in 802.16 to be independent of the network architecture, the transport network, and the protocols used at the backend and therefore allows greater flexibility on the network side. Any necessary inter-BS coordination is handled through the NCMS. This specification will only describe procedures for management and control interactions between the MAC/PHY/CS layers of the 802.16 devices and the NCMS. The details of the various entities that form the Network Control and Management System are outside the purview of this specification. An abstracted network reference model is presented to clearly depict the interfaces that are assumed to be in scope of the specification.

14.2 Requirements

<Section Notes: This section describes the functional requirements that need to be addressed by the 802.16g specification. However this section is purely informational and meant to guide the development of this document.>

14.2.1 Architectural Requirements

These are requirements that impact the SS, MS or BS from an air interface management and control perspective. These requirements do not assume a specific radio access network architectural topology and any implied physical connectivity model (eg. Routed vs Switched).

a) Data, Control and Management Plane separation shall be maintained for all protocol procedures specified.

b) The protocol procedures shall not tie a service to the access network.

c) The communication mechanisms assumed between BSes shall be protocol agnostic.

14.2.2 Configuration Requirements

a) BS shall be able to manage SS/MS configuration parameters individually or as a group.

b) BS shall be able to request parameters from neighboring BSes, including information about MSes attached to it.

c) SS/MS shall be able to override some of the configuration parameters that are managed by the BS when they do not impact the network.

d) BS should provide an interface for reading configuration parameters.

e) BS should provide the ability to update software and service capabilities on the mobile station.

14.2.3 Security Requirements

a) BS shall be able to request SS/MS re-authentication at anytime.

b) The security capabilities of the weakest SS/MS or BS should not compromise the security of the other devices.

c) BS should support faster HO re-authentication.

14.2.4 Mobility Requirements

a) MS and BS shall support primitives for enabling upper layer mobility management protocols

b) HO capabilities at varying levels should be exposed appropriately to the upper layers.

c) Location determination shall be supported within the accuracy as determined by the laws and regulations of the geographical area.

d) Location servers may request location information on demand.Primitives for a loss less handoff shall be supported for non real time traffic (e.g. HTTP.) A loss less handoff is characterized by no frame loss during the handoff. The MAC frames could be buffered at the source BS and delivered to the target after the handoff completion.

14.2.5 Data Traffic Requirements

14.2.5.1 Traffic Policies

a) Traffic Policies may be advertised during network entry and handover and may be enforceable by the BS.

b) QoS differentiation shall be supported through primitives to enable proper traffic prioritization by upper layer protocols.

14.2.5.2 Traffic filters

<Tbd>

14.2.6 Performance Requirements

14.2.6.1 Network Performance Requirements

a) Protocol primitives defined shall maximize the MS battery lifetime.

b) Protocol primitives for fast and seamless handoff shall be supported for real time traffic (e.g. VoIP). A fast and seamless handoff is characterized by low latency and tolerance for few frame drops without any noticeable glitch to the end user.

c) The following values must be made available in real-time with redisplay intervals of no less than 1000 msecs, with the option to be displayed in both cumulative and delta modes:

1) State transitions
   -Timing/ delay
2) Registrations
   -Successful and failed
   -Forward Traffic Channel Delivery
   -Total and Per user
3) MAC retries
4) PHY retries
5) MAC latency
6) Total blocks/PDU assigned and delivered
7) Uncorrectable Errors

8) Signal Strength (RSSI)
9) CINR
10) Reverse Traffic Channel Reception
    -Total and Per user
11) UL & DL Power Measurements
    -Total and per user

14.2.6.2 User Performance Requirements

Mobility creates a dynamic environment for the network that will require constant monitoring and optimization.To accomplish these tasks it is important that the network has a reasonable idea of how mobile stations are performing while moving through the network. Therefore, the air interface shall support the collection of the following metrics so that a network operator can effectively monitor the performance of the 802.16 air interface. Connection (CID) related records are needed to understand the overall performance and health of the link. For example, these statistics when correlated with upper layer protocol information may provide insight into large numbers of voice call failures or short duration calls that are associated with these connections on the specific equipment and to provide an indication as to why specific types of call failures (e.g. RF Losses, etc...) occurred. Performance management statistics within the air interface provide an overall view of system performance when correlated with (e.g. number of calls, equipment usage, etc...) and aggregate failures so that problem areas can be identified. These statistics should be made available via PM data forwarding mechanisms as defined by 3GPP (32-series) & 3GPP2 (S.S0028).

Access information
- Network details – access serving BS ID
- RF details -
  - first MOB_SCAN-REPORT,
  - first REP-RSP,
  - total timing adjustment
- Access system time

Device information
- Entry type – origination / termination, hard hand-in, cell update
- QoS Class – Best Effort, Gaming, VoIP, …
- CC status
- Service level prediction
- SS ID (mac id?)
- IP address

Summary call quality information
- Forward /Reverse packet retransmission (error) rate
- Forward / Reverse average throughput
- Constellation usage
- Average latency
- Average jitter

RF information
- Last REP-RSP
- Last MOB_SCAN-REPORT

Last sector information
- BS Transmit power
- BS Reverse RSSI

Last sector vector (NOTE: not sure what to call this but with smart antennas the location of the user to build a traffic distribution map is very useful.)

Direction
Distance
RTT

Call release information

Release system time
Call final class

14.2.6.3 HO Latency

a) FBSS - BS transition latency < (tbd)

b) Hard-HO - BS transition latency < (tbd)

14.2.7 Resource Management Requirements

a) Procedures for Emergency services shall be supported also for unidentified/unauthorized user. These procedures shall be given priority in resource allocation so as to increase the chance of success in connection initiation and handoffs.

b) Primitives for sharing available Resource/Traffic Load information dynamically among the neighbor BSs for the efficient use of radio resources.

c) Flexible bandwidth allocation shall be supported to fulfill the QoS requirement with any possible adaptation to efficiently utilize the spectrum

d) Procedures supporting load balancing shall be supported and provisioned among the BSs for increased system utilization and accommodating more users

e) BS supporting mobility, shall provide protocol primitives for collecting and forwarding neighbor BS information advertisements.

f) BSes should be capable of providing default transport connections for MSes that need to use it for emergency services.

g) 802.16g entities (BS/MS) shall provide relevant reports (e.g. measurements) on resource information for use by entities on the network.

14.2.8 Element Management Requirements

a) Statistics for the SS/MSes should be collected by the BS using primitives defined and available to a higher layer Network Management Protocols.

b) Statistics for the BS (e.g. usage of resources) should be collected by the BS and available to a higher layer Network Management Protocols

c) MS should collects statistics on the radio link that may be queried by the BS.

d) MSes and BSes should also collect statistics on neighboring BSes for the purposes of HO.

14.2.9 Specification Requirements

There are several usage scenarios based on 802.16's specifications, such as Fixed Access, Nomadicity, Portability with Simple Mobility Support, Full Mobility Support. If a procedure, message, IE or IRP does not apply to all usage scenarios, the scenarios it applies to will be clearly specified.

14.2.10 Media Independent Handover

14.2.10.1 General Requirements

a) The NCMS shall support MIH Function services for MS and BS.

b) The 802.16 Reference Model shall support MIH Function services. Both the 802.16 SS and BS shall support these MIH Function services.

c) The 802.16 specification shall support MIH capable BS's MIH Capability Delivery through broadcast message. This shall be accomplished by including capability information recommended by 802.21 specification in both DL-MAP message and Neighbor Advertisement (MOB_NBR-ADV) MAC management message.

14.2.10.2 SAP Requirements

a) The 802.16 specification shall support link layer events as specified in the 802.21 specification. For each link layer event this may result in definition of a new primitive, or change in semantics of an existing primitive or just identification of an existing primitive with appropriate semantics in the 802.16 specification. The link layer events are identified in Table-1 in IEEE 802.21 specification.

b) The 802.16 specification shall support link layer commands as specified in the 802.21 specification. For each link layer command this may result in definition of a new primitive, or change in semantics of an existing primitive or just identification of an existing primitive with appropriate semantics in the 802.16 specification.

14.2.10.3 Information Element Requirements

a) The 802.16 specification shall support Information Elements identified by the 802.21 specification.

14.2.10.4 Transport Requirements

a) The 802.16 specification shall support a new ethertype for MIH.

b) The 802.16 specification shall support interactions between MIH Function on BS and MIH Function on some other PoA (such as AP in 802.11 network).

c) The 802.16 specification shall support a L2 transport for querying/setting information elements (IEs) over the air interface between MIH Function on SS/MS and MIH Function on PoA (BS). The IEs shall be transferable over either a basic connection or a primary connection.

d) The 802.16 specification shall support a L2 transport for transferring remote events and remote command messages over the air interface between MIH Function on SS/MS and MIH Function on PoA (BS). The Remote event and remote command messages shall be transferable over either a basic connection or a primary connection.

14.2.10.5 Media Independent Event Service Requirements

The following set of events supported in the 802.21 specification shall be supported. (Table-1). Other events may be added as they are added over to 802.21 specification.

Table 386—Media Independent Event Service Requirements

Event Identifier	Event Type	Event Name	Description	Comments	802.16 Primitive
1	State Change	Link Up	L2 connection has been established	Successful registration response message is received	M_Registration.confirmation
2	State Change	Link Down	L2 connection has been broken	MS can not demodulate the downlink and exceeds number of RNG-REQ retries with the serving BS. This can be check by counting ranging retries (M_Ranging.confirmation).	M_Ranging.confirmation
3	Predictive	Link Going Down	L2 connection loss is imminent	Either when MS receives BS initiated MOB_BSHOREQ[1] message to request-handover or when link quality delivered through M_Scanning.confirmation is bad below certain threshold.	M_Scanning.confirmation or M_ScanReport.confirmation.
4	State Change	Link Detected	A new link has been detected	Successful scanning of new BS.	M_Scanning.confirmation

14.2.10.6 Media Independent Handover Inter-MIHF Communication Requirements

The 802.16 specification shall support interactions between MIH Function on SS/MS and MIH Function on some other PoA (such as AP in 802.11 network). Following is a list of handover commands and interactions between MIH Function entities supported by 802.21 specification. These handover commands shall result in interactions between the MIH on SS/MS and MIH on BS. A L2 transport such as a separate primary management connection id may be used to transfer these primitives. These primitives shall largely be transparent to the 802.16 PHY/MAC.

Table 387—Media Independent Handover (MIH) Primitives

Id	Command Name	MIHF <> MIHF	Description	Comments
1	MIH Handover Initiate	Client <> Network PoA	Initiates handovers and sends a list of suggested networks and suggested PoA.	
2	MIH Handover Prepare	Network (oPoA) <> Network (nPoA)	This command is sent by MIHF on oPoA to MIHF on suggested new network at nPoA. This allows the client to query for resources on nPoA and also allows to prepare the nPoA for handover	
3	MIH Handover Commit	Client <> Network	In this case the client commits to do the handover based on selected choices for network and PoA.	
4	MIH Handover Complete	Network (nPoA) <> Network (oPoA)	This is a notification from nPoA to oPoA that handover has been completed, new PoA has been established and any pending packets may now be forwarded to the new nPoA.	
5	MIH Network Address Information	Network (nPoA) <> Network(oPoA) <> Network (Access Router/ Foreign Agent)	This command is sent by MIHF on oPoA to MIHF on suggested new network at nPoA. nPoA may relay this command to the AR with MIHF. This allows the client to have network address related information prior to the handover to the nPoA.	

14.3 Information Model Aspects

For the purpose of Management Interface development an Interface Methodology known as Integration Reference Point (IRP) was developed to promote the wider adoption of standardized Management interfaces in telecommunication networks. The IRP methodology employs Protocol & Technology Neutral modeling methods as well as protocol specific solution sets to help achieve its goals. The Integration Reference Point is a methodology to aid a modular approach to the development of standards interfaces.

There are three cornerstones to the IRP approach:

1.Top-down, process-driven modeling approach

The process begins with a requirements phase, the aim at this step is to provide conceptual and use case definitions for a specific interface aspect as well as defining subsequent requirements for this IRP.

2.Technology-independent modeling

The second phase of the process is the development of a protocol independent model of the interface. This protocol independent model is specified in the IRP Information Service.

3. Standards-based technology-dependent modeling

The third phase of the process is to create one or more interface technology and protocol dependent models from the Information Service model. This is specified in the IRP Solution Set(s).

14.3.1 Information Service Models

Information Service Models refer to both Interface IRPs and NRM IRPs.

This section is providing the IEEE 802.16 protocol neutral (IS) resource model (NRM/MIB) definitions.

14.3.1.1 Information entities imported and local labels

Table 450—Information entities imported and local labels

Label reference	Local label
information object class, ManagedElement	ManagedElement
information object class, ManagedFunction	ManagedFunction
information object class, SubNetwork	SubNetwork
information object class, Top	Top

14.3.1.2 Class diagram

14.3.1.2.1 Attributes and relationships

Figure 1. establishes the naming and containment for the protocol neutral network management models of the 802.16 standard. The inheritance diagram show in Figure 2. is based on 802.16e and 802.16-2004. This diagram establishes the context of the IOC and shows ME's as inventory items and MF's as the functions that perform functions in the 802.16 network.

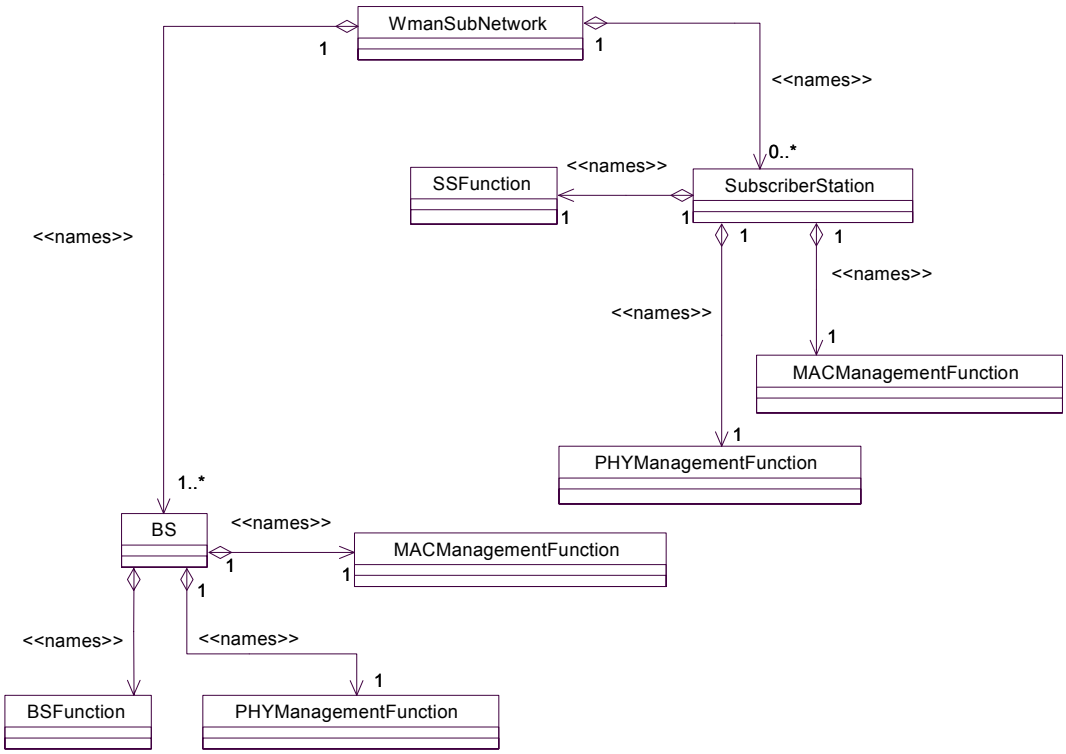


Figure 300—Containment and Naming Diagram

14.3.1.2.2 Inheritance

This clause depicts the inheritance relationships that exist between information object classes.

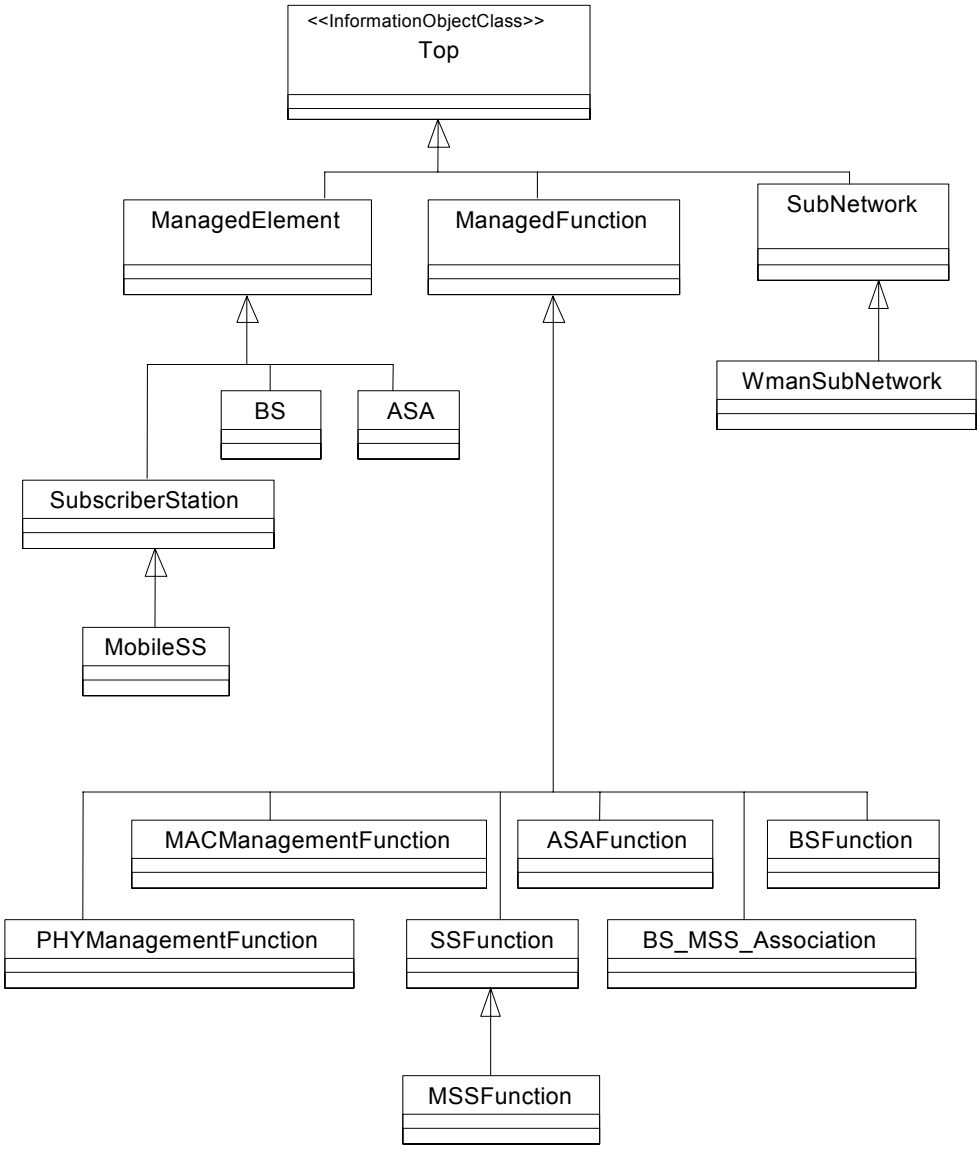


Figure 301—Inheritance Diagram

14.3.1.3 Information object classes definition

14.3.1.3.1 IOC BsFunction

14.3.1.3.1.1 Definition

This IOC represents a WMAN base station. For more information, see [zz]. It is derived from Managed-Function.

<Section Note: This table is just a template for reference.>

14.3.1.3.1.2 Attributes

Table 451—Attributes

Attribute name	Defined in	Visibility	Support Qualifier	Read Qualifier	Write Qualifier
BsFunctionId	--	+	M	M	--
objectClass	Top	+inherited	Minherited	Minherited	--inherited
objectInstance	Top	+inherited	Minherited	Minherited	--inherited
userLabel	ManagedFunction	+inherited	Minherited	Minherited	Minherited
aaa	--	+	O	M	--
bbb	--	+	O	M	--
yyy	--	+	O	M	--
zzz	--	+	O	M	--

14.3.1.3.2 IOC WmanSsFunction

14.3.1.3.2.1 Definition

This IOC represents a WMAN subscriber station. For more information, see [tbd]. It is derived from ManagedFunction.

14.3.1.3.2.2 Attributes

14.3.1.3.3 IOC xxx

14.3.1.3.4 IOC yyy

14.3.1.4 Information relationships definition

14.3.1.5 Notifications

14.3.1.6 Information attributes definition

Table 452—Attributes

Attribute name	Defined in	Visibility	Support Qualifier	Read Qualifier	Write Qualifier
SsFunctionId	--	+	M	M	--
objectClass	Top	+inherited	Minherited	Minherited	--inherited
objectInstance	Top	+inherited	Minherited	Minherited	--inherited
userLabel	ManagedFunction	+inherited	Minherited	Minherited	Minherited
ccc	--	+	O	M	--
ddd	--	+	O	M	--
www	--	+	O	M	--
xxx	--	+	O	M	--

14.3.1.6.1 Definition and legal values

Table 453—Definition and legal values

Attribute name	Definition	Legal Values
BsFunctionId	It contains 'name+value' that is the RDN, when naming an instance, of this object class containing this attribute.This RDN uniquely identifies the object instance within the scope of its containing (parent) object instance.	--
SsFunctionId		--
ZzzId		--
aaa	tbd	tbd
bbb	tbd	tbd
ccc	tbd	tbd
ddd	tbd	tbd
objectClass	As defined in [zz]: An attribute which captures the name of the class from which the object instance is an occurrence of.	--

14.4 Architectural Aspects

This specification includes primitives that are exposed to upper layers in a consistent manner for use by control and management plane protocols in a network agnostic manner. The network that manages and controls an 802.16 air interface device is therefore abstracted as a Network Control and Management System (NCMS). The NCMS shall also support management function for SS/MS. In order to provide correct MAC operation, NCMS shall be present within each SS/MS. The NCMS is a layer independent entity that may be viewed as a management entity. General system management entities can perform functions through NCMS and standard management protocols can be implemented in the NCMS.

14.4.1 Network Reference Model

The Figure 302 describes a network reference model along with the interfaces that are within the scope of this specification. Multiple SS or MS maybe attached to a BS. The SS communicate to the BS over the U interface using a Primary Management Connection or a Secondary Management Connection. MS typically only utilize the Primary Management Connection over the U interface for management and related control functions.

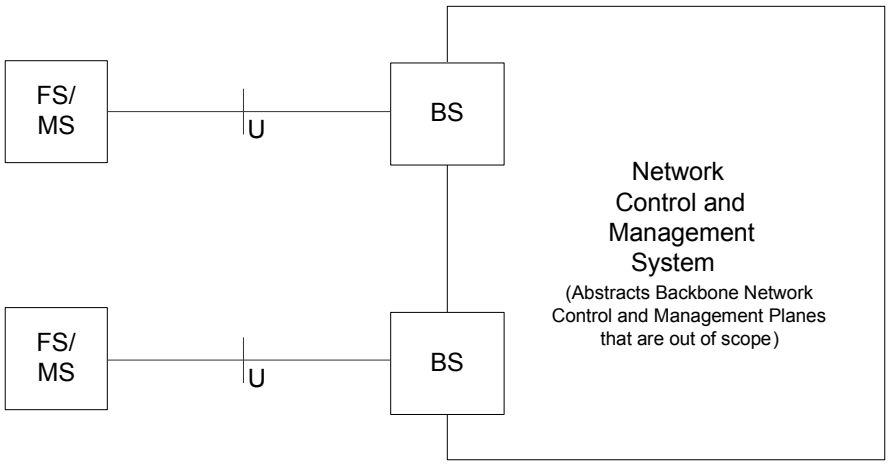


Figure 302—802.16g Network Reference Model

14.4.1.1 Network Control and Management System (NCMS)

This abstraction is detailed in Figure 303 to show the different functional entities that make up such a Network Control and Management System. These entities may be centrally located or distributed across the network. The exact functionality of these entities and their services is outside the scope of this specification but shown here for illustration purposes and to better enable the description of the management and control procedures.

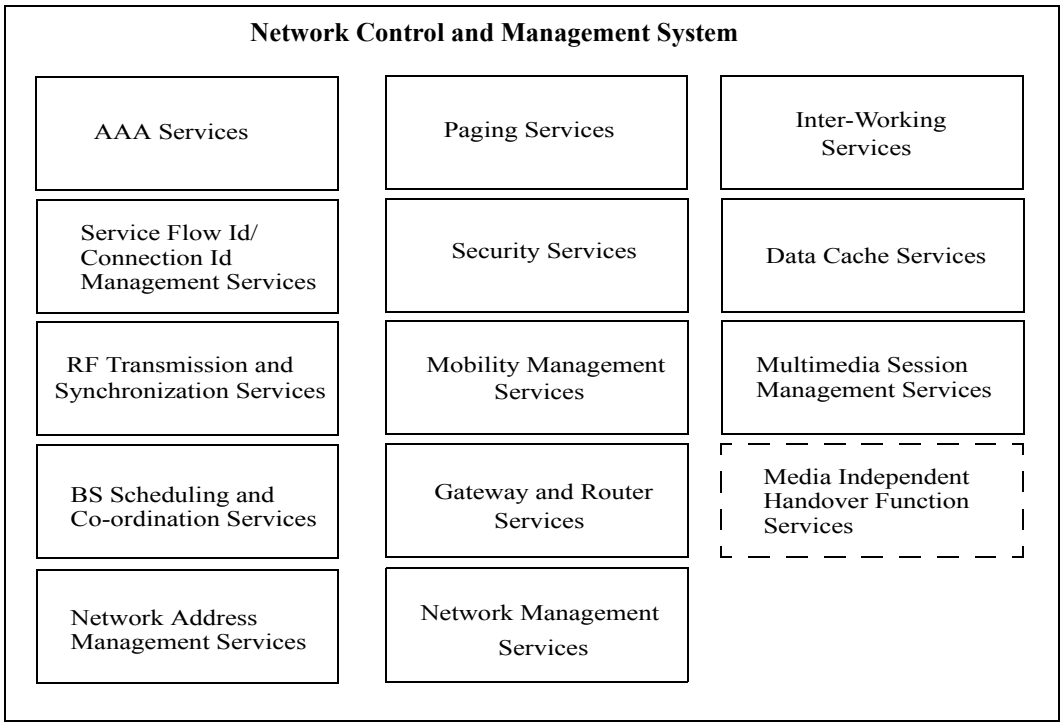


Figure 303—Illustration of the Network Control and Management System (Informational)

NCMS protocols are not defined in this specification, however information elements (IEs) and protocol primitives for these IEs are exposed using Service Access Points (SAP). This includes CS, MAC and PHY layer context information used by NCMS protocols to manage and control the air interface. Every BS is assumed to be part of an NCMS and therefore as shown in Figure 3.

14.4.1.1.1 SS/MS and BS Interface

This U interface may be implemented using either a primary management connection or a secondary management connection.

14.4.1.1.2 BS/SS/MS and NCMS Interface

This interface is a set of Service Access Points (SAP) and is represented and in the Figure 304 below. It is decomposed in to two parts for interface with NCMS: the Management SAP used for Management primitives alone and the Control SAP is used for Control plane primitives that to support handovers, security context management, radio resource management, and low power operations (such as Idle mode and paging functions). The primary goal of such an interface is to ensure protocol separation.

These primitives do not define end to end protocol flows, but rather commands and indications for access to the Management and Control entities for the CS/MAC/PHY layers. Protocol procedures are defined using one or more of these primitives for performing distinct protocol functions on the air interface (eg. Paging, Handover etc.)

Management and Control entities are logical and may have SAPs between their protocol layers, however for simplicity they are not defined.

[Replace the figure 1 in section 1.4 with the one below]

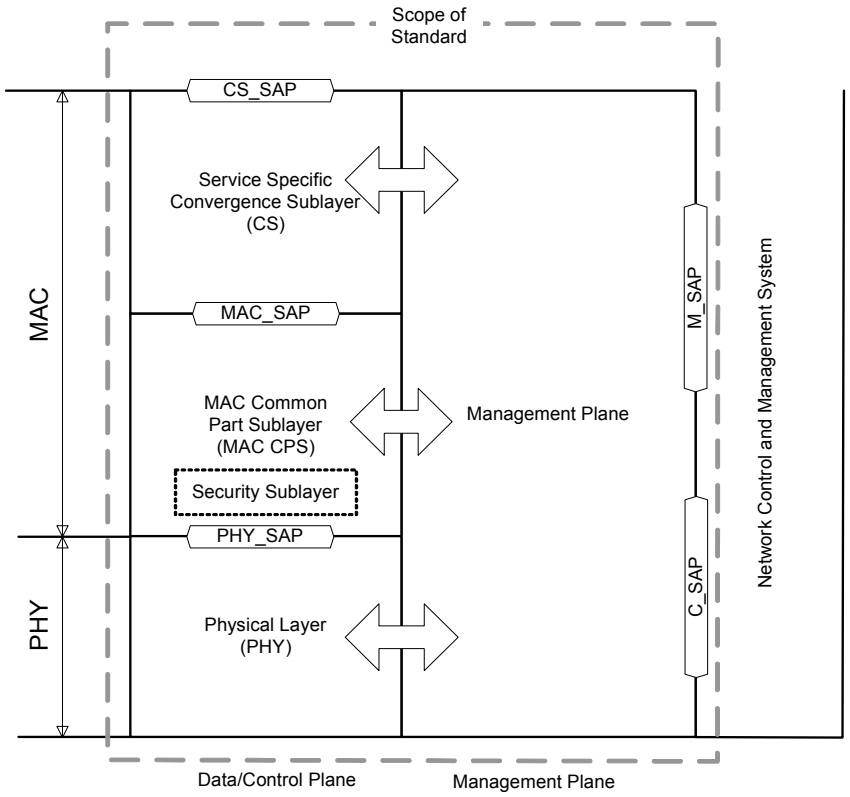


Figure 304—802.16g Protocol Architecture Model

14.4.1.1.2.1 Management SAP (M_SAP)

The Management SAP may include, but is not limited to primitives related to:

- System configuration
- Monitoring Statistics
- Notifications/Triggers
- Multi-mode interface management

14.4.1.1.2.2 Control SAP (C_SAP)

The Control SAP may include, but is not limited to primitives related to:

- Handovers (e.g. notification of HO request from MS, etc.)
- Idle mode mobility management (e.g. Mobile entering idle mode)
- Subscriber and session management (e.g. Mobile requesting session setup)
- Radio resource management, etc.
- AAA server signaling (Eg. EAP payloads).

- Media Independent Handover Function Services

14.4.2 Management Interfaces

14.4.3 Information Service Models

14.5 Management Functions

14.5.1 Fault Management

14.5.1.1 Events/Logs

14.5.1.1.1 Persistance Requirements

14.5.1.2 Notification/Triggers

<Section Note: Notification for events and trigger functions associated with some events are described>

14.5.2 Configuration Management

Configuration management is a principal and essential management function. It can be divided into: Capability Management, Basic RF Management, Basic MAC Management, Time Management, Version Management and so on.

14.5.2.1 Generic procedure and primitives

14.5.2.1.1 Generic Procedure

The Generic Procedures of configuration management are as follows:

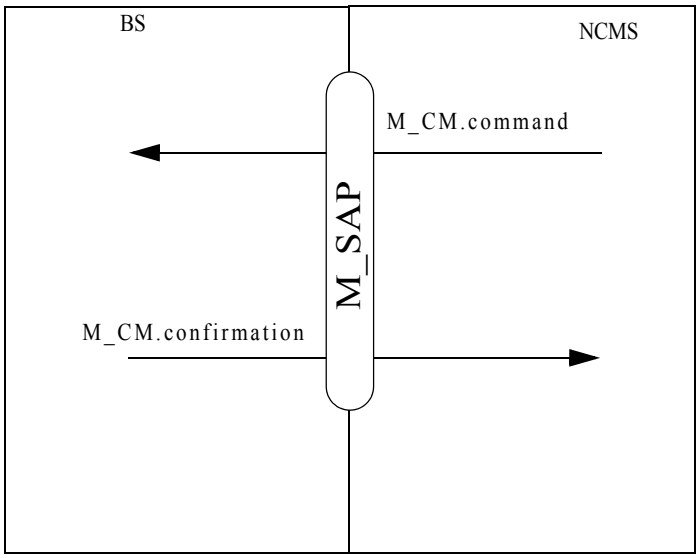


Figure 305—Procedure of configuration management initiated by NCMS

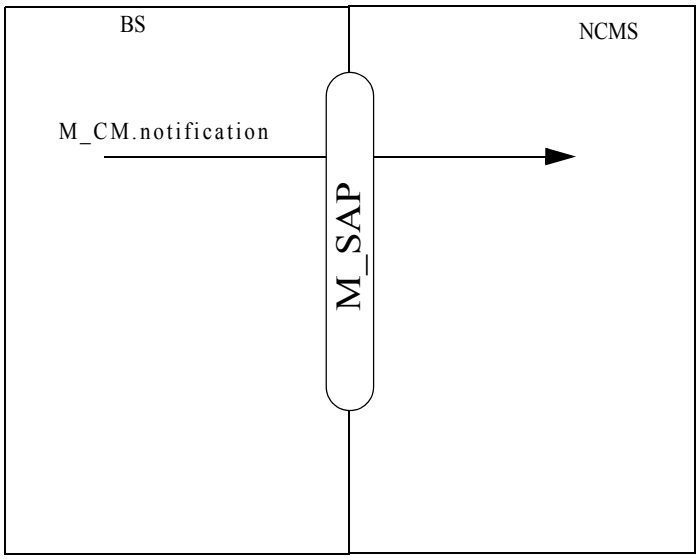


Figure 306—Procedure of configuration management initiated by BS

When NCMS needs to carry out configuration management, it can initiate the procedure with M_CM.command primitive with the specific action type and action information. When BS receives the primitive, it shall act according to the information contained in M_CM.command and response with M_CM.confirmation. The BS also may generate the M_CM.notification primitive to report the status of the configuration information to NCMS.

14.5.2.1.2 Generic Service Primitives

14.5.2.1.2.1 M_CM.command

14.5.2.1.2.1.1 Function

This primitive is originated by the NCMS to request the BS to execute the radio parameters configuration, capability configuration, RF resource configuration, Time configuration, or version configuration etc.

14.5.2.1.2.1.2 Semantics of this primitive

The parameters of this primitive are as follows:

M_CM.command
(
Object ID,
Action Type,
Attribute List
)

Object ID
Object identifier.
Action Type
SET, GET, REMOVE, CANCEL, etc.
Attribute List
Contains the list of attributes on which the action shall be performed.

14.5.2.1.2.1.3 When Generated

This primitive is originated by the NCMS when it needs to inform the BS to perform the specified configuration action.

14.5.2.1.2.1.4 Effect of receipt

When the BS receives this primitive, it shall perform the specific functions as defined in the following table and reply to the NCMS with a M_CM.confirmation with current status.

Table 454—Action Type and Action

Action Type	Action
SET	Set configuration information based on attribute list
GET	Report configuration information to NCMS based on attribute list
REMOVE	Remove configuration parameters according to the attribute list.
CANCEL	Cancel the action indicated by the last M_CM.command

14.5.2.1.2.2 M_CM.confirmation

14.5.2.1.2.2.1 Function

This primitive is originated by the BS in response to M_CM.command from the NCMS.

14.5.2.1.2.2.2 Semantics of this primitive

The parameters of this primitive are as follows:

M_CM.confirmation
(
Object ID,
Action Type,
Attribute List
)

Object ID
This is the Object identifier.
Action Type
This shall be set as the Action Type in M_CM.command.
Attribute List
It contains the list of attributes which are the action results.

14.5.2.1.2.2.3 When Generated

This primitive is originated by the BS in response to the M_CM.command.

14.5.2.1.2.2.4 Effect of receipt

When the NCMS receives this primitive, it shall check the parameters in the attribute list, update the related information, and take any further action necessitated by the result.

14.5.2.1.2.3 M_CM.notification

14.5.2.1.2.3.1 Function

This primitive is originated by the BS to report its specific configuration information to NCMS.

14.5.2.1.2.3.2 Semantics of this primitive

The parameters of this primitive are as follows:

M_CM.notification
(
Object ID,
Attribute List
)

Object ID
Object identifier.
Attribute List
It contains the specific configuration information which BS is reporting to NCMS.

14.5.2.1.2.3.3 When generated

The BS needs to notify the NCMS of its specific configuration information.

14.5.2.1.2.3.4 Effect of Receipt

When the NCMS receives this primitive, it shall check the attribute list in the primitive, update the related information, and take any further action necessitated by the result.

14.5.2.2 Capability Management

<Section Note: Subscriber Basic Capabilities negotiation recommendations>

14.5.2.3 Basic RF Configuration

<Section Note: Procedures for setting and retrieving system information about frequency assignments for sectors, channel bandwidths, FFT sizes, Tx Power, etc. are described>

14.5.2.4 Basic MAC Configuration

<Section Note: Procedures for setting and retrieving MAC parameters like SDU size limits, PDU size limits, list of Service classes supported, scan list, packing, fragmentation, ARQ block sizes etc. are described>

14.5.2.5 BS Time Configuration

<Section Note: Procedures for setting and retrieving BS time information are described.>

14.5.2.6 Version Configuration

Version configuration management is an essential and critical management function. It can be divided into; version information update, version verification, and version upload/download sub-procedures.

Figure 305b shows an example of using the generic primitives to describe the version configuration procedure.

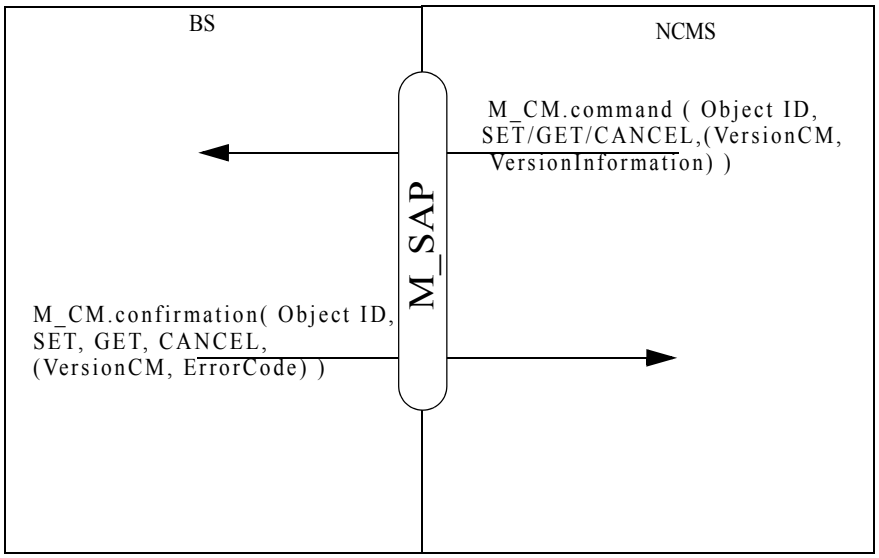


Figure 307—Procedure of version configuration initiated by NCMS

Figure 307 describes the version configuration procedure initiated by the NCMS with M_CM.command. This procedure could be used to either obtain or set the version information at the BS. It can also be used to cancel the action of version update. After BS receives the primitive, it shall respond with M_CM.confirmation to inform NCMS the result of version configuration action.

14.5.3 Accounting Management

Accounting event can be detected for an MS Network Entry. Since each MS can have multiple connections at the same time, accounting event for each connection should be detected. Accounting for an MS Network Entry is initiated when the MS registers at the network and terminated when the MS deregisters from the network. Similarly, accounting for a connection is initiated at the dynamic service addition (DSA) instant of the connection and terminated at the dynamic service deletion (DSD) instant of the connection.

14.5.3.1 Accounting Procedure

Accounting primitives consist of Accounting request and Accounting response, as shown in Figure 308 and Figure 309. Figure 308 represents accounting primitives initiated by a BS when it receives REG-REQ/RSP, DREG-REQ/RSP, DREG-CMD, DSA-REQ/RSP, DSC-REQ/RSP or DSD-REQ/RSP. Figure 309 represents accounting primitives initiated by an NCMS.

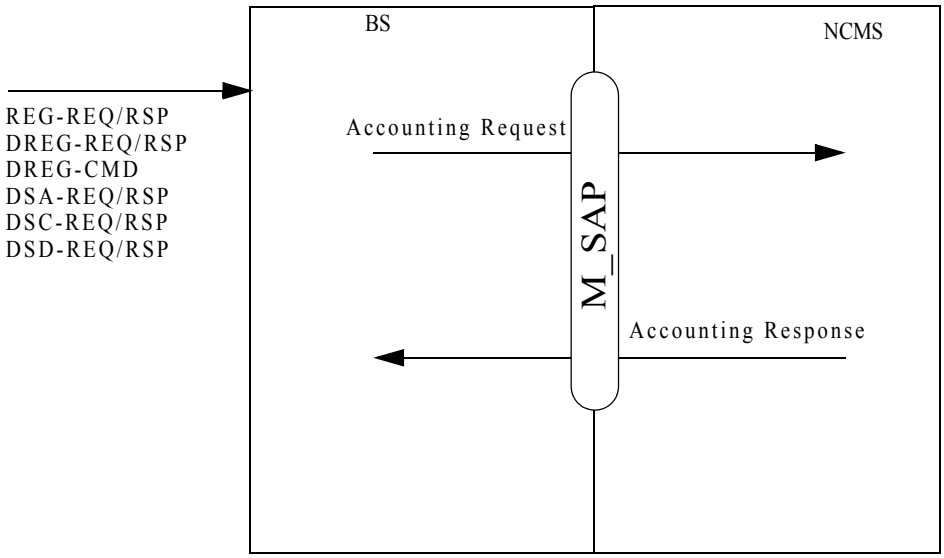


Figure 308—Accounting Primitive Initiated by a BS

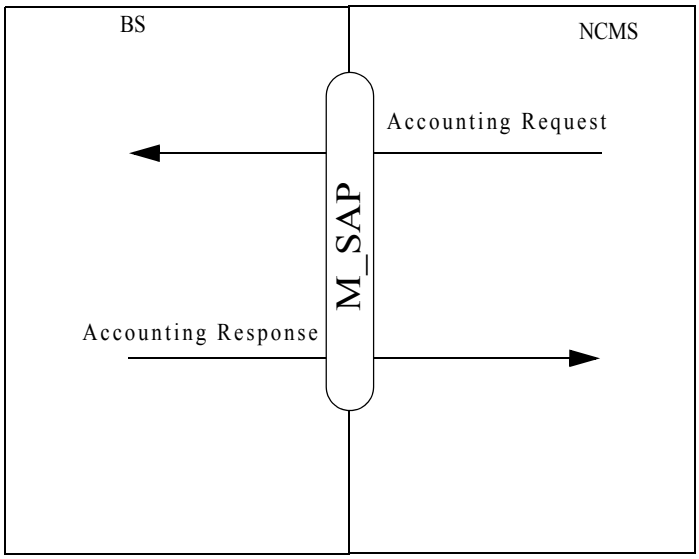


Figure 309—Accounting Primitive Initiated by an NCMS

14.5.3.2 Service Primitives for Accounting Management

14.5.3.2.1 Accounting request

14.5.3.2.1.1 Function

This primitive is issued by a BS to inform an NCMS of accounting event for MS Network Entry after Registration request/response (REG-REQ/RSP) or Deregistration command (DREG-CMD) of an MS. Also, it is issued by a BS to inform an NCMS of accounting event for connection after DSA, DSC or DSD procedure. On the other hand, this primitive can be issued by an NCMS depending on the policy of service provider.

14.5.3.2.1.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Accounting request
(
MS MAC Address
Service Flow Identifier
Accounting Record Type
Accounting Record Number
Accounting Input Octets
Accounting Output Octets
Accounting Input Packets
Accounting Output Packets
Service Flow Information
)

MS MAC Address
48-bit MAC address which will identify MS

Service Flow identifier
32-bit service flow identifier which will identify service flows of an MS

Accounting Record Type
The type of accounting record being sent and EVENT_RECORD, START_RECORD, INTERIM_RECORD, and STOP_RECORD are currently defined. An Event Record is used to indicate that a one-time event has occurred (meaning that the start and end of the event are simultaneous). A Start Record is used to initiate an accounting session and contains accounting information that is relevant to the initiation of the session. An Interim Record contains cumulative accounting information for an existing accounting session. A Stop Record is sent to terminate an accounting session and contains cumulative accounting information relevant to the existing session.

Accounting Record Number
Identifies accounting record within one session

Accounting Input Octets
The number of octets received from the MS during the session (This parameter is only included in the Accounting Request Primitive from BS to NCMS).

Accounting Output Octets
The number of octets sent to the MS during the session (This parameter is only included in the Accounting Request Primitive from BS to NCMS).

Accounting Input Packets
The number of packets received from the MS during the session (This parameter is only included in the Accounting Request Primitive from BS to NCMS).

Accounting Output Packets

The number of packets sent to the MS during the session (This parameter is only included in the Accounting Request Primitive from BS to NCMS).

Service Flow Information

Required QoS information of a service flow include traffic characteristics and a scheduling type such as service class name, QoS parameter set type, maximum sustained traffic rate, maximum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, service flow scheduling type, tolerate jitter, and maximum latency This parameter is only included in the Accounting Request Primitive from BS to NCMS).

14.5.3.2.1.3 When generated

This primitive is generated at a BS when an MS enters a network or terminates to access a network, or when an MS starts or stops dynamic services. Also, this primitive can be generated at an NCMS to request accounting event from a BS.

14.5.3.2.1.4 Effect of receipt

If this primitive is generated by a BS, accounting event is sent to an NCMS. On the other hand, if this primitive is generated by an NCMS, the BS transfers gathered accounting event to the NCMS using Accounting response primitive.

14.5.3.2.2 Accounting response

14.5.3.2.2.1 Function

This primitive is issued by either an NCMS or a BS to respond to Accounting request.

14.5.3.2.2.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Accounting response
(
MS MAC Address
Service Flow Identifier
Result Code
Accounting Record Type
Accounting Record Number
Accounting Input Octets
Accounting Output Octets
Accounting Input Packets
Accounting Output Packets
Service Flow Information
)

MS MAC Address

48-bit MAC address which will identify MS

Service Flow identifier

32-bit service flow identifier which will identify service flows of an MS

Result Code

The result of Accounting request

Accounting Record Type

The type of accounting record being sent and EVENT_RECORD, START_RECORD, INTERIM_RECORD, and STOP_RECORD are currently defined. An Event Record is used to indicate that a one-time event has occurred (meaning that the start and end of the event are simultaneous). A Start Record is used to initiate an accounting session and contains accounting information that is relevant to the initiation of the session. An Interim Record contains cumulative accounting information for an existing accounting session. A Stop Record is sent to terminate an accounting session and contains cumulative accounting information relevant to the existing session.

Accounting Record Number

Identifies accounting record within one session

Accounting Input Octets

The number of octets received from the MS during the session (This parameter is only included in the Accounting Response Primitive from BS to NCMS).

Accounting Output Octets

The number of octets sent to the MS during the session (This parameter is only included in the Accounting Response Primitive from BS to NCMS).

Accounting Input Packets

The number of packets received from the MS during the session (This parameter is only included in the Accounting Response Primitive from BS to NCMS).

Accounting Output Packets

The number of packets sent to the MS during the session (This parameter is only included in the Accounting Response Primitive from BS to NCMS).

Service Flow Information

Required QoS information of a service flow include traffic characteristics and a scheduling type such as service class name, QoS parameter set type, maximum sustained traffic rate, maximum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, service flow scheduling type, tolerate jitter and maximum latency (This parameter is only included in the Accounting Response Primitive from BS to NCMS).

14.5.3.2.2.3 When generated

This primitive is generated at either an NCMS or a BS to respond to Accounting request.

14.5.3.2.2.4 Effect of receipt

If an NCMS or a BS receives the Accounting response, it completes accounting procedure.

14.5.4 Performance Management

14.5.4.1 Performance Monitoring Procedure

The performance monitoring primitives are a set of primitives for supporting the performance monitoring procedure between BS and NCMS.

Figure 310 shows the example of performance monitoring procedure

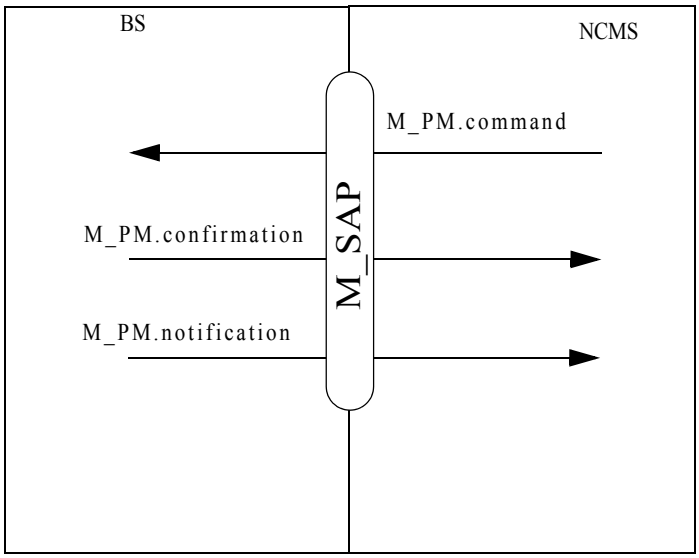


Figure 310—Example of primitive flow of Performance monitoring

14.5.4.1.1 M_PM.command

14.5.4.1.1.1 Function

This primitive is used by NCMS to inform the BS of the performance monitoring configuration information, which includes the Object identifier, Action type, PM Configuration Attribute List.

14.5.4.1.1.2 Semantics of the service primitives

The parameters of the primitive are as follows:

M_PM.command
(
Object ID
Action Type
PM_Configuration Attribute_List_ID
PM Configuration Attribute List
    (
        Performance Item Name
        Performance Monitor Parameters
        Performance Report Parameters
)
)

Object ID
This is the object identifier. It may be, for example, the BS_ID, MS_ID or SF_ID etc. according to the performance monitor requirement.

Action Type

The Action Type defines the specific action performed by the BS. The possible Action Types are CREATE, REMOVE, SUSPENT, RESUME, GET and SET.

PM_Configuration Attribute_List_ID

This uniquely identifies the PM_Attribute List

PM Configuration Attribute List

(

Performance Item Name

The performance monitoring item name

Performance Monitor Parameters

It defines the information of monitor action type (periodic or event triggered), monitoring granularity (e.g. 5ms, 10ms, etc), etc. When Action Type is set to GET, REMOVE, SUSPEND or RESUME, this field is ignored.

Performance Report Parameters

It defines the information of report type (periodic or event triggered) ,
reporting granularity (e.g. 1 hour, 1 day, etc.). When Action Type is set to GET, REMOVE, SUSPEND or RESUME, this field is ignored.

)

14.5.4.1.1.3 When generated

This primitive is used by the NCMS when it needs to start or stop monitoring the performance of the system on per BS, SS/MS or specific call based performance data. This primitive also can be used by NCMS to retrieve performance measurement from the BS immediately.

14.5.4.1.1.4 Effect of receipt

The BS will configure the performance monitoring items according to the received primitive. The BS action is defined based on Action Type in the primitive according to the following table:

Table 455—Action and Action Type

Action Type	Action
GET	The BS reports all performance measurements to NCMS according to PM Configuration Attribute List immediately.
SET	The BS configures the performance monitoring items according to PM Configuration Attribute List
CREATE	The BS creates a new PM Configuration Attribute List
REMOVE	The BS removes a PM Configuration Attribute List
SUSPEND	The BS suspends a provisioned PM_Configuration Attribute List
RESUME	The BS resumes the provisioned PM_Configuration Attribute List

14.5.4.1.2 M_PM.confirmation

14.5.4.1.2.1 Function

This primitive is used by BS to response to the NCMS of M_PM.command primitive, which confirms the proposed performance monitoring information by NCMS.

14.5.4.1.2.2 Semantics of the service primitives

The parameters of the primitive are as follows:

M_PM.confirmation
(
Object ID
Action Type
PM_Configuration Attribute_List_ID
PM Configuration Attribute List
(
Performance Item Name
Status
Performance Item Report Information
)
)
Object ID
This is the object identifier. It may be, for example, the BS ID, MS ID or SF ID etc. according to the performance monitor requirement.
PM_Configuration Attribute_List_ID
This uniquely identifies the PM_Attribute List
PM Configuration Attribute List
(
Performance Item Name
It is the name of performance monitoring item.
Status
This indicates the result of configuration performance item, it can be SUCCESS or FAILURE
Performance Item Report Information
The performance item report information. It could be the monitoring item value or other correspondent information. This information is only valid if the Action Type is set to GET.
)

14.5.4.1.2.3 When generated

This primitive is generated by the BS to confirm start or stop performance monitor when it receives the M_PM.iCommand.

14.5.4.1.2.4 Effect of receipt

The NCMS checks the status in the primitive and continues next step accordingly.

14.5.4.1.3 M_PM.notification

14.5.4.1.3.1 Function

This primitive is used by BS to report the performance monitoring items information.

14.5.4.1.3.2 Semantics of the service primitives

The parameters of the primitive are as follows:

M_PM.notification
(
Object ID
PM_Configuration Attribute_List_ID
PM Reporting Item List
(
Performance Item Name
Performance Item Report Information
)
)

Object ID
It is the object identifier and can be, for example, the MS ID, SF ID etc. according to the performance monitor requirement;
PM_Configuration Attribute_List_ID
This uniquely identifies the PM_Attribute List
PM Reporting Item List
(
Performance Item Name
It is the name of the performance reporting item.
Performance Item Report Information
The performance item report information. It could be the monitoring item value or other correspondent information
)

14.5.4.1.3.3 When generated

This primitive is generated by the BS to report the required performance metrics based on the report mode in the former performance monitoring.

14.5.4.1.3.4 Effect of receipt

The NCMS will take corresponding actions after receiving this report.

14.5.5 Security Management

14.5.5.1 EAP-based authentication procedure

When an MS try to initiate an EAP-based authentication or re-authentication procedure with a BS, it sends a PKMv2 EAP Start message. The BS informs of an NAS (Network Access Server) entity in NCMS as an EAP_start.request primitive. If the MS receives EAP-Request/Identity messages, then it sends the EAP-Response/Identity message with MN's identifier to the NAS entity. After the EAP-Response/Identity message, the EAP methods are negotiated between the MS and the AAA server and the EAP messages are exchanged several times. The EAP messages encapsulated are exchanged between the MS and the NAS entity. If the EAP authentication procedure is finished successfully and also yields an MSK (Master Session Key), the BS which does not know EAP protocols receives the MSK and a key lifetime from the EAP client entity as an EAP_Key_Notification.indication primitive. It is already shared between the AAA server and

the MS through the EAP exchanges. The MSK is used for derivation for a PMK (Pair wise Master Key) and optional EIK (EAP Integrity Key).

Figure 311 shows EAP-based authentication procedure between a BS and an NAS entity in NCMS as follows

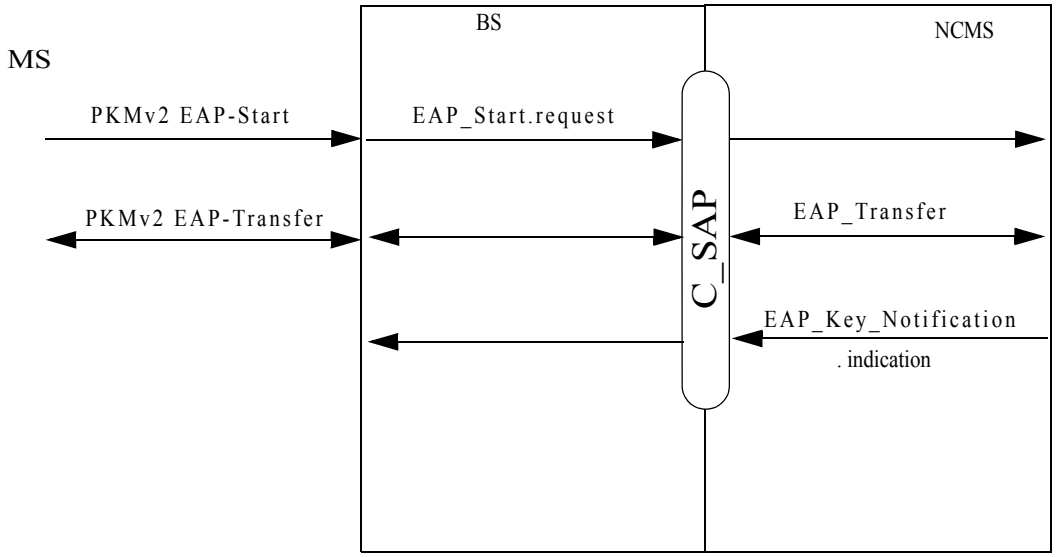


Figure 311—EAP based Authentication Procedure

14.5.5.1.1 Service Primitives

14.5.5.1.1.1 EAP_Start.request

14.5.5.1.1.1.1 Function

This primitive inform an AAA Client entity in NCMS that an MS is going to start EAP-based authentication.

14.5.5.1.1.1.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

EAP_Start.request
(
MS ID
)

MS ID
48-bit unique identifier used for user identification between BS and NCMS

14.5.5.1.1.1.3 When generated

This primitive is issued by a BS when a MS wants to initiate EAP-based authentication procedure.

14.5.5.1.1.1.4 Effect of receipt

EAP payloads are forwarded for the authentication between BS and NCMS entity.

14.5.5.1.1.2 EAP_Transfer

14.5.5.1.1.2.1 Function

After the EAP_start primitive, EAP payloads are exchanged between an MS and an NAS entity. The EAP payloads are encapsulated in the EAP Transfer because it is not interpreted in the MAC.

14.5.5.1.1.2.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

EAP_Transfer
(
MS ID
EAP Payload
)

MS ID
48-bit unique identifier used for user identification between BS and NCMS
EAP Payload
Contains the EAP authentication data

14.5.5.1.1.3 EAP_Key_Notification.indication

14.5.5.1.1.3.1 Function

A MS derives the key from the EAP payloads and the NCMS entity informs the BS of it when the EAP exchanges are successfully completed and yield the MSK.

14.5.5.1.1.3.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

EAP_Key_Notification.indication
(
MS ID
MSK
MSK Lifetime
)

MS ID
48-bit unique identifier used for user identification between BS and NCMS
MSK

MSK is the product of EAP exchanges. It is used for the derivation of PMK (Pair wise Master Key) and EIK.

MSK Lifetime

It may be transferred from the EAP method or may be set by a vendor.

14.5.5.1.1.3.3 When generated

This primitive is issued by a NCMS (a NAS entity) when the EAP exchange are successfully completed and yield the MSK.

14.5.5.1.1.3.4 Effect of receipt

The BS could derive a PMK and optional EIK from the MSK.

14.5.5.2 RSA-based authentication procedure

When an MS tries to initiate an RSA-based authentication or re-authentication procedure with a BS, it sends PKM-REQ messages with Auth Info, Auth Request or PKMv2 RSA-Request message type. When a MS sends a PKM-REQ message with Auth Info message type which includes a CA (Certificate Authority)'s certificate to the BS, the BS informs of an NCMS entity as a Certificate_Infomation primitive. The NCSM entity verifies the CA's certificate if it has no information about the CA and keeps the certificate.

When an MS sends a PKM-REQ message with Auth Request or PKMv2 RSA-Request message type to authenticate the MS, the BS informs of an NCMS entity as a Certificate_Verification_Request primitive. An NCMS entity verifies the MS's certificate through asking to a CA and an OCSP (Online Certificate Status Protocol) server. The NCMS returns the result of verification to the BS whether the MS is authenticated or not as a Certificate_Verification_Response primitive. The BS sends the result of authentication and security information to the MS including security key information.

Figure 312 shows a RSA-based authentication procedure between a BS and an NCMS entity as follows:

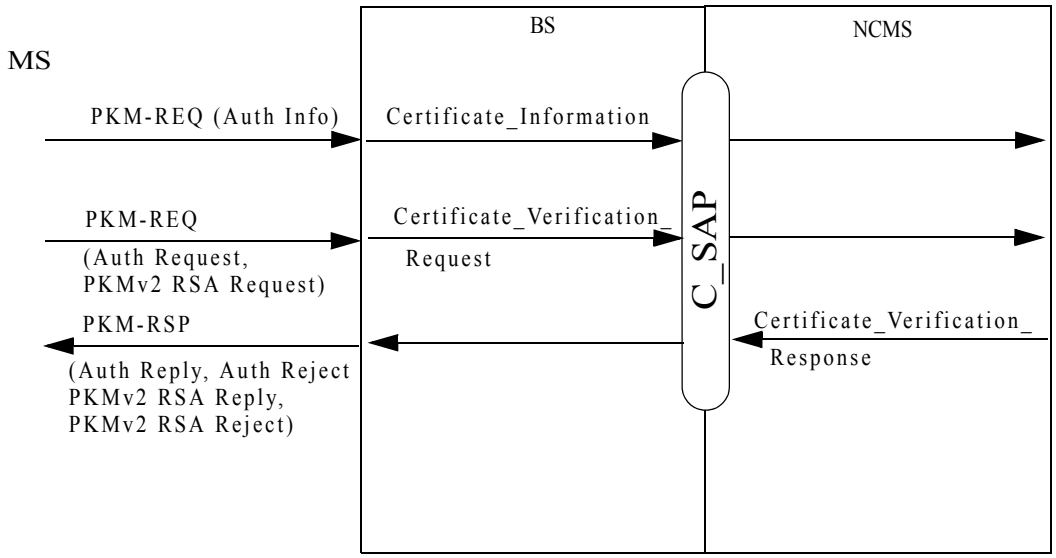


Figure 312—RSA-based authentication procedure

14.5.5.2.1 Service Primitives

14.5.5.2.1.1 Certificate_Information

14.5.5.2.1.1.1 Function

This primitive informs of an NCMS entity that a CA's certificate which issues an MS's certificate.

14.5.5.2.1.1.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

Certificate_Information
(
MS ID
Certificate
}

MS ID
48-bit unique identifier used for user identification between a BS and an NCMS
Certificate
CA's certificate which issues an MS's certificate

14.5.5.2.1.1.3 When generated

This primitive is issued by a BS (when the BS does not have CA's information that generates the certificate) when an MS informs the BS of CA's certificate.

14.5.5.2.1.1.4 Effect of receipt

The NCMS has information for a CA's certificate and is able to verify an MS's certificate whether the MS's certificate is forged or not.

14.5.5.2.1.2 Certificate_Verification_Request

14.5.5.2.1.2.1 Function

This primitive is used by a BS to inform an MS's certificate to authenticate the MS of an NCMS entity.

14.5.5.2.1.2.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

Certificate_Verification_Request
(
MS ID
Certificate
)

MS ID
48-bit unique identifier used for user identification between a BS and an NCMS
Certificate
MS's certificate which is issued by a trust CA

14.5.5.2.1.2.3 When generated

This primitive is issued by a BS (when the BS does not have CA information that generates the certificate) when an MS requests the BS for authentication to access the network.

14.5.5.2.1.2.4 Effect of receipt

The NCMS verifies an MS's certificate whether the MS's certificate is forged or not, and is revoked or good.

14.5.5.2.1.3 Certificate_Verification_Response

14.5.5.2.1.3.1 Function

This primitive informs a BS a result of MS's authentication by an NCMS entity.

14.5.5.2.1.3.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

Certificate_Verification_Response
(
MS ID
Result
)

MS ID
48-bit unique identifier used for user identification between a BS and an NCMS

Result

Result of authentication such as valid, forged or revoked

14.5.5.2.1.3.3 When generated

This primitive informs the authentication result of a BS by a NCMS.

14.5.5.2.1.3.4 Effect of receipt

The BS transmits the PKM-RSP message to the MS. If the result is success, a pre-PAK is included in it.

14.5.5.3 Authentication, Authorization and Accounting (AAA) Guidelines

<Section Note: Recommendations for utilizing EAP, RADIUS protocols>

14.5.5.4 Security Context and Key Management

<Section Note: Recommendations for establishment and management of Security Associations, Key establishment and caching policies.>

14.5.5.5 Security for Handoffs (EAP only)

In the handover procedure, if an MS tries to process the network re-entry to a target BS, but the target BS has not an MS information, then the target BS may request the MS information to a serving BS and the serving BS may give a response of it.

Figure 313 shows the context transfer primitives initiated by a serving BS between a BS and an NCMS entity.

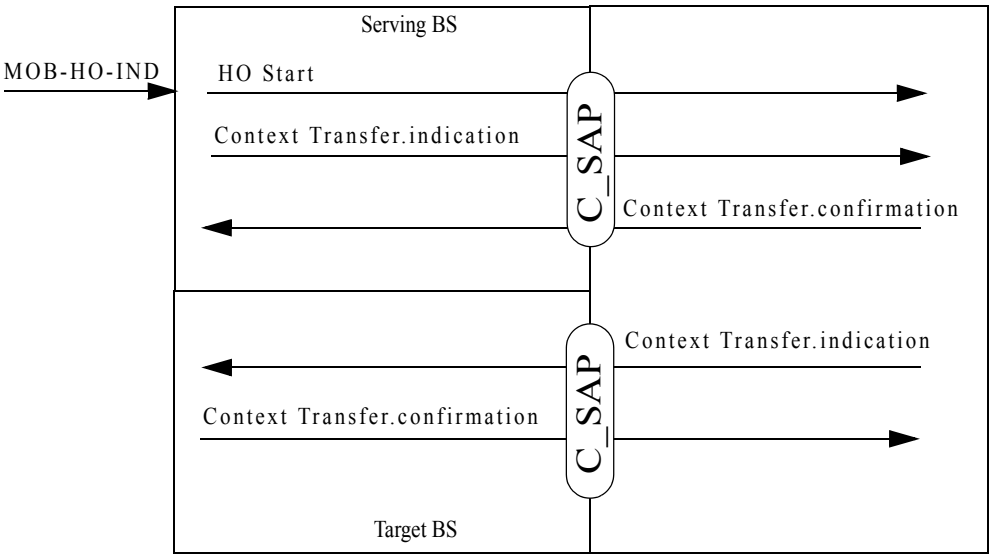


Figure 313—Context transfer primitives initiated by a serving BS

If an MS tries to process the network re-entry to a target BS, but the target BS has not an MS information, then the target BS may request the MS information to a serving BS and the serving BS may give a response of it. Figure 314 shows the context transfer procedure initiated by a target BS between a BS and an NCMS entity as follows.

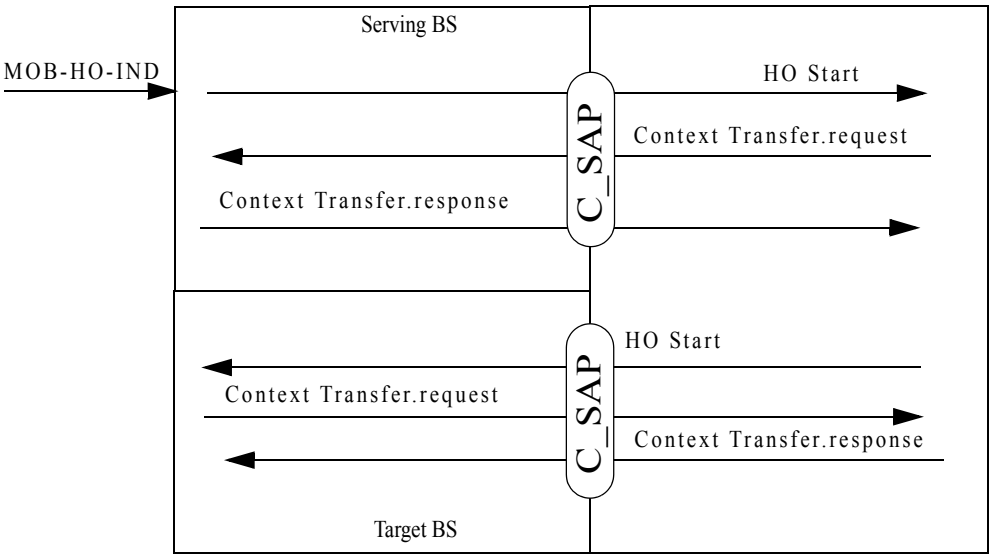


Figure 314—Context transfer primitives initiated by a target BS

14.5.5.5.1 Service Primitives

14.5.5.5.1.1 Context Transfer.indication

14.5.5.5.1.1.1 Function

This primitives is issued by the serving BS or the NCMS entity in order to give the target BS the security context information of the MS. It is transmitted only to the real target after the handover procedure. The MS information what they have could be included.

14.5.5.5.1.1.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

Context Transfer.indication
(
Serving BS ID,
Target BS ID,
MS ID,
Security Information
)

MS ID

48-bit unique identifier used for user identification between BS and NCMS

Serving BS ID

Base station unique identifier of the serving BS (same as in the DL-MAP)

Target BS ID

Base station unique identifier of the target BS (same as in the DL-MAP)

Security Information

The information negotiated during PKM procedure. It presents when the information could be provided. AK and AK sequence number transmitted by NCMS, TEK, TEK key lifetime, TEK sequence number, CBC Initialize Vector (the reuse of IV is TBD because of the security issue), SAID, GKEK, GKEK lifetime, GKEKKID, SAID, SA-type, SA service type and Cryptographic-Suite

14.5.5.5.1.1.3 When generated

This primitive is issued by a BS or the NCMS when the handover procedure is successfully processed. The actual trigger point may be different according to the security sharing policy. One example is a serving BS issues this primitive after it generates HO start primitive.

14.5.5.5.1.1.4 Effect of receipt

The entity receiving this primitive shall response with Context Transfer.confirmation primitive. In addition, if the serving BS issues this primitive for the MS security information, the NCMS entity shall forwards the MS information to the target BS or another NCMS entity using Context Transfer.indication primitive.

14.5.5.5.1.2 Context Transfer.confirmation

14.5.5.5.1.2.1 Function

This primitive is issued by the target BS or the NCMS in order to response the Context Transfer.indication.

14.5.5.5.1.2.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

Context Transfer.confirmation
(
Serving BS ID,
Target BS ID,
MS ID,
Result Code
)

MS ID

48-bit unique identifier used for user identification between BS and NCMS.

Serving BS ID

Base station unique identifier of the serving BS (same as in the DL-MAP).

Target BS ID

Base station unique identifier of the target BS (same as in the DL-MAP).

ResultCode

The result of context transfer procedure.

14.5.5.5.1.2.3 When generated

This primitive is issued by the target BS or the NCMS when the Context Transfer.indication is successfully processed.

14.5.5.5.1.2.4 Effect of receipt

This primitive informs the result of context transfer for the handover

14.5.5.5.1.3 Context Transfer.request

14.5.5.5.1.3.1 Function

After the successful handover procedure, the Target BS can re-establish the session information of MS in old BS.

14.5.5.5.1.3.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

Context Transfer.request
(
Serving BS ID,
Target BS ID,
MS ID
)

MS ID
48-bit unique identifier used for user identification between BS and NCMS
Serving BS ID
Base station unique identifier of the serving BS (same as in the DL-MAP)
Target BS ID
Base station unique identifier of the target BS (same as in the DL-MAP)

14.5.5.5.1.3.3 When generated

This primitive is issued by the target BS or the NCMS entity to request the MS's security context information.

14.5.5.5.1.3.4 Effect of receipt

The NCMS entity or the BS receiving this primitive provides the security context information using Context Transfer.response primitive.

14.5.5.5.1.4 Context Transfer.response

14.5.5.5.1.4.1 Function

This primitive is issued by the serving BS or the NCMS to response the Context Transfer.request.

14.5.5.5.1.4.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

Context Transfer.response
(
Serving BS ID,
Target BS ID,
MS ID,
Result Code
)

MS ID
48-bit unique identifier used for user identification between BS and NCMS
Serving BS ID
Base station unique identifier of the serving BS (same as in the DL-MAP)
Target BS ID
Base station unique identifier of the target BS (same as in the DL-MAP)
ResultCode
The result of context transfer procedure
Security Information
The information negotiated during PKM procedure. AK and AK sequence number transmitted by an NCMS, TEK, TEK key lifetime, TEK sequence number, CBC Initialize Vector (the reuse of IV is TBD because of the security issue), SAID, SA-type, SA service type and Cryptographic-Suite

14.5.5.5.1.4.3 When generated

This primitive is issued by the serving BS or the NCMS entity after receiving Context Transfer.request primitive.

14.5.5.5.1.4.4 Effect of receipt

This primitive informs the result of context transfer for the handover

14.5.5.6 Protecting Management Messages

<Section Note: Recommendations for protecting management messages.>

14.5.6 Service Flow Management

14.5.6.1 BS Service Provisioning

<Section Note: Provisioning of the services on the BS are described. Ex: Setting and retrieval of Operator IDs, BS IDs etc. and type of convergence layers supported and their configuration parameters are described.>

14.5.6.2 SS/MS Provisioning

<Section Note: Provisioning. Configuration and management for BS initiated connections and service flow creations for static and dynamic QoS>

14.5.6.3 SS/MS Connection Management

14.5.6.3.1 Service Primitives

These primitives are issued when the IP connection is managed by the secondary management connection. It is available for both IPv4 and IPv6.

14.5.6.3.1.1 DHCP_Transfer

14.5.6.3.1.1.1 Function

DHCP payloads are exchanged between an SS/MS and a DHCP Client entity. The DHCP payloads are encapsulated in the DHCP Transfer primitive because it is not interpreted in the BS.

14.5.6.3.1.1.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

DHCP_Transfer
(
MS/SS ID
DHCP Payload
)

MS/SS ID
48-bit unique identifier used for user identification between BS and NCMS
DHCP Payload
Contains the DHCP payload

14.5.6.3.1.2 MIP_Transfer

14.5.6.3.1.2.1 Function

MIP payloads are exchanged between an MS and an entity with functionalities of mobility agent in NCMS. The MIP payloads are encapsulated in the MIP Transfer primitive because it is not interpreted in the BS.

14.5.6.3.1.2.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

MIP_Transfer
(
MS ID
MIP Payload
)

MS ID
48-bit unique identifier used for user identification between BS and NCMS
MIP Payload
Contains the MIP payload

14.5.6.3.1.3 IP_Allocation_Notification.indication

14.5.6.3.1.3.1 Function

After MIP or DHCP exchanges are completed, the status of IP address for a SS/MS may be changed. For the BS, NCMS may notify BS of the status of the IP address of the SS/MS. If the status value is NEW, NCMS sends a new allocated IP address for the SS/MS in IP_Allocation.indication primitive.

14.5.6.3.1.3.2 Semantics of the Service Primitives

The parameters of the primitives are as follows:

IP_Allocation_Notification.indication
{
MS ID
Status
IP Address
}

MS ID
48-bit unique identifier used for user identification between BS and NCMS
Status
The status of the IP address of a SS/MS. The value may be NEW, REMAIN, RELEASE
IP Address
If the Status value is NEW, this parameters should be a new address allocated to the SS/MS using DHCP or MIP.

14.5.6.3.1.3.3 When generated

This primitive is issued by a NCMS (a DHCP client or a Mobility Agent) when the IP exchange procedure are successfully completed.

14.5.6.3.1.3.4 Effect of receipt

The BS knows the IP address and its status of the SS/MS

14.5.6.4 QoS Management

The QoS Management Primitives are a set of primitives for supporting QoS management between BS and NCMS (access network). They are defined to support QoS service flows. A service flow ID is created and managed by the NCMS (or a network entity). A unique identifier of all SAPs is service flow ID because the service flow ID can only be identified in a network operator. The CID is only managed in MAC layer in a BS. MS ID in ASF request and CSF request is used to authorize the MS whether the QoS information is permitted.

Service flow application clients that interact with CS convergence layer should transform service flow information and CS parameter information to appropriate parameters of network protocol in network side and in reverse direction. How to convert specific QoS parameters between 802-16-Service-Flow and Network Flows is out of scope. Network side protocol modules such as RSVP, COPS (Common Open Policy Service) and SNMP (Simple Network Management Protocol) have better convert the specific QoS parameters between two sides. The service flow management primitives are designed as 2-way handshake style because

resource reservation protocols in IETF and primitives at the 802.16 MAC SAP are designed as 2-way handshake style but service flow messages in IEEE 802.16-2004 is designed as 3-way handshake style to negotiate QoS requirements in a service flow.

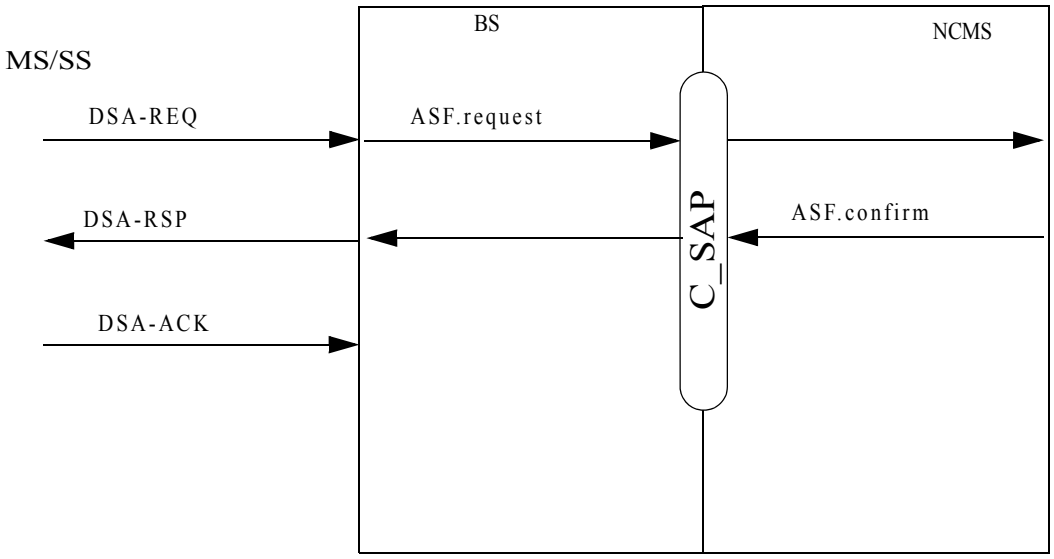


Figure 315—ASF request and ASF confirm primtives flow

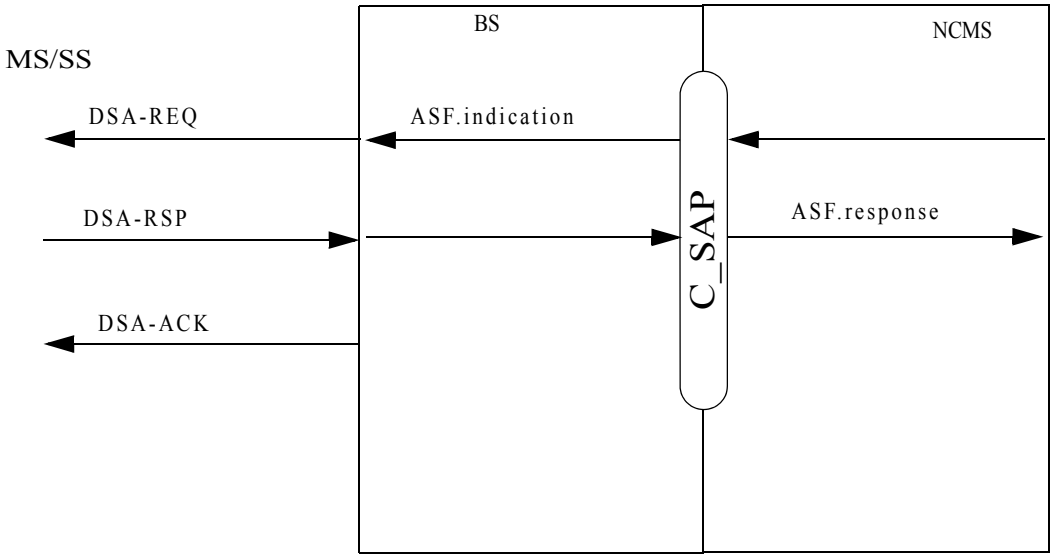


Figure 316—ASF indication and ASF response primtives flow

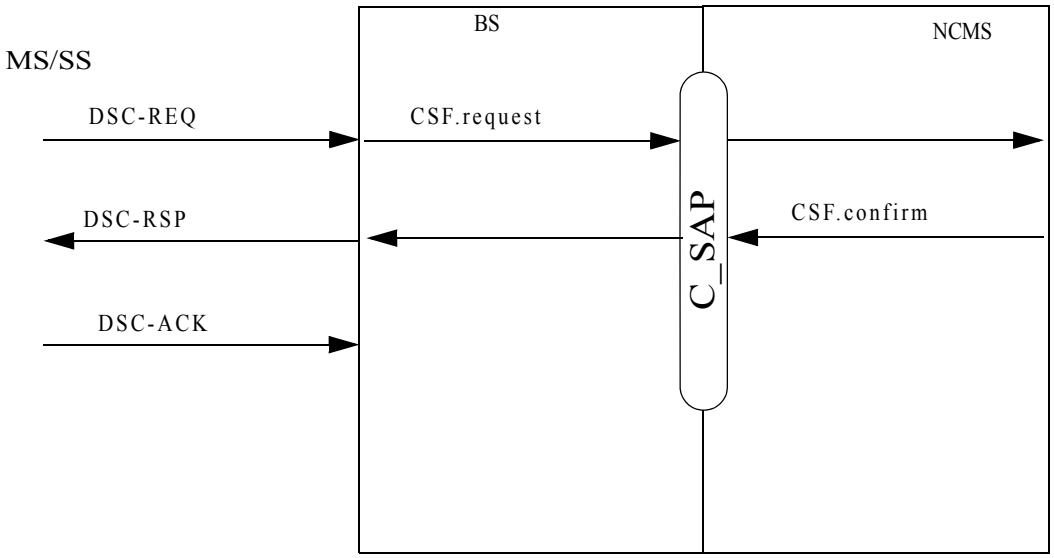


Figure 317—CSF request and CSF confirm primtives flow

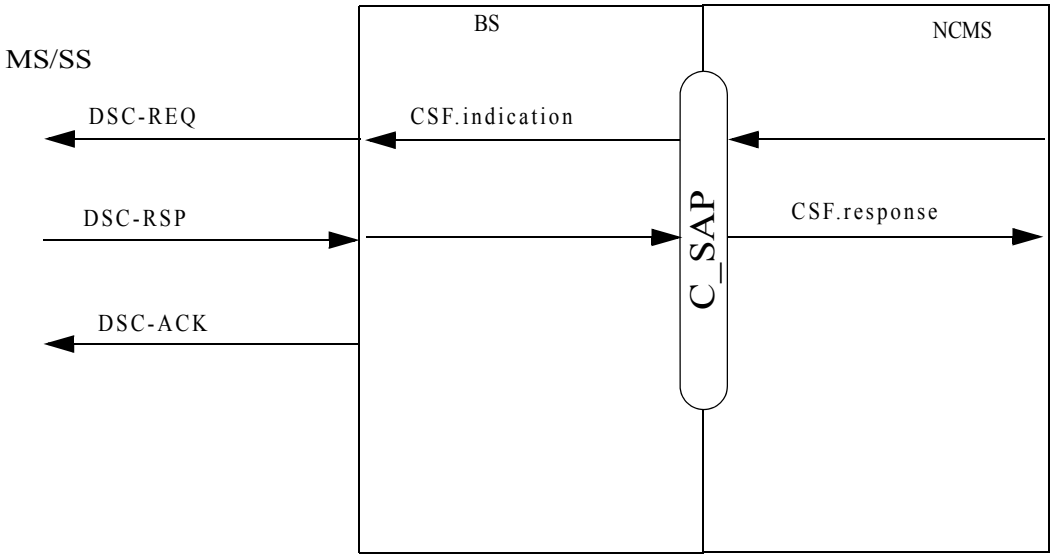


Figure 318—CSF indication and ASF response primtives flow

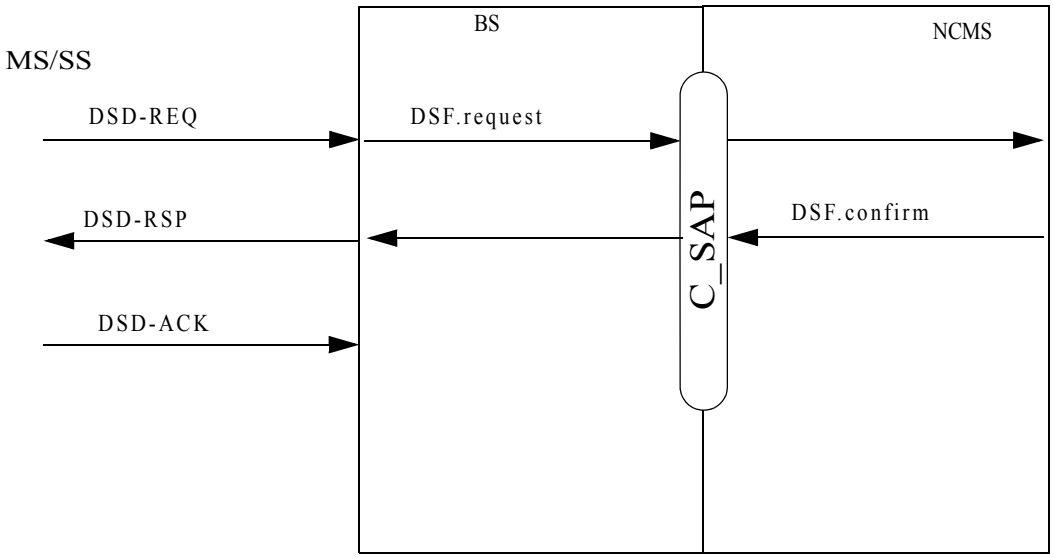


Figure 319—DSF request and DSF confirm primtives flow

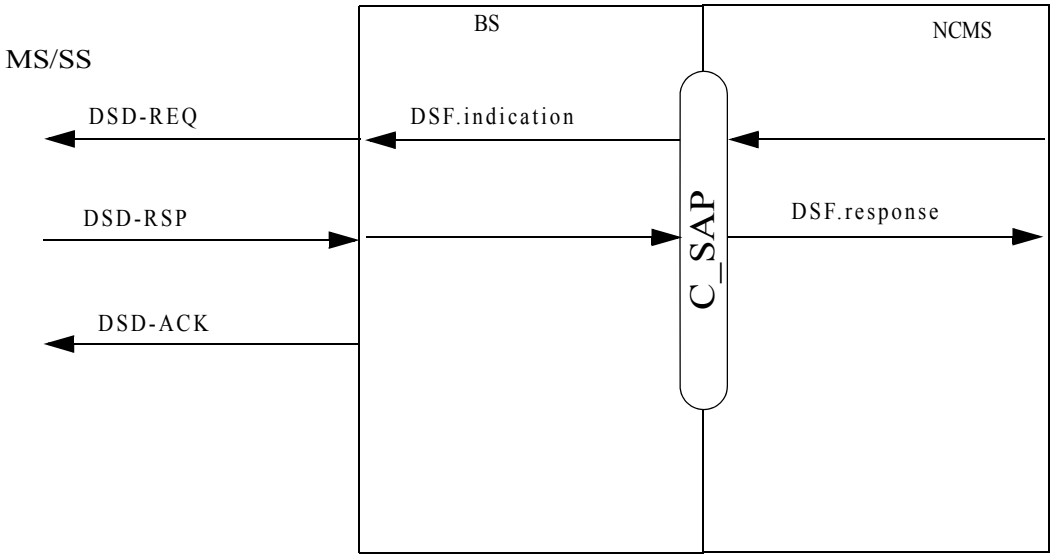


Figure 320—DSF indication and DSF response primtives flow

14.5.6.4.1 Add_Service_Flow.request (ASF.request)

14.5.6.4.1.1 Function

This primitive is used by a BS to inform an QoS information from an MS of the QoS management entity in NCMS.

14.5.6.4.1.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Add_Service_Flow.request
(
Transaction ID
MS ID
Service flow descriptor
Service flow information
CS parameter information
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
MS ID
48-bit unique identifier used by MS. MS ID is used for user authorization
Service flow descriptor
Information regarding the attribute an uplink or downlink service flow
Service flow information
Required QoS information of a service flow include traffic characteristics and a scheduling type such as service class name, QoS parameter set type, maximum sustained traffic rate, maximum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, service flow scheduling type, tolerate jitter and maximum latency
CS parameter information
Required IP filter rules of a service flow such as packet classification rule and IPv6 flow label

14.5.6.4.1.3 When generated

This primitive is generated when a BS receives a DSA-REQ message.

14.5.6.4.1.4 Effect of receipt

The QoS management entity in NCMS shall respond to this primitive by sending Add_Service_Flow.confirm. The management entity for service flows checks the validity of the request from the point of view of its own resources. If the request is accepted, the QoS management entity in NCMS creates unique service flow ID for the request.

14.5.6.4.2 Add_Service_Flow.confirm (ASF.confirm)

14.5.6.4.2.1 Function

This primitive is used by the QoS management entity in NCMS to response the ASF.request from a BS. Service flow information in ASF response has approved QoS information if the ASF.request is accepted.

14.5.6.4.2.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Add_Service_Flow.confirm
(
Transaction ID
MS ID
Service flow ID
Service flow descriptor
Service flow information
CS parameter information
Service flow error parameter information
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
MS ID
48-bit unique identifier used by MS. MS ID is used for user identification
Service flow ID
Unique identifier to identify a service flow
Service flow descriptor
Information regarding the attribute an uplink or downlink service flow
Service flow information
Approved complete QoS information of a service flow such as service class name, QoS parameter set type, maximum sustained traffic rate, maximum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, service flow scheduling type, tolerate jitter and maximum latency
CS parameter information
Approved IP filter rules of a service flow such as packet classification rule and IPv6 flow label
Service flow error parameter information
Failed reason and every specific failed QoS parameter if a ASF request is rejected

14.5.6.4.2.3 When generated

This primitive is generated when the QoS management entity in NCMS responds to Add_Service_Flow.request primitive.

14.5.6.4.2.4 Effect of receipt

This primitive informs the result of the service flow creation of a BS. A BS receiving the primitive shall transmit DSA-RSP message following the information provided by this message.

14.5.6.4.3 Add_Service_Flow.indication (ASF.indication)

14.5.6.4.3.1 Function

This primitive is used by the QoS management entity in NCMS to inform QoS information. Service flow information and service flow ID are included in ASF.indication of a BS.

14.5.6.4.3.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Add_Service_Flow.indication
(
Transaction ID
MS ID,
Service flow descriptor
Service flow ID
Service flow information
CS parameter information
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
MS ID
48-bit unique identifier used by MS.
Service flow descriptor
Information regarding the attribute an uplink or downlink service flow
Service flow ID
Unique identifier to identify a service flow.
Service flow information
Approved complete QoS information of a service flow such as service class name, QoS parameter set type, maximum sustained traffic rate, maximum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, service flow scheduling type, tolerate jitter and maximum latency.
CS parameter information
Approved IP filter rules of a service flow such as packet classification rule and IPv6 flow label

14.5.6.4.3.3 When generated

This primitive is generated when the QoS management entity in NCMS informs QoS information of a BS.

14.5.6.4.3.4 Effect of receipt

A BS receiving the primitive shall transmit DSA-REQ message following the information provided by this message.

14.5.6.4.4 Add_Service_Flow.response (ASF.response)

14.5.6.4.4.1 Function

This primitive is used by a BS to respond the ASF.indication to the QoS management entity in NCMS.

14.5.6.4.4.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Add_Service_Flow.response
(
Transaction ID
Service flow ID
Service flow descriptor
Service flow information
CS parameter information
Service flow error parameter information
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
Service flow ID
Unique identifier to identify a service flow
Service flow descriptor
Information regarding the attribute an uplink or downlink service flow
Service flow information
Approved complete QoS information of a service flow such as service class name, QoS parameter set type, maximum sustained traffic rate, maximum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, service flow scheduling type, tolerate jitter and maximum latency
CS parameter information
Approved IP filter rules of a service flow such as packet classification rule and IPv6 flow label
Service flow error parameter information
Failed reason and every specific failed QoS parameter if a ASF request is rejected

14.5.6.4.4.3 When generated

This primitive is generated when a BS receives a DSA-RSP message.

14.5.6.4.4.4 Effect of receipt

This primitive informs the result of the service flow creation of the QoS management entity in NCMS.

14.5.6.4.5 Change_Service_Flow.request (CSF.request)

14.5.6.4.5.1 Function

This primitive is used by a BS to inform an QoS information from an MS of the QoS management entity in NCMS.

14.5.6.4.5.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Change_Service_Flow.request
(
Transaction ID
MS ID
Service flow ID
Service flow information
CS parameter information
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
MS ID
48-bit unique identifier used by MS. MS ID is used for user authorization
Service flow ID
Unique identifier to identify a service flow
Service flow information
Required QoS information of a service flow include traffic characteristics and a scheduling type such as service class name, QoS parameter set type, maximum sustained traffic rate, max-

imum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, tolerate jitter and maximum latency

CS parameter information

Required IP filter rules of a service flow such as packet classification rule and IPv6 flow label

14.5.6.4.5.3 When generated

This primitive is generated when a BS receives a DSC-REQ message.

14.5.6.4.5.4 Effect of receipt

The QoS management entity in NCMS shall respond to this primitive by sending Change_Service_Flow.confirm. The management entity for service flows checks the validity of the request from the point of view of its own resources.

14.5.6.4.6 Change_Service_Flow.confirm (CSF.confirm)

14.5.6.4.6.1 Function

This primitive is used by the QoS management entity in NCMS to response the CSF.request from a MS. Service flow information in CSF response have approved QoS information if the CSF request is accepted.

14.5.6.4.6.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Change_Service_Flow.confirm
(
Transaction ID
Service flow ID
Service flow information
CS parameter information
Service flow error parameter information
)

Transaction ID

A unique sequential identifier of the transaction set by the BS

Service flow ID

Unique identifier to identify a service flow

Service flow information

Approved complete QoS information of a service flow such as service class name, QoS parameter set type, maximum sustained traffic rate, maximum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, tolerate jitter and maximum latency

CS parameter information

Approved IP filter rules of a service flow such as packet classification rule and IPv6 flow label

Service flow error parameter information

Failed reason and every specific failed QoS parameter if the request is rejected

14.5.6.4.6.3 When generated

This primitive is generated when the QoS management entity in NCMS responds to Change_Service_Flow.request primitive.

14.5.6.4.6.4 Effect of receipt

This primitive informs the result of the service flow modification of a BS. A BS receiving the primitive shall transmit DSC-RSP message following the information provided by this message.

14.5.6.4.7 Change_Service_Flow.indication (ASF.indication)

14.5.6.4.7.1 Function

This primitive is used by the QoS management entity in NCMS to inform QoS information. Service flow information is included in CSF.indication of a BS.

14.5.6.4.7.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Change_Service_Flow.indication
(
Transaction ID
MS ID,
Service flow ID
Service flow information
CS parameter information
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
MS ID
48-bit unique identifier used by MS.
Service flow ID
Unique identifier to identify a service flow
Service flow information
Approved complete QoS information of a service flow such as service class name, QoS parameter set type, maximum sustained traffic rate, maximum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, tolerate jitter and maximum latency
CS parameter information
Approved IP filter rules of a service flow such as packet classification rule and IPv6 flow label

14.5.6.4.7.3 When generated

This primitive is generated when the QoS management entity in NCMS informs QoS information of a BS.

14.5.6.4.7.4 Effect of receipt

A BS receiving the primitive shall transmit DSC-REQ message following the information provided by this message.

14.5.6.4.8 Change_Service_Flow.response (CSF.response)

14.5.6.4.8.1 Function

This primitive is used by a BS to respond the CSF.indication to the QoS management entity in NCMS.

14.5.6.4.8.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Change_Service_Flow.response
(
Transaction ID
Service flow ID
Service flow information
CS parameter information
Service flow error parameter information
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
Service flow ID
Unique identifier to identify a service flow
Service flow information
Approved complete QoS information of a service flow such as service class name, QoS parameter set type, maximum sustained traffic rate, maximum traffic burst, minimum reserved traffic rate, minimum tolerable traffic rate, tolerate jitter and maximum latency
CS parameter information
Approved IP filter rules of a service flow such as packet classification rule and IPv6 flow label
Service flow error parameter information
Failed reason and every specific failed QoS parameter if a CSF request is rejected

14.5.6.4.8.3 When generated

This primitive is generated when a BS receives a DSC-RSP message.

14.5.6.4.8.4 Effect of receipt

This primitive informs the result of the service flow creation of the QoS management entity in NCMS.

14.5.6.4.9 Delete_Service_Flow.request (DSF.request)

14.5.6.4.9.1 Function

This primitive is used by a BS to inform QoS information from an MS of the QoS management entity in NCMS.

14.5.6.4.9.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Delete_Service_Flow.request
(
Transaction ID
Service flow ID
)

Transaction ID
A unique sequential identifier of the transaction set by the BS

Service flow ID
Unique identifier to identify a service flow

14.5.6.4.9.3 When generated

This primitive is generated when a BS receives a DSD-REQ message.

14.5.6.4.9.4 Effect of receipt

The QoS management entity in NCMS shall respond to this primitive by sending Delete_Service_Flow.confirm. The management entity for service flows delete assigned resources for service flow ID.

14.5.6.4.10 Delete_Service_Flow.confirm (DSF.confirm)

14.5.6.4.10.1 Function

This primitive is used by the QoS management entity in NCMS to response the DSF.request from a MS.

14.5.6.4.10.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Delete_Service_Flow.confirm
(
Transaction ID
Service flow ID
Service flow error parameter information
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
Service flow ID
Unique identifier to identify a service flow
Service flow error parameter information
Failed reason and every specific failed QoS parameter if a DSF request is rejected

14.5.6.4.10.3 When generated

This primitive is generated when the QoS management entity in NCMS responds to Delete_Service_Flow.request primitive.

14.5.6.4.10.4 Effect of receipt

This primitive informs the result of the service flow deletion to a BS. A BS receiving the primitive shall transmit DSD-RSP message following the information provided by this message.

14.5.6.4.11 Delete_Service_Flow.indication (DSF.indication)

14.5.6.4.11.1 Function

This primitive is used by the QoS management entity in NCMS to inform QoS information. Service flow ID is included in DSF.indication of a BS.

14.5.6.4.11.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Delete_Service_Flow.indication
(
Transaction ID
Service flow ID
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
Service flow ID
Unique identifier to identify a service flow

14.5.6.4.11.3 When generated

This primitive is generated when the QoS management entity in NCMS informs QoS information of a BS.

14.5.6.4.11.4 Effect of receipt

A BS receiving the primitive shall transmit DSD-REQ message following the information provided by this message.

14.5.6.4.12 Delete_Service_Flow.response (DSF.response)

14.5.6.4.12.1 Function

This primitive is used by a BS to respond the DSF.indication to the QoS management entity in NCMS.

14.5.6.4.12.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Delete_Service_Flow.response
(
Transaction ID
Service flow ID
Service flow error parameter information
)

Transaction ID
A unique sequential identifier of the transaction set by the BS
Service flow ID
Unique identifier to identify a service flow
Service flow error parameter information

Failed reason and every specific failed QoS parameter if a DSF request is rejected

14.5.6.4.12.3 When generated

This primitive is generated when a BS receives a DSD-RSP message.

14.5.6.4.12.4 Effect of receipt

This primitive informs the result of the service flow deletion of the QoS management entity in NCMS. The QoS management entity in NCMS deletes assigned resources for service flow ID.

14.5.6.5 Managing Connection Resources

<Section Note: Managing constraints on the CID and SFID related resources. Recommendations on when CIDs could be recycled etc.>

14.5.6.6 Managing Multicast Broadcast Services

<Section Note: >

14.5.7 Subscriber Mode Management

The following informative subsection describes subscriber mode management.

14.5.7.1 Managing Device States

In Normal Operation, an MS transmits and receives packets to/from a BS. Currently, two subscriber modes are defined, i.e., Sleep and Idle Modes. Sleep Mode is intended to minimize an MS power usage and decrease usage of serving BS air interface resources by pre-negotiated periods of absence from the serving BS air interface. Idle Mode allows an MS to become periodically available for DL broadcast traffic without registration at a specific BS as the MS traverses an air link environment populated by multiple BSs, and thus, allows the MS to conserve power and operational resources.

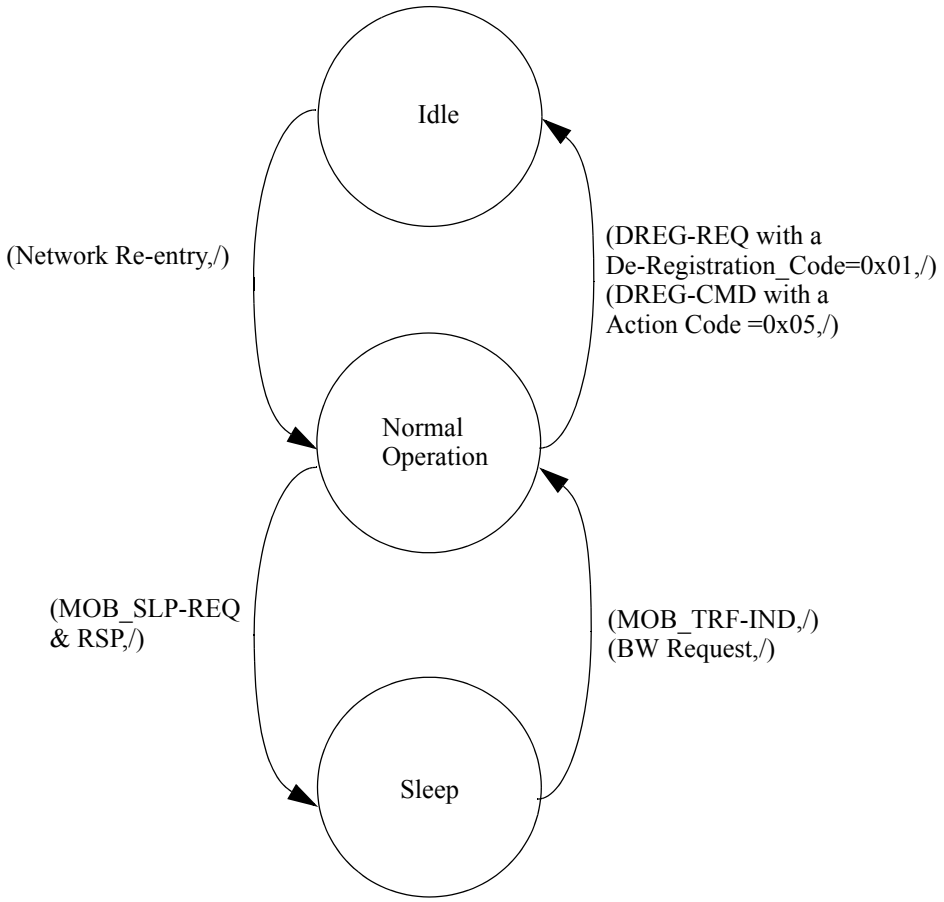


Figure 321—Subscriber Mode transition diagram at MS and BS

Sleep Mode operation is defined between an MS and a BS only, and an NCMS does not need to manage Sleep Mode of subscriber. Thus, both an MS and a BS manage all Normal Operation, Sleep Mode, and Idle Mode of subscriber. On the other hand, an NCMS manages Normal Operation and Idle Mode. In this contribution, Subscriber Mode transitions at an MS, a BS, and an NCMS are modeled and described, as shown in Figure 321 and Figure 322.

Figure 321 shows Subscriber Mode transition diagram at both an MS and a BS. Subscriber Mode at both an MS and a BS changes from Normal Operation to Idle Mode when the MS issues an MS De-registration Request (DREG-REQ) message with De-Registration_Request_Code=0x01 or the BS issues an De-register Command (DREG-CMD) message with Action Code = 0x05. Then, the MS stays at Idle Mode and updates its location when the paging group changes. The Subscriber Mode returns back to Normal Operation from Idle Mode after completing Network re-entry. Transition from Normal Operation to Sleep Mode is performed after an MS successfully exchanges Sleep Request (MOB_SLP-REQ) and Sleep Response (MOB_SLP-RSP) messages with a BS. If there is any DL traffic toward an MS from a BS, MOB_TRF-IND is broadcast to the MS from the BS and Subscriber Mode of the MS and the BS changes from Sleep Mode to Normal Operation. If there is any UL traffic from an MS, Bandwidth Request (BW Request) is sent to the serving BS from the MS and Subscriber Mode of the MS and the BS changes from Sleep Mode to Normal Operation, too.

Figure 322 shows Subscriber Mode transition diagram at an NCMS with service primitives related with the Subscriber Mode transition. Subscriber Mode transition from Normal Operation to Idle Mode is performed

by exchanging Idle_mode_initiation.request and Idle_mode_initiation.response between a BS and an NCMS after successful DREG-REQ message with De-Registration_Request _Code=0x01 or DREG-CMD message with Action Code = 0x05 between an MS and a BS, where Idle_mode_initiation.request and Idle_mode_initiation.response are defined in 14.5.11.1 and 14.5.11.2, respectively. Subscriber Mode transition from Idle Mode to Normal Operation is initiated after exchanging Paging_announce, Idle_ReEntry.indication, and Idle_ReEntry.confirmation between a BS and an NCMS, where Paging_announce, Idle_ReEntry.indication, and Idle_ReEntry. confirmation are defined in 14.5.11.3, 14.5.11.4, and 14.5.11.5, respectively.

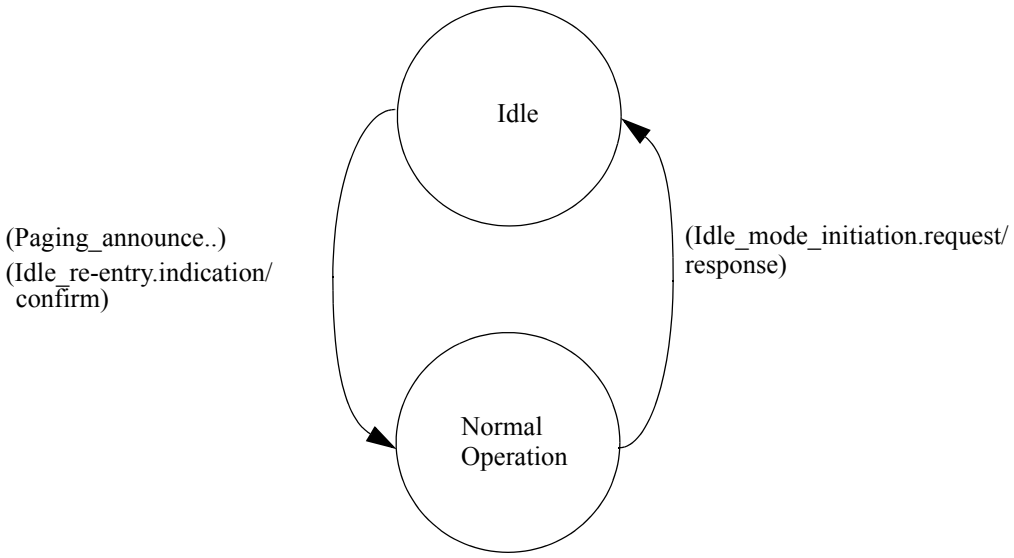


Figure 322—Subscriber Mode transition diagram at NCMS

14.5.7.2 Idle Mode Service Primitives

14.5.7.2.1 Idle_Mode_Initiation.request

14.5.7.2.1.1 Function

This primitive is issued by BS to inform a management entity of Paging Services in NCMS that an MS requests to initiate Idle Mode.

14.5.7.2.1.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Idle_Mode_Initiation.request
(
MS MAC Address
Paging_Cycle_Request
Idle Mode Retain Information
MAC Hash Skip Threshold
Service Flow parameters
Service and operational information

)

MS MAC Address
48-bit MAC Address which will identify MS during Idle Mode
Paging_Cycle_Request
Paging Cycle requested by MS
Idle Mode Retain Information
MS request for Paging Controller retention of network re-entry related MAC management message and MS service and operational information to expedite future Network Re-entry from Idle Mode. (see 6.3.2.3.42.)
MAC Hash Skip Threshold
Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS individual notification for an MS, including MS MAC Address Hash of an MS for which Action Code is 0b00, 'No Action Required'.
Service Flow parameters
Parameters for Service Flow which exists without actually being activated to carry traffic at MS Idle Mode Initialization, e.g. Paging Preference.
Service and operational information
MS service and operational information associated with MAC state machines, CS classifier information, etc.

14.5.7.2.1.3 When generated

This primitive is generated when a BS receives a DREG-REQ message with Deregistration_Request_Code=0x01, "request for MS De-Registration from serving BS and initiation of MS Idle Mode.

14.5.7.2.1.4 Effect of receipt

This primitive shall be generated on BS side and a management entity of Paging Services shall respond to this primitive by sending Idle_Mode_Initiation.response.

14.5.7.2.2 Idle_Mode_Initiation.response

14.5.7.2.2.1 Function

This primitive is issued by a management entity in Paging Services in NCMS to respond to Idle_Mode_Initiation.Request.

14.5.7.2.2.2 Semantics of the Service Primitive

The parameters of the primitives are as follows:

Idle_Mode_Initiation.response
(
Action code
MS MAC Address
Paging Information
Paging Controller ID
Idle Mode Retain Information
MAC Hash Skip Threshold
REQ-duration
)

Action code
Indicates the value of Action code to be included in DREQ-CMD message. (see Table 55.)
MS MAC Address
48-bit MAC Address which will identify MS during Idle Mode
Paging Information
Paging Group ID, Paging Cycle, and Paging Offset parameters followed by MS in Idle Mode.
Paging Controller ID
A logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administrating paging activity for the MS while in Idle Mode. Paging Controller ID shall be set to BS ID when a BS is acting as Paging Controller.
Idle Mode Retain Information
MS request for Paging Controller retention of network re-entry related MAC management message and MS service and operational information to expedite future Network Re-entry from Idle Mode. (see 6.3.2.3.42.)
MAC Hash Skip Threshold
Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS individual notification for an MS, including MS MAC Address Hash of an MS for which Action Code is 0b00, 'No Action Required'.
REQ-duration
Waiting value for the DREG-REQ message re-transmission (measured in frames).

14.5.7.2.2.3 When generated

This primitive is generated to request a BS to issue a DREG-CMD message.

14.5.7.2.2.4 Effect of receipt

A BS receiving Idle_Mode_Initiation.response shall transmit DREG-CMD message with setting each field in accordance with the information elements in this primitive.

14.5.7.2.3 Paging_Announce

14.5.7.2.3.1 Function

This primitive is issued by a management entity of Paging Services in NCMS to request a BS to page an MS which is supposed to be in Idle Mode by transmitting MOB_PAG-ADV message including the MS MAC Address Hash and relevant Action Code.

14.5.7.2.3.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Paging_Announce
(
MS MAC Address
Paging Information
Action Code
)

MS MAC Address
48-bit MAC Address which will identify MS during Idle Mode
Paging Information
Paging Group ID, Paging Cycle, and Paging Offset parameters followed by MS in Idle Mode.
Action Code

Action required for MS in Idle Mode (e.g. Network Re-entry, ranging for location update, and so on)

14.5.7.2.3.3 When generated

This primitive is generated by a management entity of Paging Services to request a BS to transmit BS Broadcast Paging message.

14.5.7.2.3.4 Effect of receipt

A BS receiving Paging_Announce shall transmit MOB_PAG-ADV message following the information provided by this primitive.

14.5.7.2.4 Idle_ReEntry.indication

14.5.7.2.4.1 Function

This primitive is issued by a BS to inform a management entity of Paging Services that the specified MS is attempting to re-enter network in response to paging.

14.5.7.2.4.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Idle_ReEntry.indication
(
MS MAC Address
Paging Information
Paging Controller ID
BS ID
)

MS MAC Address
48-bit MAC Address which will identify MS during Idle Mode

Paging Information
Paging Group ID, Paging Cycle, and Paging Offset parameters followed used by MS in Idle Mode.

Paging Controller ID
A logical network identifier for the serving BS or other network entity retaining MS service and
operational information and/or administrating paging activity for the MS while in Idle Mode. Paging Controller ID shall be set to BS ID when a BS is acting as Paging Controller.

BS ID
A network identifier of the BS at which the MS is attempting to re-enter network

14.5.7.2.4.3 When generated

This primitive is generated by a BS when it receives a RNG-REQ message including Ranging Purpose Indication with setting bit #0 to 1 in combination with Paging Controller ID.

14.5.7.2.4.4 Effect of receipt

Idle_ReEntry.indication notifies a management entity of Paging Services that the specified MS is attempting to re-enter network through the specified BS in order to receive DL traffic. The management entity also

checks MS service and operational information for the MS, and transmits Idle_ReEntry.confirmation in response to this primitive.

14.5.7.2.5 Idle_ReEntry.confirmation

14.5.7.2.5.1 Function

This primitive is issued by a management entity of Paging Services to confirm the MS Network Re-entry from Idle Mode and provides the BS at which the MS is attempting to re-enter network with service and operational information.

14.5.7.2.5.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Idle_ReEntry.confirmation
(
MS MAC Address
Service and operational information
)

MS MAC Address
48-bit MAC Address which will identify MS during Idle Mode
Service and operational information
MS service and operational information associated with MAC state machines, CS classifier information, etc.

14.5.7.2.5.3 When generated

This primitive is generated by BS when a RNG-REQ message including Ranging Purpose Indication with setting bit #0 to 1 in combination with Paging Controller ID.

14.5.7.2.5.4 Effect of receipt

BS receiving Idle_ReEntry.confirmation transmits RNG-RSP message including HO Process Optimization which is based on the service and operational information in this primitive.

14.5.7.2.6 Idle_ReEntry_Complete

14.5.7.2.6.1 Function

This primitive is issued by a BS to inform a management entity of Paging Services that an MS has re-entered network successfully.

14.5.7.2.6.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Idle_ReEntry.confirmation
(
MS MAC Address
Paging Controller ID
BS ID
)

MS MAC Address
48-bit MAC Address which will identify MS during Idle Mode
Paging Controller ID
A logical network identifier for the serving BS or other network entity retaining MS service and
operational information and/or administrating paging activity for the MS while in Idle Mode. Paging Controller ID shall be set to BS ID when a BS is acting as Paging Controller.
BS ID
A network identifier of the BS at which the MS is attempting to re-enter network

14.5.7.2.6.3 When generated

This primitive is generated by a BS when Network Re-entry process specified in 6.3.22.10 has been completed.

14.5.7.2.6.4 Effect of receipt

The buffered DL traffic is delivered to the serving BS and finally to MS.

14.5.8 Roaming Management

14.5.9 Mobility and Handover Management

14.5.9.1 Mobility Parameters

<Section Note: Requirements for different kinds of handoff (Hard-Handoff, FBSS, SHO). Thresholds etc.>

14.5.9.1.1 Handover Context for Connections

Handover context for connections is the set of information which is shared between the serving BS and the target BS for re-establishment of the transport connections during HO. HO context is consisted of the following information.

General MS Information
It is the information required to identify the MS. IP address and MAC address of the MS can be included in this information.
MS Capability Information
It is the information about MS capabilities which need to be negotiated with the serving BS at the initial network entry.
Security Information
It is the information negotiated during PKM procedure. If the MS and the target BS can derive the AK for them without the help of the serving BS, AK key may be excluded from this information.
Service Flow Information
It is the information negotiated during DSx-related procedure.
MAC state Information
It is the information used to maintain MAC state machine and to manage MAC PDU transmission.

For the re-establishment of connections at target BS during HO, serving BS shall provide target BS with the HO context through the mobility management entity in NCMS using HO primitives. If the target BS can not re-use some information in the HO context for restoring the former MAC state or re-establishing connections, the mobility management entity in NCMS may exclude the information from the shared HO context.

14.5.9.1.2 Neighbor BS List Management

14.5.9.1.2.1 Primitives for managing Neighbor BS List

14.5.9.1.2.1.1 NBR_BS_Update.request

14.5.9.1.2.1.1.1 Function

This primitive is issued by a mobility management entity in NCMS to inform BS of neighbor BS list and channel information for those neighbor BSs.

14.5.9.1.2.1.1.2 Semantics of the service primitive

The parameters of the primitive are as follow:

NBR_BS_Update.request
(
Number of neighbor BSs,
List of neighbor BS information
)
Number of neighbor BSs
The number of the current active neighbor BSs
List of neighbor BS information
This parameter includes channel information for neighbor BSs. BS ID and UCD/DCD parameters per each neighbor BS may be included in this parameter

14.5.9.1.2.1.1.3 When generated

This primitive is generated when the mobility management entity in NCMS recognizes that initialization of BS is completed or there are some changes in neighbor BS list or in channel information of one of neighbor BSs.

14.5.9.1.2.1.1.4 Effect of receipt

A BS receiving NBR_BS_Update.request shall update internal information about neighbor BSs and adopt the information into subsequent MOB_NBR-ADV messages. The BS also shall response to this primitive by sending NBR_BS_update.response.

14.5.9.1.2.1.2 NBR_BS_Update.response

14.5.9.1.2.1.2.1 Function

This primitive is issued by BS to response to NBR_BS_Update.request.

14.5.9.1.2.1.2.2 Semantics of the service primitive

The parameters of the primitive are as follow:

NBR_BS_Update.response
(
Result
)

14.5.9.1.2.1.2.3 When generated

This primitive is generated when BS receives NBR_BS_Update.request.

14.5.9.1.2.1.2.4 Effect of receipt

The mobility management entity in NCMS shall inform the neighbor BS of the updating result.

14.5.9.1.2.1.3 NBR_BS_Update.indication

14.5.9.1.2.1.3.1 Function

This primitive is issued by BS to inform the mobility management entity in NCMS of changes in UCD and DCD.

14.5.9.1.2.1.3.2 Semantics of the service primitive

The parameters of the primitive are as follow:

NBR_BS_Update.indication
(
DCD configuration change count,
UCD configuration change count,
DCD parameters,
UCD parameters
)

14.5.9.1.2.1.3.3 When generated

This primitive is generated when one or more parameters in DCD and UCD are changed to inform mobility management entity of such changes.

14.5.9.1.2.1.3.4 Effect of receipt

If mobility management entity in NCMS receives this primitive, it shall inform neighbor BSs of those changes.

14.5.9.1.2.1.4 NBR_BS_Update.confirmation

14.5.9.1.2.1.4.1 Function

This primitive is issued by mobility management entity in NCMS to respond to NBR_BS_Update.indication.

14.5.9.1.2.1.4.2 Semantics of the service primitive

The parameters of the primitive are as follow:

NBR_BS_Update.confirmation
(
Result
)

14.5.9.1.2.1.4.3 When generated

This primitive is generated when mobility management entity receives NBR_BS_Update.indication.

14.5.9.1.2.1.4.4 Effect of receipt

If the value of result field in NBR_BS_Update.confirmation is not success, then BS shall retransmit NBR_BS_Update.indication within pre-defined number of times.

14.5.9.1.3 Connection Management during handover

14.5.9.2 Paging Management

14.5.9.2.1 Paging Group Management

14.5.9.2.1.1 Paging Group Management Procedure

The location information of an idle MS is managed by the unit of Paging Group in Paging Service of an NCMS, and paging messages are sent to all the BSs within the called MS's Paging Group. The NCMS should divide the whole service area into multiple Paging Groups and notify this Paging Group information to all the BSs within the service area, where a BS may be a member of one or more Paging Groups. In this contribution, we propose service primitive for Paging Group Action which is exchanged through Management Service Access Point (M-SAP) of Management Plane specified in IEEE 802.16g baseline document. Paging Group Action is performed by Paging Service of an NCMS, as shown in Fig. 2

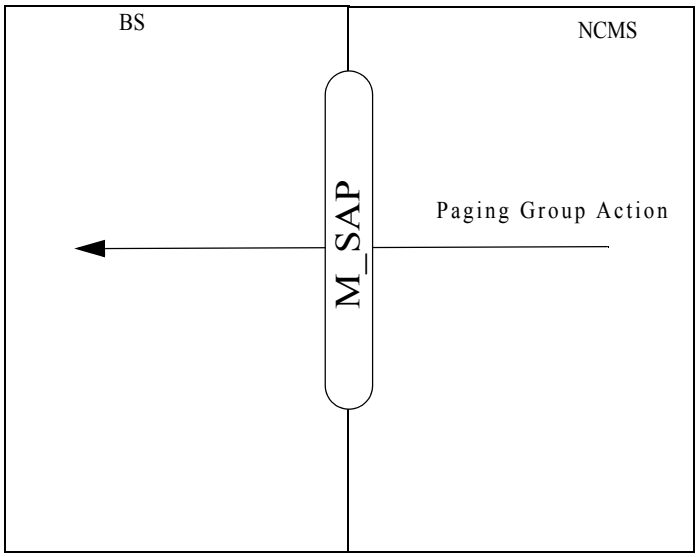


Figure 323—ASF indication and ASF response primtives flow

14.5.9.2.1.2 Service Primitive for Paging Group Management

14.5.9.2.1.2.1 Paging Group Action

14.5.9.2.1.2.1.1 Function

This primitive is issued by an NCMS to inform a BS of Paging Group ID(s) of the BS.

14.5.9.2.1.2.1.2 Semantics of the service primitive

The parameter of the primitive is as follows:

Paging Group Action
(
Paging Controller ID
Number of Paging Group IDs
Paging Group ID List
)

Paging Controller ID
The Paging Controller ID is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administering paging activity for the MS while in Idle Mode.

Number of Paging Group IDs
The number of Paging Group IDs in this primitive.

Paging Group ID List
List of Paging Group IDs of a BS (eg, Paging Group ID1, Paging Group ID2, … , Paging Group IDn)

14.5.9.2.1.2.1.3 When generated

This primitive is generated when an NCMS initializes or updates paging group configuration information and notifies the information to a BS.

14.5.9.2.1.2.1.4 Effect of receipt

When the BS receives this primitive, it updates its Paging Group ID information according to the delivered Paging Group ID List, and broadcasts the updated Paging Group ID information in MOB_NBR-ADV, DREG-CMD, MOB_PAG-ADV, DCD, RNG-RSP messages.

14.5.9.2.2 Paging Procedure

14.5.9.3 Location Management

14.5.9.3.1 Location Update Procedure

Location management of an MS is performed by mobility management service of an NCMS. An MS in idle mode performs Location Update in order to inform an NCMS of its current location information, i.e., paging group, and this information is used to page cells within paging group of the called MS when there is pending DL traffic toward the MS.

Location Update is performed if any of Location Update conditions is met and there are currently four Location Update conditions defined: Zone Update, Timer Update, Power Down Update, and MAC Hash Skip Threshold Update. In Zone Update, the MS shall perform Location Update process when the MS detects a change in paging group by comparing the paging group identifier, PG_ID, stored in the MS with that of transmitted by the preferred BS in the DCD message or MOB_PAG-ADV broadcasting message. In Timer Update, MS shall periodically perform Location Update process prior to the expiration of the idle mode timer. In Power Down Update, the MS shall attempt to complete a Location Update once as part of its orderly power down procedure. In MAC Hash Skip Threshold update, the MS shall perform Location Update process when the MS MAC hash skip counter exceeds MAC hash skip threshold.

All the above Location Updates are realized by Ranging request/response (RNG-REQ/RSP) message between an MS and a BS, and Location Update request and Location Update response service primitives are defined between a BS and an NCMS to perform Location Update.

Figure 324 shows service primitives for Location Update between a BS and an NCMS.

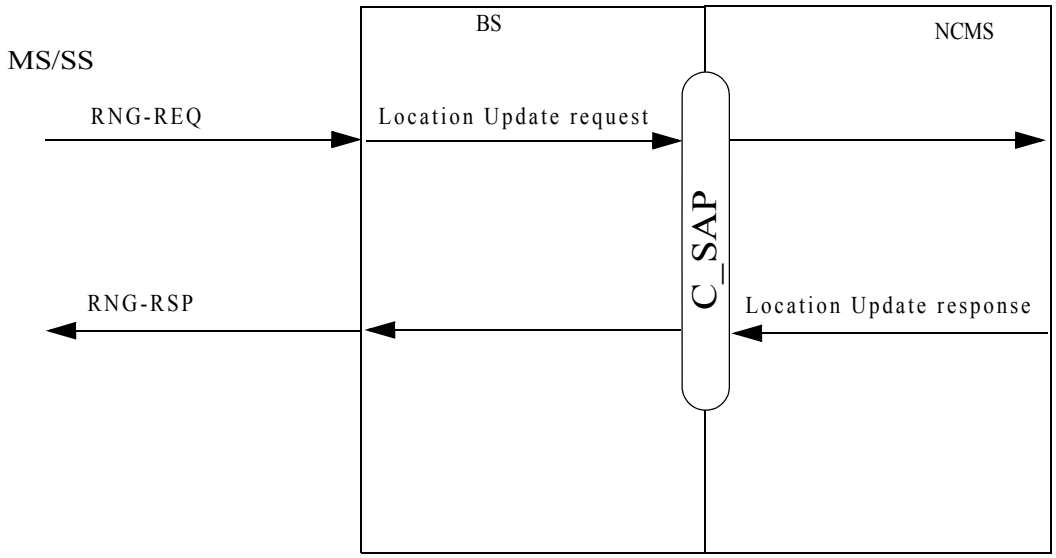


Figure 324— Location Update Primitives

14.5.9.3.2 Service Primitives for Location Update

14.5.9.3.2.1 Location Update request

14.5.9.3.2.1.1 Function

This primitive is issued by a BS to inform a management entity of Mobility Management Services in an NCMS that an MS requests to initiate Location Update.

14.5.9.3.2.1.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Location Update request
(
MS MAC Address
BS ID
Paging Controller ID
Paging Group ID
MAC Hash Skip Threshold
Power Down Indicator
)

MS MAC Address
48-bit MAC address which will identify MS
BS ID
Identifier of serving BS
Paging Controller ID
The Paging Controller ID is a logical network identifier for the serving BS or other network

entity retaining MS service and operational information and/or administering paging activity for the MS while in Idle Mode.

Paging Group ID

One or more logical affiliation groupings of BS

MAC Hash Skip Threshold

Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS without individual notification for an MS, including MAC address hash of an MS for which Action Code is 00, 'No Action Required'.

Power Down Indicator

Indicates the MS is currently attempting to perform Location Update due to power down.

14.5.9.3.2.1.3 When generated

This primitive is generated when the BS receives RNG-REQ message with Paging Controller ID and Ranging Purpose Indication with bit #1 set to 1, MAC Hash Skip Threshold, or Power Down Indicator.

14.5.9.3.2.1.4 Effect of receipt

This primitive shall be generated on BS side and a management entity of Mobility Management Services shall respond to this primitive by sending Location Update response.

14.5.9.3.2.2 Location Update response

14.5.9.3.2.2.1 Function

This primitive is issued by the NCMS to respond to Location Update request from the BS

14.5.9.3.2.2.2 Semantics of the service primitive

The parameters of the primitives are as follows:

Location Update response
(
MS MAC Address
Location Update Result
Paging Information
Paging Controller ID
MAC Hash Skip Threshold
Power Down Response
)

MS MAC Address

48-bit MAC address which will identify MS

Location Update Result

Response to Location Update Request:

0b00=Failure of Idle Mode Location Update. The MS shall perform Network Re-entry from Idle Mode

0b01=Success of Idle Mode Location Update

0b10, 0b11: Reserved

Paging Information

New Paging Information assigned to MS. Paging Information shall only be included if Location Update Response=0x01 and if Paging Information has changed. The Paging Information TLV defines the Paging Group ID, PAGING_CYCLE and PAGING OFFSET parameters to be

used by the MS in IDLE mode. PAGING_CYCLE is the cycle in which the paging message is transmitted within the paging group. PAGING OFFSET determines the frame within the cycle in which the paging message is transmitted and it must be smaller than PAGING CYCLE value. Paging Group ID specifies the paging group the MS is assigned to.

Paging Controller ID

Paging Controller ID is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administering paging activity for the MS while in Idle Mode. Paging Controller ID shall only be included if Location Update Response=0x01 and if Paging Controller ID has changed.

MAC Hash Skip Threshold

Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS without individual notification for an MS, including MAC address hash of an MS for which Action Code for the MS is 00,'No Action Required'. If BS does not include this TLV item in the RNG-RSP message, any BS may omit MAC Address Hash of the MS with Action Code 00,'No Action Required' from any MOB_PAG-ADV message.

Power Down Response

Indicates the MS's Power Down Location Update result.

0x00= Failure of Power Down Information Update.

0x01= Success of Power Down Information Update.

14.5.9.3.2.2.3 When generated

This primitive is generated at an NCMS in order to request a BS to issue a RNG-RSP message.

14.5.9.3.2.2.4 Effect of receipt

A BS receiving Location Update response shall transmit RNG-RSP message with the appropriate parameters settings.

14.5.9.4 MS Handover Management

<Section Note: How an MS handles its handover functions>

14.5.9.5 Inter BS Handover Management

<Section Note: How a BS handles its handover functions with neighboring BSes>

14.5.9.6 Macro Diversity Management

<Section Note: How a BS along with the NCMS entities handles macro diversity>

14.5.9.7 Handover Control Protocol Procedures

14.5.9.7.1 HO Control Primitives

The HO Control Primitives are a set of primitives for supporting HO procedure between BS and NCMS. They are defined for access to the Mobility Control entity to support handovers.

14.5.9.7.1.1 HO request

This primitive is used by a serving BS to inform the mobility control entity in NCMS of an incoming HO request from an MS. The following parameters are included in this primitive.

Serving BS ID
Base station unique identifier (Same number as that broadcasted on the DL-MAP message).
MS ID
48-bit unique identifier used by MS.
HO Type
Indication of HO types; HO or SHO/FBSS.
Mode
Various modes in Anchor BS update or Active Set Update.
Candidate target BS list
This is the list of BSes which are recommended for a target BS or an active BS by the MS. Additional HO quality information such as Service Level Prediction also can be included in this list.
Service flow Information
Information of all the service flows that have been established between the MS and the serving BS.
CS parameter information
Approved IP filter rules of a service flow such as packet classification rule and IPv6 flow label.

14.5.9.7.1.2 HO indication

This primitive is used by the mobility control entity in NCMS to inform target BSes of the pending HO. It delivers the following parameters.

Serving BS ID
Base station unique identifier (Same number as that broadcasted on the DL-MAP message)
MS ID
48-bit unique identifier used by MS
HO Type
Indication of HO types; HO or SHO/FBSS
Mode
Various modes in Anchor BS update or Active Set Update
Service flow Information
Information of all the service flows that have been established between the MS and the serving BS
HO Quality Information
Information related with quality of HO procedure; Service Level Prediction, HO Optimization Flag, Arrival Time Difference, etc.
CS parameter information
Approved IP filter rules of a service flow such as packet classification rule and IPv6 flow label

14.5.9.7.1.3 HO response

The Mobility Control entity in NCMS responds to the serving BS with the list of recommended target BSes. This primitive is always sent in reply to the HO request primitive.

The following parameters are included in this primitive.

MS ID
48-bit unique identifier used by MS
HO Type
Indication of HO types; HO or SHO/FBSS
Mode
Various modes in Anchor BS update or Active Set Update
Recommended target BS list

The list must be a subset of the candidate target BS list from the corresponding HO request. The recommended target BS list is to be delivered to the MS in the MOB_BSHO-RSP. The BSes in the list may be the candidate target BSes for HO or an Anchor BS or Active BSes for SHO/FBSS according to the value of HO type and Mode. MS Access Information, Newly Allocation Information, and HO Quality Information can be included in this list

14.5.9.7.1.4 HO confirmation

This primitive is used by the target BS to responds to the HO indication primitive from the serving BS or the mobility control entity in NCMS. It delivers the following parameters.

Target BS ID
Base station unique identifier of the target BS
MS ID
48-bit unique identifier used by MS
Result Flag
HO Type
Indication of HO types; HO or SHO/FBSS
Mode
Various modes in Anchor BS update or Active Set Update
MS Access Information
Information needed by MS to access the target BS; HO ID, CQI CH Information, HO Authorization Policy Information
Newly Allocated Information
Newly allocated information for the MS or each service flow; SAID, CID
HO Quality Information
Information related with quality of HO procedure; HO Optimization Flag, Service Level Prediction

14.5.9.7.1.5 HO start

In case of HO, this primitive is used to indicate the starting of the actual HO. In case of SHO/FBSS, it can be used to update Anchor BS or to add a new Active BS to the current Active set. Both of the serving BS and the mobility control entity in NCMS can use this primitive to inform the target BS or the mobility control entity in NCMS of the starting of the actual HO. The following parameters are included in this primitive.

MS ID
48-bit unique identifier used by MS
HO Type
Indication of HO types; HO or SHO/FBSS
Mode
Various modes in Anchor BS update or Active Set Update
Target BS ID
Base station unique identifier to which the MS attempts the actual HO

14.5.9.7.1.6 HO cancel

In case of HO, this primitive indicates the cancellation of the pending HO. In case of SHO/FBSS, it can be used to cancel anchor BS update or Active set update, or to remove a target BS from the current active set. Both of the serving BS and the mobility control entity in NCMS can use this primitive. This primitive conveys the following parameters.

MS ID
48-bit unique identifier used by MS

HO Type
Indication of HO type; HO and SHO/FBSS
Mode
It is valid for SHO/FBSS and cancels Anchor BS update or Active set update. In addition, it may indicate removal of the target BS from the current active set.

14.5.9.7.1.7 HO Directive

This primitive is generated by the Mobility Control entity in NCMS to induce the handover of a particular MS. Transmission of MOB_BSHO-REQ message is triggered by this primitive.

MS ID
48-bit unique identifier used by MS
HO Type
Indication of HO types; HO or SHO/FBSS
Mode
Various modes in Anchor BS update or Active Set Update
Recommended target BS list
This is the list of recommended target BSes by the mobility control entity. The BSes in the list may be the candidate target BSes for HO or an Anchor BS or Active BSes for SHO/FBSS according to the value of HO type and Mode. MS Access Information, Newly Allocation Information, and HO Quality Information can be included in this list

14.5.9.7.1.8 Scanning.request

14.5.9.7.1.8.1 Function

This primitive is issued by the mobility management entity in NCMS to request radio signal information of MSs.

14.5.9.7.1.8.2 Semantics of the service primitive

The parameters of the primitive are as follow:

Scanning.request
(
Number of MS,
List of MS ID
)
Number of MS
Number of MSs
List of MS ID
The list of MS ID

14.5.9.7.1.8.3 When generated

This primitive is generated when the mobility management entity in NCMS decides that BS-initiated HO should be occurred because the BS is about to be overloaded.

14.5.9.7.1.8.4 Effect of receipt

The BS shall response to the scanning.request primitive using scanning.response primitive.

14.5.9.7.1.9 Scanning.response

14.5.9.7.1.9.1 Function

This primitive is issued by the BS to respond to scanning.request

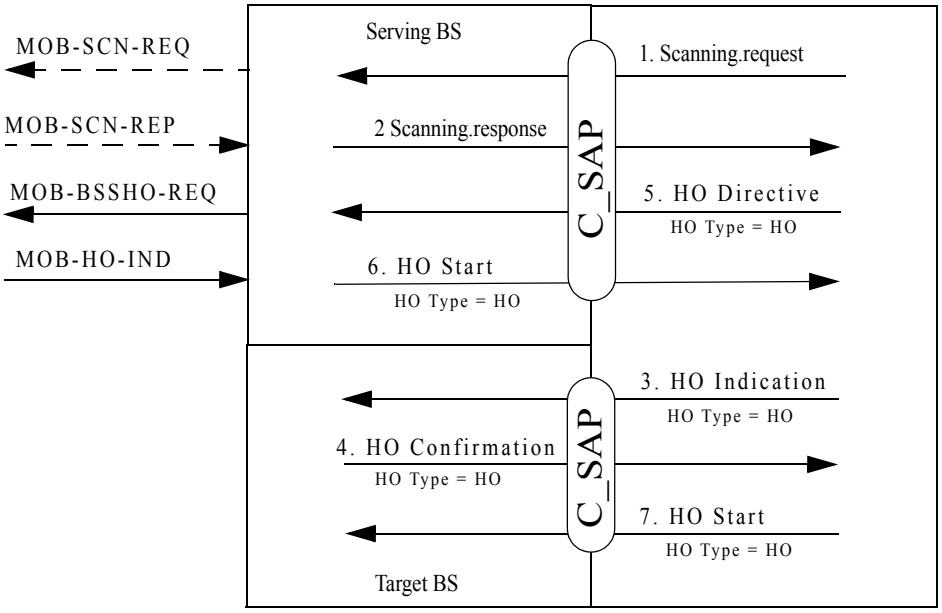


Figure 325—Example Primitive Flow of HO initiated by BS

14.5.9.7.1.9.2 Semantics of the service primitive

The parameters of the primitive are as follows:

Scanning.confirmation
(
Number of MS,
List of MS ID,
List of Signal information
)

Number of MS
Number of MSs
List of MS ID
The list of MS ID

List of Signal Information

TBD.

14.5.9.7.1.9.3 When generated

This primitive is generated when the receives scanning.request

14.5.9.7.1.9.4 Effect of receipt

The mobility management entity in NCMS may decide the specific MS and its potential target BS for BS-initiated HO based on the reported signal quality in the scanning.response primitive.

14.5.9.7.2 Hard Handoff Procedures

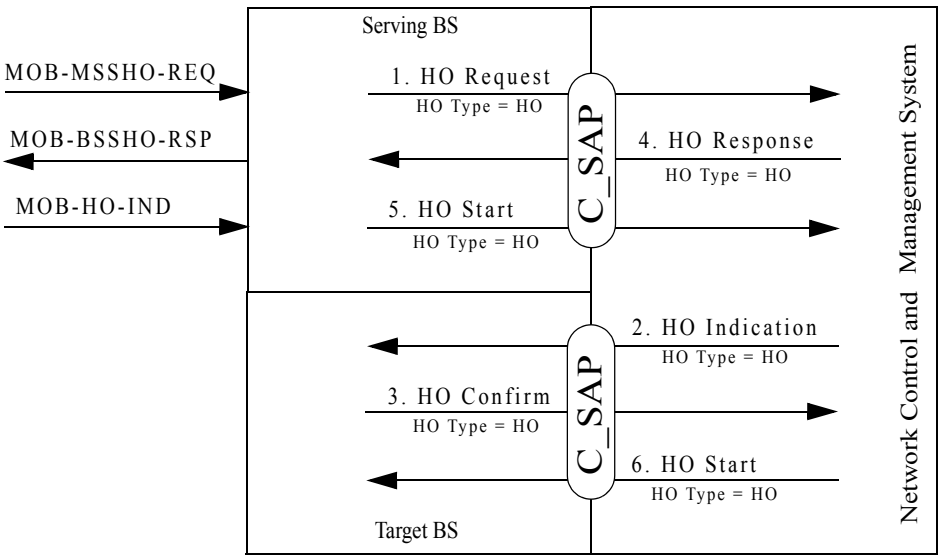


Figure 326—Example Primitive Flow of HO Initiated by MS

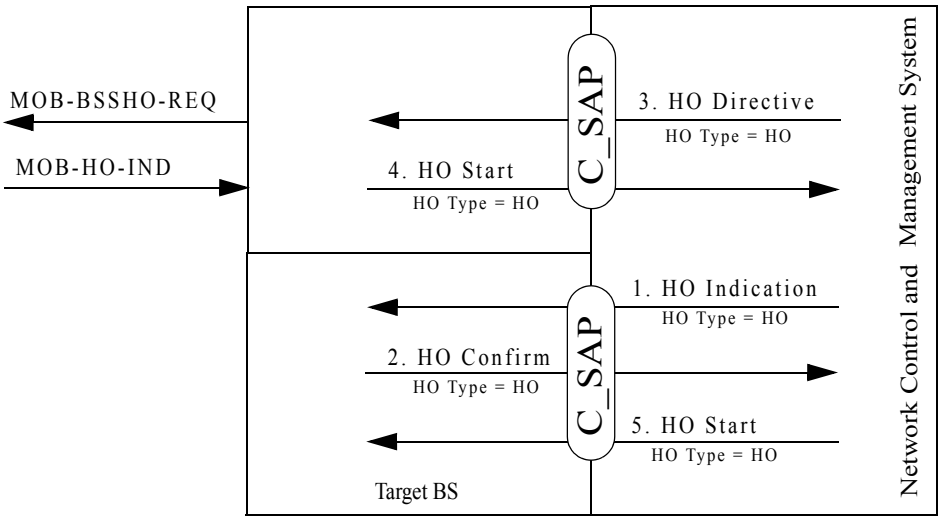


Figure 327—Example Primitive Flow of HO Initiated by BS

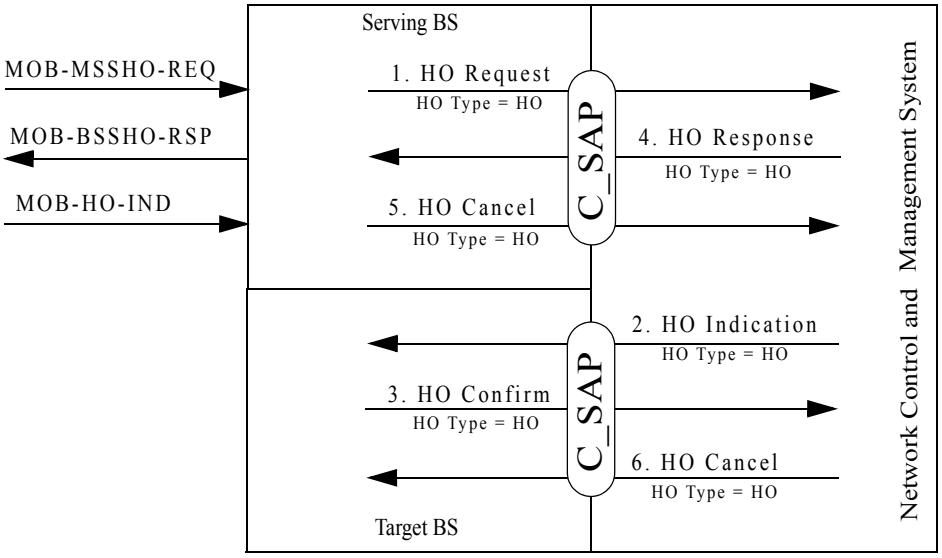


Figure 328—Example Primitive Flow of HO Cancel

14.5.9.7.3 Fast Base Station Switching Procedures

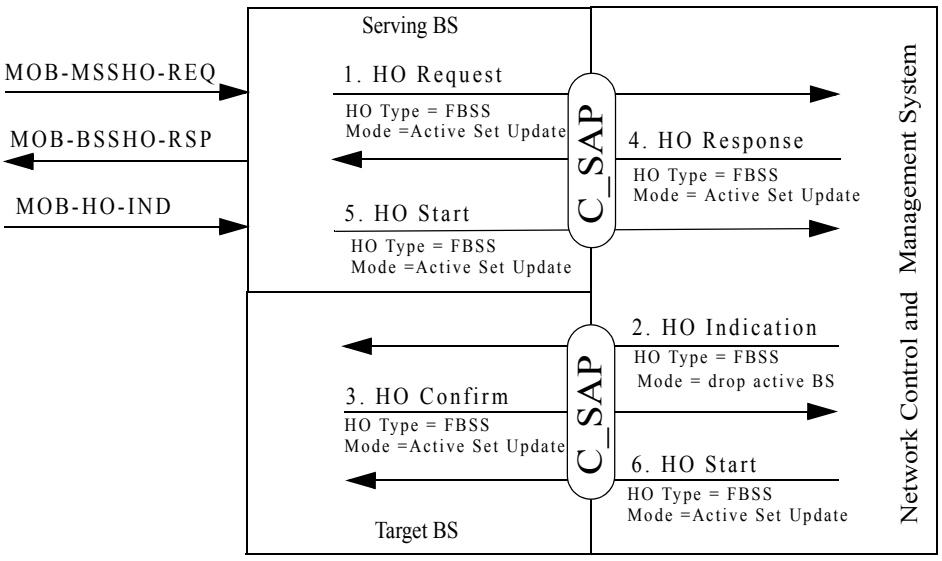


Figure 329—Example Primitive Flow of Active Set Update (Add)

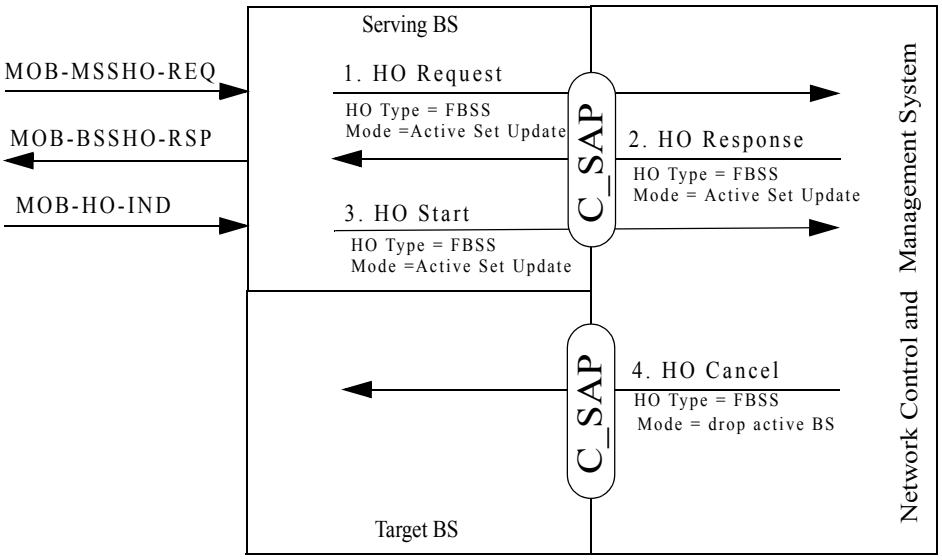


Figure 330—Example Primitive Flow of Active Set Update (Drop)

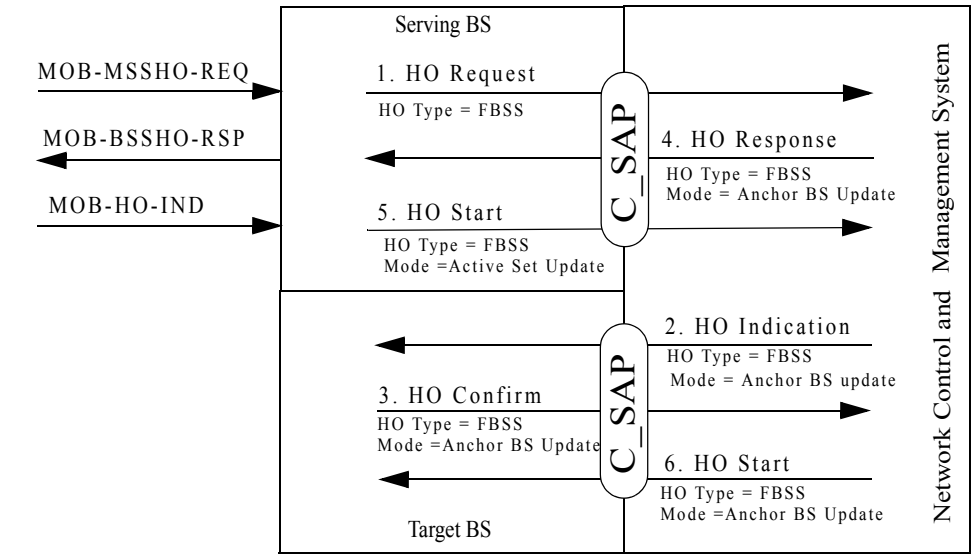


Figure 331—Example Primitive Flow of Anchor BS Update (Using MAC messages)

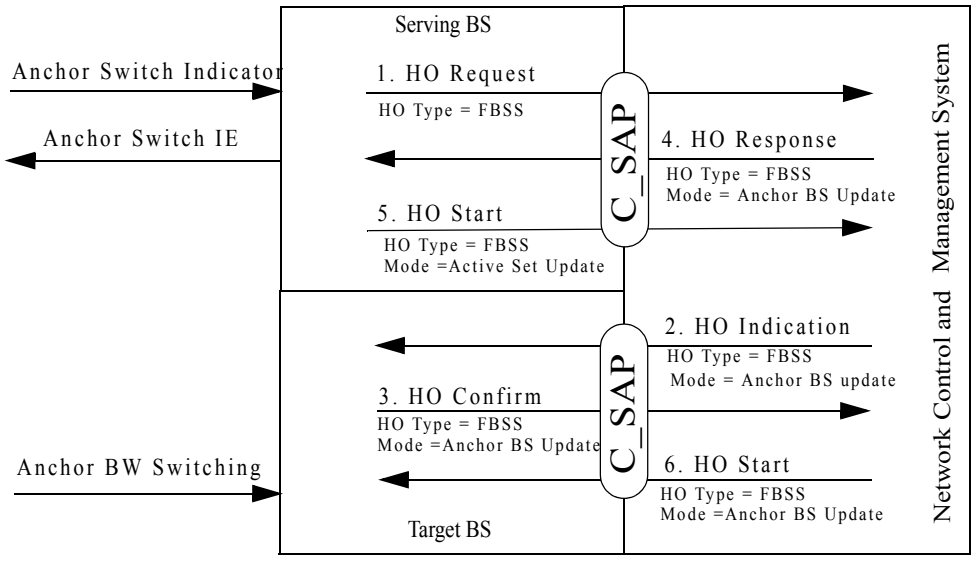


Figure 332—Example Primitive Flow of Anchor BS Update (Using selection feedback mechanism)

14.5.9.7.4 Soft Handoff Procedures

SHO procedures are the same as FBSS procedures except that the primitives may have different parameter values.

[Insert new subclause 14.5.10]

14.5.10 Radio Resource Management

14.5.10.1 Radio Measurements and Reporting

The RRM Primitives are a set of primitives for supporting RRM procedures between BS and NCMS.

14.5.10.1.1 RRM Primitives

14.5.10.1.1.1 RRM Spare Capacity Request Primitive

The Radio Resource Controller (RRC) may use this primitive to request a BS to provide spare capacity information to the RRC. Note that the RRC may be located in another BS, or in a central entity in the NCMS.

RRM Type
Indication of RRM type: Spare Capacity Request
Sender NCMS Node ID
NCMS Node or BS unique identifier
Target NCMS Node ID
NCMS Node or BS unique identifier
Spare Capacity Report Type
Type of requested report profile. 1 for spare capacity report type 1. (Types > 1 reserved for future types)
Report Characteristics
Indicates whether report should be sent periodically, or event driven. Following events are possible:
- Completion of Network Entry
- Deregistration of MS
- Adding / changing / deleting connections
- MOB_MSHO-REQ received from MS
- MOB_SCAN-REPORT received from MS
- Association performed by MS
- MOB_HO-IND received by Serving BS
- Completion of network re-entry at Target BS after HO
- Report solicitation from RRC

14.5.10.1.1.2 Spare capacity report primitive

The BS may use this primitive to provide spare capacity information to the RRC, as requested by the RRC within the Spare Capacity Request Primitive.

RRM Type
Indication of RRM type: Spare Capacity Report
Sender NCMS Node ID
NCMS Node or BS unique identifier
Target NCMS Node ID
NCMS Node or BS unique identifier

Spare Capacity Report Type
Type of report profile = 1
Available Radio Resource
Percentage of reported average available subchannels and symbols resources per frame, as defined in section 14.5.13.3
Radio Resource Fluctuation
Radio Resource Fluctuation is used to indicate the degree of fluctuation in DL and UL channel data traffic throughputs. When Radio Resource Fluctuation is set to 0, it implies that the DL and UL data traffic is constant in data throughput. Hence, there is no fluctuation in Available Radio Resource. When Radio Resource Fluctuation is set to maximum value 255, the data traffic is very volatile in nature which makes the Available Radio Resource unpredictable. The Radio Resource Fluctuation for all traffic models should be in the range of 0 to 255.

14.5.10.1.1.3 PHY report request primitive

The Radio Resource Controller (RRC) may use this primitive to request a BS to provide a report of the link level quality for a specific MS.

RRM Type
Indication of RRM type: Physical Parameters Request
Sender NCMS Node ID
NCMS Node or BS unique identifier
Target NCMS Node ID
BS unique identifier
MS ID
48-bit unique identifier of the MS

14.5.10.1.1.4 RRM PHY report primitive

The BS may use this primitive to provide a report of the link level quality for a specific MS to the Radio Resource Controller (RRC).

RRM Type
Indication of RRM type: Physical Parameters Report
Sender NCMS Node ID
BS unique identifier
Target NCMS Node ID
NCMS Node or BS unique identifier
MS ID
48-bit unique identifier used by MS
Downlink Physical Service Level
Channel rate available for the MS calculated as a multiple of 1/32 of nominal bandwidth in the correspondent direction assuming 1 bit/Hz. For example, if DL channel bandwidth is 10 MHz, value PSL=4 means 4*1/32*10 Mbps = 1.25 Mbps. 1 PSL 96 (Number of sub channels in different OFDMA modes is multiple of 16 or 32; highest modulation (QAM64) provides 3 bits/Hz)
Downlink RSSI mean
As specified in 8.1.9 Channel quality measurements [802.16-2004].
Downlink RSSI standard deviation
As specified in 8.1.9 Channel quality measurements [802.16-2004].
Downlink CINR mean
As specified in 8.1.9 Channel quality measurements [802.16-2004].
Downlink CINR standard deviation

As specified in 8.1.9 Channel quality measurements [802.16-2004].

Uplink Physical Service Level

Channel rate available for the MS calculated as a multiple of 1/32 of nominal bandwidth in the correspondent direction assuming 1 bit/Hz. (see definition of Downlink Physical Service Level)

Uplink RSSI mean

As specified in 8.1.9 Channel quality measurements [802.16-2004].

Uplink RSSI standard deviation

As specified in 8.1.9 Channel quality measurements [802.16-2004].

Uplink CINR mean

As specified in 8.1.9 Channel quality measurements [802.16-2004].

Uplink CINR standard deviation

As specified in 8.1.9 Channel quality measurements [802.16-2004].

14.5.10.1.1.5 RRM Neighbor-BS Radio Resource Status Update primitive

This primitive can be used by RRC to inform a Serving BS about the list of Neighbor BS's which are potential HO Target Base Stations for any MS's being served by the SBS, including an information about their radio resource status

RRM Type

Indication of RRM type: Neighbor-BS Radio Resource Status Update

Sender NCMS Node ID

NCMS Node or BS unique identifier

Target NCMS Node ID

BS unique identifier

N NEIGHBORS

Number of neighbor BS's

For (j=0; j<N NEIGHBORS; j++) {

BS Identity

Unique identifier of BS

Available Radio Resource

Percentage of reported average available subchannels and symbols resources per frame, as defined in section 14.5.13.3

Radio Resource Fluctuation

Radio Resource Fluctuation is used to indicate the degree of fluctuation in DL and UL channel data traffic throughputs. When Radio Resource Fluctuation is set to 0, it implies that the DL and UL data traffic is constant in data throughput. Hence, there is no fluctuation in Available Radio Resource. When Radio Resource Fluctuation is set to maximum value 255, the data traffic is very volatile in nature which makes the Available Radio Resource unpredictable. The Radio Resource Fluctuation for all traffic models should be in the range of 0 to 255.

DCD Configuration Change Count

This represents the Neighbor BS current Downlink Channel Descriptor (DCD) configuration change count

UCD Configuration Change Count

This represents the Neighbor BS current Uplink Channel Descriptor (UCD) configuration change count

}

14.5.10.1.2 RRM Procedures

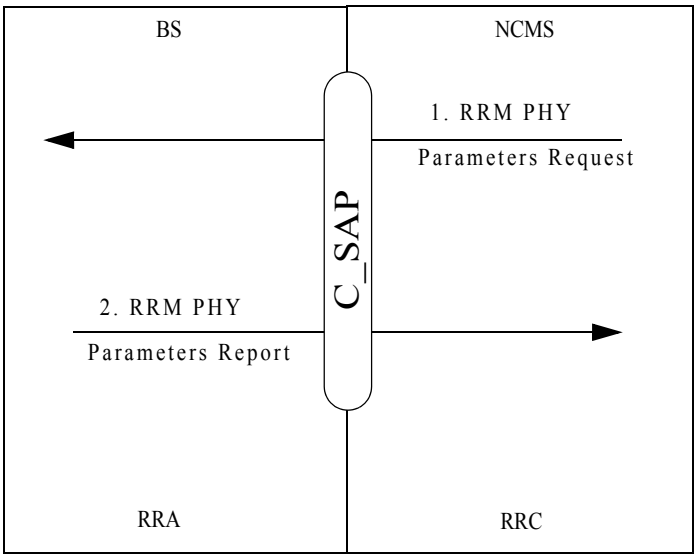


Figure 333—Example Primitive Flow of Physical Parameter Report

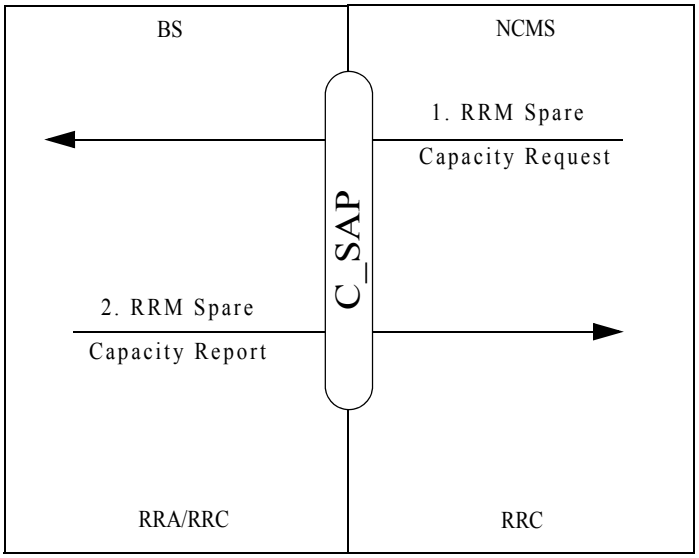


Figure 334—Example Primitive Flow of Spare capacity Report

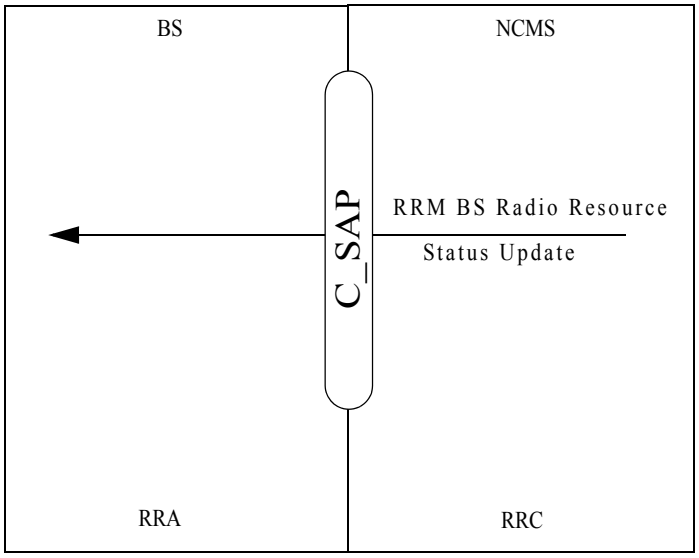


Figure 335—Example Primitive Flow of Radio Resource Status Update

[Insert new subclause 14.5.10.2]

14.5.10.2 Power Control Management

<Section Note: PHY Specific sections>

[Insert new subclause 14.5.11]

14.5.11 MAC Management Enhancements

14.5.11.1 Service Identity Broadcast

[Add the following entries to Table 14 in IEEE Standard 802.16-2004]

Table 456—MAC Management Messages

Type	Message name	Message description	Connection
201	SII-ADV	MAC management message	broadcast CID

14.5.11.1.1 Service Identity Information (SII-ADV) message

A BS may use the SII-ADV message to broadcast service identity information. The message may be broadcast periodically without solicitation or could be solicited by an (M)SS. This message is sent from the BS to all MSs on a broadcast CID.

Table 457—Service Identity Information (SII-ADV) message format

Syntax	Size	Notes
SII-ADV () {		
Management message type = 201	8 bits	
TLV Encoded Information	Variable	TLV specific
}		

14.5.11.1.2 Service Information Identity (SII) TLV

It is a compound TLV that contains 1 or more service identity, and it is used in a broadcast SII-ADV message.

Table 458—Service Identity Information (SII) Compound TLV

Type	Length	Value
1	Variable	Compound

14.5.11.1.3 Service Identity TLV

The service identity can be represented as a 24-bit identity or NAI. The following TLVs are defined for each representation of the identity.

Table 459—Using 24-bit Identity

Type	Length	Value
2	3 bytes	24-bit Identifier

[Insert new subclause 14.5.11.2]

Table 460—Using NAI

Type	Length	Value
3	32 bytes	realm

14.5.11.2 Management Signaling Method

14.5.11.2.1 Management Signalling Messages

The following messages may be used to query and set the information elements (IE) on the SS by the BS. These messages shall only be used to query or set IEs that are indicated in the table A1. The table A1 explicitly indicates the type of operation that can be performed on a particular IE.

[Add the following entries as additions to the end of Table 14:]

Table 461—Management Signalling Messages

Type	Message name	Message description	Connection
202	QRY_IE_REQ	Query IE request	primary management
203	QRY_IE_RSP	Query IE response	primary management
204	SET_IE_REQ	Set IE request	primary management
205	SET_IE_RSP	Set IE response	primary management
206	NTF_IE_REQ	Notify IE request	primary management
207	NTF_IE_RSP	Notify IE response	primary management

Table 462—Information Elements for Query/Set Operations

Information Element (IE) Name	Description	Type of Operation = One of (Query Only, Set Only, Query and Set)
tbd	tbd	

14.5.11.2.1.1 Query IE Request message (QRY_IE_REQ)

BS uses the QRY_IE_REQ message to query information on the SS by describing by one or more IEs. The QRY_IE_REQ message is sent from the BS to the SS on the SS's primary management connection.

Table 463—Query IE Request (QRY_IE_REQ) Message Format

Syntax	Size	Notes
QRY_IE_REQ_Message_Format() {		
Management message type=202	8 bits	
Transaction id	8 bits	
Response timeout	8 bits	In units of 5 frames
TLV Encoded Information	variable	
}		

Parameters shall be as follows:

Transaction id
A unique sequential identifier of the transaction set by the initiator.
Response timeout
In units of 5 frames (by which the sender expects to receive a corresponding QRY_IE_RSP message)

The QRY_IE_REQ shall include the following parameters encoded as TLV Tuples:
HMAC Tuple (see 11.12)
The HMAC Tuple shall be the last attribute in the message.

The base station will serialize all the QRY_IE-REQ messages sent to the SS, waiting until the SS has responded, or a timeout has occurred before querying the SS again, or with more information. The BS may replay a message to override previously sent messages before the timeout has occurred. In this case the SS will not respond to the previous request instead will process the newly received message.

14.5.11.2.1.2 Query IE Response message (QRY_IE_RSP)

The QRY_IE_RSP message is sent by the SS in response to QRY_IE-REQ containing the results of the information elements sent in the corresponding QRY_IE-REQ. The QRY_IE_RSP message is sent from the SS to the BS on the SS's primary management CID.

Parameters shall be as follows:

Transaction id

Table 464—Query IE Response(QRY_IE_RSP) message format

Syntax	Size	Notes
QRY_IE_RSP_Message_Format() {		
Management message type = 203	8 bits	
Transaction id	8 bits	
RSP Status	8 bits	Allowed values are: 0 – success 1 – Error Response timeout too short 2 – Error TLV
TLV Encoded Information	variable	
}		

A unique sequential identifier of the transaction set by the initiator.

RSP Status

Error encoding of the response status. Allowed values are:

0 – success
1 – Error Response timeout too short
2 – Error TLV

The QRY_IE_RSP shall include the following parameters encoded as TLV Tuples:

HMAC Tuple (see 11.12)

The HMAC Tuple shall be the last attribute in the message.

14.5.11.2.1.3 Set IE Request message (SET_IE_REQ)

BS uses the SET_IE_REQ message to set information on the SS describing by one or more IEs. SS uses the SET_IE_REQ message to notify or alert the BS of an event or error condition. The SET_IE_REQ message is sent from the BS to the SS or from the SS to the BS on the SS's primary management CID.

Parameters shall be as follows:

Transaction id

A unique sequential identifier of the transaction set by the initiator.

Response timeout

Number of frames x 5 by which the sender expects to receive a corresponding SET_IE_RSP message with either a success or error RSP Status. If this value is set to 0, the sender does not require a response and the receiver will not issue one.

The SET_IE_REQ shall include the following parameters encoded as TLV Tuples:

HMAC Tuple (see 11.12)

Table 465—Set IE Request (SET_IE_REQ) message format

Syntax	Size	Notes
SET_IE_REQ_Message_Format() {		
Management message type = 204	8 bits	
Transaction id	8 bits	
Response timeout	8 bits	Number of frames x 5 by which the sender expects to receive a corresponding SET_IE_RSP message with either a success or error RSP Status. If this value is set to 0, the sender does not require a response and the receiver will not issue one.
TLV Encoded Information	variable	
}		

The HMAC Tuple shall be the last attribute in the message.

14.5.11.2.1.4 Set IE Response message (SET_IE_RSP)

The SET_IE_RSP message is sent by the SS in response to SET_IE-REQ containing the results of the operation in the corresponding QRY_IE-REQ.

The SET_IE_RSP message is sent from the SS to the BS on the SS's primary management CID.

Parameters shall be as follows:

Transaction id
A unique sequential identifier of the transaction set by the initiator.
RSP Status
Error encoding of the response status. Allowed values are:
0 – success
1 – Error Response timeout too short
2 –TLV set operation Error

The SET_IE_RSP shall include the following parameters encoded as TLV Tuples:

HMAC Tuple (see 11.12)
The HMAC Tuple shall be the last attribute in the message.

Table 466—Set IE Reponse (SET_IE_RSP) message format

Syntax	Size	Notes
SET_IE_RSP_Message_Format() {		
Management message type = 204	8 bits	
Transaction ID	16 bits	
RSP Status	8 bits	Allowed values are: 0 – success 1 – Error Response timeout too short 2 – TLV set Operation Error
TLV Encoded Information	variable	
}		

The base station will serialize all the SET_IE-REQ messages sent to the MS, waiting until the MS has responded, or a timeout has occurred before configuring the MS again, or with additional settings. In case a timeout has occurred

14.5.11.2.1.5 Notify IE Request message (NTF_IE_REQ)

MS uses the NTF_IE_REQ message to query information on the BS by describing by one or more IEs. The NTF_IE_REQ message is sent from the MS to the BS on the MS's primary management connection.

Parameters shall be as follows:

Transaction id
A unique sequential identifier of the transaction set by the initiator.

Response timeout
Number of frames x 5 by which the sender expects to receive a corresponding NTF_IE_RSP message with either a success or error RSP Status. If this value is set to 0, the sender does not require a response and the receiver will not issue one.

The NTF_IE_REQ shall include the following parameters encoded as TLV Tuples:

HMAC Tuple (see 11.1.2)
The HMAC Tuple shall be the last attribute in the message.

The MS will serialize all the NTF_IE_REQ messages sent to the base station, waiting until the base station has responded, or a timeout has occurred before querying the base station again, or with more information. The MS may replay a message to override previously sent messages before the timeout has occurred. In this case the base station will not respond to the previous request instead will process the newly received message.

Table 467—Notify IE Request (NTF_IE_REQ) message format

Syntax	Size	Notes
NTF_IE_REQ_Message_Format() {		
Management message type = 206	8 bits	
Transaction ID	8 bits	
Response timeout	8 bits	Number of frame x 5 by which the sender expects to receive a corresponding NTF_IE_RSP message with either a success or error RSP Status. If this value is set to 0, the sender does not require a response and the receiver will not issue one.
TLV Encoded Information	variable	
}		

14.5.11.2.1.6 Notify IE Response message (NTF_IE_RSP)

The NTF_IE_RSP message is sent by the SS in response to NTF_IE_REQ containing the results of the information elements sent in the corresponding NTF_IE_REQ. The NTF_IE_RSP message is sent from the SS to the BS on the SS's primary management CID.

Table 468—Notify IE Response (NTF_IE_RSP) message format

Syntax	Size	Notes
NTF_IE_RSP_Message_Format() {		
Management message type = 207	8 bits	
Transaction ID	8 bits	
RSP Status	8 bits	Allowed values are: 0 - success 1 - Error Response timeout too short 2 - Error TLV
TLV Encoded Information	variable	
}		

Parameters shall be as follows:

Transaction id
A unique sequential identifier of the transaction set by the initiator.
RSP Status
Error encoding of the response status. Allowed values are:
0 - success
1 - Error Response timeout too short
2 - Error TLV

The NTF_IE_RSP shall include the following parameters encoded as TLV Tuples:

HMAC Tuple (see 11.1.2)

[Insert new subclause 14.5.12]

14.5.12 Management Primitives

The IEEE 802.16 MAC shall support the following primitives which are delivered through C_SAP (Control Service Access Point) or M_SAP (Management Service Access Point) interfacing with NCMS (Network Control and Management System).

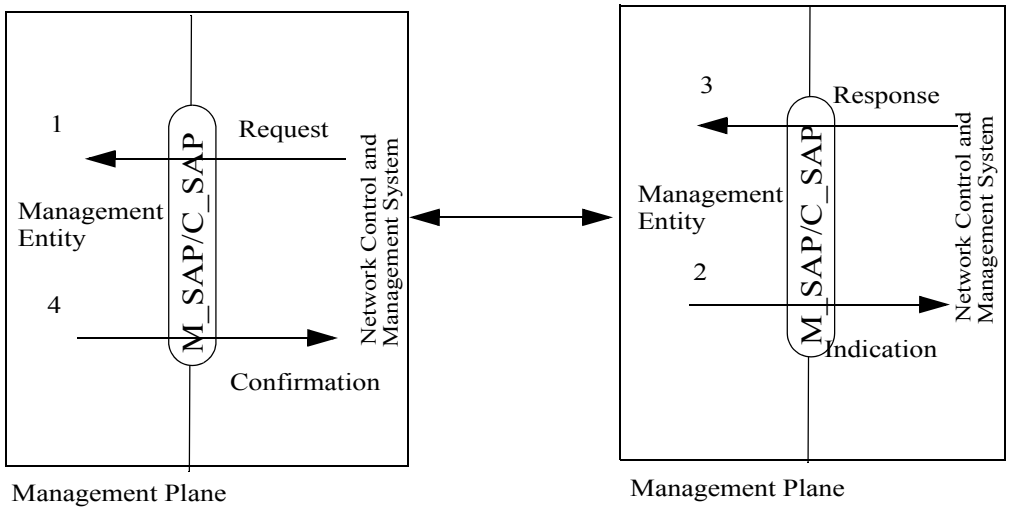
– M_Ranging.request/indication/response/confirmation
– M_Registration.request/indication/response/confirmation
– M_Neighbor.indication
– M_ScanScheduling.request/indication/response/confirmation
– M_Scanning.request/confirmation
– M_MACHandover.request/indication/response/confirmation
– M_HOIND.request/confirmation
– M_Management.request/indication/response/confirmation

The use of these primitives to provide peer communication is shown in Figure 3. The use of primitive can be divided into two categories. The first category is with interaction with the peer entity, and the second category is primitive exchange within local stack.

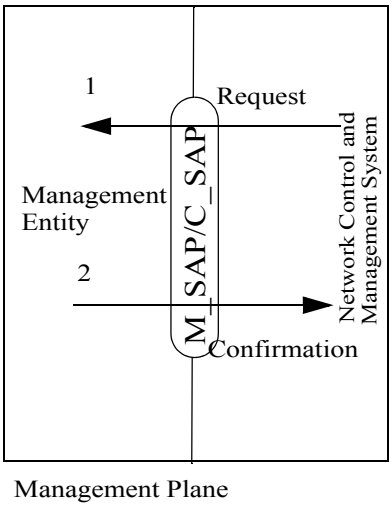
The initial request for service from a higher layer through NCMS is provided by the “Request” primitive. The request triggers to generate appropriate MAC management message and the MAC management message is sent across the air interface to the peer MAC.

Upon reception of the MAC management message over the air interface, corresponding “Indication” primitive is generated to inform NCMS of the request; When the response for the request is made from the higher layer, the response is delivered through the NCMS by the “Response” primitive. The response triggers to generate appropriate response MAC management message and this message is transmitted over the air interface to the originating side. Upon reception of the response MAC management message over the air interface, corresponding “Confirmation” primitive is generated and delivered to higher layer via NCMS.

Primitives exchange for the unidirectional MAC management messages, which don’t require response messages, such as MOB_HOIND, MOB_TRF-IND, and for the local management of the MAC state machine, is shown in Fig. 3, (2). The initial request for service from a higher layer through NCMS is provided by the “Request” primitive. The request triggers either to generate appropriate unidirectional MAC management message or MAC state change depending on the primitive. “Confirmation” primitive conveying the result of the request is delivered to the higher layer through NCMS.



(1) Primitives when Message Exchange is Required with Remote Entity



(1) Primitives exchange within Local Entity

Figure 336—The use of primitives to generate MAC management messages

14.5.12.1 M_Ranging.request/indication/response/confirmation

Upper layers can control ranging procedure with these primitives. Upper layers shall commence 802.16 link setup procedure by sending M_Ranging.request primitive through NCMS.

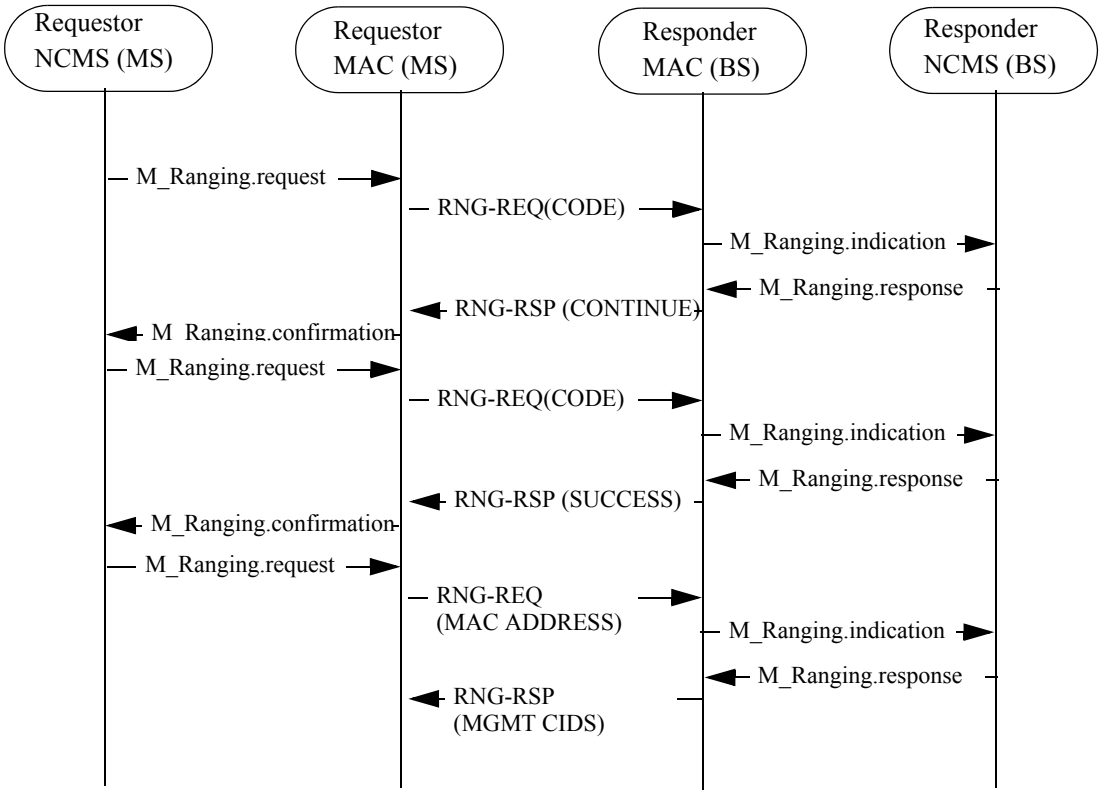


Figure 337—The use of Ranging Primitives

14.5.12.1.1 M_Ranging.request

14.5.12.1.1.1 Function

This primitive requests ranging. Upper layer management entities shall request ranging by sending this primitive to the MAC layer through NCMS.

14.5.12.1.1.2 Semantics

```
M_Ranging.request
(
      Source ,
      Destination ,
      Ranging Type
)
```

Table 469—M_Ranging.request Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Ranging Type	Enumeration	Initial, Handoff, Location Update, Periodic	This identifies the ranging type

14.5.12.1.1.3 When generated

This primitive is generated by the upper layer management entities to initiate ranging procedure for initial network entry, network reentry after handover, periodic ranging, network re-entry from Idle mode, and location update of Idle Mode mobile terminals.

14.5.12.1.1.4 Effect of receipt

MAC layer shall generate RNG-REQ MAC management message including corresponding TLVs depending on the Ranging type and RNG-REQ message shall be sent to the BS over air interface.

14.5.12.1.2 M_Ranging.indication

14.5.12.1.2.1 Function

This primitive notifies the upper layer management entity in BS that the mobile terminal requests ranging with RNG-REQ.

14.5.12.1.2.2 Semantics

M_Ranging.indication
(
Source ,
Destination ,
MS Address ,
CDMA code ,
MAC Version ,
Required Downlink Burst Profile ,
Serving BS ID ,
Target BS ID ,
HO Indication ,
Location Update Request ,
Paging Controller ID
)

Table 470—M_Ranging.indication Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
MS Address	MAC Address	Any valid individual MAC Address	MAC Address of MS that requests ranging
CDMA Code			CDMA code received for ranging
MAC Version	Enumeration	IEEE Std 802.16-2001, IEEE Std 802.16-2004, IEEE Std 802.16e	MAC version supported by MS
Required Downlink Burst profile			DIUC value of Downlink Burst Profile
Serving BS Id			Serving BS ID during ranging
Target BS Id			Target BS ID during ranging
HO Indication			This parameter indicates the MS is currently attempting to HO or Network Re-entry from Idle Mode to the BS.
Location Update Request			This parameter indicates MS action of Idle Mode Location Update Process
Paging Controller ID			This is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administering paging activity for the MS while in Idle Mode.

14.5.12.1.2.3 When generated

This primitive is generated by MAC layer when MAC layer receives RNG-REQ message over the air interface.

14.5.12.1.2.4 Effect of receipt

Upon receipt ranging indication, M_Ranging.response is generated

14.5.12.1.3 M_Ranging.response

14.5.12.1.3.1 Function

This primitive returns the result of ranging request.

14.5.12.1.3.2 Semantics

```
M_Ranging.response
(
    Source ,
    Destination ,
    MS Address ,
    Result Code ,
    Management CIDs ,
    Resource Retain Flag ,
    HO Process Optimization ,
    Location Update Response ,
    Paging information ,
    Paging Controller ID ,
    Next Periodic Ranging
)
```

Table 471—M_Ranging.response Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
MS Address	MAC Address	Any valid individual MAC Address	MAC Address of MS that requests ranging
Result Code	Enumeration		Result of ranging request
Management CID	Enumeration	Basic CID Primary Management CID	Management CID of MT if ranging succeeded
Resource Retain Flag			MT information retained
HO Process Optimization			Network re-entry process optimization after handover
Location Update Response	Enumeration	Success Failure	Location Update result in idle mode
Paging information			Changed paging information if location update succeeded
Paging Controller ID			Idle mode management entity (Paging controller ID)
Next Periodic Ranging			Frame offset of next ranging during sleep mode

14.5.12.1.3.3 When generated

This primitive is generated when decided to notify the ranging result after receiving M_Ranging.indication

14.5.12.1.3.4 Effect of receipt

MAC layer sends RNG-RSP message

14.5.12.1.4 M_Ranging.confirmation

14.5.12.1.4.1 Function

This primitive notifies the result of ranging from M_Ranging.response to upper layer entity

14.5.12.1.4.2 Semantics

M_Ranging.confirmation
(
Source ,
Destination ,
MS Address ,
ResultCode ,
ManagementCIDs ,
Resource Retain Flag ,
HO Process Optimization ,
Location Update Response ,
Paging Information ,
Paging Controller ID ,
Next Periodic Ranging
)

Table 472—M_Ranging.confirmation Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated

Table 472—M_Ranging.confirmation Parameters

Name	Type	Valid Range	Description
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
MS Address	MAC Address	Any valid individual MAC Address	MAC Address of MS that requests ranging
Result Code	Enumeration		Result of ranging request
Management CID	Enumeration	Basic CID Primary Management CID	Management CID of MT if ranging succeeded
Resource Retain Flag			MT information retained
HO Process Optimization			Network re-entry process optimization after handover
Location Update Response	Enumeration	Success Failure	Location Update result in idle mode
Paging information			Changed paging information if location update succeeded
Paging Controller ID			Idle mode management entity (Paging controller ID)
Next Periodic Ranging			Frame offset of next ranging during sleep mode

14.5.12.1.4.3 When generated

This primitive is generated when MAC layer receives RNG-RSP message.

14.5.12.1.4.4 Effect of receipt

The upper layer entity receives the result of ranging

14.5.12.2 M_Registration.request/indication/response/confirmation

Upper layers can control registration procedure with these primitives. Upper layers are notified of link setup by M_Registration.confirmation.

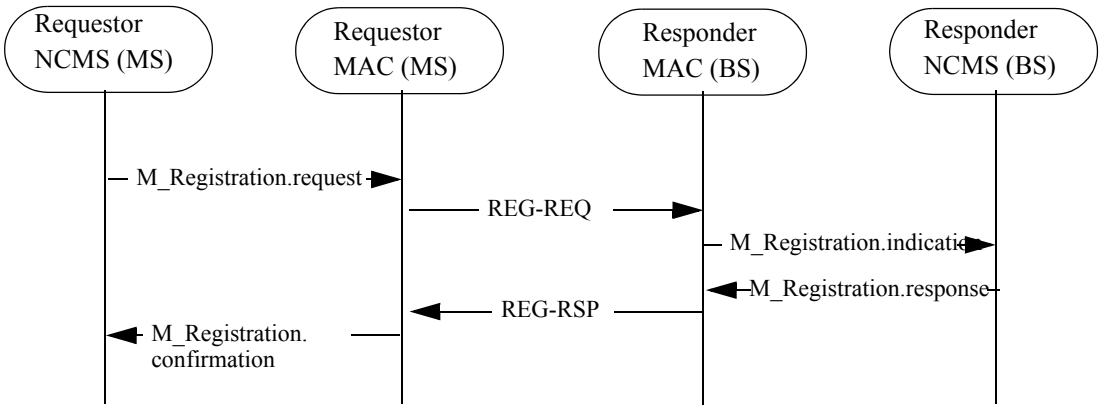


Figure 338—The use of Registration Primitives

14.5.12.2.1 M_Registration.request

14.5.12.2.1.1 Function

This primitive is initiated by the upper layer entity to request registration.

14.5.12.2.1.2 Semantics

```
M_Registration.request
(
      Source ,
      Destination ,
      IP management mode ,
      IP Version ,
      Method of Allocating IP Address ,
      Previous IP Address
)
```

Table 473—M_Registration.request Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
IP management mode	Enumeration	Unmanaged Mode Managed Mode	This identifies the ranging type
IP Version	Enumeration	Version 4 Version 6	IP Version
Method of Allocation IP Address	Enumeration	DHCP Mobile IPv4 DHCPv6 Mobile IPv6 IPv6 Stateless address auto configuration	IP Address configuration method
Previous IP Address	IP Address		Previously assigned IP Address of MS on the secondary management connection.

14.5.12.2.1.3 When generated

This primitive is generated when upper layer entity requests registration

14.5.12.2.1.4 Effect of receipt

REG-REQ message including necessary TLV parameter is sent

14.5.12.2.2 M_Registration.indication

14.5.12.2.2.1 Function

This primitive notifies that upper layer entity requests registration

14.5.12.2.2.2 Semantics

```
M_Registration.indication
(
      Source ,
      Destination ,
      IP management mode ,
      IP Version ,
      Method of Allocating IP Address ,
      Previous IP Address
)
```

Table 474—M_Registration.indication Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
IP management mode	Enumeration	Unmanaged Mode Managed Mode	This identifies the ranging type
IP Version	Enumeration	Version 4 Version 6	IP Version
Method of Allocation IP Address	Enumeration	DHCP Mobile IPv4 DHCPv6 Mobile IPv6 IPv6 Stateless address auto configuration	IP Address configuration method
Previous IP Address	IP Address		Previously assigned IP Address of MS on the secondary management connection.

14.5.12.2.2.3 When generated

This primitive is generated when MAC layer receives REG-REQ message .

14.5.12.2.2.4 Effect of receipt

M_Registraion.response is generated.

14.5.12.2.3 M_Registration.response

14.5.12.2.3.1 Function

This primitive returns the result of registration request.

14.5.12.2.3.2 Semantics

```
M_Regisration.response
(
    Source ,
    Destination ,
    IP management mode ,
    IP Version ,
    Method of Allocating IP Address ,
```

Skip IP Address Acquisition
)

Table 475—M_Registration.response Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
IP management mode	Enumeration	Unmanaged Mode Managed Mode	This identifies the ranging type
IP Version	Enumeration	Version 4 Version 6	IP Version
Method of Allocation IP Address	Enumeration	DHCP Mobile IPv4 DHCPv6 Mobile IPv6 IPv6 Stateless address auto configuration	IP Address configuration method
Skip IP Address Acquisiton	Enumeration	No IP address change Re-acquire IP address	This indicates to an MS whether it should reqcquire its IP address on the secondary management connection and related context or reuse its prior context

14.5.12.2.3.3 When generated

This primitive is generated to notify the result of registration after M_Registration.indication is received

14.5.12.2.3.4 Effect of receipt

MAC layer sends REG-RSP message

14.5.12.2.4 M_Registration.confirmation

14.5.12.2.4.1 Function

This primitive notifies the registration result from M_Registration.response to upper layer entity

14.5.12.2.4.2 Semantics

M_Registration.confirmation
(
Source ,
Destination ,
IP management mode ,
IP Version ,
Method of Allocating IP Address ,
Skip Address Acquisition
)

Table 476—M_Registration.confirmation Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
IP management mode	Enumeration	Unmanaged Mode Managed Mode	This identifies the ranging type
IP Version	Enumeration	Version 4 Version 6	IP Version
Method of Allocation IP Address	Enumeration	DHCP Mobile IPv4 DHCPv6 Mobile IPv6 IPv6 Stateless address auto configuration	IP Address configuration method
Skip IP Address Acquisiton	Enumeration	No IP address change Re-acquire IP address	This indicates to an MS whether it should reqcquire its IP address on the secondary management connection and related context or reuse its prior context

14.5.12.2.4.3 When generated

This primitive is generated when REG-RSP is received

14.5.12.2.4.4 Effect of receipt

Registration result is notified to the upper layer entity

14.5.12.3 M_Neighbor.indication

When 802.16 MAC receives neighbor advertisement (MOB_NBR-ADV), this primitive is used to deliver the information to upper layers.

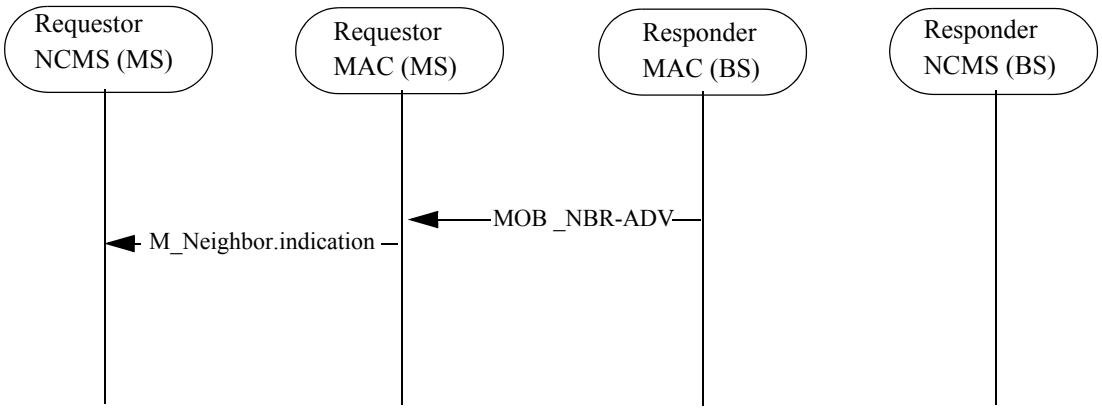


Figure 339—The use of Neighbor Advertisement Indication Primitives

14.5.12.3.1 M_Neighbor.indication

14.5.12.3.1.1 Function

This primitive is generated by MAC layer to notify the upper layer entity of reception of neighbor advertisement (MOB_NBR-ADV) from BS.

14.5.12.3.1.2 Semantics

```
M_Neighbor.indication
(
      Source,
      Destination,
      Operator ID,
      N_Neighbors,
      Neighbor BS-ID,
      HO Process Optimization,
      Current BS's MIH Capability INFO
      MIH INFO Bitmap
)
```

Table 477—M_Neighbor.indication Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Operator ID			Unique ID assigned to the operator
N_Neighbors			The count of the unique combination of Neighbor BSID, Preamble Index and DCD.
Neighbor BS-ID			Base station ID
HO Process Optimization	Enumeration	Bit #0: Omit SBCREQ/ RSP management messages during re-entry processing Bit #1: Omit PKM Authentication phase except TEK phase during current re-entry processing Bit #2: Omit PKM TEK creation phase during reentry processing Bit #3: Omit REGREQ/ RSP management during current re-entry processing Bit #4: Omit Network Address Acquisition management messages during current reentry processing Bit #5: Omit Time of Day Acquisition management messages during current reentry processing Bit #6: Omit TFTP management messages during current re-entry processing Bit #7: Full service and operational state transfer or sharing between serving BS and target BS (ARQ, timers, counters, MAC state machines, etc…)	Network re-entry process optimization after handover

Table 477—M_Neighbor.indication Parameters

Name	Type	Valid Range	Description
Current BS's MIH Capability MIH INFO	Enumeration	MIH Not Supported MIH Supported	This indicates whether current BS delivering neighbor advertisement supports MIH or not.
MIH INFO bitmap	Enumeration	Available WLAN AP, Available WLAN AP MIH Enabled, Available WLAN AP MIH Capability unknown, Available 3GPP BS, Available 3GPP BS MIH Enabled, Available 3GPP BS MIH Capability unknown, Available 3GPP2 BS, Available 3GPP2 BS MIH Enabled, Available 3GPP2 BS MIH Capability unknown,	

14.5.12.3.1.3 When generated

This primitive is generated for the MAC layer to notify the upper layer entity of MOB_NBR-ADV contents received from the BS.

14.5.12.3.1.4 Effect of receipt

Upper layer entity acquires information of BSes.

14.5.12.4 M_ScanScheduling.request/indication/response/confirmation

Upper layers can schedule scanning period with BS. During scanning period BS may buffer downlink traffic to the mobile terminal.

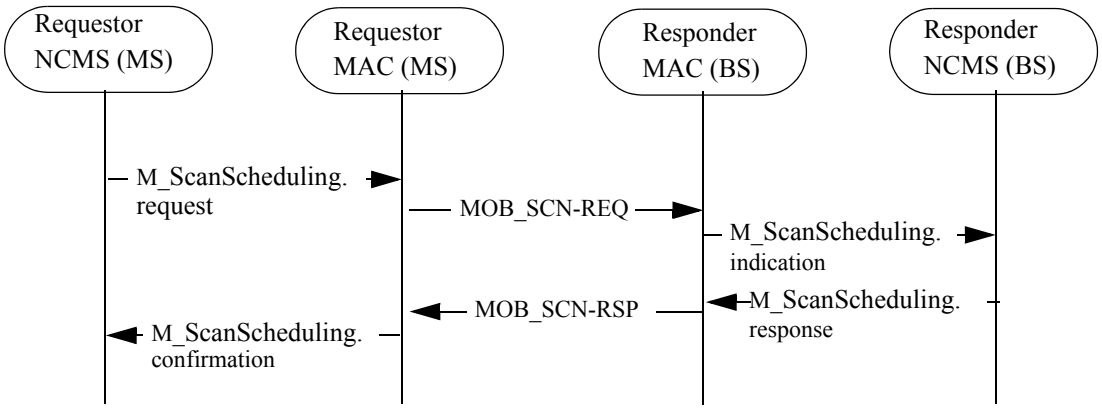


Figure 340—The use of Scan Scheduling Primitives

14.5.12.4.1 M_ScanScheduling.request

14.5.12.4.1.1 Function

This primitive requests the MAC layer to send MOB_SCN-REQ message

14.5.12.4.1.2 Semantics

```
M_ScanScheduling.request
(
    Source ,
    Destination ,
    Scan duration ,
    BSID
)
```

Table 478—M_ScanScheduling.request Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Scan duration			Scan duration time
BSID			Peer BS ID for SCN-REQ

14.5.12.4.1.3 When generated

This primitives is generated when the upper layer entity indicates to send MOB-SCN-REQ

14.5.12.4.1.4 Effect of receipt

MAC layer sends MOB-SCN-REQ to BS

14.5.12.4.2 M_ScanScheduling.indication

14.5.12.4.2.1 Function

This primitive carries the information related MOB-SCN-REQ message to the upper layer entity

14.5.12.4.2.2 Semantics

M_ScanScheduling.indication
(
Source ,
Destination ,
MS MAC Address ,
Scan duration
)

Table 479—M_ScanScheduling.indication Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
MS MAC Address			MAC Address of scan request MS
Scan duration			Scan duration time

14.5.12.4.2.3 When generated

This primitive is generated after BS receives MOB_SCN-REQ from MS

14.5.12.4.2.4 Effect of receipt

The upper layer decides whether allowing scan request or not

14.5.12.4.3 M_ScanScheduling.response

14.5.12.4.3.1 Function

This primitive transmits the result of scan request to MAC layer

14.5.12.4.3.2 Semantics

```
M_ScanScheduling.response
(
    Source ,
    Destination ,
    MS MAC Address ,
    Scan duration ,
    Start frame
)
```

Table 480—M_ScanScheduling.response Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Scan duration			Scan duration time
Start frame			Scan start frame

14.5.12.4.3.3 When generated

This primitive is generated when the upper layer entity decide to carry the result of scan request

14.5.12.4.3.4 Effect of receipt

BS sends MOB_SCN-RSP message to carry the information from the received M_ScanScheduling.response

14.5.12.4.4 M_ScanScheduling.confirmation

14.5.12.4.4.1 Function

This primitive is to transmit the information related to MOB_SCN-REQ message to the upper layer entity

14.5.12.4.4.2 Semantics

```
M_ScanScheduling.confirmation
(
    Source
    Destination ,
```

Scan duration ,
Start frame
)

Table 481—M_ScanScheduling.confirmation Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Scan duration			Scan duration time
Start frame			Scan start frame

14.5.12.4.4.3 When generated

This primitive is generated when MS sends scan information from BS to the upper layer entity

14.5.12.4.4.4 Effect of receipt

The upper layer entity indicates scanning to MS with the information from M_ScanScheduling.confirmation

14.5.12.5 M_Scanning.request/confirmation

Upper layers can command autonomous scanning with these primitives.

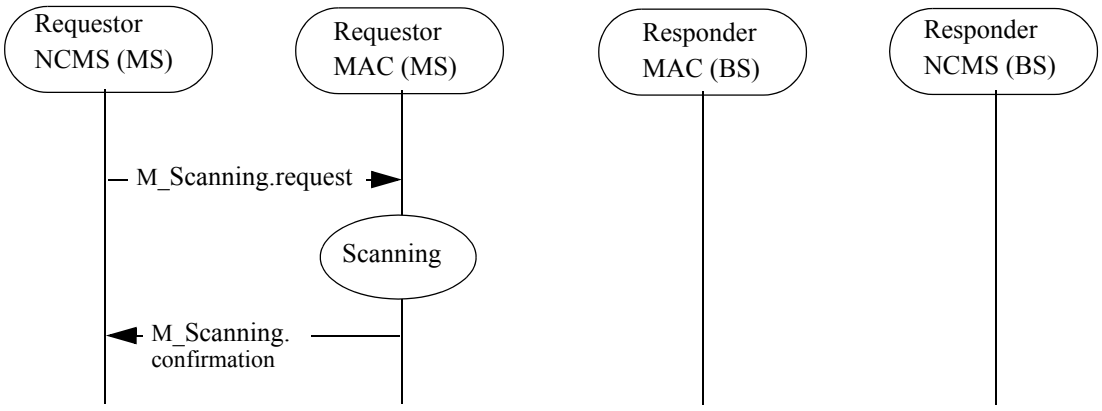


Figure 341—The use of Scanning Primitives

14.5.12.5.1 M_Scanning.request

14.5.12.5.1.1 Function

This primitive is for upper layer entity to request scanning to MS

14.5.12.5.1.2 Semantics

```
M_Scanning.request
(
      Source ,
      Destination ,
      Scan duration
      Link Quality Threshold
      Link Status Report Period
)
```

Table 482—M_Scanning.request Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Scan duration			Scan duration time
Link Quality Threshold			Signal Quality threshold. Scanning report shall be made when link quality goes worse than this threshold.
Link Status Report Period			Time period that the scanning report shall be made.

14.5.12.5.1.3 When generated

This primitive is generated when the upper layer entity requests scanning to MAC layer

14.5.12.5.1.4 Effect of receipt

MAC layer starts to scan

14.5.12.5.2 M_Scanning.confirmation

14.5.12.5.2.1 Function

This primitive is for MAC layer to notify the upper layer entity of scan result.

14.5.12.5.2.2 Semantics

```
M_Scanning.confirmation
(
      Source ,
      Destination ,
      ResultCode ,
      ResultCode
      BS ID ,
      CINR ,
      RSSI
      MIH Capability
)
```

Table 483—M_Scanning.confirmation Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
ResultCode	Enumeration		Scan Result
BS ID			Scanned BS ID
CINR			CINR of Available BS
RSSI			RSSI of Available BS
MIH Capability	Enumeration		RSSI of Available BS

14.5.12.5.2.3 When generated

This primitive responds to M_Scanning.request to notify the upper layer entity of scan result

14.5.12.5.2.4 Effect of receipt

The upper layer entity receives the channel status of available BSes as a scanning result.

14.5.12.6 M_ScanReport primitives

Usage scenario is shown in Figure 6. Only primitives delivered by NCMS are shown. Delivery of the primitives shall be based on the pre-registration procedure between upper layer management entities and NCMS.

Scan report can be made remotely to the BS or locally to the upper layer entity depending on the report target value in M_ScanReport.request.

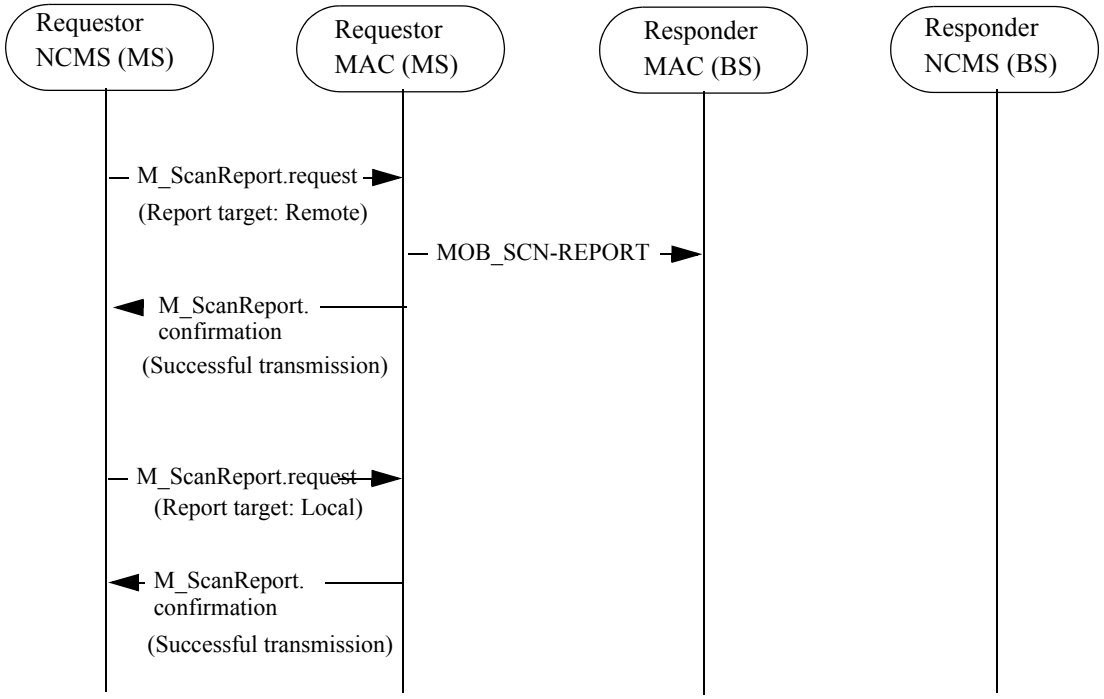


Figure 342—Use of Scan Report Primitives

14.5.12.6.1 M_ScanReport.request

14.5.12.6.1.1 Function

This primitive is for the MAC layer to report scan result locally or remotely.

14.5.12.6.1.2 Semantics

```
M_ScanReport.request
(
      Source ,
      Destination
      Report Target
)
```

Table 484—M_ScanReport.request Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Report Target	Enumeration	Local Remote	This indicates the object to which report shall be made.

14.5.12.6.1.3 When generated

This primitive is generated when the upper layer entity requests to send MOB_SCAN-REPORT message to the BS or to report the scan result to the upper layer entity.

14.5.12.6.1.4 Effect of receipt

MAC layer sends MOB_SCAN-REPORT to BS in case of remote report. In case of local report, upper layer entity transmits scan report with M_ScanReport.confirmation.

14.5.12.6.2 M_ScanReport.confirmation

14.5.12.6.2.1 Function

This primitive notifies the upper layer entity of the result of M_ScanReport.request. In case of remote report, this primitive carries the remote message transmission result. In case of local report, this primitive carries scanning report to the upper layer entity.

14.5.12.6.2.2 Semantics

```
M_ScanReport.confirmation
(
    Source ,
    Destination ,
    ResultCode
    BS ID
    RSSI
    CINR
)
```

14.5.12.6.2.3 When generated

When this primitive is generated as a response to M_ScanReport.request with remote report target, this primitive is generated after MAC layer sends scan report to BS. When this primitive is generated as a response to M_ScanReport.request with local report target, this primitive is generated after scanning the BSes.

Table 485—M_ScanReport.confirmation Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Result Code	Enumeration	Success Fail No Available BS	The result of scan report message transmission . When there is no available BS to scan, 'No Available BS' result code shall be included.
BS ID			Scanned BS ID
RSSI			RSSI of Available BS
CINR			CINR of Available BS

14.5.12.6.2.4 Effect of receipt

An upper layer entity receives the result of remote scan report message (MOB_SCAN-REPORT) or scanning result.

14.5.12.7 M_MACHandover.request/indication/response/confirmation

Upper layers can control handover procedure by using these primitives.

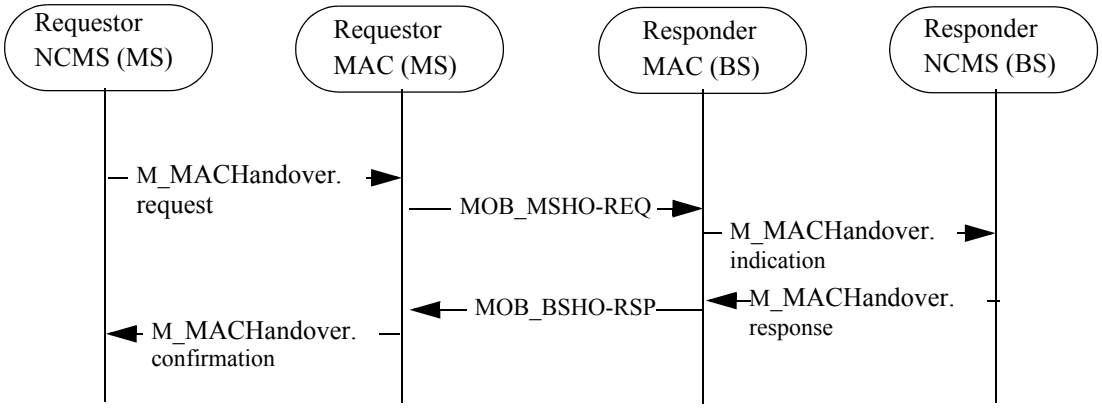


Figure 343—The use of Handover Primitives

14.5.12.7.1 M_MACHandover.request

14.5.12.7.1.1 Function

This primitive requests MAC layer to send handover request message.

14.5.12.7.1.2 Semantics

```
M_MACHandover.request
(
    Source ,
    Destination ,
    N_Recommended ,
    Neighbor BS ID ,
)
```

Table 486—MACHandover.request Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
N_Recommended			The Number of target BS
Neighbor BS ID			Available neighbor BS ID

14.5.12.7.1.3 When generated

This primitive is generated when the upper layer requests MAC layer to send MOB_MSHO-REQ message

14.5.12.7.1.4 Effect of receipt

MAC layer sends MOB_MSHO-REQ to BS

14.5.12.7.2 M_MACHandover.indication

14.5.12.7.2.1 Function

This primitive is for MAC layer of BS to deliver handover request received from the MS to the upper layer entity.

14.5.12.7.2.2 Semantics

```
M_MACHandover.indication
```

(
Source ,
Destination ,
MS MAC Address ,
N_Recommended ,
Neighbor BS ID ,
BS CINR Mean
BS RSSI Mean
Relative delay
)

Table 487—M_MACHandover.indication Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
N_Recommended			The Number of target BS
Neighbor BS ID			Available neighbor BS ID
BS CINR Mean			This indicates the CINR in dB measured at the MS on the downlink signal of a particular BS.
BS RSSI Mean			This indicates the Received Signal Strength measured by the MS from the particular BS
Relative delay			This indicates the delay of neighbor DL signals relative to the serving BS, as measured by the MS for the particular BS.

14.5.12.7.2.3 When generated

This primitive is generated when the MAC layer receives MOB_MSHO-REQ message

14.5.12.7.2.4 Effect of receipt

The upper layer selects recommended target BSes by signaling with other BSes through backbone messages.

14.5.12.7.3 M_MACHandover.response

14.5.12.7.3.1 Function

The upper layer entity transfers the result of handover request to MAC layer

14.5.12.7.3.2 Semantics

```
M_MACHandover.response
(
      Source ,
      Destination ,
      N_Recommended ,
      Neighbor BS ID ,
      HO Process Optimization ,
      HO ID
)
```

Table 488—M_MACHandover.response Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
N_Recommended			The Number of target BS
Neighbor BS ID			Available neighbor BS ID
HO Process Optimization			Network re-entry process optimization after handover
HO ID			ID assigned for use in initial ranging to the target BS once this BS is selected as the target BS.

14.5.12.7.3.3 When generated

This primitive response to M_MACHandover.request

14.5.12.7.3.4 Effect of receipt

MAC layer of BS sends MOB_BSHO-RSP to MS

14.5.12.7.4 M_MACHandover.confirmation

14.5.12.7.4.1 Function

MAC layer transmits the result of handover request to the upper layer entity

14.5.12.7.4.2 Semantics

```
M_MACHandover.confirmation
(
    Source ,
    Destination ,
    N_Recommended ,
    Neighbor BS ID ,
    HO Process Optimization ,
    HO ID
)
```

Table 489—M_MACHandover.confirmation Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
N_Recommended			The Number of target BS
Neighbor BS ID			Available neighbor BS ID
HO Process Optimization			Network re-entry process optimization after handover
HO ID			ID assigned for use in initial ranging to the target BS once this BS is selected as the target BS.

14.5.12.7.4.3 When generated

This primitive is generated after MAC layer of MS receives MOB_BSHO-RSP message

14.5.12.7.4.4 Effect of receipt

The upper layer entity decides to do handover to target BS

14.5.12.8 M_HOIND.request/confirmation

An MS transmits a MOB_HO-IND message for final indication that is about performing a HO.

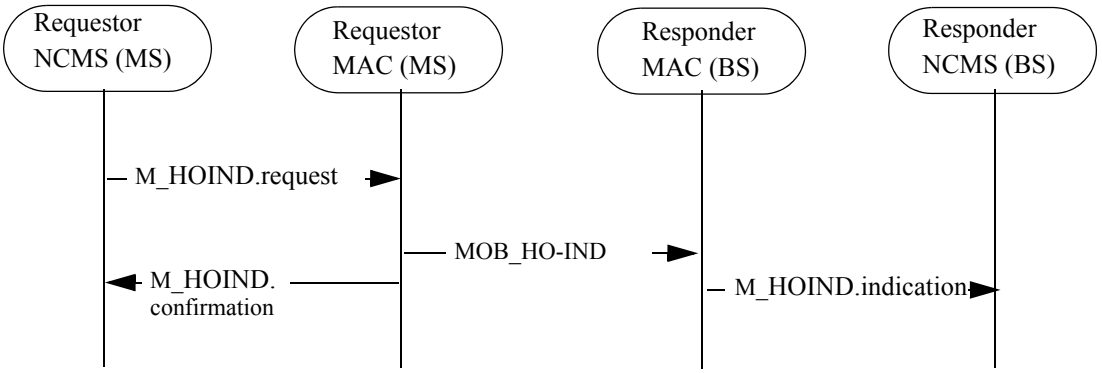


Figure 344—The use of Handover Indication Primitives

14.5.12.8.1 M_HOIND.request

14.5.12.8.1.1 Function

This primitive transfers the information about target BS to MAC layer

14.5.12.8.1.2 Semantics

```
M_HOIND.request
(
      Source ,
      Destination ,
      HO_IND_type
      Target_BSID
)
```

14.5.12.8.1.3 When generated

This primitive is generated when the upper layer entity requests MAC layer to start handover

14.5.12.8.1.4 Effect of receipt

MS starts handover when HO_IND_type indicates ‘handover’

14.5.12.8.2 M_HOIND.confirmation

14.5.12.8.2.1 Function

This primitive informs the upper layer entity whether MOB_HO-IND message transmission is carried out successfully or not

Table 490—M_HOIND.request Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
HO_IND_type	Enumeration	Handover Handover cancel Handover reject	This identifies the ranging type
Target_BSID			Target BS ID for Handover

14.5.12.8.2.2 Semantics

M_HOIND.confirmation
(
Source ,
Destination ,
Result Code
)

Table 491—M_HOIND.confirmation Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Result code	Enumeration	Success Fail	The result of MOB_HOIND message transmission

14.5.12.8.2.3 When generated

This primitive responds to M_HOIND.request

14.5.12.8.2.4 Effect of receipt

The upper layer recognizes that MOB_HO-IND message transmission has been carried out successfully

14.5.12.8.3 M_HOIND.indication

14.5.12.8.3.1 Function

This primitive is for MAC layer of BS to deliver handover indication (MOB-HO-IND) received from the MS to the upper layer entity.

14.5.12.8.3.2 Semantics

```
M_HOIND.indication
(
    Source ,
    Destination ,
    HO_IND_type
    Target_BS_ID
)
```

Table 492—M_HOIND.indication Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
HO_IND_type	Enumeration	Handover Handover cancel Handover reject	

14.5.12.8.3.3 When generated

This primitive is generated when the MAC layer of BS receives MOB_HO-IND message

14.5.12.8.3.4 Effect of receipt

The upper layer is notified of MS's handover decision.

14.5.12.9 M_Management.request/indication/response/confirmation

These primitives are used to manage the status of mobile terminal. Upper layer can change the status of mobile terminal into power on/down/hold/de-register, etc.

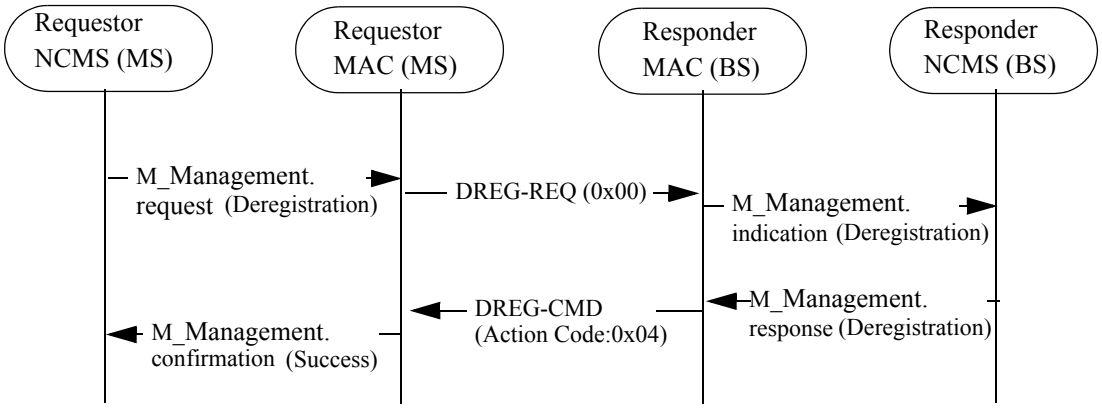


Figure 345—Mobile registration deregistration from the BS and power off

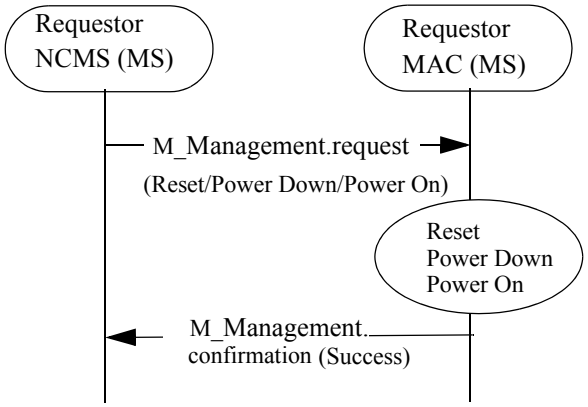


Figure 346—Mobile node status management (Reset / Power Down / Power On)

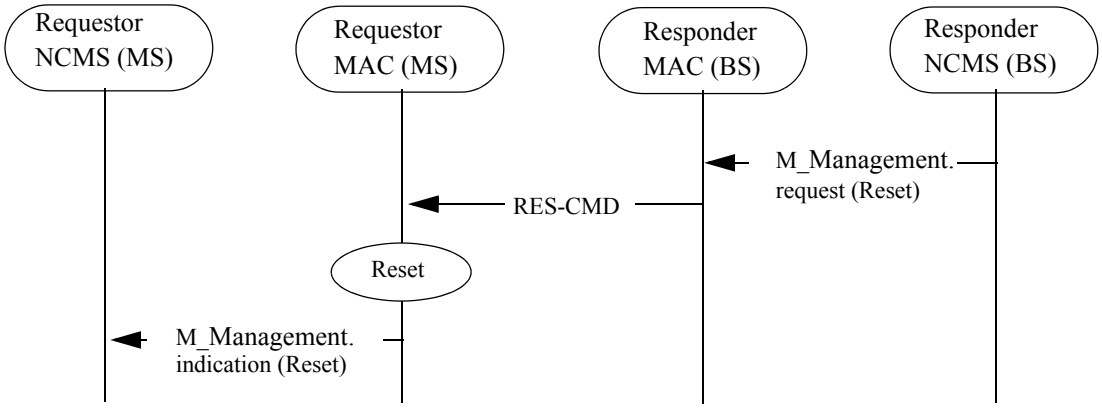


Figure 347—Remote Reset by BS

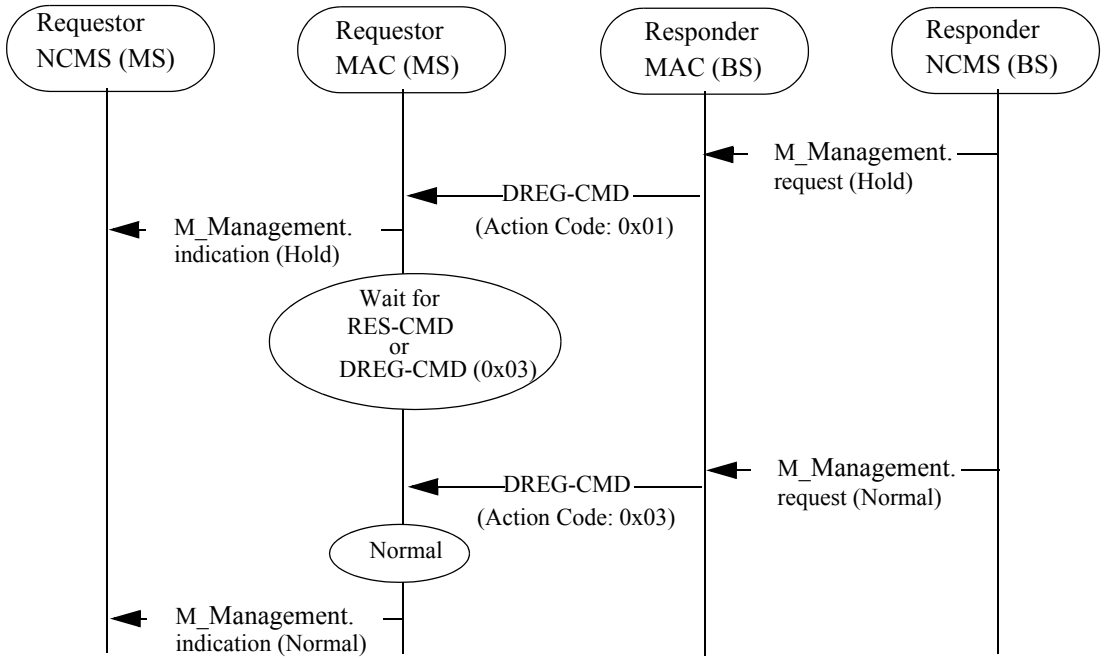


Figure 348—Remote control by BS (DREG-CMD)

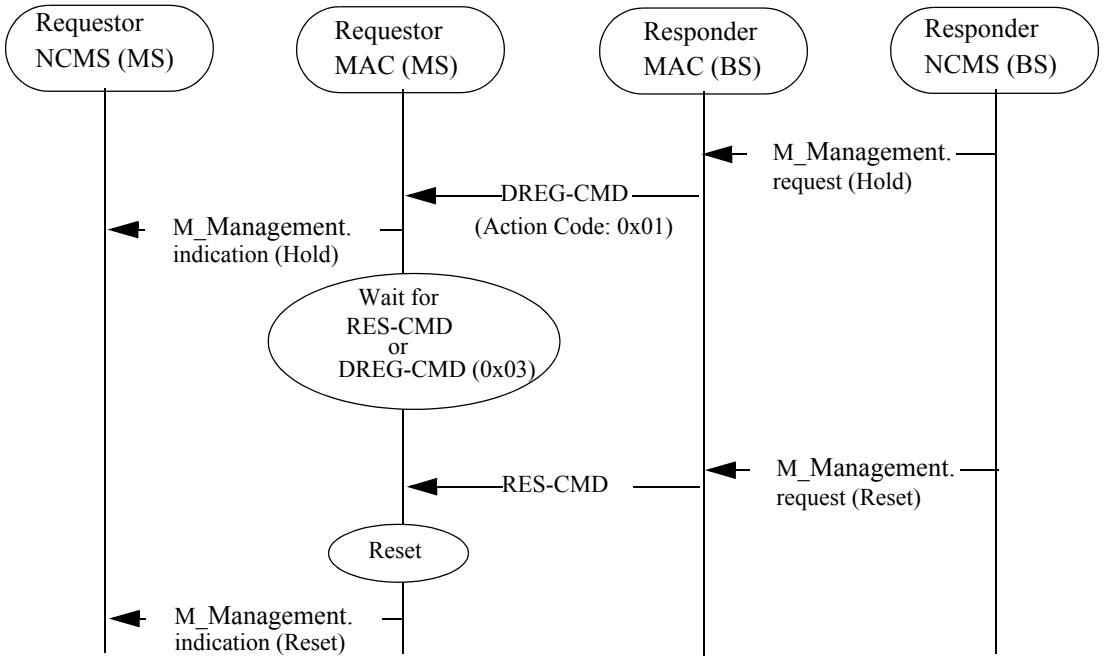


Figure 349—Remote control by BS (RES-CMD)

14.5.12.9.1 M_Management.request

14.5.12.9.1.1 Function

Upper layer entities in BS or MS can request MS's status change with this primitive.

14.5.12.9.1.2 Semantics

```
M_Management.request
(
    Source ,
    Destination ,
    MS Address ,
    Action Code
)
```

Table 493—M_Management.request Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
MS Address	MAC Address	Any valid individual-MAC Address	This parameter is included when BS makes request.
Action Code	Enumeration	Power on Power off Reset Deregistration Hold Normal	Type of management

14.5.12.9.1.3 When generated

When the upper layer entity of MS generates this primitive, this primitive is used to change its MAC status, such as power on, power off, reset, etc with or without interaction with BS. When the upper layer entity of BS generates this primitive, this primitives is used to change the status, such as hold, reset, normal, etc. of the specific MSes, identified by MS addresses.

14.5.12.9.1.4 Effect of receipt

In case of local request in MS, MAC layer changes its status into the requested status and send M_Management.confirmation with the status change result. If MS needs to interact with BS for its status change, MS's MAC layer transmits MAC management message with corresponding action code.

In case of remote request from BS, BS's MAC layer transmits MAC management messages to specific MS in order to change MS's status.

14.5.12.9.2 M_Management.indication

14.5.12.9.2.1 Function

This primitive delivers received status change MAC management message to the upper layer entity.

14.5.12.9.2.2 Semantics

```
M_Managment.indicaiton
(
      Source ,
      Destination ,
      MS Address ,
      Action Code
)
```

Table 494—M_Managment.indicaiton Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
MS Address	MAC Address	Any valid individual-MAC Address	This parameter is included when BS makes request.
Action Code	Enumeration	Power on Power off Reset Deregistration Hold Normal	Type of management

14.5.12.9.2.3 When generated

This primitive is generated by MAC layer upon reception of status change MAC management messages, such as, DREG-REQ, DREG-CMD, RES-CMD, etc.

14.5.12.9.2.4 Effect of receipt

The upper layer entity is able to control the status of MS.

14.5.12.9.3 M_Management.response

14.5.12.9.3.1 Function

As a response to the MS's request, upper layer entity in the BS can command the MS's status change.

14.5.12.9.3.2 Semantics

```
M_Management.response
(
      Source ,
      Destination ,
      MS Address ,
      Action Code
)
```

Table 495—M_Management.response Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
MS Address	MAC Address	Any valid individual-MAC Address	This parameter is included when BS makes request.
Action Code	Enumeration	Power on Power off Reset Deregistration Hold Normal	Type of management

14.5.12.9.3.3 When generated

This primitive is generated, when the upper layer entity receives M_Management.indication with Deregistration Action Code and upper layer entity decides to deregister the specific MS.

14.5.12.9.3.4 Effect of receipt

Upon reception of this primitive, MAC layer of BS transmits DREG-CMD to the specific MS.

14.5.12.9.4 M_Management.confirmation

14.5.12.9.4.1 Function

This primitive transmits the result of status changes.

14.5.12.9.4.2 Semantics

M_Management.confirmation
(
Source ,
Destination ,
Result
)

Table 496—M_Management.confirmation Parameters

Name	Type	Valid Range	Description
Source	EVENT_SOURCE	N/A	The origination point from where this primitive is initiated
Destination	EVENT_DESTINATION	N/A	This specifies the destination where this primitive finally arrives
Result	Enumeration	Success Fail	The result of status changes

14.5.12.9.4.3 When generated

This primitive is generated when the status of MS is changed.

14.5.12.9.4.4 Effect of receipt

The upper layer can correctly update the status change of MS. Depending on the result, the upper layer entity can perform correct action, e.g, MS's status update, re-issuing status change command.

Appendix 1

<Section Note: Discussion on Spanning Tree>

Annex F: IRP Solution Sets for Management (Informative)

Annex G: Network Topologies (Informative)

This annex provides two types of network topologies without precluding other typical topologies.

G.1 Full distributed network

Figure 350 is a diagram of the typical full distributed network.

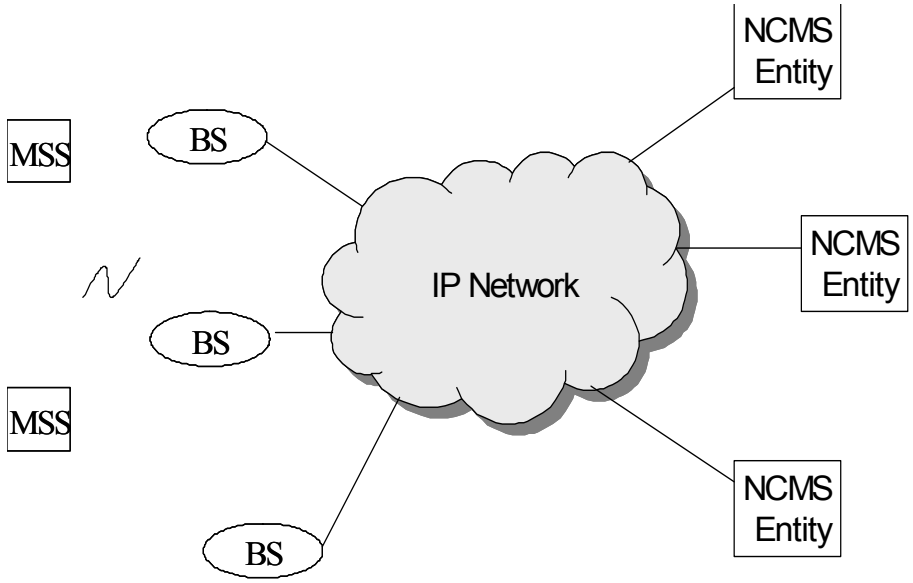


Figure 350—Distributed network

In a full distributed network, BS connects to IP network directly. NCMS is implemented as several network elements, each of the elements is also connects to IP network directly. Some NCMS functions, such as gateway and router service, are embedded in BS.

G.2 Centralized network

802.16's network can also be deployed as cellular system does now. Figure 7 is a diagram of the typical centralized network, which is similar to 3G core network.

<Section Note: Figure 7 TBD>