

Project	IEEE 802.16 Broadband Wireless Access Working Group < http://ieee802.org/16 >	
Title	802.21 Media Independent Handover Function Requirements and Amendments	
Date Submitted	2005-11-09	
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Re:	Call for comment	
Abstract	This contribution proposes requirements and amendments to 802.16g specification for 802.21 Media Independent Handover (MIH) Function.	
Purpose	This document proposes a 802.21 requirements and amendments	
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Requirements and amendments for 802.21 Media Independent Handover Function

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1. Introduction

IEEE 802.21 working group is currently developing a standard to improve the user experience during handover between networks including IEEE 802.16 network. In the IEEE 802.21 draft, Media Independent Handover Function (MIHF) is defined for inter technology handover.

The MIHF provides asynchronous services, e.g., Media Independent Event Service (MIES) and synchronous services, e.g., Media Independent Command Service (MICS) through well defined SAPs (Service Access Point) for lower layers and upper layers. MIH technology is comprised of three key MIHF services and MIH protocol. Three key MIHF services are Media Independent Event Service (MIES), Media Independent Command Service (MICS), and Media Independent Information Service (MIIS).

However, specific changes in order to incorporate MIHF should be made in 802.16g specification. Therefore, in this contribution we propose requirements and amendments for 802.21 Media Independent Handover Function.

The purpose of this document is to identify requirements to be satisfied by IEEE 802.16 specification for supporting MIH Services as specified by the IEEE 802.21 specification. This document also includes suggestions for possible amendments to the IEEE 802.16g specification for satisfying the identified requirements.

2. Proposed Text Change

Remedy 1:

802.21 requirements that need to be met by the 802.16g specification are added

[In 14.2.10 802.21 Media Independent Handover, page 95, line 42, Add new sub- section]:

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

<u>Event Identifier</u>	<u>Event Type</u>	<u>Event Name</u>	<u>Description</u>	<u>Comments</u>	<u>802.16 Primitive</u>
<u>1</u>	<u>State Change</u>	<u>Link Up</u>	<u>L2 connection has been established</u>	<u>Successful registration response message is received</u>	<u>M_Registration.confirmation</u>
<u>2</u>	<u>State Change</u>	<u>Link Down</u>	<u>L2 connection has been broken</u>	<u>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).</u>	<u>M_Ranging.confirmation</u>
<u>3</u>	<u>Predictive</u>	<u>Link Going Down</u>	<u>L2 connection loss is imminent</u>	<u>Either when MS receives BS initiated MOB_BSHO-REQ^[1] message to request handover or when link quality delivered through M_Scanning.confirmation is bad below certain threshold.</u>	<u>M_Scanning.confirmation or M_ScanReport.confirmation.</u>
<u>4</u>	<u>State Change</u>	<u>Link Detected</u>	<u>A new link has been detected</u>	<u>Successful scanning of new BS.</u>	<u>M_Scanning.confirmation</u>

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14.2.10.6 Media Independent Information Element Requirements

The 802.16 specification shall support Information Elements identified by the 802.21 specification. The following set of information elements shall be supported:

No	Name of Information Element	Description	Comments	802.16 specific amendments
I	<u>List of Neighboring Access Networks</u>	<u>Link types of the networks that are available in a given geographical area.</u>	<u>e.g.,</u> : Ethernet : Wireless - Other : Wireless - IEEE 802.11 : Wireless – IEEE 802.16 : Wireless - CDMA2000 : Wireless - UMTS : Wireless - 1X-EV Etc.	

For each Access Network the following fields are defined

1	<u>Number of Point of Attachments (PoA) for that Access Network in the Neighborhood</u>	<u>Number of APs, BSs etc. in the vicinity of client device</u>		<u>Can be derived from 802.16 Neighbor list</u>
2	<u>Network Operator</u>	<u>The operator of the network.</u>		<u>Already available (first 24 bits of BS ID)</u>
3	<u>Roaming Partners</u>	<u>Operators with which the current network operator has direct roaming agreements.</u>	<u>Each operator has the same structure as Network Operator information element.</u>	<u>Already Available NSI_List</u>
4	<u>Cost</u>	<u>Indication of cost for service or network usage.</u>	<u>Cost is represented as a binary value, i.e., free or charged.</u>	<u>May not be feasible</u>
5	<u>Link Layer Security Capabilities</u>	<u>General Security characteristics of the link layer of a given network.</u>	<u>Authentication methods and cipher suites supported</u>	<u>Already available</u>
6	<u>Link Layer QoS capabilities</u>	<u>General QoS (Quality of Service) characteristics of the link layer.</u>	<u>QoS classes supported</u>	<u>Already available</u>

For each PoA within an access network the following fields are defined

a	<u>Address Information</u>	<u>MAC Address of PoA</u>		<u>Already available (BS ID)</u>
b	<u>Location of PoA</u>	<u>Geographical location of a given PoA. Multiple location types can be supported including coordinate-based location information and civic address.</u>	<u>The coordinate-based location information is defined in RFC 3825 and consists of:</u> <ul style="list-style-type: none"> - <u>Latitude</u> - <u>Longitude</u> - <u>Altitude</u> <u>The civic address location information is TBD.</u>	
c	<u>Data Rate</u>	<u>The minimum and maximum value of data rate supported by the link layer of a given PoA.</u>	<u>A data rate can be represented as a 32-bit unsigned integer in unit of Kbps.</u>	<u>Already available (Traffic Rate/service Flows)</u>
d	<u>PHY Type</u>	<u>The media PHY type.</u>	<u>The PHY type can be defined by media-specific MIB.</u>	<u>Already available</u>
e	<u>MAC Type</u>	<u>The media MAC type.</u>	<u>The MAC type can be defined by media-specific MIB.</u>	<u>Already available</u>
f	<u>Channel Range/parameters</u>	<u>Spectrum range supported by the Channel for that PoA</u>	<u>This could be range in MHz, GHz etc.</u>	<u>Already available</u>
g	<u>Subnet Information</u>	<u>Information about subnets supported by a typical PoA</u>		
h	<u>Specific PoA Capabilities</u>	<u>Bitmap of PoA capabilities:</u>	<u>Security supported: Y/N</u> <u>QoS supported: Y/N</u> <u>Access to Internet: Y/N (??)</u> <u>Etc.</u>	

14.2.10.7 Media Independent Handover Inter-MIHF Communication Requirements

The 802.16 specification shall support interactions between MIH Function on FS/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 FS/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.

<u>Id</u>	<u>Command Name</u>	<u>MIHF <> MIHF</u>	<u>Description</u>	<u>Comments</u>
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1	<u>MIH Handover Initiate</u>	<u>Client <> Network PoA</u>	<u>Initiates handovers and sends a list of suggested networks and suggested PoA.</u>	
2	<u>MIH Handover Prepare</u>	<u>Network (oPoA) <> Network (nPoA)</u>	<u>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</u>	
3	<u>MIH Handover Commit</u>	<u>Client <> Network</u>	<u>In this case the client commits to do the handover based on selected choices for network and PoA.</u>	
4	<u>MIH Handover Complete</u>	<u>Network (nPoA) <> Network (oPoA)</u>	<u>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.</u>	
5	<u>MIH Network Address Information</u>	<u>Network (nPoA) <> Network(oPoA) <> Network (Access Router/ Foreign Agent)</u>	<u>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.</u>	

Remedy 2:

In order for an FS/MS to support primitives, which are used for interaction between upper layers and MAC/PHY layers, make NCMS applicable to FS/MS and change relevant language.

[In 14.4 Architectural Aspects, page 19, line 3, modify]:

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 FS/MS. In order to provide correct MAC operation, NCMS shall be present within each FS/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.

Remedy 3:

NCMS is required to be extended to support MIH event services, command services, and information services. When NCMS in terminal or BS interfaces with MIH Function, NCMS may provide means for MIH Function to interface with management plane in MS or BS.

In order for NCMS to support MIH function, extend NCMS functionality.

[In 14.4.1.1 Network Control and Management System (NCMS), page 13, figure 4, modify]:

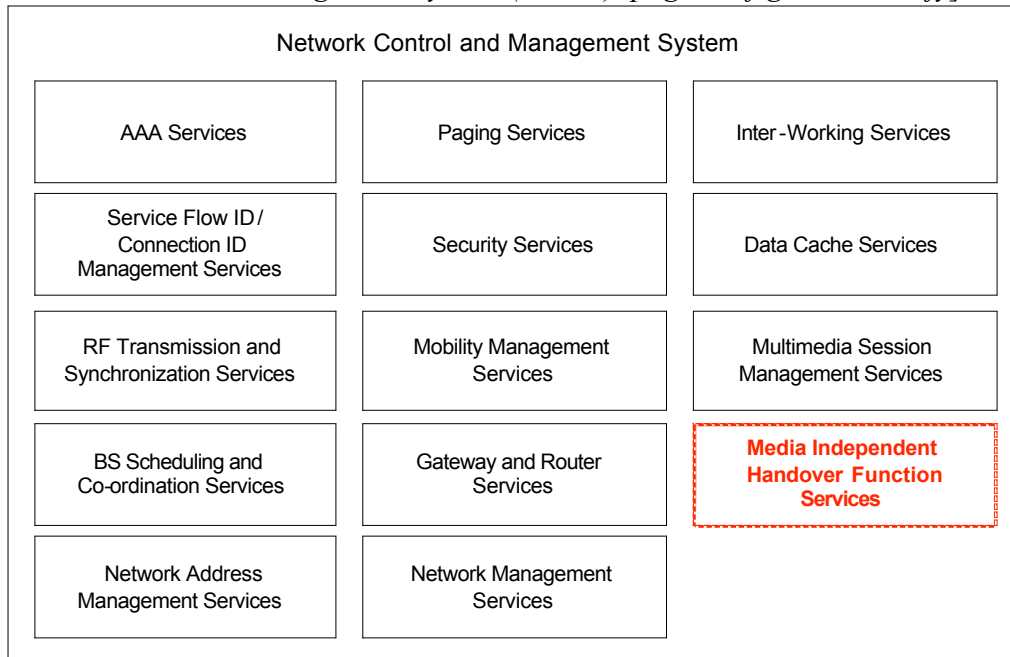


Figure 4. Illustration of the Network Control and Management System

Remedy 4:

In order for NCMS to support FS/MS, interface between FS/MS and NCMS should be described.

[In 14.4.1.2 BS and NCMS Interface, page 13, line 47, modify]:

14.4.1.1.2 BS/FS/MS and NCMS Interface

This interface is a set of Service Access Points (SAP) and is represented and in the Figure 5 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.

Management plane or NCMS in FS/MS or BS has a interface with Media Independent Handover (MIH) Function. MIH_MGMT_SAP defines the interface between NCMS and the MIH Function.

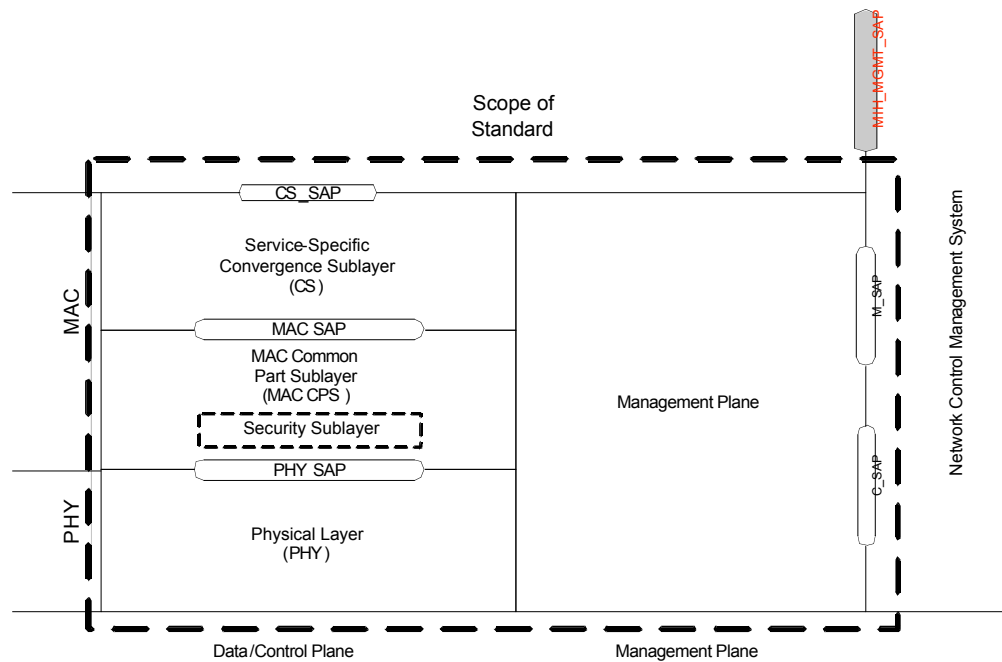


Figure 5 – 802.16g Protocol Architecture Model

Remedy 5:

In order to support Media Independent Handover Function, functionality of SAPs with NCMS shall be extended.

[Add new items in the sub-section 14.4.1.1.2.3, 14.4.1.1.2.4, page 21, line 52, insert]:

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

Remedy 6:

In order to support Media Independent Handover Protocol Packet, CS shall be extended for MIH.

[Add MIH classifier in 11.13.19.1, 11.13.19.2, page 6, line 26, Modify]:

11.13.19.1 CS specification

Type	Length	Value	Scope
[145/146].28	1	0: No CS 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, IPv4 with Header Compression (ROHC) 11: Packet, IPv4 with Header Compression (ECRTP) 12: Packet, IPv6 with Header Compression (ROHC) 13: Packet, IPv6 with Header Compression (ECRTP) 14: Packet, IPv4 over 802.3/Ethernet with Header Compression (ROHC) 15: Packet, IPv4 over 802.3/Ethernet with Header Compression (ECRTP) 16: Packet, IPv6 over 802.3/Ethernet with Header Compression (ROHC) 17: Packet, IPv6 over 802.3/Ethernet with Header Compression (ECRTP) 18: Packet, IPv4 over 802.1Q VLAN with Header Compression (ROHC) 19: Packet, IPv4 over 802.1Q VLAN with Header Compression (ECRTP) 20: Packet, IPv6 over 802.1Q VLAN with Header Compression (ROHC) 21: Packet, IPv6 over 802.1Q VLAN with Header Compression (ECRTP) 22: GPCS (Generic Packet Convergence Sublayer) 23: <u>MIH (Media Independent Handover)</u> 2324~255: reserved	DSx-REQ

11.13.19.2 CS parameter encoding rules

CST	CS
98	No CS
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)
112	Packet, IPv4 over 802.3/Ethernet with header compression (ROHC)
113	Packet, IPv4 over 802.3/Ethernet with header compression (ECRTP)
114	Packet, IPv6 over 802.3/Ethernet with header compression (ROHC)
115	Packet, IPv6 over 802.3/Ethernet with header compression (ECRTP)
116	Packet, IPv4 over 802.1Q VLAN with header compression (ROHC)
117	Packet, IPv4 over 802.1Q VLAN with header compression (ECRTP)
118	Packet, IPv6 over 802.1Q VLAN with header compression (ROHC)
119	Packet, IPv6 over 802.1Q VLAN with header compression (ECRTP)
120	Packet, Generic Packet CS (GPCS)
<u>121</u>	<u>Media Independent Handover (MIH)</u>

Remedy 7:

MS can obtain MIH Capability information for target BS by receiving DL-MAP message from the target BS. BS could inform MS of its MIH Capability information through DL-MAP message, and MS obtains MIH Capability for the BS after receiving DL-MAP message. New MIH_Capability_IE are added in DL-MAP message.

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

8.4.5.3.2.2 DL-MAP extended-2 IE format

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

Extended 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-0D	<u>MIH_Capability_IE</u>
<u>0C-0D</u>	<i>Reserved</i>
0E	AAS_SDMA_DL_IE
0F	<i>Reserved</i>

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

Remedy 8:

MS may obtain MIH Capability information for target BS by receiving MOB_NBR-ADV broadcast message during scanning the target BS. BS could inform MS of its MIH Capability information through MOB_NBR-ADV message, and MS obtains MIH Capability of the BS after receiving MOB_NBR-ADV message.

Neighbor Advertisement can also support heterogeneous network information to cover inter-technology handovers. MS may obtain the information whether there is an available other type of PoAs with or without MIH Capability by receiving MOB_NBR-ADV message from the Serving BS before performing handover from 802.16 system to other interface networks. In MOB_NBR-ADV message, MIH enabled 802.16 BS may provide MSs with MIH Capability information of other interface PoAs (e.g, WLAN AP, or 3GPP/3GPP2 BS). MIH INFO bitmap indicates availability and MIH capability of the WLAN AP and Cellular System BS which is located near the serving 802.16 BS. For each bit location, a value of “1” indicates the correspondent is supported.

[Add MIH_Capability and Heterogeneous Network information in 6.3.2.3.47 Neighbor Advertisement, page 3, line 51, Modify]:

6.3.2.3.47 Neighbor Advertisement (MOB_NBR-ADV) message

Table 108g—MOB_NBR-ADV message format

Syntax	Size	Notes
MOB_NBR-ADV_Message_Format() {		
Management Message Type = 53	8 bits	

Skip-Optional-Fields bitmap	8 bits	Bit [0]: if set to '1', omit Operator ID field Bit [1]: if set to '1', omit NBR BS ID field Bit [2]: if set to '1', omit HO process optimization field Bit [3]: if set to '1', omit QoS related fields <u>Bit [4]: if set to '1', omit Current BS's MIH Capability INFO</u> <u>Bit [5]: if set to '1', omit MIH INFO bitmap</u> Bit [4][6]-[7]: reserved
.....
TLV Encoded Neighbor information	<i>variable</i>	TLV specific
}		
<u>If (Skip-Optional-Fields-[4]=0) {</u>		
<u>Current BS's MIH Capability INFO</u>	<u>1 bit</u>	<u>[0] : MIH not Supported</u> <u>[1] : MIH Supported</u>
<u>}</u>		
<u>If (Skip-Optional-Fields-[5]=0) {</u>		
<u>MIH INFO bitmap</u>	<u>16bits</u>	<u>[0] Available WLAN AP</u> <u>[1] Available WLAN AP MIH Enabled</u> <u>[2] Available WLAN AP MIH Capability unknown</u> <u>[3] Available 3GPP BS</u> <u>[4] Available 3GPP BS MIH Enabled</u> <u>[5] Available 3GPP BS MIH Capability unknown</u> <u>[6] Available 3GPP2 BS</u> <u>[7] Available 3GPP2 BS MIH Enabled</u> <u>[8] Available 3GPP2 BS MIH Capability unknown</u> <u>[9]-[15] reserved</u>
<u>}</u>		
}		

Remedy 9:

MS and BS could use MAC management message to deliver MIH related messages. There are four MAC management messages are proposed for delivering MIH message through basic connection.

[Add 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, page 3, line 51, Modify]:

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 108xx— MOB_MSMIH-REQ message format

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

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 108xx— MOB_MSMIH-RSP message format

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

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 108xx— MOB_BSMIH-REQ message format

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

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 108xx— MOB_BSMIH-RSP message format

Syntax	Length	Description
<u>MOB_BSMIH-REQ_Message_Format() {</u>		
<u>Management Message Type = 70</u>	<u>8bits</u>	
<u>TLV Encoded Information</u>	<u>variable</u>	<u>Specific TLV</u>
<u>}</u>		

Remedy 9:

In FS/MS or BS shall have management primitives for upper layer management entity to control device. Control also includes procedures related to air interface.

[Add New management primitives section in 14.5.14, page 95, line 43, Modify]:

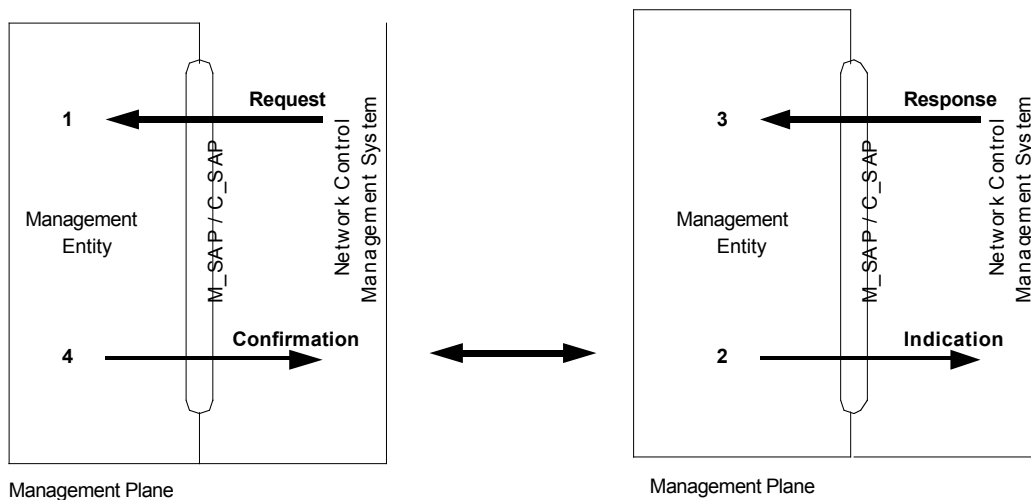
14.5.14 Management Primitives

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).

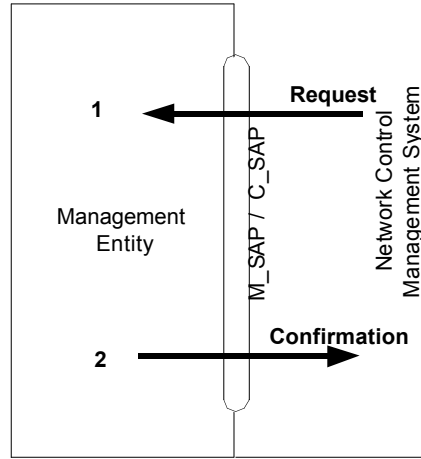
- M_Ranging.request/indication/response/confirmation
- M_Registration.request/indication/response/confirmation
- M_Neighbor.indication
- M_ScanScheduling.request/indication/response/confirmation
- M_Scanning.request/confirmation
- M_MACHandover.request/indication/response/confirmation
- M_HOIND.request/confirmation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



Management Plane

(2) Primitives exchange within Local Entity

Figure xxx: The use of primitives to generate MAC management messages

14.5.14.1 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.

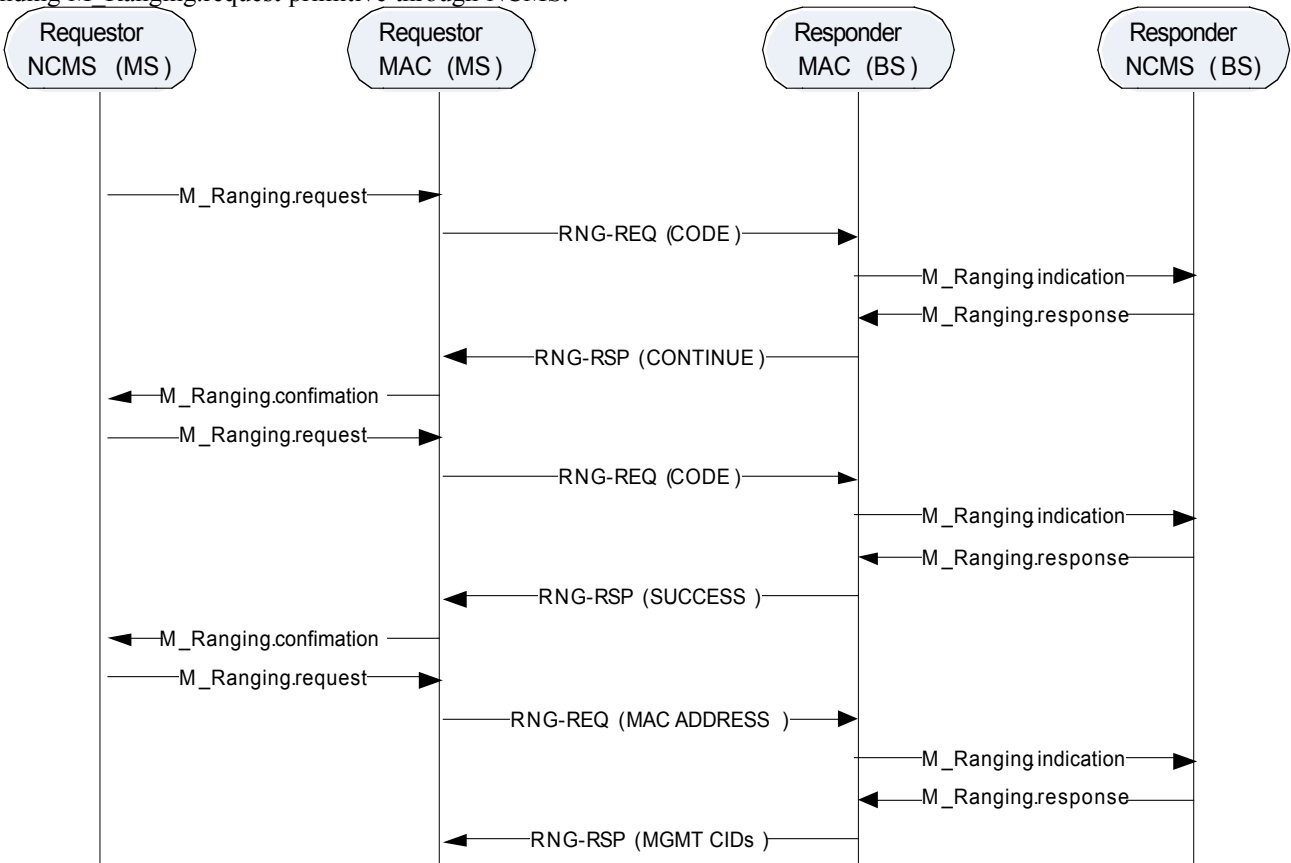


Figure xxx: The use of Ranging Primitives

14.5.14.1.1 M_Ranging.request

14.5.14.1.1.1 Function

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

14.5.14.1.1.2 Semantics

M_Raning.request

```
(
  Source ,
  Destination ,
  Ranging Type
)
```

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

14.5.14.1.1.3 When generated

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

14.5.14.1.1.4 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.

14.5.14.1.2 M_Ranging.indication

14.5.14.1.2.1 Function

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

14.5.14.1.2.2 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
)
```

Name	Type	Valid	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.

14.5.14.1.2.3 When generated

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

14.5.14.1.2.4 Effect of receipt

Upon receipt ranging indication, M_Ranging.response is generated

14.5.14.1.3 M_Ranging.response

14.5.14.1.3.1 Function

This primitive returns the result of ranging request.

14.5.14.1.3.2 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
)
```

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

14.5.14.1.3.3 When generated

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

14.5.14.1.3.4 Effect of receipt

MAC layer sends RNG-RSP message

14.5.14.1.4 M_Ranging.confirmation

14.5.14.1.4.1 Function

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

14.5.14.1.4.2 Semantics

M_Raning.confirmation

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

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

14.5.14.1.4.3 When generated

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

14.5.14.1.4.4 Effect of receipt

The upper layer entity receives the result of ranging

14.5.14.2 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.

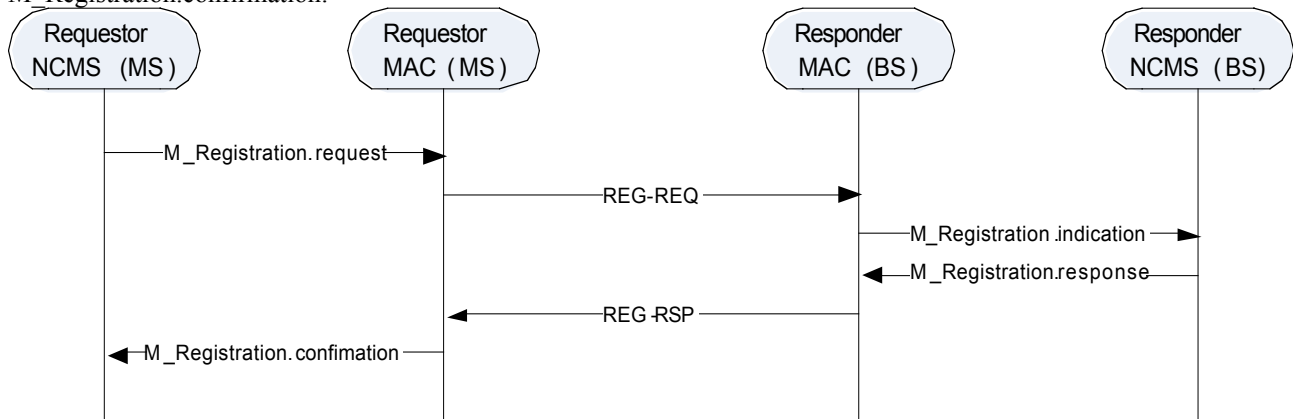


Fig 4: The use of Registration Primitives

14.5.14.2.1 M_Registration.request

14.5.14.2.1.1 Function

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

14.5.14.2.1.2 Semantics

M_Registration.request

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

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	
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.

14.5.14.2.1.3 When generated

This primitive is generated when upper layer entity requests registration

14.5.14.2.1.4 Effect of receipt

REG-REQ message including necessary TLV parameter is sent

14.5.14.2.2 M_Registration.indication

14.5.14.2.2.1 Function

This primitive notifies that upper layer entity requests registration

14.5.14.2.2.2 Semantics

M_Registration.indication

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

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	
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.

14.5.14.2.2.3 When generated

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

14.5.14.2.2.4 Effect of receipt

M_Registraion.response is generated.

14.5.14.2.3 M_Registration.response

14.5.14.2.3.1 Function

This primitive returns the result of registration request.

14.5.14.2.3.2 Semantics

M_Regisration.response

```
(
  Source ,
  Destination ,
  IP management mode ,
  IP Version ,
  Method of Allocating IP Address ,
  Skip IP Address Acquisition
)
```

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	
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 Acquisition	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
-----------------------------	-------------	---	--

14.5.14.2.3.2 When generated

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

14.5.14.2.3.3 Effect of receipt

MAC layer sends REG-RSP message

14.5.14.2.4 M_Registration.confirmation

14.5.14.2.4.1 Function

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

14.5.14.2.4.2 Semantics

M_Registration.confirmation

```
(
  Source ,
  Destination ,
  IP management mode ,
  IP Version ,
  Method of Allocating IP Address ,
  Skip Address Acquisition
)
```

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	
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 Address Acquisition	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

14.5.14.2.4.3 When generated

This primitive is generated when REG-RSP is received

14.5.14.2.4.4 Effect of receipt

Registration result is notified to the upper layer entity

14.5.14.3 M_Neighbor.indication

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

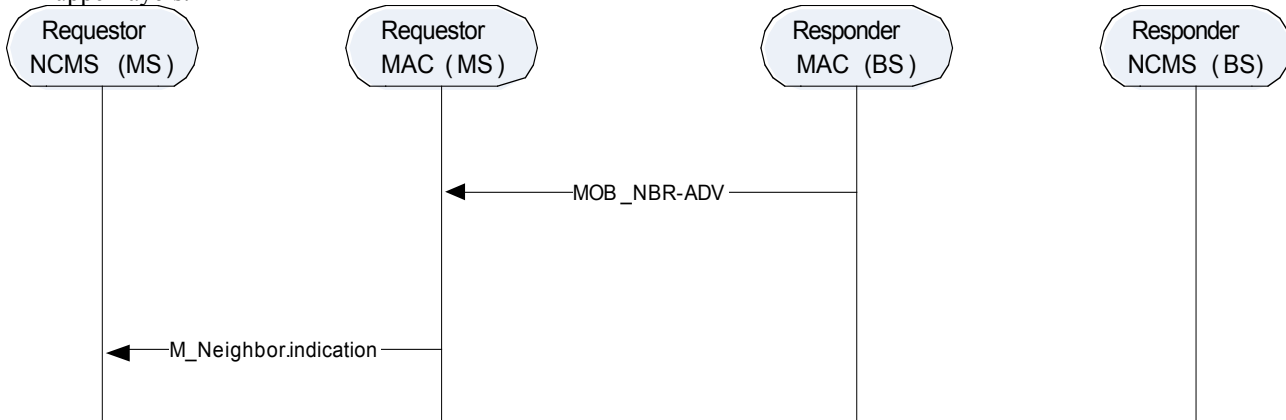


Fig 4: The use of Neighbor Advertisement Indication Primitives

14.5.14.3.1 M_Neighbor.indication

14.5.14.3.1.1 Function

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

14.5.14.3.1.2 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
}
    
```

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	<p>Bit #0: Omit SBC-REQ/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 REG-REQ/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...)</p>	Network re-entry process optimization after handover
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	<p>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,</p>	This indicates existence of different network point of attachments and their MIH capability.

14.5.14.3.1.3 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.

14.5.14.3.1.4 Effect of receipt

Upper layer entity acquires information of BSes.

14.5.14.4 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.

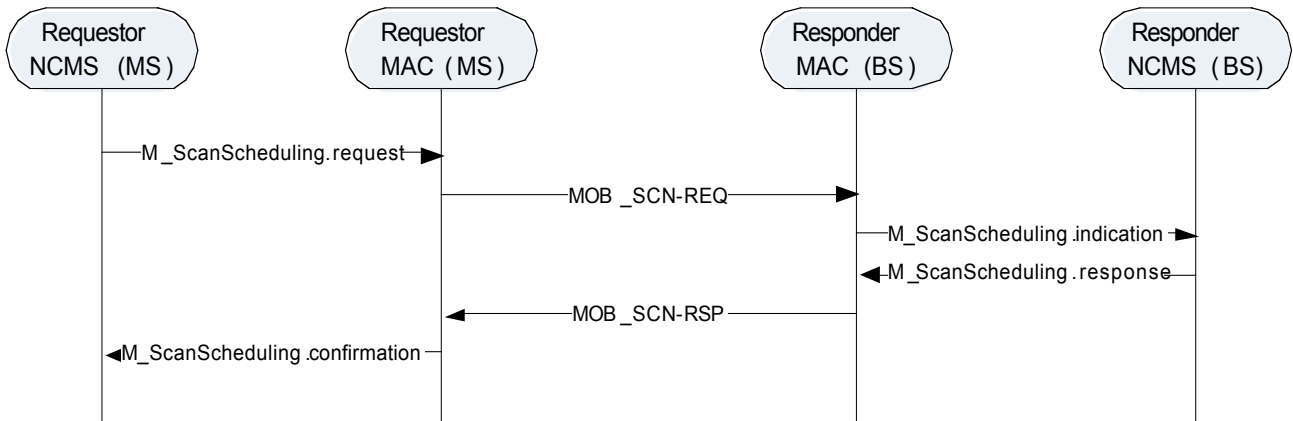


Fig 5: The use of Scan Scheduling Primitives

14.5.14.4.1 M_ScanScheduling.request

14.5.14.4.1.1 Function

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

14.5.14.4.1.2 Semantics

M_ScanScheduling.request

(
 Source ,
 Destination ,
 Scan duration ,
 BSID
)

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

14.5.14.4.1.3 When generated

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

14.5.14.4.1.4 Effect of receipt

MAC layer sends MOB-SCN-REQ to BS

14.5.14.4.2 M_ScanScheduling.indication

14.5.14.4.2.1 Function

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

14.5.14.4.2.2 Semantics

M_ScanScheduling.indication

```
(
  Source ,
  Destination ,
  MS MAC Address ,
  Scan duration
)
```

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

14.5.14.4.2.3 When generated

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

14.5.14.4.2.4 Effect of receipt

The upper layer decides whether allowing scan request or not

14.5.14.4.3 M_ScanScheduling.response

14.5.14.4.3.1 Function

This primitive transmits the result of scan request to MAC layer

14.5.14.4.3.2 Semantics

M_ScanScheduling.response

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

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		MAC Address of scan request MS
Scan duration			Scan duration time
Start frame			Scan start frame

14.5.14.4.3.3 When generated

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

14.5.14.4.3.4 Effect of receipt

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

14.5.14.4.4 M_ScanScheduling.confirmation

14.5.14.4.4.1 Function

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

14.5.14.4.4.2 Semantics

M_ScanScheduling.confirmation

```
(
  Source
  Destination ,
  Scan duration ,
  Start frame
)
```

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

14.5.14.4.4.3 When generated

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

14.5.14.4.4.4 Effect of receipt

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

14.5.14.5 M_Scanning.request/confirmation

Upper layers can command autonomous scanning with these primitives.

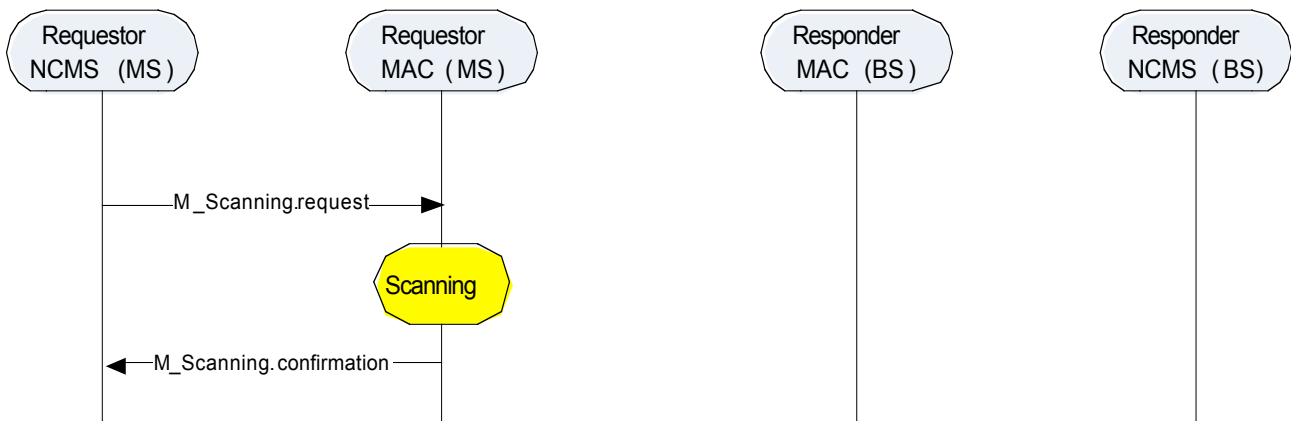


Fig 6: The use of Scanning Primitives

14.5.14.5.1 M_Scanning.request

14.5.14.5.1.1 Function

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

14.5.14.5.1.2 Semantics

M_Scanning.request

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

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.

14.5.14.5.1.3 When generated

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

14.5.14.5.1.4 Effect of receipt

MAC layer starts to scan

14.5.14.5.2 M_Scanning.confirmation

14.5.14.5.2.1 Function

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

14.5.14.5.2.2 Semantics

M_Scanning.confirmation

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

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	Available BS No Available BS	Scan Result
BS ID			Scanned BS ID
CINR			CINR of Available BS
RSSI			RSSI of Available BS
MIH Capability	Enumeration	MIH not supported MIH supported	MIH Capability of available BS

14.5.14.5.2.3 When generated

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

14.5.14.5.2.4 Effect of receipt

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

14.5.14.6 Scan Report 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.

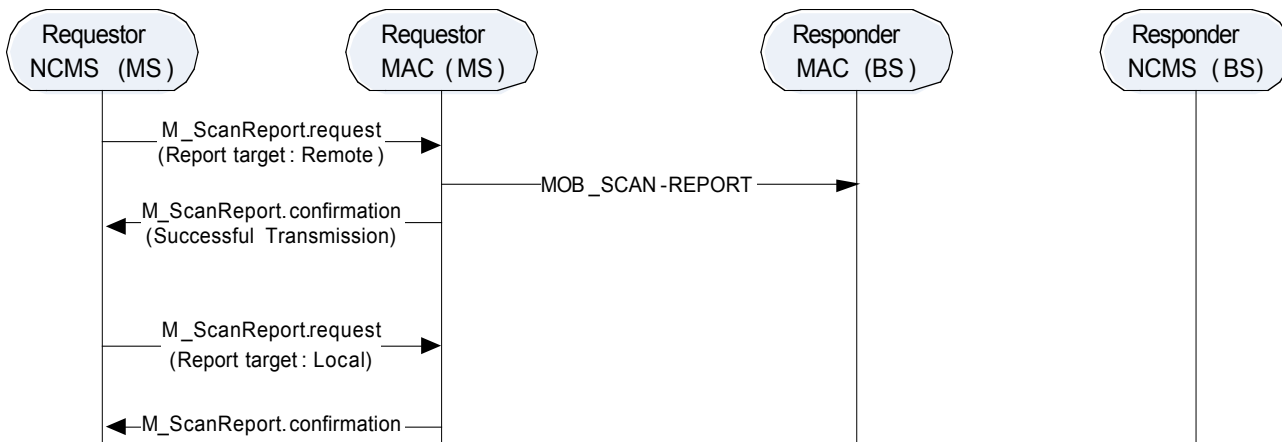


Figure 6. Use of Scan Report Primitives

14.5.14.6.1 M_ScanReport.request

14.5.14.6.1.1 Function

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

14.5.14.6.1.2 Semantics

M_ScanReport.request

(
Source,
Destination
Report Target
)

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.

14.5.14.6.1.3 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.

14.5.14.6.1.4 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.

14.5.14.6.2 M_ScanReport.confirmation

14.5.14.6.2.1 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.

14.5.14.6.2.2 Semantics

M_ScanReport.confirmation

```
(
    Source ,
    Destination ,
    ResultCode
    BS ID
    RSSI
    CINR
)
```

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			CINR of Available BS
CINR			RSSI of Available BS

14.5.14.6.2.3 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.

14.5.14.6.2.4 Effect of receipt

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

14.5.14.7 M_MACHandover.request/indication/response/confirmation

Upper layers can control handover procedure by using these primitives.

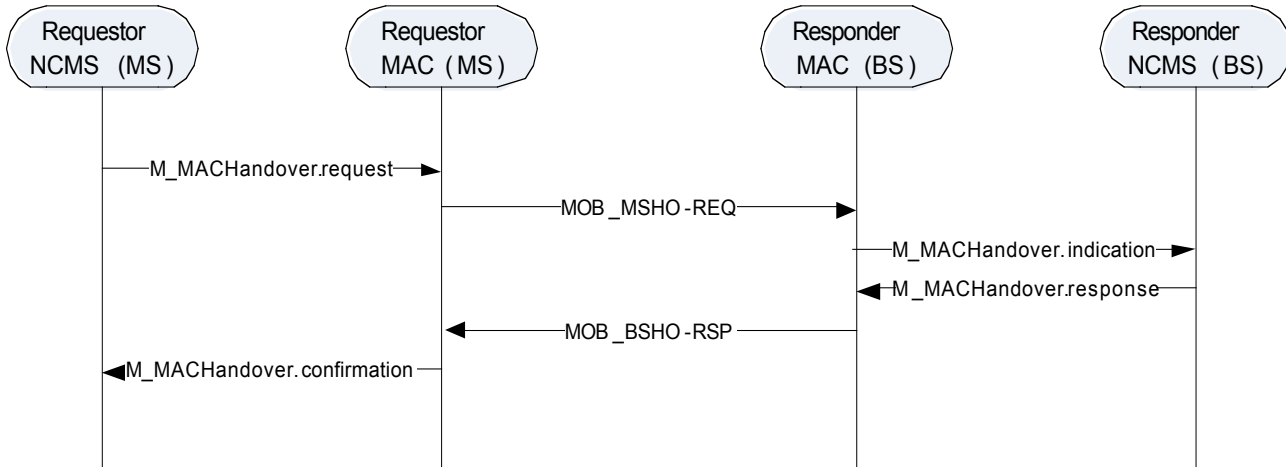


Fig 7: The use of Handover Primitives

14.5.14.7.1 M_MACHandover.request

14.5.14.7.1.1 Function

This primitive requests MAC layer to send handover request message.

14.5.14.7.1.2 Semantics

M_MACHandover.request

(
 Source ,
 Destination ,
 N_Recommended ,
 Neighbor BS ID ,
)

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

14.5.14.7.1.3 When generated

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

14.5.14.7.1.4 Effect of receipt

MAC layer sends MOB_MSHO-REQ to BS

14.5.14.7.2 M_MACHandover.indication

14.5.14.7.2.1 Function

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

14.5.14.7.1.2 Semantics

M_MACHandover.indication

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

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			MS MAC Address
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.

14.5.14.7.1.3 When generated

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

14.5.14.7.1.4 Effect of receipt

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

14.5.14.7.2 M_MACHandover.response

14.5.14.7.2.1 Function

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

14.5.14.7.2.2 Semantics

M_MACHandover.response

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

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.

14.5.14.7.2.3 When generated

This primitive response to M_MACHandover.request

14.5.14.7.2.4 Effect of receipt

MAC layer of BS sends MOB_BSHO-RSP to MS

14.5.14.7.3 M_MACHandover.confirmation

14.5.14.7.3.1 Function

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

14.5.14.7.3.2 Semantics

M_MACHandover.confirmation

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

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.

14.5.14.7.3.3 When generated

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

14.5.14.7.3.4 Effect of receipt

The upper layer entity decides to do handover to target BS

14.5.14.8 M_HOIND.request/confirmation

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

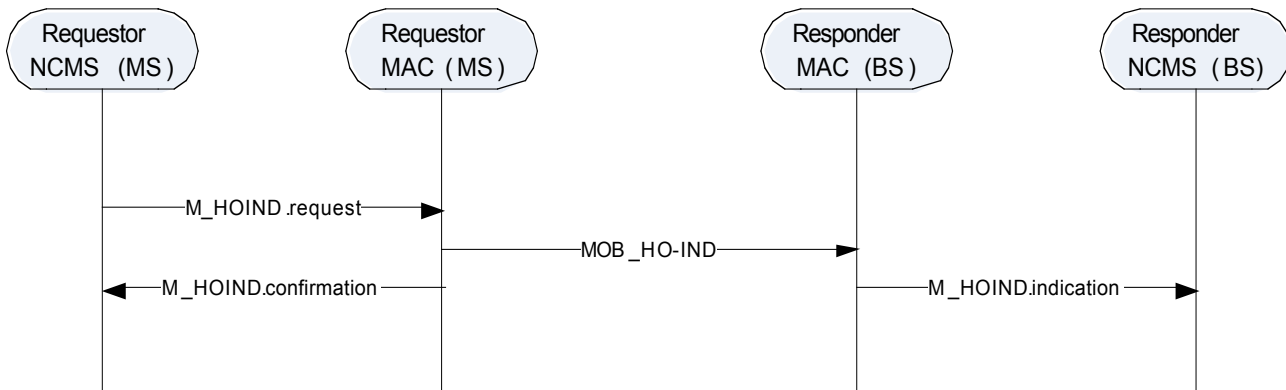


Fig 8: The use of Handover Indication Primitives

14.5.14.8.1 M_HOIND.request

14.5.14.8.1.1 Function

This primitive transfers the information about target BS to MAC layer

14.5.14.8.1.2 Semantics

M_HOIND.request
 (Source ,
 Destination ,
 HO_IND_type
 Target_BS_ID
)

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	
Target_BS_ID			Target BS ID for Handover

14.5.14.8.1.3 When generated

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

14.5.14.8.1.4 Effect of receipt

MS starts handover when HO_IND_type indicates 'handover'

14.5.14.8.2 M_HOIND.confirmation

14.5.14.8.2.1 Function

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

14.5.14.8.2.2 Semantics

M_HOIND.confirmation

```
(
  Source ,
  Destination ,
  Result Code
)
```

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_HO-IND message transmission

14.5.14.8.2.3 When generated

This primitive responds to M_HOIND.request

14.5.14.8.2.4 Effect of receipt

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

14.5.14.8.3 M_HOIND.indication

14.5.14.8.3.1 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.

14.5.14.8.3.2 Semantics

M_HOIND.indication

```
(
  Source ,
  Destination ,
  HO_IND_type
  Target_BS_ID
)
```

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	
-------------	-------------	--	--

14.5.14.8.3.3 When generated

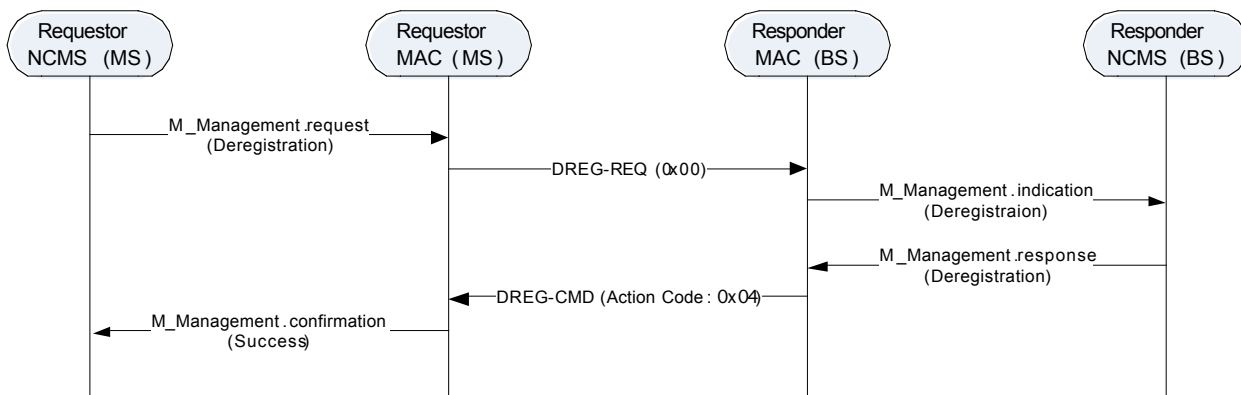
This primitive is generated when the MAC layer of BS receives MOB_HO-IND message

14.5.14.8.3.4 Effect of receipt

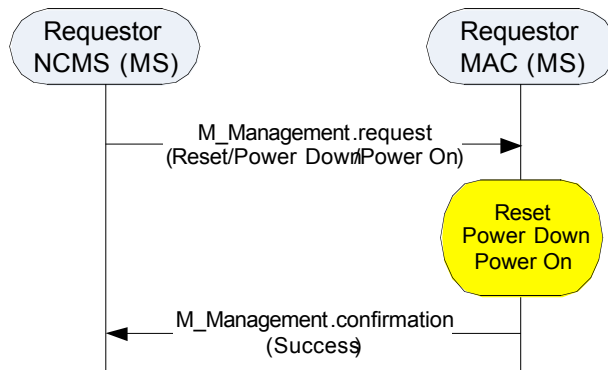
The upper layer is notified of MS's handover decision.

14.5.14.9 M_Management.request/indication/response/confirmation

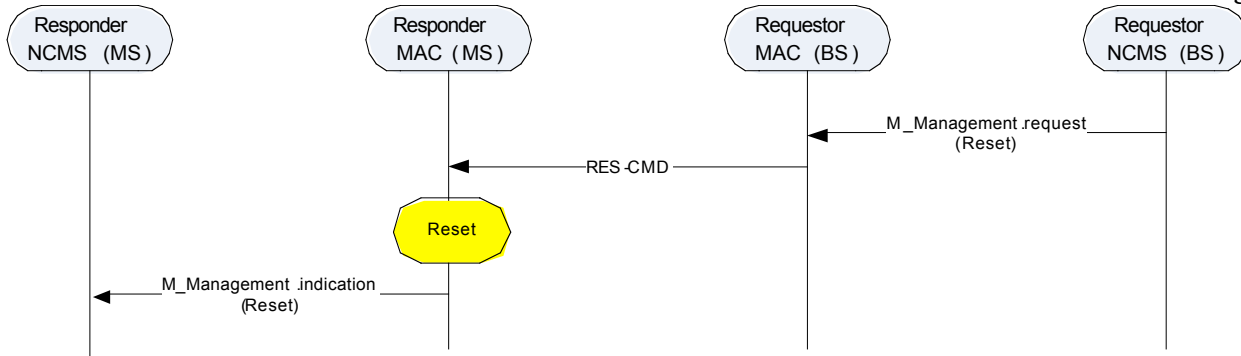
These primitives are used to manage the status of mobile terminal. Upper layer can change the status of mobile terminal into power on/down/hold/de-register, etc.



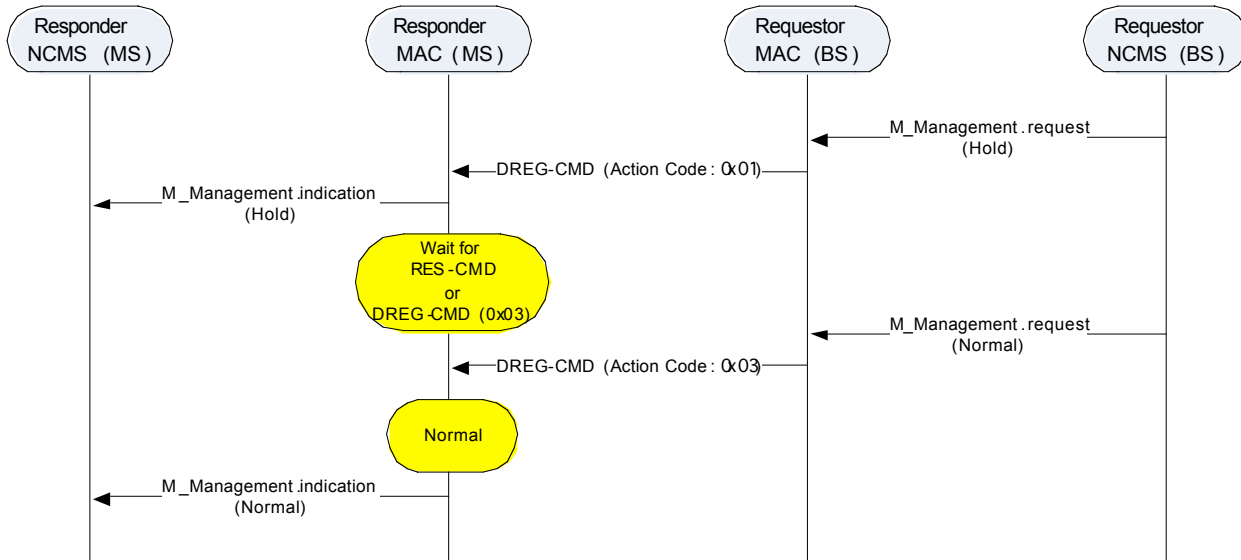
(a) Mobile registration deregistration from the BS and power off



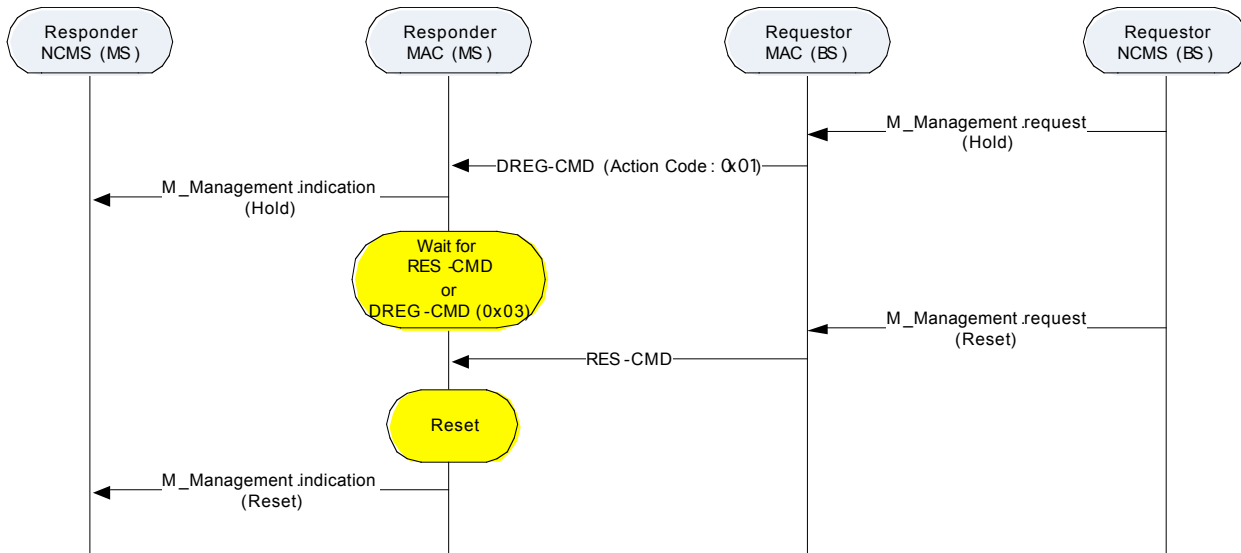
(b) Mobile node status management (reset / Power Down / Power On)



(c) Remote Reset by BS



(d) Remote control by BS



(e) Remote control by BS

14.5.14.9.1 M_Management.request

14.5.14.9.1.1 Function

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

14.5.14.9.1.2 Semantics

M_Management.request

```
(
    Source ,
    Destination ,
    MS Address ,
    Action Code
)
```

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

14.5.14.9.1.3 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 primitive is used to change the status, such as hold, reset, normal, etc. of the specific MSes, identified by MS addresses.

14.5.14.9.1.4 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.

14.5.14.9.2 M_Management.indication

14.5.14.9.2.1 Function

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

14.5.14.9.2.2 Semantics

M_Management.indication

```
(
    Source ,
    Destination ,
    MS Address ,
    Action Code
)
```

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
Action Code	Enumeration	Power on Power off Reset Deregistration Hold Normal	Type of management

14.5.14.9.2.3 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.

14.5.14.9.2.4 Effect of receipt

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

14.5.14.9.3 M_Management.response

14.5.14.9.3.1 Function

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

14.5.14.9.3.2 Semantics

M_Management.response

```
(
  Source ,
  Destination ,
  MS Address ,
  Action Code
)
```

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
Action Code	Enumeration	Power on Power off Reset Deregistration Hold Normal	Type of management

14.5.14.9.3.3 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.

14.5.14.9.3.4 Effect of receipt

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

14.5.14.9.4 M_Management.confirmation

14.5.14.9.4.1 Function

This primitive transmits the result of status changes.

14.5.14.9.4.2 Semantics

M_Management.confirmation

```
(
  Source ,
  Destination ,
  Result
)
```

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

14.5.14.9.4.3 When generated

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

14.5.14.9.4.4 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.