Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Revision of Hand-over Mechanism for Mobility Enhancement**
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Re:	Response to IEEE 802.16e-03/23 (Call for Contributions on IEEE 802.16e/07r4) Response to Session 27 Minutes remand C802.16e-03/54r0 to Ad Hoc Group for refinement and continued revision
Abstract	Clarification, revision, and definition of Hand-over mechanism for Mobility Enhancements
Purpose	Stimulate discussion on a more completely defined, flexible model and mechanism for facilitating mobility functionality
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Revision of Hand-over Mechanism for Mobility Enhancement

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Introduction

The mobility enhancements proposed in IEEE 802.16e-03/07r4 provide an initial framework for a robust mechanism to conduct mobility based on the IEEE 802.16 prior art. However, the current definition suffers several significant over-specifications in some areas; and critical omissions in other areas—notification mechanisms for initiation of hand-over and recovery on failed or terminated hand-over attempts being the most noticeable and objectionable. A systemic review of the model and mechanism provides insight into ways to streamline the solution, eliminate inconsistencies, and fill-in persistent holes.

Systemic Assumptions

Establishing some systemic assumptions grants us an opportunity to create criteria for evaluating the merit of various solution mechanisms. My simple set includes:

- Mobility support for fixed, portable, mobile SS additions/modifications to existing standard
  - Enhancements to existing and proposed fixed standards only
    - Minimize changes to only what is necessary to accomplish task
    - Optional solutions whenever possible; avoid over-specification of new requirements
  - Support of all three multimedia modes of use on the same network seamlessly
    - Minimize performance impact on other modes of operation to support optional modes/multimedia
- Support for multimedia/timing sensitive traffic intrinsic/not just supported
  - Support of all three types of multimedia with adequate service granularity to enable meaningful market models
    - Minimize air interface and network performance impact of changes to support larger concurrent subscriber base with most robust performing multimedia set
    - Network and MSS may perform some activities less efficiently in order to conserve performance in other more critical areas
      - For instance an MSS may elect to temporarily use a course Ranging negotiated value that is moderately inefficient on UL power consumption in order to expedite a soft hand-over
- Support for variety of network configurations, sophistication, relationships
  - Minimize specification that limits configuration, operation, and interaction; only specify what is required to achieve mobility goals

- Not possible to completely predict all of the forms of successful network configuration; err on the side of flexibility and minimalism

- MSS more sophisticated than fixed device; more sophisticated knowledge, more complex decisions
  - Support for variety of MSS provisioned service profiles
  - MSS may be either use a centrally managed or distributed decision architecture for everything from authentication and service provisioning to hand-over mechanisms
    - MSS may have a great deal of knowledge about operating environment; things that connected network may be insensitive to
  - MSS may have other relationships
    - Private network connections
    - Foreign network connections
  - MSS has requirement to continuously evaluate its operating environment and assess mobility, network, and service options
    - MSS may be out-of-touch from connected network for periods while analyzing and assessing options
  - MSS has power conservation requirements
    - MSS may be out-of-touch from connected network for periods on power conservation
- Network is resource gatekeeper/master control for network resources
  - He who controls the resources has final say on the allocation of those resources
  - Resource conservation, especially air interface conservation, is priority
  - Network or MSS may make decisions that reduce MSS allocated QoS in order to maximize other performance criteria

Observations on Current IEEE 802.16e-03/07r4 Based on Criteria from Assumptions

1. **Neighbor Advertisement, Scanning, and Ranging for Hand-over**

Problem:

For mobility, MSS have a consistent periodic need to evaluate their changing operating environment. This requirement exceeds the periodic 6.2.10 proscribed periodic ranging for fixed SS and includes MSS interest in viewing other networks, a concept foreign to fixed SS networks.

In the current proposal, the solution mechanism includes BS neighbor broadcast advisories, MSS scanning and possibly ranging nearby same and foreign network BS.

BS neighbor broadcast currently contains inadequate information for SS to base distributed information hand-over decisions on and would necessitate MSS scanning and possibly ranging, likely with unacceptable frequency, of nearby BS to determine suitability for hand-over, even for BS on the same network. Excessive scanning is undesirable because it results in frequent absence of the MSS from the Serving BS scheduler and

unavailability to initiation of timing sensitive DL traffic. Excessive ranging is undesirable because it unnecessarily consumes ranging contention slots and UL/DL scheduler slots on Target BS, impacting effective throughput, service granularity, and support for timing sensitive traffic. Inclusion of Beacon TLV elements is a careful balancing act between mobility prosecution efficiency and air interface/backhaul loading. Implementers should maintain flexibility by leaving TLV inclusions optional.

Remedy:

Expand the role and increase the TLV data provided in MOB_NBR-ADV broadcast message. This will decrease the need for MSS to scan and range same network neighbor BS to obtain information useful in making hand-over/network re-entry decisions. Also, MOB_NBR-ADV beacon can be scanned and used by MSS on initial network entry to identify those networks to which it has provisioned affiliation and may be interested in establishing connection without having to scan and range all nearby BS. Make TLV items optional. Decrease frequency of Beacon events and allow flexible Beacon-to-Beacon structure to decrease overhead.

Remedy Action 1:

*[In **1.4.1.2.1.1 Network topology advertisement**, replace paragraph 1 in its entirety with:]*

'A BS may periodically broadcast information about the network topology using the BEA-ADV MAC broadcast management message. An MSS may decode this message to find out information about the parameters of available networks and neighbor BS. Each MSS will thus be able to assess interest in joining the network and synchronize quickly with neighbor BS.'

Remedy Action 2:

In *P802.16-REVd/D1-2003*, **6.4.2.3.2 Downlink Map (DL-MAP) message**, paragraph 5, Base Station ID defines Operator ID as 'The most significant 24 bits…' of the Base Station ID 48 bit value. This is very restrictive to both the Base Station ID (cannot use MAC address for Base Station ID) and for Operator ID. Need to create a separate 24 bit Operator ID for the network. We can broadcast the Operator ID less frequently using the **6.4.2.3.44 Beacon Network Broadcast Advisory (MOB_BEA-ADV) management message** and still get the same benefit of '…a network management hook that can be combined with the Downlink Channel ID of the DCD message for handling edge-of-sector and edge-of-cell situations.'

*[Replace P802.16-REVd/D1-2003, **6.4.2.3.2 Downlink Map (DL-MAP) message**, paragraph 5 with:]*

'**Base Station ID**

The Base Station ID is a 48-bit long field uniquely identifying the BS. The Base Station ID shall be programmable.'

Remedy Action 3:

*[Replace **6.4.2.3.44 Neighbor Advertisement (MOB_NBR-ADV)** in its entirety with:]*
'**6.4.2.3.44 Beacon Network Broadcast Advisory (MOB_BEA-ADV) management message**

An MOB_BEA-ADV management message may be broadcast by a BS at a periodic interval (BEA-ADV interval, see Table 118a2) to identify the network and define the characteristics of neighbor BS to potential MSS seeking initial network entry or hand-over, and to identify the network to foreign networks. The BS may restrict MOB_BEA-ADV to data covering only BS sharing the same Operator ID. BS may restrict MOB_BEA-ADV to data changed during BEA-ADV interval. BS may include all, select, or no TLV data in MOB_BEA-ADV. BS may vary TLV data elements included in MOB_BEA-ADV message from message to message.

Table 84d—MOB_BEA-ADV Beacon Broadcast

Syntax	Size	Notes
MOB_BEA-ADV_Message_Format() {		
Management Message Type=48	8 bits	
BS ID	48 bits	Base station unique identifier (Same number as that broadcasted on the DL-MAP message)
Operator ID	48 bits	Unique Network ID
Configuration Change Count	8 bits	
TLV encoded items	Variable	See Table 292a
}		

A BS shall generate MOB_BEA-ADV messages in the format shown in Table 56ad. The following parameters shall be included in the MOB_BEA-ADV message unless otherwise noted as an optional item in which case they may be included,

BS ID — same as the Base Station ID parameter in the DL-MAP message

Operator ID — the unique network ID shared by an association of BS

Configuration Change Count – Incremented by one (modulo 256) whenever any of the values relating to any included data element changes. If the value of this count in a subsequent MOB_BEA-ADV message remains the same, the MSS can quickly disregard the entire message

All other parameters are coded as TLV values (see Table 292a). All TLV items are optional.

Network Type — defines networks based on service management type and prosecution of non-affiliated MSS connection. The following encodings apply:
0=not specified
1=managed, restricted; ASA function is network managed, MSS access to the network is restricted to affiliated MSS
2=managed, provisional; ASA function is network managed, MSS access to the network is restricted to affiliated MSS, however, limited access may be provided to non-affiliated MSS
3=managed, unrestricted; ASA function is network managed, MSS access to the network is unrestricted
4=unmanaged, restricted; ASA function is either static or unmanaged, MSS access to the network is restricted to affiliated MSS
5=unmanaged, provisional; ASA function is either static or unmanaged, MSS access to the network is restricted to affiliated MSS, however, limited access may be provided to non-affiliated MSS

6=unmanaged, unrestricted; ASA function is either static or unmanaged, MSS access to the network is unrestricted
other=reserved

Time Stamp — number of milliseconds since midnight GMT

BS Next Beacon — estimated time interval in milliseconds until next BS beacon event

BS Next Contention Network Entry — estimated time interval in frames until next BS contention based SS network entry interval

BS Network Managed Handover Supported — binary value indicating support for network managed MSS hand-over at BS. 0=no; 1=yes

BS Air Interface Advertised Bandwidth —a coarse, implementation specific calculated value

BS Air Interface Available Bandwidth — a coarse, implementation specific calculated value

BS Backhaul Advertised Bandwidth — a coarse, implementation specific calculated value

BS Backhaul Available Bandwidth — a coarse, implementation specific calculated value

N_QoS_Records — Number of AvailableQoSParamSet Records

Service Class Code — Code of Service Class in AvailableQoSParamSet

N_Neighbors – Number of advertised neighbor BS

For each advertised Neighbor BS, the following TLV parameters may be included,

Neighbor BS-ID – Same as the Base Station ID parameter in the DL-MAP message of Neighbor BS

Configuration Change Count – Incremented by one (modulo 256) whenever any of the values relating to any included TLV data element changes. If the value of this count in a subsequent MOB_BEA-ADV message remains the same, the MSS can quickly disregard the entire message

Neighbor Operator ID — the unique network ID shared by an association of BS; may be omitted if same as for transmitting BS

Neighbor Network Type — defines networks based on service management type and prosecution of non-affiliated MSS connection. The following encodings apply:
0=not specified
1=managed, restricted; ASA function is network managed, MSS access to the network is restricted to affiliated MSS
2=managed, provisional; ASA function is network managed, MSS access to the network is restricted to affiliated MSS, however, limited access may be provided to non-affiliated MSS

3=managed, unrestricted; ASA function is network managed, MSS access to the network is unrestricted
4=unmanaged, restricted; ASA function is either static or unmanaged, MSS access to the network is restricted to affiliated MSS
5=unmanaged, provisional; ASA function is either static or unmanaged, MSS access to the network is restricted to affiliated MSS, however, limited access may be provided to non-affiliated MSS
6=unmanaged, unrestricted; ASA function is either static or unmanaged, MSS access to the network is unrestricted
other=reserved

Neighbor Physical Frequency – DL center frequency (kHz).

Neighbor Time Stamp — number of milliseconds since midnight GMT when neighbor info created for transfer to Serving BS

Neighbor BS Next Beacon — estimated time interval in milliseconds from Time Stamp until next BS beacon event

Neighbor BS Next Contention Network Entry — estimated time interval in frames until next BS contention based SS network entry interval

Neighbor BS Network Managed Handover Supported — binary value indicating support for network managed MSS hand-over at Neighbor BS

Neighbor DCD_Settings — DCD_settings is a compound TLV value that encapsulates a DCD message that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MSS with the advertised BS downlink. The DCD settings fields shall contain only neighbor's DCD TLV values which are different from the serving BS corresponding values. For values that are not included, the MSS shall assume they are identical to the serving BSs corresponding values.

Neighbor UCD_Settings — UCD_settings is a compound TLV value that encapsulates a UCD message that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MSS with the advertised BS uplink. The UCD settings fields shall contain only neighbor's UCD TLV values which are different from the serving BS's corresponding values. For values that are not included, the MSS shall assume they are identical to the serving BS's corresponding values.

Neighbor BS Air Interface Advertised Bandwidth — a coarse, implementation specific calculated value

Neighbor BS Air Interface Available Bandwidth — a coarse, implementation specific calculated value

Neighbor BS Backhaul Advertised Bandwidth — a coarse, implementation specific calculated value

Neighbor BS Backhaul Available Bandwidth — a coarse, implementation specific calculated value'

Neighbor N_QoS_Records — Number of AvailableQoSParamSet Records

Neighbor Service Class Code — Code of Service Class in AvailableQoSParamSet'

Remedy Action 4:

*[Replace **11.1.8 NBR-ADV Message Encodings** in its entirety with:]*

‘**11.1.8 BEA-ADV Message Encodings**

Table 292a—BEA-ADV Encodings

Name	Type (1 byte)	Length (1 byte)	Value (Variable-length)
Network Type	?	8 bits	0=not specified; 1=managed, restricted; 2=managed, provisional; 3=managed, unrestricted; 4=unmanaged, restricted; 5=unmanaged, provisional; 6=unmanaged, unrestricted; other=reserved
Time Stamp	?	32 bits	Number of milliseconds since midnight GMT (set to 0xffffffff to ignore)
BS Next Beacon	?	16 bits	Estimated time interval in frames until next BS beacon event
BS Next Contention Network Entry	?	8 bits	Time interval in frames until next BS contention based SS network entry interval; value=0 indicates feature not supported
BS Network Managed Handover Supported	?	1 bit	Binary 0=no; 1=yes
BS Air Interface Advertised Bandwidth	?	32 bits	In bits per second
BS Air Interface Available Bandwidth	?	32 bits	In bits per second
BS Backhaul Advertised Bandwidth	?	32 bits	In bits per second
BS Backhaul Available Bandwidth	?	32 bits	In bits per second
N_QoS_Records	?	8 bits	Number of AvailableQoSParamSet Records
For (j=0 ; j<N_QoS_Records ; j++) {			
Service Class Code	?	8 bits	Code of Service Class in AvailableQoSParamSet

}			
N_Neighbors	?	8 bits	Number of advertised BS neighbors
For (j=0 ; j<N_Neighbors ; j++) {			
Neighbor BS-ID	?	48 bits	
Neighbor Operator ID	?	48 bits	Unique Network ID
Neighbor Network Type	?	8 bits	0=not specified; 1=managed, restricted; 2=managed, provisional; 3=managed, unrestricted; 4=unmanaged, restricted; 5=unmanaged, provisional; 6=unmanaged, unrestricted; other=reserved
Neighbor Time Stamp	?	32 bits	Number of milliseconds since midnight GMT (set to 0xffffffff to ignore)
Neighbor BS Next Beacon	?	16 bits	Time interval in frames until next neighbor BS beacon event
Neighbor BS Next Contention Network Entry	?	16 bits	Time interval in frames until next neighbor BS contention based SS network entry interval; value=0 indicates feature not supported
Neighbor BS Network Managed Handover Supported	?	1 bit	Binary 0=no; 1=yes
Neighbor DCD_Settings	?	Variable	DCD_settings is a compound TLV that encapsulates an entire DCD message (excluding the generic MAC header). All the rules and settings that apply to the DCD message apply to the contents encapsulated in this TLV.
Neighbor UCD_Settings	?	Variable	UCD_settings is a compound TLV value that encapsulates an entire UCD message (excluding the generic MAC header). All the rules and settings that apply to the UCD message apply to the contents encapsulated in this TLV.
Neighbor BS Air Interface Advertised Bandwidth	?	32 bits	In bits per second
Neighbor BS Air Interface Available Bandwidth	?	32 bits	In bits per second
Neighbor BS Backhaul Advertised Bandwidth	?	32 bits	In bits per second
Neighbor BS Backhaul Available Bandwidth	?	32 bits	In bits per second
Neighbor N_QoS_Records	?	8 bits	Number of AvailableQoSParamSet Records

For (h=0 ; h<N_QoS_Records ; h++) {			
Neighbor Service Class Code	?	8 bits	Code of Service Class in AvailableQoSParamSet
}			
}			

‘

Remedy Action 5:

*[In **10.1 Global Values, Table 275a—Parameters and Constants**, pages 39&40, modify as:]*

In order to partially compensate for the increased DL data load introduced by the more extensive MOB_BEA-ADV broadcast management message, change references from ‘NBR-ADV’ to ‘BEA-ADV’ in Table 275a and extend the MAX interval for BEA-ADV interval to 30 seconds. Could dynamically reduce applied interval based on cell characteristics and transient MSS requirements.

Remedy Action 6:

One useful mechanism for building neighbor BS relationships for reporting in MOB_BEA-ADV is to have MSS periodically provide scanning results to the Serving BS. The advantages of this solution type are that 1) the MSS can provide information about BS on both affiliated and foreign networks that may impact MSS hand-over decisions, that the Serving network might otherwise be unaware; and 2) that this model allows for dynamic neighbor BS table creation and maintenance thus not requiring static programming or centralized management. This solution requires the creation of INF-REQ and INF-RSP MAC management messages. SS_INF-REQ/RSP provides some similar information to REP-REQ/RSP but far less detailed and for a much broader frequency domain. We can also provide other useful information about the MSS like Home Network ID, Authentication Server Address (that holds the MSS provisioned service profile and account status), Mobility Support Type (0=none, 1=portable, 2=mobile, SS managed hand over, 3=mobile, network managed hand over), Power Type (A/C, battery), Power Status (10% increments), other?? We also need to add a timer to expire aged Neighbor BS from the Neighbor BS table. And we need to add the relevant backbone messages to maintain neighbor relationships between affiliated BS and pass the relevant information for reporting in MOB_BEA-ADV.

*[In **1.4.1.2.1.1 Network topology advertisement**, append to end of section:]*

‘BEA-ADV Neighbor BS associations may be acquired by static or dynamic configuration. Static sources may include implementation configuration of the BS and/or configuration of the BS through another network management device. Dynamic sources may include Neighbor BS identified and reported to the Serving BS by attached MSS through SS_INF-RSP management messages. In dynamic association operation, BS may identify each other over the backhaul network as Neighbor BS using the **C.2.9 Neighbor_Notification.request message**, **C.2.10 Neighbor_Notification.response message** and **C.2.11 Neighbor_Notification confirmation message**.

Neighbor BS operational and performance TLV data for BEA-ADV broadcast may be assembled by the BS using **C.2.12 Neighbor_Info message** and/or **C.2.4 MSS-info-response messages**.’

Add new MAC Data/Control Plane sub-section:

*[Add **6.4.2.3.51 SS_INF-REQ management message**-]*

‘**6.4.2.3.51 SS_INF-REQ message**

A BS may transmit an SS_INF-REQ message to an SS at any time to obtain SS operating information and neighbor and foreign network BS measurements. The message shall be transmitted on the MSS basic CID.

Table 84l—SS_INF-REQ message format

Syntax	Size	Notes
SS_INF-REQ _Message_Format() {		
Management Message Type = 55	8-bits	
}		

A BS shall generate SS_INF-REQ messages in the format shown in Table 84l.’

*[Add **6.4.2.3.52 SS_INF-RSP management message**-]*

‘**6.4.2.3.52 SS_INF-RSP message**

A MSS shall transmit an SS_INF-RSP message to a BS in response to an SS_INF-REQ or may send an unsolicited SS_INF-RSP to a BS. The message shall be transmitted on the basic CID.

Table 84m—SS_INF-RSP message format

Syntax	Size	Notes
SS_INF-REQ _Message_Format() {		
Management Message Type = 56	8 bits	
Mobility Support Type	4 bits	What, if any, type of mobility functionality the MSS supports. 0=none; 1=portable; 2=mobile, MSS managed hand over; 3=mobile, network managed hand over; other=reserved
Power Type	4 bits	Disclosure of what power source the MSS employs. 0=line power; 1=battery power; other=reserved
Power Status	4 bits	Disclosure of current MSS power supply status. Value provided as whole number representing the tens grouping of percentage of power

		remaining, in 10% increments, rounded up
TLV Encoded information	Variable	TLV specific, See Table 321a
}		

A BS shall generate SS_INF-RSP messages in the format shown in Table 84m. The following parameters shall be included in the SS_INF-REQ message unless otherwise noted as an optional item in which case they may be included,

Mobility Support Type — Disclosure of what, if any, type of mobility functionality the MSS supports. The following encodings apply:

0=none

1=portable

2=mobile, MSS managed hand over

3=mobile, network managed hand over

other=reserved

Power Type — Disclosure of what power source the MSS employs. The following encodings apply:

0=line power

1=battery power

other=reserved

Power Status — Disclosure of current MSS power supply status. Value provided as whole number representing the tens grouping of percentage of power remaining, in 10% increments, rounded up (i.e. 18% power remaining would report a value of 2; 31% power remaining would report a value of 4; 97% power remaining would report a value of 0).

All other parameters are coded as TLV values (see Table 321a). All TLV items are optional.

Home Network ID — Operator ID of default network to which MSS is associated; only include if different than Serving BS Operator ID

Authentication Server Address — Address of ASA network device that holds the MSS provisioned service profile and account status for the MSS

N_Neighbors – Number of discovered neighbor BS

For each neighbor BS, the following parameters shall be included,

Neighbor BS-ID – Same as the Base Station ID parameter in the DL-MAP message of neighbor BS

Neighbor BS Operator ID — the unique network ID shared by an association of BS; only include if different than Serving BS Operator ID

Neighbor BS Physical Frequency – DL center frequency (kHz).

Neighbor BS S/(N + I) –This parameter indicates the signal to noise and interference ratio measured by the MSS from the particular BS. The value shall be interpreted as an unsigned byte with units of 0.25dB.

Neighbor BS Service level prediction – This value indicates the level of service the MSS can expect from this BS. The following encodings apply:

0 = No service possible for this MSS; service level undetermined.

1 = Some service is available for the MSS.

2 = Service with QoS specified at ASA server (for the MSS identified by the 48-bit MAC address) is available.'

Remedy Action 6a:

*[Add **11.1.9 INF-RSP Message Encodings**]*
'11.1.9 INF-RSP Message Encodings

Table 321a— INF-RSP Encodings

Name	Type (1 byte)	Length (1 byte)	Value (Variable-length)
Home Network ID	?	48 bits	Operator ID of default network to which MSS is associated
Authentication Server Address	?	48 bits	Address of ASA network device that holds the MSS provisioned service profile and account status for the MSS
N_Neighbors	?	8 bits	Number of discovered neighbor BS
For (j=0 ; j<N_NEIGHBORS			

; j++) {			
Neighbor BS-ID	?	48 bits	Same as the Base Station ID parameter in the DL-MAP message of neighbor BS
Neighbor BS Operator ID	?	48 bits	the unique network ID shared by an association of BS
Neighbor BS Physical Frequency	?	32 bits	DL center frequency (kHz).
Neighbor BS S/(N + I)	?	8 bits	This parameter indicates the signal to noise and interference ratio measured by the MSS from the particular BS. The value shall be interpreted as an unsigned byte with units of 0.25dB
Neighbor BS Service level prediction	?	8 bits	This value indicates the level of service the MSS can expect from this BS. 0 = No service possible for this MSS/service level undetermined; 1 = Some service is available for the MSS; 2 = Service with QoS specified at ASA server (for the MSS identified by the 48-bit MAC address) is available
}			

‘

Remedy Action 7:

To support dynamic neighbor table administration, need to add Neighbor_Notification.request, Neighbor_Notification.response, and Neighbor_Notification.confirmation backbone messages to **Annex C.1**. Also, need to add Neighbor_Info backbone message to C.1 to periodically transfer Neighbor BS information between neighbor associated BS regardless of the mechanism employed to build the Neighbor BS table.

*[In **C.1 Backbone network services, Table C1—Backbone Network Services**, page 44, modify as:]*

for data row 2, ‘Provide a BS with the identity of its neighbors’, in column 2 ‘Possible Method for Providing service’, add third option ‘(3) Build list from SS_INF-RSP obtained from MSS’

*[In **C.1 Backbone network services**, change **Table C1—Backbone Network Services**, page 44, append the following rows to the end of the table:]*

Service	Possible Method for Providing service	Comments
Provide Neighbor Notification request	Sending BS notifies affiliated BS that Sending BS considers affiliated BS a Neighbor for Neighbor BS purposes	Message format and transport protocol need to be specified for interoperability.

Provide Neighbor Notification response	Affiliated BS response to Sending BS request for Neighbor BS designation	Message format and transport protocol need to be specified for interoperability.
Provide Neighbor Notification confirmation	Sending BS confirmation of Affiliated BS response to Sending BS request for Neighbor BS affiliation	Message format and transport protocol need to be specified for interoperability.

*[Add new sub-section to **C.2 Inter-base station message formats**:]*

‘**C.2.9 Neighbor_Notification.request message**

An originating BS may send a Neighbor_Notification.request to another BS indicating it considers the BS a Neighbor BS.

Table C9—Neighbor_Notification request message

Field	Size	Notes
Global Header	152 bits	
Security Field	TBD	A means to authenticate this message
CRC Field	32 bits	IEEE CRC-32

‘

Note: Need Management Message ID Number for Global Header

*[Add new sub-section to **C.2 Inter-base station message formats**:]*

‘**C.2.10 Neighbor_Notification.response message**

A notified BS shall respond with a Neighbor_Notification.response message confirming or denying a Neighbor_Notification request. If the neighbor relationship is affirmed, both BS shall place each other on their dynamic Neighbor BS tables and begin aging timer (Neighbor-Aging-Timer, see Table 275a).

Table C10—Neighbor_Notification response message

Field	Size	Notes
Global Header	152 bits	
ACK/NACK	1 bit	Acknowledgement or Negative acknowledgement. 0=Negative acknowledgement which means that

		the notified BS refuses to accept neighbor association with the originating BS 1=Acknowledgement which means that the notified BS accepts neighbor association with the originating BS
Security Field	TBD	A means to authenticate this message
CRC Field	32 bits	IEEE CRC-32

‘

Note: Need Management Message ID Number for Global Header

*[Add new sub-section to **C.2 Inter-base station message formats**:]*

‘**C.2.11 Neighbor_Notification confirmation message**

The originating BS shall confirm acknowledgement of receipt of the Neighbor_Notification.response using a Neighbor_Notification confirmation message.

Table C11—Neighbor_Notification confirmation message

Field	Size	Notes
Global Header	152 bits	
Security Field	TBD	A means to authenticate this message
CRC Field	32 bits	IEEE CRC-32

‘

Note: Need Management Message ID Number for Global Header

*[Add new sub-section to **C.2 Inter-base station message formats**:]*

‘**C.2.12 Neighbor_Info message**

Each BS may send a Neighbor_Info message on periodic intervals (Neighbor_Info interval, see Table 275a) to each other BS on its Neighbor BS table. Also, immediately following sending of a positive Neighbor_Notification.response message, the notified BS shall send a Neighbor_Info message to the originating BS of the Neighbor_Notification request message.

Table C12—Neighbor_Info message

Field	Size	Notes

Global Header	152 bits	
BS ID	48 bits	Base station unique identifier (Same number as that broadcasted on the DL-MAP message)
Operator ID	48 bits	Unique Network ID
Network Type	8 bits	0=not specified; 1=managed, restricted; 2=managed, provisional; 3=managed, unrestricted; 4=unmanaged, restricted; 5=unmanaged, provisional; 6=unmanaged, unrestricted; other=reserved
Time Stamp	32 bits	Number of milliseconds since midnight GMT (set to 0xffffffff to ignore)
BS Next Beacon	16 bits	Time interval in frames until next BS beacon event
BS Next Contention Network Entry	8 bits	Time interval in frames until next BS contention based SS network entry interval; value=0 indicates feature not supported
BS Network Managed Handover Supported	1 bit	Binary 0=no; 1=yes
BS Air Interface Advertised Bandwidth	32 bits	In bits per second
BS Air Interface Available Bandwidth	32 bits	In bits per second
BS Backhaul Advertised Bandwidth	32 bits	In bits per second
BS Backhaul Available Bandwidth	32 bits	In bits per second
N_QoS_Records	8 bits	Number of AvailableQoSParamSet Records
For (j=0 ; j<N_QoS_Records ; j++) {		
Service Class Code	8 bits	Code of Service Class in AvailableQoSParamSet
}		
Security Field	TBD	A means to authenticate this message
CRC Field	32 bits	IEEE CRC-32

‘

Note: Need Management Message ID Number for Global Header

*[In **10.1 Global Values, Table 275a—Parameters and Constants**, pages 34&40, append to table:]*

System	Name	Time Reference	Min. Value	Default Value	Max. Value
BS	Neighbor_Info	Nominal time between			600s

	interval	transmission of Neighbor_Info messages			
BS	Neighbor-Aging-Timer	Nominal time for aging of BS neighbor association and removal from the dynamic Neighbor BS table	3600s		

2. **Association**

Problem:

I am not sure I see an important reason to keep Association as a distinct concept in the doc. The adoption of the changes to max power/initial power setting (this is a mandatory use item) in IEEE 802.16d/r2 6.2.9.5 provides a good shortcut method for curtailing lengthy Ranging negotiation--exactly Association's proposed function. Certainly, given that you would be using the IEEE 802.16d/r2 6.2.9.5 method during Ranging to get Association to begin with, IEEE 802.16d/r2 6.2.9.5 likely provides as good of a shortcut mechanism to minimize the Ranging negotiation interval during actual handover as Association is likely to provide.

Remedy:

Make 'Association' a passive function performed by MSS and attached to 6.4.9.5 Initial Ranging. Modify relevant section dedicated to Association. Eliminate MSS Association Channel ID TLV item for RNG-REQ. It serves no purpose since we have added Serving BS ID. As currently defined, MSS Association Channel ID requires ASA to implement and manage; unnecessary to maintain uniqueness.

Remedy Action 1:

*[Replace **1.4.1.2.1.3 Association Procedure** in its entirety with:]*

'**1.4.1.2.1.3 Association**

Association is an optional table notation maintenance procedure occurring after MSS Ranging of a BS. The Association relationship function is to memorialize MSS successful Scanning and Ranging of a BS for the purpose of expediting a potential future hand-over of the MSS to the then Target BS. MSS may store successful Ranging information for Associated BS for the purpose of setting initial Ranging values in a future Ranging event, possibly associated with a hand-over, to the Associated BS.

Upon completion of a successful MSS initial-ranging of a BS as specified in *IEEE P802.16-REVd/D1-2003 "Part 16: Air Interface for Fixed Broadband Wireless Access Systems"* section **6.4.9.5 Initial ranging and automatic adjustments** with the extensions specified in **11.1.4 REG-RSP TLVs for connection re-establishment**, **Table 290a—RNG-REQ Message Encodings**, if the RNG-RSP message contains a Service Level Prediction parameter set to 2, the MSS marks the BS as Associated in its MSS local Association table of identities, recording elements of the RNG-RSP to the MSS local Association table, and setting an appropriate aging timer (See **Table 275a—Parameters and Constants**, ASC-AGING-TIMER). Association state in the

MSS local Association table shall be aged-out after ASC-AGING-TIMER timeout and the Association entry removed.

While Association is current (aging timer has not expired), MSS may use recorded Associated Ranging values to set initial Ranging values in a new initial Ranging event to the same Associated BS. An MSS may have several Associated BS in its local Association table concurrently and shall use the respective stored Associated Ranging values only with the related Associated BS.

Information on Association may be reported by the MSS to its Serving BS in periodic **6.4.2.3.52 SS_INF-RSP messages** to the Serving BS.'

Remedy Action 2:

*[In **10.1 Global Values, Table 275a—Parameters and Constants**, pages 34&40, append to table:]*

System	Name	Time Reference	Min. Value	Default Value	Max. Value
SS	Serving BS ID AGING-TIMER	Nominal time for aging of Serving BS association. Timer recycles on successful Serving BS DL-MAP read			5s

Remedy Action 3:

*[In **6.4.2.3.5 Ranging Request (RNG-REQ) message**, page 17, lines 9-12, modify as:]*

'The following parameters may be included in the RNG-REQ message:

Serving BS ID — the BS ID of the BS to which the MSS is currently connected (has completed complete registration cycle and is in Normal Operation). Serving BS ID shall not be included if interval timer is timed-out (Serving BS ID AGING-TIMER, see **Table 275a—Parameters and Constants**). Inclusion of Serving BS ID in the RNG-REQ message signals to the Target BS that the MSS is currently connected to the network through Serving BS and is in the process of either a hand-over or network re-entry.'

Remedy Action 4:

*[In **6.4.2.3.6 Ranging Response (RNG-RSP) message**, page 17, lines 19&20, modify as:]*

change reference from '**MSS Association Channel ID TLV**' to '**Serving BS ID TLV**'

Remedy Action 5:

*[In **11.1.3 RNG-REQ message encodings**, replace **Table 289a—RNG-REQ Message Encodings** with:]*

‘**Table 289a—RNG-REQ Message Encodings**

Name	Type (1 byte)	Length (1 byte)	Value (Variable-length)
Serving BS ID	4	6	the BS ID of the BS to which the MSS is currently connected (has completed complete registration cycle and is in Normal Operation)

‘

Remedy Action 6:

*[In IEEE P802.16-REVd/D1-2003 “Part 16: Air Interface for Fixed Broadband Wireless Access Systems” section **6.4.9.5 Initial ranging and automatic adjustments**, page 173, insert the following between lines 27 & 29:]*

‘For SS that are employing the optional Association procedure, and to which the SS and BS are currently Associated, the SS may use its un-expired, previously obtained and retained associated Ranging values to set initial ranging values including $P_{TX_IR_MAX}$ power levels.’

3. **Scanning, Ranging, and Sleep**

Problem:

The fact that we have created a logical separation/use distinct between 'sleep' mode and 'scanning' mode seems unnecessary. When determining whether differentiating mechanically, I think it best to look at impact on the Serving BS and network when assessing the importance of maintaining a logical distinction. All the network cares is that the SS is 'unavailable' during the described interval, for whatever reason, and that the Serving BS should not schedule any DL/UL slots addressed to the SS. What the SS does during that interval of absence is irrelevant to the Serving BS and network and does not affect the mechanics of the standard.

There is benefit to unifying the two concepts for performance reasons, as well as conceptually. We spent some time at the last meetings talking about re-synchronization on timing for SS returning from 'sleep' mode. We did not make similar correction for SS returning from 'scanning' mode. By combining the allocation mechanism for both under the 'sleep' mode rules we effectively eliminate that problem for 'scanning', and any other logical use, as well.

Finally, we also made changes to SLP-REQ allowing for single iteration 'sleep' intervals which, in instances were a single 'sleep' interval is specified, eliminates the need for a TRF-IND. And there is need to support a succession of same-duration sleep intervals to support a series of Scanning and/or Ranging events while allowing the MSS to return and ‘listen’ during interleaving intervals. The geometric algorithm currently

proposed in 16eR4 precludes this procedure and require a succession of repetitive SLP-REQ/RSP actions that can be avoided by a minor reconfiguration of the algorithm.

Remedy:

Delete the separate rules allocation for Scanning. Expand the definition and rules for 'Sleep' mode to be more flexible and generalized as an MSS 'Unavailable' period. Create an appropriate aging timer for Serving BS to consider connection to MSS in 'Sleep' mode lost.

Remedy Action 1:

*[Delete **1.4.1.2.1.2 MSS Scanning of neighbor BS** in its entirety.]*

Remedy Action 2:

*[Delete **6.4.2.3.45 Scanning Interval Allocation Request (MOB_SCN-REQ) message** in its entirety.]*

Remedy Action 3:

*[Delete **6.4.2.3.46 Scanning Interval Allocation Response (MOB_SCN-RSP) message** in its entirety.]*

Remedy Action 4:

omitted

Remedy Action 5:

*[In **6.4.2.3.41 Sleep Request message (MOB_SLP-REQ),** replace **Table 84a—Sleep-Request (MOB_SLP-REQ) message format** with:]*

'**Table 84a—Sleep-Request (MOB_SLP-REQ) message format**

Syntax	Size	Notes
MOB_SLP-REQ_Message_Format() {		
Management Message Type=45	8 bits	
reserved	2 bits	
initial-sleep window	6 bits	
sleep-window factor	4 bits	
final-sleep window	12 bits	
sleep-window iterations	8 bits	
}		

'

*[In **6.4.2.3.41 Sleep Request message (MOB_SLP-REQ)**, paragraph 2, replace current paragraph with:]*

‘Parameters shall be as follows:

initial-sleep window

Requested start value for sleep-window for the sleep-interval (measured in frames).

sleep-window factor

Multiplying factor for increasing the sleep-window value through multiple sleep-window iterations

final-sleep window

Requested maximum sleep-window value for the sleep-interval (measured in frames).

sleep-window iterations

Number of iterations of sleep-window to perform prior to completing sleep-interval’

*[In **6.4.2.3.42 Sleep Response message (M0B_SLP-RSP),** replace **Table 84b—Sleep-Response (MOB_SLP-RSP) message format** with:]*

‘**Table 84b—Sleep-Response (MOB_SLP-RSP) message format**

Syntax	Size	Notes
MOB_SLP-RSP_Message_Format() {		
Management Message Type=46	8 bits	
Sleep approved	1 bit	0: Sleep-mode request denied 1: Sleep-mode request approved
If (Sleep-approved == 0) {		
After-REQ-action	3 bits	000: The MSS may retransmit the MOB_SLP-REQ message at any time 001: The MSS shall retransmit the MOB_SLP-REQ message after the time duration (REQ-duration) given by the BS in this message 010: The MSS shall not retransmit the MOB_SLP-REQ message and wait the MOB_SLP-RSP message from the BS 011:111: Reserved
REQ-duration	4 bits	Time duration for case where After-REQ-action value is 001.
} else {		
Reserved	3 bits	
Start frame	7 bits	lower byte of the frame number in which the SS shall enter into sleep mode

initial-sleep window	6 bits	
sleep-window factor	4 bits	
final-sleep window	12 bits	
sleep-window iterations	8 bits	
}		
}		

‘

*[In **6.4.2.3.42 Sleep Response message (M0B_SLP-RSP)**, paragraph 2, replace current paragraph with:]*

‘Parameters shall be as follows:

Sleep approved

Response indication whether or not SS request to enter sleep-mode has been approved by the BS.

0: Sleep-mode request denied

1: Sleep-mode request approved

After-REQ-action

On SS request to enter sleep-mode rejected by the BS, indicates recourse action.

000: The MSS may retransmit the MOB_SLP-REQ message at any time

001: The MSS shall retransmit the MOB_SLP-REQ message after the time duration (REQ-duration) given by the BS in this message

010: The MSS shall not retransmit the MOB_SLP-REQ message and wait the MOB_SLP-RSP message from the BS

011:111: Reserved

REQ-duration

Waiting value for the MOB_SLP-REQ message re-transmission (measured in frames)

Start-frame

Lower byte of the frame number in which the SS shall enter into sleep mode.

initial-sleep window

Start value for sleep-window for the sleep-interval (measured in frames).

sleep-window factor

Multiplying factor for increasing the sleep-window value through multiple sleep-window iterations

final-sleep window

Maximum sleep-window value for the sleep-interval (measured in frames).

sleep-window iterations

Number of iterations of sleep-window to perform prior to completing sleep-interval.’

*[In **6.4.16 Sleep-mode for mobility-supporting SS**, **6.4.16.1 Introduction**, pages 26&27, paragraphs 1 thru 10, replace current section with:]*

‘Sleep-mode is a mode in which SS’s supporting mobility may power down, scan neighbor and foreign network BS, range neighbor and foreign network BS, or perform other activities for which the MSS will be unavailable to the Serving BS for DL or UL traffic. Sleep-mode is intended to enable mobility-supporting SS’s to minimize

their energy usage and facilitate hand-over decision and operation while staying connected to the network, but sleep-mode use should not be narrowly interpreted. Implementation of sleep-mode is optional.

An SS that supports sleep-mode can be in one of two modes:

— Awake
— Sleep

When an SS is in awake-mode, it is receiving and transmitting PDUs as in Normal Operation. When the SS is in sleep-mode, it does not send or receive PDUs. When an SS is in sleep-mode, it has no obligation to listen to DL traffic and may power-down one or more physical operation components.

Two intervals are defined:

Sleep-interval
A time duration, measured in whole frames, where the SS is in sleep-mode. The sleep-interval is constructed of one or more variable-length, consecutive sleep-windows, with interleaved listening intervals, through one or more iterations. During consecutive sleep-windows comprising a single sleep-interval , sleep-window may be updated using an increasing algorithm with an adjustable maximum limit.

Listening-interval
Length, measured in whole frames, of the listening interval. During this interval the SS shall decide whether to stay awake or go back to sleep based on an indication from the BS. The Listening-interval parameter is reported to the SS in REG-RSP.

Before entering sleep-mode the SS shall inform the BS using MOB_SLP-REQ and obtain its approval. Serving BS shall respond with a MOB_SLP-RSP message. Serving BS may send an unsolicited MOB_SLP-RSP to SS to initiate SS sleep-interval. Upon Serving BS transmittal of an affirming MOB_SLP-RSP, Serving BS shall initiate aging timer (MSS Sleep-Aging-Timer, see Table 275a) to coincide with initiation of sleep-interval at start-frame. The BS may buffer (or it may drop) incoming PDUs addressed to the sleeping SS, and shall send notification to the SS in its listening-interval about whether data has been addressed for it during a preceding sleep-window.

An SS shall awaken, enter into an interleaved listening-interval, according to the sleep-interval and check whether there were PDUs addressed for it. The listening-interval parameter defines the number of frames the SS shall remain awake waiting for a TRF-IND message. If such PDUs exist, the SS shall remain awake, terminating the sleep-interval and re-entering Normal Operation. An SS may terminate sleep-mode and return to awake-mode anytime (i.e. there is no need to wait until the sleep-interval is over). If the BS receives an MPDU from an SS that is supposed to be in sleep-mode, the BS shall assume that the SS is no longer in sleep-mode. Any UL message from the SS to the Serving BS shall interrupt the sleep-interval, shall signal the Serving BS that the SS is still active and connected and has not dropped connection during its sleep-interval, and the Serving BS shall terminate the aging timer (MSS Sleep-Aging-Timer, see Table 275a).

Traffic indication message (TRF-IND) shall be sent by the BS on the broadcast CID during each appropriate MSS listening interval. If the number of positive indications is zero, the BS sends an empty indication message, that is, TRF-IND message with num-positive=0.

Upon completion of sleep-interval, the SS shall awaken and return to Normal Operation. .

If the intervening interval of MSS absence exceeds the aging timer, then the Serving BS shall assume loss of connection to the MSS and process as if it had received a backbone message announcing another BS becoming the Serving BS for the specified MSS (see section Backbone network HO procedures).'

*[In **10.1 Global Values**, **Table 275a—Parameters and Constants**, pages 39&40, append row to table:]*

System	Name	Time Reference	Min. Value	Default Value	Max. Value
BS	MSS Sleep-Aging-Timer	Nominal time for aging of MSS Sleep disconnect.			10500s

*[In **6.4.16.2 Sleep-interval update algorithm**, page 34, paragraph 1, replace current paragraph with:]*

'An SS shall enter sleep-mode, at the appropriate frame proscribed by start-frame, after receiving an MOB_SLP-RSP message from the BS. The MSS shall use the following algorithm for calculating and performing the sleep-interval:

$$\{ \; I_k = min\{\text{initial-sleep window} + \text{initial-sleep window} \bullet \text{sleep-window factor} \bullet (k-1)\}, \text{final-sleep window} \} \; k > 0, k < \text{sleep-window iterations}$$

```
For (j=0 ; j<sleep-window iterations ; j++) {
    sleep-window = initial-sleep window + initial-sleep window * (sleep-window factor * (j – 1))
    If (sleep-window > final-sleep window) {
        sleep-window = final-sleep window
    }
    Process SS sleep for sleep-window duration
    If (sleep-window iterations > 1) {
        Process SS listening for listening interval duration
    }
}
```

Upon completion of sleep-interval, SS and BS shall return to Normal Operation.'

*[In **6.4.16.3 Traffic indication signaling**, page 35, replace current paragraphs with:]*

'A BS shall notify each SS in sleep-mode, during its listening-interval, if traffic has been addressed to the SS during any sleep-window iteration. The indication shall be sent on the TRF-IND broadcast message. The SS shall examine the frame number from the PHY Synchronization Field during each listening-interval and shall verify synchronization with the BS. If the expected frame number is different than the discovered frame number, the SS shall return to awake mode, Normal Operation. Similarly, if the SS does not find the expected TRF-IND broadcast message, the SS shall return to awake mode, Normal Operation.

If the SS does not find any positive indication with its CID in the TRF-IND message, or no CID in the TRF-IND message matches the SS's basic CID, it shall consider this as a negative indication and shall continue in sleep mode through the next sleep-window iteration. For an example of sleep mode operation, see Annex D.'

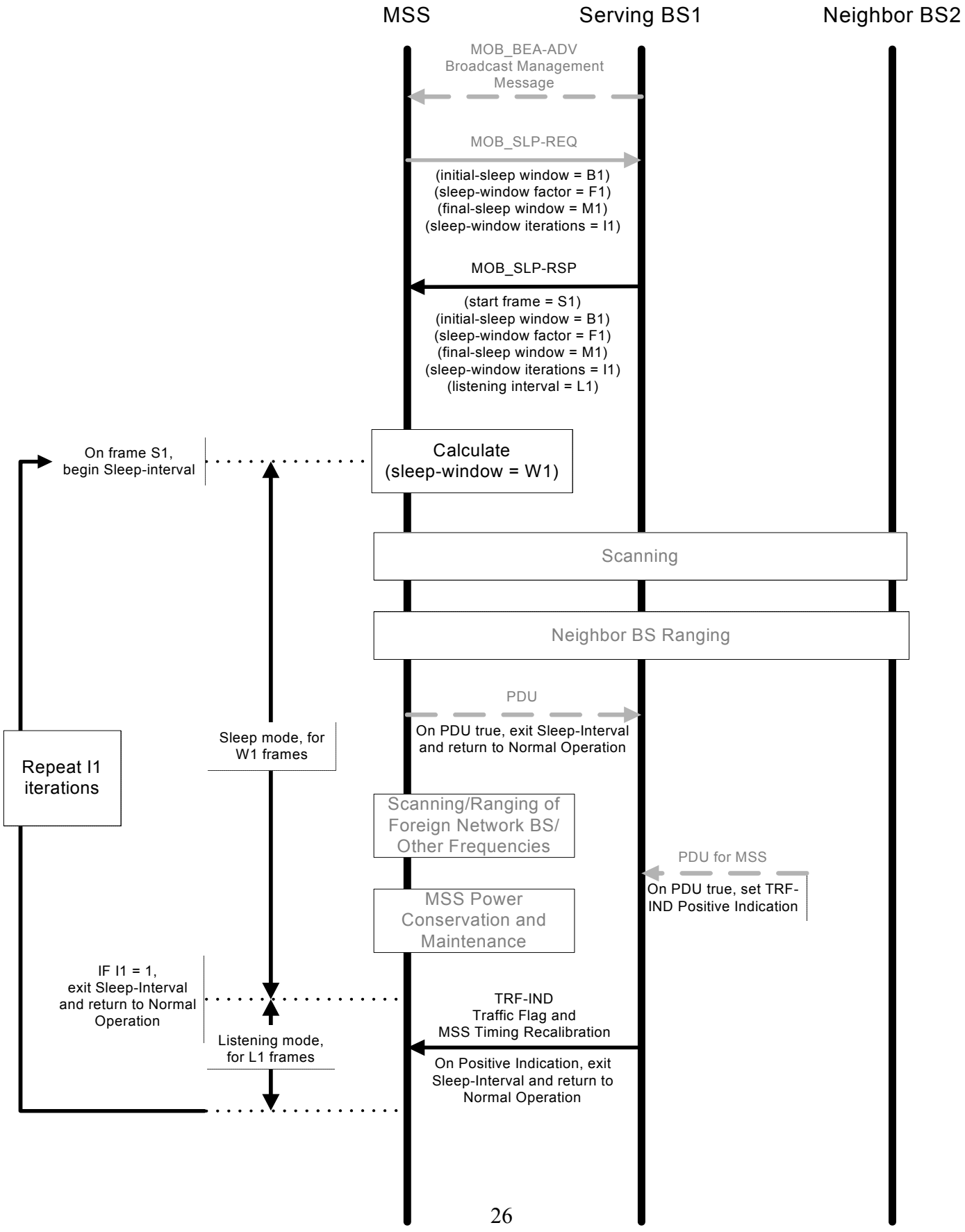
*[In **10.1 Global Values, Table 275a—Parameters and Constants**, pages 39&40, modify as:]*

delete the second row of data entirely: Max_sleep_interval. Max_sleep_interval is appropriately constrained by virtue of the max values of its constituent variables. Max_sleep_interval calculates as 1,038,592 frames under current constraints. This will probably equal to about 5,193 seconds, which should be acceptable. Should this number be seen as too high, it is far preferable to reduce the bit size of some of the constituent variables to reduce Max_sleep_interval.

*[In **10.1 Global Values, Table 275a—Parameters and Constants**, pages 39&40, modify as:]*

delete the third row of data entirely: Listening_interval. Listening interval is now being set as a global variable expressed as a REG-RSP TLV through **11.4.14.1 Listening Interval**.

*[In **Annex D.2**, page 61, replace **Figure D.10** with:]*


MSS
Serving BS1
Neighbor BS2
MOB_BEA-ADV
Broadcast Management
Message
MOB_SLP-REQ
(initial-sleep window = B1)
(sleep-window factor = F1)
(final-sleep window = M1)
(sleep-window iterations = I1)
MOB_SLP-RSP
(start frame = S1)
(initial-sleep window = B1)
(sleep-window factor = F1)
(final-sleep window = M1)
(sleep-window iterations = I1)
(listening interval = L1)
On frame S1,
begin Sleep-interval
Calculate
(sleep-window = W1)
Scanning
Neighbor BS Ranging
PDU
On PDU true, exit Sleep-Interval
and return to Normal Operation
Repeat I1
iterations
Sleep mode, for
W1 frames
Scanning/Ranging of
Foreign Network BS/
Other Frequencies
PDU for MSS
On PDU true, set TRF-
IND Positive Indication
MSS Power
Conservation and
Maintenance
IF I1 = 1,
exit Sleep-Interval
and return to Normal
Operation
TRF-IND
Traffic Flag and
MSS Timing Recalibration
Listening mode,
for L1 frames
On Positive Indication, exit
Sleep-Interval and return to
Normal Operation

*[In **Annex D.2**, pages 62 & 63, delete **Figures D.11** and **D.12** entirely]*

4. **Hand-over**

Problem:

As currently defined, mechanics for hand-over are incomplete or poorly defined. Elements are out of order. Specifically, too many HO process elements are unnecessarily made 'mandatory' instead of 'optional', impose excessive amounts of overhead not providing additional functionality or security to the HO process, are excessively restrictive instead of being enabling and permissive, and fail to take advantage of opportunities for corrective or recovery actions that would streamline and increase the utility and robustness of the HO process.

Remedy:

Revise hand-over process.

Remedy Action 1:

The language in the introductory paragraph for Network Reference Model for Mobile Communications is unnecessarily restrictive.

It is entirely possible to have smaller private mobile networks, say, using Mobile IP to facilitate a campus mobile network. Also, these networks may be partially or completely 'unmanaged', that is to say not a sophisticated AAA support system on the backbone, not a sophisticated hand-over management infrastructure. And there should be some discussion of the core concept that defines a 'mobile' network, that is MSS peforming intra- or inter-network hand-overs. Soft hand-overs are Persistence of Active Service Flows during relocation of network attachment point.

*[In **1.4.1.1 Network reference model**, **1.4.1.1.1 Entities**, page 3, paragraph 1, replace paragraph with:]*

'The network reference model consists of BS units providing contigious/non-contigious service coverage across a distributed geographic region where the BS units are connected by a backbone network and share network affiliation. The reference network may be public or private, managed or unmanaged, restricted entry or open connection. Multiple networks, of varying design and performance and operated by disparate operators may coexist in the same geography. Depending on the relationship of the varying operators, configuration of the networks, operational deployment, etc..., MSS may perform uninterrupted, persistent active service flow hand-over (soft hand-over) or interrupted, persistent active service flow hand-over (hard hand-over) between BS on the same or disparate networks. Hand-overs may be intra- or inter-network. Hand-over management may be centrally controlled or employ a distributed decision mechanism, or some combination thereof. Back-bone networks may employ sophisticated centralized AAA (Authorization, Authentication and Accounting), management, provisioning or other specialized servers. Specifically, those servers responsible for authentication and service authorization are collectively referred to as ASA-server(s) and may be single, multiple, centralized or distributed. The operation of these servers with the BS and MSS is specified to the extent of defining the control messages.'

Remedy Action 2:

Language problems with paragraph. Correct reference to Association.

*[In **1.4.1.1.4 MSS Service Context**, page 6, paragraph 2, sentences 2 & 3, replace with:]*

'For each SU certain AuthorizedQoSParamSet shall be provisioned identified by the corresponding Service Class name. In the initial Network Entry, Ranging and Hand-over processes, MSS shall request from the Target BS certain QoS levels per Active Service Flow, differentiated by Service Class and represented by AuthorizedQoSParamSet. The BS shall respond with name of Service Class available for the Service Flow. This Service Class will become AdmittedQoSParamSet in the case of successful Network Entry/HO.'

Remedy Action 3:

In **1.4.1.1.4 MSS Service Context**, page 6, paragraph 3, lines 1, 2, 3, and 4, and **Table 1d**

Inappropriate references to 'permanent IP address' and association of a 'permanent IP address' with the MSS home attachment point for Mobile IP.

Inappropriate reference to 6.4.14 Dynamic Frequency Selection

Two requirements here that are being improperly bound and creating confusion:

1) No requirement for a 'permanent IP address' in 6.4.9; don't need it for mobility

2) Need network 'MSS Home Network address' referencing the home address attachment point for Mobile IP and other traffic forwarding mobility models

*[In **1.4.1.1.4 MSS Service Context**, page 6, paragraph 3, sentences 1 thru 4 & **Table 1d**, replace with:]*

'*Network Service* is defined as a service provided to the MSS by the network through a single, persistent IP address with particular connectivity and air-interface MAC parameters (including QoS properties). A MSS persistent IP address is defined as an MSS network connection address as allocated in 6.4.9.10 for as long as it remains persistent on the network. Connectivity properties, including Home Network address, are defined by specification in the MSS Configuration file in 6.4.9.12. QoS properties are those of Service Flow associated with the network service, as specified in 6.4.13.'

*[In **1.4.1.1.4 MSS Service Context**, page 6, **Table 1d**, row 2, change reference:]*

Replace 'Address of MSS at Home Network' with 'MSS Home attachment address'

Replace 'IP address of MSS at its Home Network. This address does not change while MSS travels from one BS to another' with 'MSS static configured home attachment point address for traffic forwarding mobile addressing model.'

*[Add new section TLV to **11.3 Configuration file encodings**:]*

‘**11.3.7 MSS Home Attachment address**:

For mobile enabled networks, MSS Home Attachment address defines the static reference address location for traffic forwarding mobility models

Type	Length	Value
??	4 or 16	IP Address

‘

Remedy Action 4:

Adding to, correcting language and structure for hand-over. Unifying hand-over/network initial entry/network re-entry into a single, rule based process with multiple correction opportunities, a more robust failure recovery mechanism, and lower air interface and backhaul overhead.

*[In **1.4.1.2.2 HO process**, page 8, paragraphs 1 thru 4, replace with:]*
‘The section defines the HO process in which an MSS migrates from the air-interface provided by one BS to the air-interface provided by another BS. The HO process consists of the stages:

Cell Selection — MSS may use Neighbor BS information acquired from a decoded BEA-ADV message, or may make uninformed decision, to schedule sleep-intervals to scan, and possibly range, Neighbor BS for the purpose of evaluating MSS interest in hand-over to potential Target BS. MSS may provide results of its scanning and ranging activity to Serving BS through SS_INF-RSP.

HO Decision — a hand-over begins with a decision for an MSS to hand-over its air interface, service flow, and network attachment from a Serving BS to a Target BS. The decision may originate either at the MSS, the Serving BS, or on the network. The HO Decision consummates with a notification of MSS intent to hand-over through HO-REQ. The HO notification is recommended, but not required. The HO notification may originate with either the Serving BS or MSS. Acknowledgement with HO-RSP of a notification is required.

Backbone HO Notification — Serving BS may notify Target BS(s) over the backbone network of MSS intent to hand-over to Target BS (see section Backbone network HO procedures). Serving BS may also send MSS information over the backbone that can expedite hand-over. If Target BS receives a backbone notification message, subsequent backbone HO notification response and confirmation messages are recommended, but not required.

Sleep — the MSS shall use sleep-interval to establish a working ‘unavailable’ service window with Serving BS to conduct network re-entry with Target BS. This mechanism permits continued

service with the Serving BS should the hand-over attempt fail or be aborted. The MSS shall send a SLP-REQ sleep request message, or Serving BS may send an unsolicited SLP-RSP sleep response message. The burden for message origination lies with the party that originated HO-REQ hand-over request. If MSS sends SLP-REQ, then Serving BS SLP-RSP is required. An MSS may continue the HO process even if the Serving BS fails to respond to a SLP-REQ, but not if SLP-RSP denies the sleep request. If denied, the MSS may re-attempt a SLP-REQ at the appropriate interval. If an MSS operational parameter changes after HO-REQ but prior to start-frame of an approved sleep-interval, MSS must abort the hand-over attempt, return to HO Decision, and re-notify the Serving BS of intent to hand-over.

Target BS Scanning — MSS shall scan Target BS for downlink channel & synchronization and uplink channel & synchronization. If MSS had previously decoded a BEA-ADV message including Target BS ID, Physical Frequency, DCD and UCD, then the scanning and synchronization process may be shortened. If the Target BS had previously received HO notification from Serving BS over the backbone (see section Backbone network HO procedures), then Target BS may place a non-contention based Fast_UL_ranging_IE MSS maintenance opportunity in the UL-MAP. MSS shall scan Target BS for UL-MAP that includes either a contention or non-contention based SS maintenance opportunity.

Network Re-entry — MSS and Target BS shall conduct Ranging per 6.2.9.5 to begin network re-entry. If MSS RNG-REQ includes an unexpired Serving BS ID and Target BS had not previously received MSS information over the backbone (see section Backbone network HO procedures), then Target BS may make an MSS information request of Serving BS over the backbone network and Serving BS may respond. Regardless of having received MSS information from Serving BS, Target BS may request MSS information from an Authorizing Station via the backbone network. Network re-entry proceeds per 6.2.9.5 except as may be shortened by Target BS possession of MSS information obtained from Serving BS over the backbone network. Network re-entry process completes with establishment of MSS normal operations.

Termination of Service — The final step in hand-over is any termination of MSS services with previous Serving BS. If Target BS had received a HO notification from Serving BS over the backbone (see section Backbone network HO procedures), or MSS RNG-REQ included an unexpired Serving BS ID, then Target BS may send a HO complete/Serving BS notification message over the backbone network to the Serving BS and any Authorizing Station. HO acknowledgement is recommended, but not required. Upon receipt of a HO complete/Serving BS notification message, Serving BS shall terminate all connections belonging to the MSS and the context associated with them (i.e. information in queues, ARQ state-machine, counters, timers, etc…, is discarded). Target BS now becomes the new Serving BS for all purposes.'

*[In **1.4.1.2.2.1 Cell Selection**, pages 9&10, paragraph 1, replace with:]*

'Cell Selection refers to the process of an MSS Scanning and/or Ranging one or more BS in order to determine suitability, along with other performance considerations, for network connection or hand-over. MSS may incorporate information acquired from a BEA-ADV message to give insight into available Neighbor BS for cell selection consideration. If currently connected to a Serving BS, an MSS shall schedule sleep-intervals to conduct Cell Selection for the purpose of evaluating MSS interest in hand-over to potential Target BS. Such procedure does not involve termination of existing connections to a Serving BS and their re-opening in a Target BS. If ranging a Target BS for hand-over, any newly assigned basic and primary CIDs are specific to the Target BS and do not replace or supplant the basic and primary CIDs the MSS employs in its communication with its Serving BS. MSS may provide results of its scanning and ranging activity to Serving BS through SS_INF-RSP.'

*[In **1.4.1.2.2.2 HO initiation**, pages 10&11, paragraph 1 thru 4, replace with:]*

'Either an MSS or a BS may initiate a HO by transmitting the MOB_MSSHO-REQ or MOB_BSHO-REQ MAC messages. Transmission of the HO-REQ MAC message is recommended, but not required.

When MOB_MSSHO-REQ is sent by an MSS, the MSS may indicate one or more possible Target BS. When MOB_BSHO-REQ is sent by a a Serving BS, the Serving BS may indicate one or more recommended Target BS. Serving BS criteria for recommendation of Target BS may include factors like expected Target BS QoS performance to MSS requirements. The MOB_MSSHO-REQ message may include an indication of the estimated time for performing the HO. Acknowledgement with MOB_xxxHO-RSP of a MOB_xxxHO-REQ notification is required. MSS actual pursuit of hand-over to Target BS in MOB_xxxHO-RSP is recommended, but not required. MSS may elect to attempt hand-over to a different Target BS, a Target BS that may or may not have been included in MOB_xxxHO-REQ, with the understanding that the different Target BS may not receive notification of the pending hand-over from the Serving BS over the backbone network prior to MSS initial Ranging of Target BS (see section Backbone network HO procedures). If the MSS signals rejection of Serving BS instruction to HO through HO_type field in the MSS_HO-RSP set value of 01 (HO reject option), the BS may reconfigure the Target BS list and retransmit MOB_HO-RSP message including a new Target BS list.

Serving BS may notify one or more Target BS over the backbone network of MSS intent to hand-over to Target BS (see section Backbone network HO procedures). Serving BS may also send MSS information to Target BS over the backbone that can expedite hand-over. If Target BS receives a backbone notification message, subsequent backbone HO notification response and confirmation messages, including expected post- hand-over MSS performance levels, are recommended, but not required.

After an MSS or BS has indicated intent to HO using MOB_xxxHO-REQ, the MSS may cancel the HO at any time prior to transmission of MOB_SLP-REQ. The cancellation may be made through transmission of a MOB_HO-IND with the HO cancel option (HO Type=01) or through the transmission of a new MOB_xxxHO-REQ message.'

*[In **1.4.1.2.2.3 HO cancellation**, page 11, relocate text to **1.4.1.2.2.2 HO initiation**, replace entire section with:]*

‘**1.4.1.2.2.3 Sleep and Hand-over**

The MSS shall use sleep-interval to establish a working ‘unavailable’ service window with Serving BS to conduct scanning, initial ranging and network re-entry with Target BS. This mechanism permits continued service with the Serving BS should the hand-over attempt fail or be aborted. The MSS shall send a MOB_SLP-REQ sleep request message, or Serving BS may send an unsolicited MOB_SLP-RSP sleep response message. The burden for message origination lies with the party that originated MOB_xxxHO-REQ hand-over request. If no MOB_xxxHO-REQ message was issued, then the requirement falls to the MSS. If MSS sends MOB_SLP-REQ, then Serving BS MOB_SLP-RSP is required. An MSS may continue the HO process even if the Serving BS fails to respond to a MOB_SLP-REQ, but not if MOB_SLP-RSP denies the sleep request. If denied, the MSS may re-attempt a MOB_SLP-REQ at the appropriate interval.

If an MSS operational parameter changes after MOB_xxxHO-REQ but prior to start-frame of an approved sleep-interval, MSS must abort the hand-over attempt, return to HO Decision, and re-notify the Serving BS of intent to hand-over.

MSS may abort the hand-over attempt at any time, for any reason, by aborting the sleep-interval and returning to normal operation with its Serving BS.’

*[In **1.4.1.2.2.4 Termination with the serving BS**, page 11, relocate text to **1.4.1.2.2.2 HO initiation**, replace entire section with:]*

‘**1.4.1.2.2.4 Scanning of Target BS**

During the sleep-interval attributed to hand-over, MSS shall scan Target BS for downlink channel & synchronization and uplink channel & synchronization. If MSS had previously decoded a BEA-ADV message including Target BS ID, Physical Frequency, DCD and UCD, then the scanning and synchronization process may be shortened. If the Target BS had previously received HO notification from Serving BS over the backbone (see section Backbone network HO procedures), then Target BS may place a non-contention based MSS maintenance opportunity using the PHY dependent Fast_UL_ranging_IE() (see 8.3.1.5.5.3.3 Fast ranging (Paging) Information Element, 8.4.6.3.4 Fast ranging (Paging) Information Element, and 8.5.5.3.5 & 8.5.5.3.6 Fast ranging (Paging) Information Element) in the UL-MAP. MSS shall scan Target BS for UL-MAP that includes either a contention or non-contention based SS maintenance opportunity.’

*[In **1.4.1.2.2.5 HO rejection**, page 11, relocate text to **1.4.1.2.2.2 HO initiation**, replace entire section with:]*

‘**1.4.1.2.2.5 Network Entry/Re-entry**

Unless otherwise excepted in this section, MSS mobile network entry/re-entry is processed according to **6.4.9 Network entry and initialization**. For purposes of this process, MSS network re-entry and hand-over are synonymous.

During its sleep-interval or at MSS initial entry, MSS and Target BS shall conduct Ranging per **6.4.9.5 Initial ranging and automatic adjustments** to begin network entry/re-entry except as MSS may take advantage of a

non-contention based SS maintenance opportunity if present. If MSS RNG-REQ includes an unexpired Serving BS ID and Target BS had not previously received MSS information over the backbone (see section Backbone network HO procedures), then Target BS may make an MSS information request of Serving BS over the backbone network and Serving BS may respond. Regardless of having received MSS information from Serving BS, Target BS may request MSS information from an Authorizing Station via the backbone network. Network re-entry proceeds per **6.4.9.5 Initial ranging and automatic adjustments** except as may be shortened by Target BS possession of MSS information obtained from Serving BS over the backbone network.

If Target BS had previously received an MSS-Info response message (see section Backbone network HO procedures) containing MSS information, Target BS may use the embedded TLV SBC-REQ information to build and send an unsolicited SBC-RSP message to MSS. Target BS may ignore only the first SBC-REQ message received if it sends an unsolicited SBC-RSP message. MSS is not required to send an SBC-REQ if it receives an unsolicited SBC-RSP prior to MSS attempt to send SBC-REQ.

If MSS RNG-REQ included an unexpired Serving BS ID and Target BS had previously received an MSS-Info response message (see section Backbone network HO procedures) containing MSS information, MSS and Target BS shall use the embedded TLV PKM-REQ information and the re-authorization process as defined in **7.2 PKM protocol**.

If Target BS had previously received an MSS-Info response message (see section Backbone network HO procedures), Target BS may use the embedded TLV REG-REQ & DSA-REQ information to build and send an unsolicited REG-RSP message. The REG-RSP message may include the New_CID, Old_CID, and Connection_Info TLVs. Target BS may ignore only the first REG-REQ message received if it sends an unsolicited REG_RSP message. MSS is not required to send an REG-REQ if it receives an unsolicited REG-RSP prior to MSS attempt to send REG-REQ.

If Target BS had previously received an MSS-Info response message (see section Backbone network HO procedures) that included the MSS Network Address in the embedded TLV, and provided that MSS Network Address is compatible with Target BS network addressing scheme, Target BS may skip most of the Network Address allocation process and re-provision the same address through an unsolicited Network Address Response. Target BS may ignore only the first Network Address discover message received if it sends an unsolicited Network Address response message. MSS is not required to send an Network Address discover if it receives an unsolicited Network Address response prior to MSS attempt to send Network Address discover.

If MSS RNG-REQ included an unexpired Serving BS ID, MSS and Target BS may skip Time of day process.

If MSS RNG-REQ included an unexpired Serving BS ID, MSS may skip the SS configuration file download procedure.

If MSS received a REG-RSP message that included the New_CID, Old_CID, and Connection_Info TLVs, MSS and Target BS may skip the establish connections procedure.

Network entry/re-entry process completes with establishment of MSS normal operations.'

*[Add new section **1.4.1.2.2.6 Termination of Service**:]*

‘**1.4.1.2.2.6 Termination of Service**

The final step in hand-over/network re-entry is any termination of MSS services with previous Serving BS. If Target BS had received a HO notification from Serving BS over the backbone (see section Backbone network HO procedures), or MSS RNG-REQ included an unexpired Serving BS ID, then Target BS may send a HO complete/Serving BS notification message over the backbone network to the Serving BS and any Authorizing Station. HO acknowledgement is recommended, but not required. Upon receipt of a HO complete/Serving BS notification message, Serving BS shall terminate all connections belonging to the MSS and the context associated with them (i.e. information in queues, MPDUs, ARQ state-machine, counters, timers, etc…). Regardless of transmittal of a HO complete/Serving BS notification message or its acknowledgment, Target BS now becomes the new Serving BS for all purposes.’

*[In **6.4.2.3.6 Ranging Response (RNG-RSP) message**, page 17, lines 43-58, relocate and append to IEEE P802.16-REVd/D1-2003 “Part 16: Air Interface for Fixed Broadband Wireless Access Systems”, **6.4.2.3.8 Registration Response (REG-RSP) message**:]*

‘For mobile networks, Target BS shall include New_CID, Old_CID, and Connection_Info TLVs in the REG-RSP for MSS recognized by the Target BS as performing HO or network re-entry by the presence of an unexpired Serving BS ID in the RNG-REQ. New_CID, Old_CID, and Connection_Info TLVs provide a shorthand method for renewing active connections used by the MSS in its previous Serving BS. The TLVs specify CID in the Target BS that shall replace active CID used in the previous Serving BS. Multiple iterations of these TLVs may occur in the REG-RSP suitable to re-creating and re-assigning all active Service Flows for the MSS from its previous Serving BS. If any of the Service Flow parameters change, then those Service Flow parameters and CS parameter encoding TLVs that have changed will be added. Only active Service Flows are transferred in this manner. These TLVs enable the Target BS to renew connections used in the previous Serving BS, but with different QoS settings.’

*[In **11.1.4 REG-RSP TLVs for connection re-establishment, Table 291a—REG-RSP Encodings**, page 41, replace as:]*

Table 291a—REG-RSP Encodings

Name	Type (1 byte)	Length (1 byte)	Value (Variable-length)
New_CID	TBD	2	New CID after handover to new BS.
Old_CID	TBD	2	Old CID before handover from old BS.
Connection_Info	TBD	Variable	Connection_Info is a compound TLV value that encapsulates the **Service Flow Parameters** and the **CS Parameter** that have changed for the service. All the rules and settings that apply to the parameters when used in the DSC-RSP message apply to the contents encapsulated in this TLV.

*[In **C.2.4 MSS-info-response message**, **Table C5—MSS-info-response Message**, page 46, modify as:]*

Remove duplicate row references to TLV SBC-REQ MAC messages

*[In **C.2.4 MSS-info-response message**, **Table C5—MSS-info-response Message**, page 46:]*

Add rows with appropriate references to TLV REG-REQ MAC messages

*[In **C.2.4 MSS-info-response message**, **Table C5—MSS-info-response Message**, page 46:]*

Add row with appropriate references to MSS Network Address

*[In **C.2.4 MSS-info-response message**, **Table C5—MSS-info-response Message**, page 46:]*

Add rows with appropriate references to populate Old_CID and Connection_Info TLVs for Target BS REG-RSP to MSS during hand-over.

*[In **1.4.1.2.3 Drops and corrupted HO attempts**, page 11, paragraph 2, append to end of paragraph:]*

'Serving BS can also detect a drop by MSS failure to communicate exceeding MSS Sleep-Aging-Timer.'

*[In **1.4.1.2.4 Re-entry with the target BS**, page 12, paragraph 1, replace entire paragraph with:]*

'Network re-entry is processed using the mechanics for hand-over as detailed in **1.4.1.2.2 HO process** and as shown in Figure 0f'

*[Delete **1.4.1.2.4.1 Synchronize with downlink and obtain parameters** thru **1.4.1.2.4.6 Commence Normal Operation** completely; text relocated to **1.4.1.2.2 HO process]***

*[In **C.2.2 I-am-host-of message**, page 45, paragraph 1, replace entire paragraph with:]*

'**C.2.2 HO complete/Serving BS notification message**

This message is sent by a BS to notify other BS (or the ASA server) that a certain MSS is registered with it. The primary use is to notify previous Serving BS and/or ASA or other network services access control administrator that MSS has successfully completed network entry or hand-over and that the BS originating the HO complete/Serving BS notification message is now the Serving BS for the MSS. The message may be sent upon MSS establishment of normal operation, and periodically on timer interval (MSS Registration-TIMER). The message might trigger a Neighbor BS to request more information on the MSS (either directly from the Serving BS, or from an ASA server). The message contains the following information,

Table C3—HO complete/Serving BS notification message'

*[In **10.1 Global Values**, **Table 275a—Parameters and Constants**, pages 39&40, modify as:]*

Append to end of table:

System	Name	Time Reference	Min. Value	Default Value	Max. Value
BS	MSS Registration-TIMER	Nominal time for aging of MSS registration association with Serving BS. Timer expiration may trigger re-registration, re-broadcast of MSS/Serving BS association, or other action.			86400s

*[In **C.2.7 HO-notification-confirm message**, page 48, entire section, replace with:]*

C.2.7 currently is useless duplication of C.2.6

‘**C.2.7 HO complete/Serving BS notification acknowledge message**

A BS may send a HO complete/Serving BS notification acknowledge message to acknowledge receipt of a HO complete/Serving BS notification message. The message contains the following information:

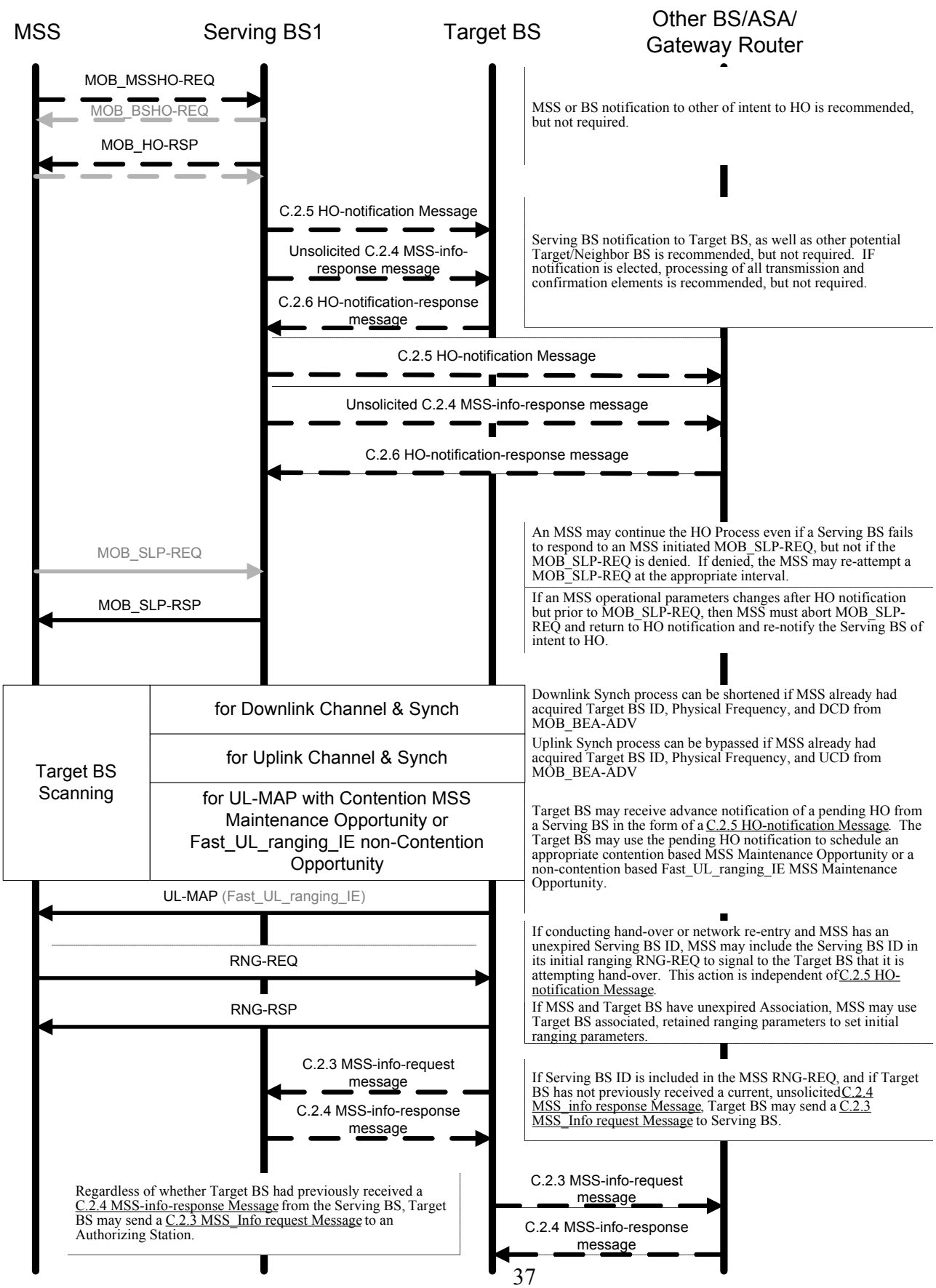
Table C8— HO complete/Serving BS notification acknowledge message

Field	Size	Notes
Global Header	152 bits	
Security Field	TBD	A means to authenticate this message
CRC Field	32-bits	IEEE CRC-32

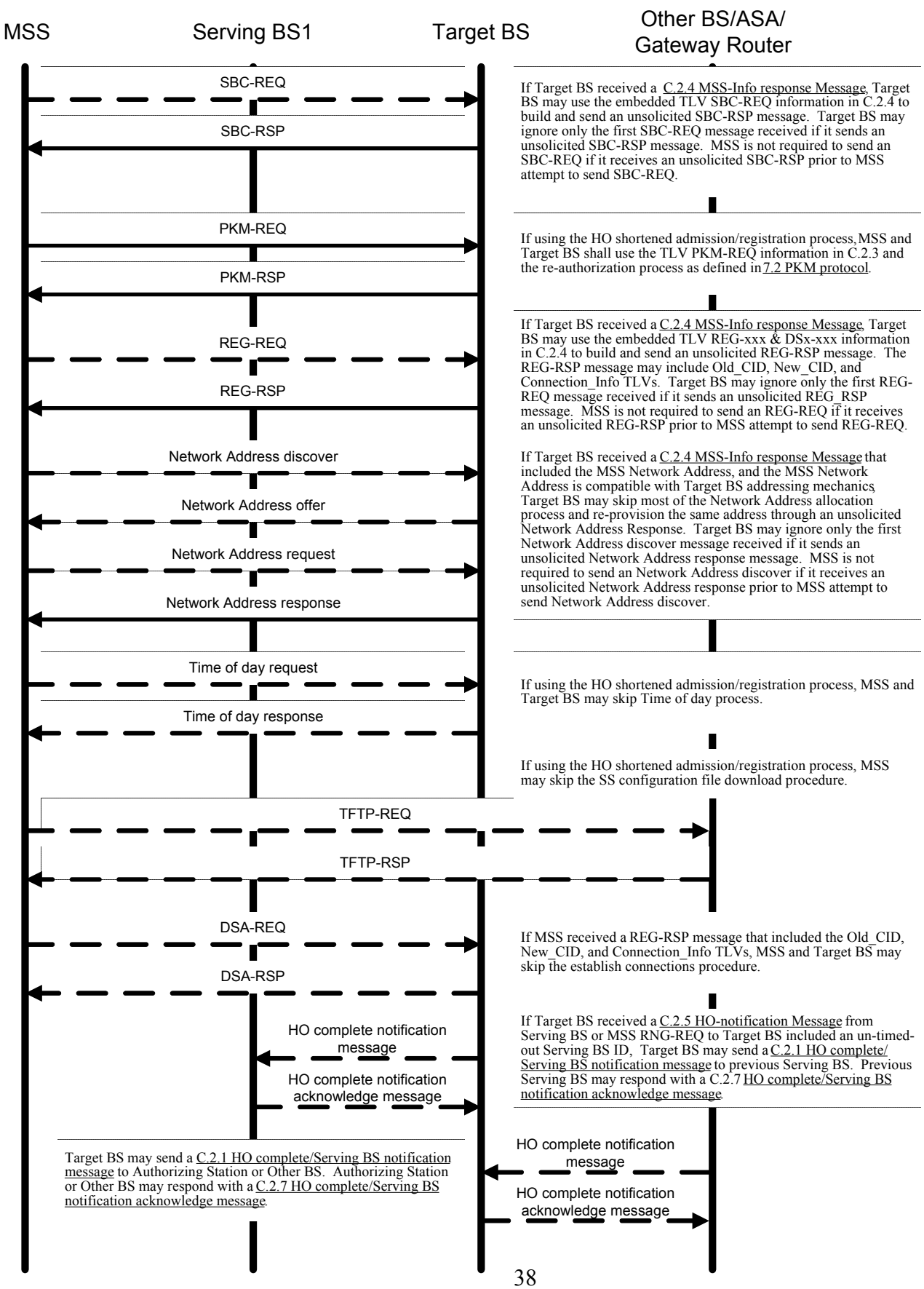
‘

Note: Need Management Message ID Number for Global Header

*[In **C.2.8 Example of Backbone Network HO procedure**, pages 48-50, delete **Figure C.2—Example of HO call flow by BS** entirely and replace **Figure C.1—Example of HO call flow by MS** with:]*



Continued on next page


MSS
Serving BS1
Target BS
Other BS/ASA/ Gateway Router
SBC-REQ
SBC-RSP
PKM-REQ
PKM-RSP
REG-REQ
REG-RSP
Network Address discover
Network Address offer
Network Address request
Network Address response
Time of day request
Time of day response
TFTP-REQ
TFTP-RSP
DSA-REQ
DSA-RSP
HO complete notification message
HO complete notification acknowledge message
HO complete notification message
HO complete notification acknowledge message
If Target BS received a C.2.4 MSS-Info response Message, Target BS may use the embedded TLV SBC-REQ information in C.2.4 to build and send an unsolicited SBC-RSP message. Target BS may ignore only the first SBC-REQ message received if it sends an unsolicited SBC-RSP message. MSS is not required to send an SBC-REQ if it receives an unsolicited SBC-RSP prior to MSS attempt to send SBC-REQ.
If using the HO shortened admission/registration process, MSS and Target BS shall use the TLV PKM-REQ information in C.2.3 and the re-authorization process as defined in 7.2 PKM protocol.
If Target BS received a C.2.4 MSS-Info response Message, Target BS may use the embedded TLV REG-xxx & DSx-xxx information in C.2.4 to build and send an unsolicited REG-RSP message. The REG-RSP message may include Old_CID, New_CID, and Connection_Info TLVs. Target BS may ignore only the first REG-REQ message received if it sends an unsolicited REG_RSP message. MSS is not required to send an REG-REQ if it receives an unsolicited REG-RSP prior to MSS attempt to send REG-REQ.
If Target BS received a C.2.4 MSS-Info response Message that included the MSS Network Address, and the MSS Network Address is compatible with Target BS addressing mechanics, Target BS may skip most of the Network Address allocation process and re-provision the same address through an unsolicited Network Address Response. Target BS may ignore only the first Network Address discover message received if it sends an unsolicited Network Address response message. MSS is not required to send an Network Address discover if it receives an unsolicited Network Address response prior to MSS attempt to send Network Address discover.
If using the HO shortened admission/registration process, MSS and Target BS may skip Time of day process.
If using the HO shortened admission/registration process, MSS may skip the SS configuration file download procedure.
If MSS received a REG-RSP message that included the Old_CID, New_CID, and Connection_Info TLVs, MSS and Target BS may skip the establish connections procedure.
If Target BS received a C.2.5 HO-notification Message from Serving BS or MSS RNG-REQ to Target BS included an un-timed-out Serving BS ID, Target BS may send a C.2.1 HO complete/ Serving BS notification message to previous Serving BS. Previous Serving BS may respond with a C.2.7 HO complete/Serving BS notification acknowledge message.
Target BS may send a C.2.1 HO complete/Serving BS notification message to Authorizing Station or Other BS. Authorizing Station or Other BS may respond with a C.2.7 HO complete/Serving BS notification acknowledge message.

Note: still need to rework all of sections D.1 through D.5 Figures and Diagrams.

5. **Change Document in Revision Outline Format**

*[In **1.4.1.1 Network reference model**, **1.4.1.1.1 Entities**, page 3, paragraph 1, modify paragraph with:]*

1.4.1.1.1 Entities

The network reference model consists of BS units providing contigious/non-contigious service coverage across a distributed geographic region where the BS units are ~~covering a certain area, and~~ connected by a backbone network and share network affiliation. The reference network may be public or private, managed or unmanaged, restricted entry or open connection. Multiple ~~Several such~~ networks, of varying design and performance and operated ~~owned~~ by disparate ~~different~~ operators may coexist in the same geography~~service area~~. Depending on the relationship of the varying operators, configuration of the networks, operational deployment, etc..., MSS may perform uninterrupted, persistent active service flow hand-over (soft hand-over) or interrupted, non-persistent active service flow hand-over (hard hand-over) between BS on the same or disparate networks. Hand-overs may be intra- or inter-network. Hand-over management may be centrally controlled or employ a distributed decision mechanism, or some combination thereof. ~~Each b~~Backbone networks may employ sophisticated~~contain~~ centralized AAA (Authorization, Authentication and Accounting), management, provisioning or other specialized servers. Specifically, those servers responsible for authentication and service authorization are collectively referred to as ASA-server(s) and may be single, multiple, centralized or distributed. The operation of these servers with the BS and MSS is specified to the extent of defining the control messages.

*[In **1.4.1.1.4 MSS Service Context**, page 6, modify with:]*

1.4.1.1.4 MSS Service Context

In mobile environment certain Service Flows are provisioned for each MSS. QoS parameters are provisioned by the operator for each flow and identified by certain Service Class name. Set of Service Classes should be provisioned through upper layers (e.g. network management) at each BS and each MSS.

For each SU certain AuthorizedQoSParamSet shall be provisioned identified by the corresponding Service Class name. In the ~~process of~~ initial Network Entry, ~~as well as in the processes of Association~~Ranging and Hand-over processes, MSS shall request~~s~~ from the ~~target~~ Target BS certain ~~level of~~ QoS levels per Active Service Flow, differentiated by ~~in the terms of~~ Service Class ~~which~~ and ~~represents~~ represented by AuthorizedQoSParamSet. The BS shall respond~~s~~ with name of Service Class available for the Service Flow. This Service Class will become AdmittedQoSParamSet in the case of successful Network Entry/HO.

Network Service is defined as a service provided to the MSS by the network through a single persistent ~~, permanent~~ IP address with particular connectivity and air-interface MAC parameters (including QoS properties). A MSS persistent IP address is defined as an MSS network connection address as allocated in 6.4.9.10 for as long as it remains persistent on the network. Connectivity properties, including Home Network address, are defined by specification in the ~~of~~ MSS Configuration file in 6.4.9.12~~permanent IP address~~. The permanent IP address defines the MSS home-network. QoS properties are those of Service Flow associated with the network service, as specified in 6.4.13.

MSS Service Context is defined as a set of network services authorized for a given MSS. It is specified by an MSS Service Context Descriptor composed of the following elements:

Table 1d—MSS Service Context Descriptor

Context Element	Meaning
MSS 48-bit MAC address unique identifier	48-bit universal MAC address, as specified in 6.4.1.During HO it is used to refer to specific connectivity (addressing) and properties of MAC connections (including QoS properties)
MSS Home attachment address~~Address of MSS at Home Network~~	MSS static configured home attachment point address for traffic forwarding mobile addressing model~~IP address of MSS at its Home Network. This address does not change while MSS travels from one BS to another~~
Number N of Network Service IEs	Number of Network Service Information Elements (NSIEs). Each SIE corresponds to a single data connection
N x NSIE	The structure of SIE is specified below
Number M of Security Association	Number M of Security Associations established for the MSS.
M x SAIE	TBD

*[In **1.4.1.2.1.1 Network topology advertisement**, page 8, modify as:]*

1.4.1.2.1.1 Network topology advertisement

A BS may periodically broadcast information about the network topology using the BEA-ADV ~~NBR-ADV~~ MAC broadcast management message~~.~~. An MSS may decode this message to find out information about the parameters of available networks and neighbor BS. Each MSS will thus be able to assess interest in joining the network and synchronize quickly with neighbor BS.

BEA-ADV Neighbor BS associations may be acquired by static or dynamic configuration. Static sources may include implementation configuration of the BS and/or configuration of the BS through another network management device. Dynamic sources may include Neighbor BS identified and reported to the Serving BS by attached MSS through SS_INF-RSP management messages. In dynamic association operation, BS may identify each other over the backhaul network as Neighbor BS using the **C.2.9 Neighbor_Notification.request message**, **C.2.10 Neighbor_Notification.response message** and **C.2.11 Neighbor_Notification confirmation message**.

Neighbor BS operational and performance TLV data for BEA-ADV broadcast may be assembled by the BS using **C.2.12 Neighbor_Info message** and/or **C.2.4 MSS-info-response messages**.

*[Delete **1.4.1.2.1.2 MSS Scanning of neighbor BS in its entirety:]***

~~**1.4.1.2.1.2 MSS Scanning of neighbor BS**~~

~~A BS may allocate time intervals to MSS's for the purpose of seeking and monitoring neighbor BS suitability as targets for HO. Such a time interval will be referred to as a scanning interval.~~

~~An MSS may request an allocation of a scanning interval using the MOB_SCN-REQ MAC message. The MSS indicates in this message the duration of time it requires for the scan, based on its PHY capabilities.~~

~~Upon reception of this message, the BS shall respond with placement of a Scanning_IE in the DL-MAP. The Scanning_IE shall either grant the requesting MSS a scanning interval that is at least as long as requested by that MSS, or deny the request. The BS may also place unsolicited Scanning_IE.~~

~~An MSS, upon detection of a Scanning_IE addressed to it in the DL-MAP, shall use the allocated interval to seek for neighbor BS. When neighbor BS are identified, the MSS shall attempt to synchronize with their downlink transmissions, and estimate the quality of the PHY connection.~~

*[Replace **1.4.1.2.1.3 Association Procedure**, page 8, in its entirety with:]*

1.4.1.2.1.3 Association Procedure

~~An MSS may use this interval for ranging as well as for the association procedure. When associating with a neighbor BS, the MSS shall not only synchronize with neighbor BS downlink, but shall also perform two additional stages called association-initial-ranging and association-pre-registration. Association-initial ranging is performed by transmitting a RNG-REQ MAC message as specified in IEEE Standard P802.16-REVd/D1-2003 section 6.4.2.3.5 with the extensions specified in Ranging Request (RNG_REQ) message and Ranging Response (RNG-RSP) message. Upon reception of a RNG-RSP message with the prediction of service level parameter set to 2, the MSS marks the target BS as Associated. Information on Association is reported to the Serving BS. The target BS may store information on newly associated MSS. Association state of specific MSS at the BS shall be aged-out after ASC-AGING-TIMER timeout.~~

Association is an optional table notation maintenance procedure occurring after MSS Ranging of a BS. The Association relationship function is to memorialize MSS successful Scanning and Ranging of a BS for the purpose of expediting a potential future hand-over of the MSS to the then Target BS. MSS may store successful Ranging information for Associated BS for the purpose of setting initial Ranging values in a future Ranging event, possibly associated with a hand-over, to the Associated BS.

Upon completion of a successful MSS initial-ranging of a BS as specified in *IEEE P802.16-REVd/D1-2003 "Part 16: Air Interface for Fixed Broadband Wireless Access Systems"* section **6.4.9.5 Initial ranging and automatic adjustments** with the extensions specified in **11.1.4 REG-RSP TLVs for connection re-establishment**, **Table 290a—RNG-REQ Message Encodings**, if the RNG-RSP message contains a Service Level Prediction parameter set to 2, the MSS marks the BS as Associated in its MSS local Association table of identities, recording elements of the RNG-RSP to the MSS local Association table, and setting an appropriate aging timer (See **Table 275a—Parameters and Constants**, ASC-AGING-TIMER). Association state in the MSS local Association table shall be aged-out after ASC-AGING-TIMER timeout and the Association entry removed.

While Association is current (aging timer has not expired), MSS may use recorded Associated Ranging values to set initial Ranging values in a new initial Ranging event to the same Associated BS. An MSS may have several Associated BS in its local Association table concurrently and shall use the respective stored Associated Ranging values only with the related Associated BS.

Information on Association may be reported by the MSS to its Serving BS in periodic **6.4.2.3.52 SS_INF-RSP messages** to the Serving BS.

*[In **1.4.1.2.2 HO process**, page 8, modify with:]*

1.4.1.2.2 HO process

The section defines the HO process in which an MSS migrates from the air-interface provided by one BS to the air-interface provided by another BS. The HO process consists of the stages ~~listed below (not necessarily in the order listed)~~:

~~— HO initiation, the decision to start the process is taken~~
~~— Termination of service with the serving BS, where all connections belonging to the MSS are terminated, and the context associated with them (i.e. information in queues, ARQ state-machine, counters, timers, etc.) is discarded~~
~~— Network re-entry in target BS, where the MSS re-enters the network using a fast network entry procedure. After network re-entry, service flows belonging to the MSS are re-associated with newly established connections. QoS parameters of service flows (AdmittedQoSParamSet) may be different from AuthorizedQoSParamSet, based on the availability of resources in the target BS.~~

Cell Selection — MSS may use Neighbor BS information acquired from a decoded BEA-ADV message, or may make uninformed decision, to schedule sleep-intervals to scan, and possibly range, Neighbor BS for the purpose of evaluating MSS interest in hand-over to potential Target BS. MSS may provide results of its scanning and ranging activity to Serving BS through SS_INF-RSP.

HO Decision — a hand-over begins with a decision for an MSS to hand-over its air interface, service flow, and network attachment from a Serving BS to a Target BS. The decision may originate either at the MSS, the Serving BS, or on the network. The HO Decision consummates with a notification of MSS intent to hand-over through HO-REQ. The HO notification is recommended, but not required. The HO notification may originate with either the Serving BS or MSS. Acknowledgement with HO-RSP of a notification is required.

Backbone HO Notification — Serving BS may notify Target BS(s) over the backbone network of MSS intent to hand-over to Target BS (see section Backbone network HO procedures). Serving BS may also send MSS information over the backbone that can expedite hand-over. If Target BS receives a backbone notification message, subsequent backbone HO notification response and confirmation messages are recommended, but not required.

Sleep — the MSS shall use sleep-interval to establish a working ‘unavailable’ service window with Serving BS to conduct network re-entry with Target BS. This mechanism permits continued service with the Serving BS should the hand-over attempt fail or be aborted. The MSS shall send a SLP-REQ sleep request message, or Serving BS may send an unsolicited SLP-RSP sleep response message. The burden for message origination lies with the party that originated HO-REQ hand-over request. If MSS sends SLP-REQ, then Serving BS SLP-RSP is required. An MSS may continue the HO process even if the Serving BS fails to respond to a SLP-REQ, but not if SLP-RSP denies the sleep request. If denied, the

MSS may re-attempt a SLP-REQ at the appropriate interval. If an MSS operational parameter changes after HO-REQ but prior to start-frame of an approved sleep-interval, MSS must abort the hand-over attempt, return to HO Decision, and re-notify the Serving BS of intent to hand-over.

Target BS Scanning — MSS shall scan Target BS for downlink channel & synchronization and uplink channel & synchronization. If MSS had previously decoded a BEA-ADV message including Target BS ID, Physical Frequency, DCD and UCD, then the scanning and synchronization process may be shortened. If the Target BS had previously received HO notification from Serving BS over the backbone (see section Backbone network HO procedures), then Target BS may place a non-contention based Fast_UL_ranging_IE MSS maintenance opportunity in the UL-MAP. MSS shall scan Target BS for UL-MAP that includes either a contention or non-contention based SS maintenance opportunity.

Network Re-entry — MSS and Target BS shall conduct Ranging per 6.2.9.5 to begin network re-entry. If MSS RNG-REQ includes an unexpired Serving BS ID and Target BS had not previously received MSS information over the backbone (see section Backbone network HO procedures), then Target BS may make an MSS information request of Serving BS over the backbone network and Serving BS may respond. Regardless of having received MSS information from Serving BS, Target BS may request MSS information from an Authorizing Station via the backbone network. Network re-entry proceeds per 6.2.9.5 except as may be shortened by Target BS possession of MSS information obtained from Serving BS over the backbone network. Network re-entry process completes with establishment of MSS normal operations.

Termination of Service — The final step in hand-over is any termination of MSS services with previous Serving BS. If Target BS had received a HO notification from Serving BS over the backbone (see section Backbone network HO procedures), or MSS RNG-REQ included an unexpired Serving BS ID, then Target BS may send a HO complete/Serving BS notification message over the backbone network to the Serving BS and any Authorizing Station. HO acknowledgement is recommended, but not required. Upon receipt of a HO complete/Serving BS notification message, Serving BS shall terminate all connections belonging to the MSS and the context associated with them (i.e. information in queues, ARQ state-machine, counters, timers, etc…, is discarded). Target BS now becomes the new Serving BS for all purposes.

The HO process, and its similarity to the initial network entry process, is depicted in Figure 0f.

*[In **1.4.1.2.2.1 Cell Selection**, pages 9&10, modify with:]*

Cell selection ~~is a terminology used to~~ refers to the process of an MSS Scanning and/or Ranging one or more BS in order to determine suitability, along with other performance considerations, for network connection or hand-over~~situations where an MSS leaves a BS before getting to the normal-operation state~~. MSS may incorporate information acquired from a BEA-ADV message to give insight into available Neighbor BS for cell selection consideration. If currently connected to a Serving BS, an MSS shall schedule sleep-intervals to conduct Cell Selection for the purpose of evaluating MSS interest in hand-over to potential Target BS. Such procedure does not involve termination of existing connections to a Serving BS and their re-opening in a Target BS~~, nor does it change the status of any existing connections, or establish new ones~~. If ranging a Target BS for

hand-over, any newly assigned basic and primary CIDs are specific to the Target BS and do not replace or supplant the basic and primary CIDs the MSS employs in its communication with its Serving BS. MSS may provide results of its scanning and ranging activity to Serving BS through SS_INF-RSP~~An MSS may perform a cell selection if such an action is necessary with respect to its PHY signal quality. In such a case the MSS shall restart the initial re-entry sequence or the HO sequence as applicable. No action is required from the BS during an cell selection~~.

*[In **1.4.1.2.2.2 HO initiation**, pages 10&11, modify with:]*

Either an MSS or a BS may initiate a HO by transmitting the MOB_MSSHO-REQ or MOB_BSHO-REQ MAC messages. Transmission of the HO-REQ MAC message is recommended, but not required. ~~It is anticipated that in most situations the MSS will be the initiator of the HO, but sometimes a BS may be the initiator of a HO to facilitate load sharing among BS or because of uplink connection quality.~~

When MOB_MSSHO-REQ is sent by an MSS, the MSS may indicate one or more possible ~~target~~ Target BS ~~(from signal quality point of view)~~. When MOB_BSHO-REQ is sent by a a Serving BS, the Serving BS may indicate ~~the~~ one or more recommended ~~target~~ Target BS ~~(based on their capability to meet the MSS QoS requirements)~~. Serving BS criteria for recommendation of Target BS may include factors like expected Target BS QoS performance to MSS requirements. The MOB_MSSHO-REQ message may include an indication of the estimated time for performing the HO. Acknowledgement with MOB_xxxHO-RSP of a MOB_xxxHO-REQ notification is required. MSS actual pursuit of hand-over to Target BS in MOB_xxxHO-RSP is recommended, but not required. MSS may elect to attempt hand-over to a different Target BS, a Target BS that may or may not have been included in MOB_xxxHO-REQ, with the understanding that the different Target BS may not receive notification of the pending hand-over from the Serving BS over the backbone network prior to MSS initial Ranging of Target BS (see section Backbone network HO procedures). If the MSS signals rejection of Serving BS instruction to HO through HO_type field in the MSS_HO-RSP set value of 01 (HO reject option), the BS may reconfigure the Target BS list and retransmit MOB_HO-RSP message including a new Target BS list.

Serving BS may notify one or more Target BS over the backbone network of MSS intent to hand-over to Target BS (see section Backbone network HO procedures). Serving BS may also send MSS information to Target BS over the backbone that can expedite hand-over. If Target BS receives a backbone notification message, subsequent backbone HO notification response and confirmation messages, including expected post- hand-over MSS performance levels, are recommended, but not required.~~At the BS side, before sending MOB_BSHO-REQ or after receiving a MOB_MSSHO-REQ message, the BS shall notify neighboring BS through the backbone of the HO request. The BS shall further acquire from the neighbor BS information regarding their capability of serving the requesting MSS. See sections Ranging Request (RNG_REQ) message and Ranging Response (RNG-RSP) message sections contain specifications for the communication through the backbone network, and the information exchanged between BS.~~

~~After receiving MOB_MSSHO-REQ or MOB_BSHO-REQ message, the receiving party shall respond with a MOB_HO-RSP MAC message. When sent by a BS, the MOB_HO-RSP message may indicate a recommended target BS. The MSS, at the risk that if it chooses an alternative target BS, it might receive a degraded level of~~

~~service, may ignore this recommendation (this includes staying with its serving BS, i.e. skipping the HO). The MOB_HO-RSP message may also includes an estimation of the time when the HO would take.~~

After an MSS or BS has indicated intent to HO using MOB_xxxHO-REQ, the MSS may cancel the HO at any time prior to transmission of MOB_SLP-REQ. The cancellation may be made through transmission of a MOB_HO-IND with the HO cancel option (HO Type=01) or through the transmission of a new MOB_xxxHO-REQ message.

*[Replace **1.4.1.2.2.3 HO cancellation**, page 11, in its entirety with:]*

~~**1.4.1.2.2.3 HO cancellation**~~

~~After the MSS or BS have initiated an HO using MOB_HO-REQ, the MSS may cancel the HO at any time prior to transmission of the MOB_HO-IND. The cancellation shall be made through transmission of a MOB_HO-IND with the HO cancel option (HO Type=01).~~

1.4.1.2.2.3 Sleep and Hand-over

The MSS shall use sleep-interval to establish a working 'unavailable' service window with Serving BS to conduct scanning, initial ranging and network re-entry with Target BS. This mechanism permits continued service with the Serving BS should the hand-over attempt fail or be aborted. The MSS shall send a MOB_SLP-REQ sleep request message, or Serving BS may send an unsolicited MOB_SLP-RSP sleep response message. The burden for message origination lies with the party that originated MOB_xxxHO-REQ hand-over request. If no MOB_xxxHO-REQ message was issued, then the requirement falls to the MSS. If MSS sends MOB_SLP-REQ, then Serving BS MOB_SLP-RSP is required. An MSS may continue the HO process even if the Serving BS fails to respond to a MOB_SLP-REQ, but not if MOB_SLP-RSP denies the sleep request. If denied, the MSS may re-attempt a MOB_SLP-REQ at the appropriate interval.

If an MSS operational parameter changes after MOB_xxxHO-REQ but prior to start-frame of an approved sleep-interval, MSS must abort the hand-over attempt, return to HO Decision, and re-notify the Serving BS of intent to hand-over.

MSS may abort the hand-over attempt at any time, for any reason, by aborting the sleep-interval and returning to normal operation with its Serving BS.

*[Replace **1.4.1.2.2.4 Termination with the serving BS**, page 11, in its entirety with:]*

~~**1.4.1.2.2.4 Termination with the serving BS**~~

~~After the [MSS/BS]MOB_HO-REQ/MOB_HO-RSP handshake is completed, the MSS may begin the actual HO. This is done by sending a MOB_HO-IND MAC message with the serving BS release option (HO_type=00).~~

~~If the HO_type field has the value of 00 (serving BS release option), the BS may close all connections and discard MAC state machines and MAC PDUs associated with the MSS.~~

1.4.1.2.2.4 Scanning of Target BS

During the sleep-interval attributed to hand-over, MSS shall scan Target BS for downlink channel & synchronization and uplink channel & synchronization. If MSS had previously decoded a MOB_BEA-ADV message including Target BS ID, Physical Frequency, DCD and UCD, then the scanning and synchronization process may be shortened. If the Target BS had previously received HO notification from Serving BS over the backbone (see section Backbone network HO procedures), then Target BS may place a non-contention based MSS maintenance opportunity using the PHY dependent Fast_UL_ranging_IE() (see 8.3.1.5.5.3.3 Fast ranging (Paging) Information Element, 8.4.6.3.4 Fast ranging (Paging) Information Element, and 8.5.5.3.5 & 8.5.5.3.6 Fast ranging (Paging) Information Element) in the UL-MAP. MSS shall scan Target BS for UL-MAP that includes either a contention or non-contention based SS maintenance opportunity.

*[Replace **1.4.1.2.2.5 HO rejection**, page 11, in its entirety with:]*

~~**1.4.1.2.2.5 HO rejection**~~

~~If the HO_type field has the value of 01 (HO reject option), the BS may reconfigure target BS list and retransmit MOB_HO-RSP message including new target BS list.~~

1.4.1.2.2.5 Network Entry/Re-entry

Unless otherwise excepted in this section, MSS mobile network entry/re-entry is processed according to **6.4.9 Network entry and initialization**. For purposes of this process, MSS network re-entry and hand-over are synonymous.

During its sleep-interval or at MSS initial entry, MSS and Target BS shall conduct Ranging per **6.4.9.5 Initial ranging and automatic adjustments** to begin network entry/re-entry except as MSS may take advantage of a non-contention based SS maintenance opportunity if present. If MSS RNG-REQ includes an unexpired Serving BS ID and Target BS had not previously received MSS information over the backbone (see section Backbone network HO procedures), then Target BS may make an MSS information request of Serving BS over the backbone network and Serving BS may respond. Regardless of having received MSS information from Serving BS, Target BS may request MSS information from an Authorizing Station via the backbone network. Network re-entry proceeds per **6.4.9.5 Initial ranging and automatic adjustments** except as may be shortened by Target BS possession of MSS information obtained from Serving BS over the backbone network.

If Target BS had previously received an MSS-Info response message (see section Backbone network HO procedures) containing MSS information, Target BS may use the embedded TLV SBC-REQ information to build and send an unsolicited SBC-RSP message to MSS. Target BS may ignore only the first SBC-REQ message received if it sends an unsolicited SBC-RSP message. MSS is not required to send an SBC-REQ if it receives an unsolicited SBC-RSP prior to MSS attempt to send SBC-REQ.

If MSS RNG-REQ included an unexpired Serving BS ID and Target BS had previously received an MSS-Info response message (see section Backbone network HO procedures) containing MSS information, MSS and Target BS shall use the embedded TLV PKM-REQ information and the re-authorization process as defined in **7.2 PKM protocol**.

If Target BS had previously received an MSS-Info response message (see section Backbone network HO procedures), Target BS may use the embedded TLV REG-REQ & DSA-REQ information to build and send an unsolicited REG-RSP message. The REG-RSP message may include the New_CID, Old_CID, and Connection_Info TLVs. Target BS may ignore only the first REG-REQ message received if it sends an

unsolicited REG_RSP message. MSS is not required to send an REG-REQ if it receives an unsolicited REG-RSP prior to MSS attempt to send REG-REQ.

If Target BS had previously received an MSS-Info response message (see section Backbone network HO procedures) that included the MSS Network Address in the embedded TLV, and provided that MSS Network Address is compatible with Target BS network addressing scheme, Target BS may skip most of the Network Address allocation process and re-provision the same address through an unsolicited Network Address Response. Target BS may ignore only the first Network Address discover message received if it sends an unsolicited Network Address response message. MSS is not required to send an Network Address discover if it receives an unsolicited Network Address response prior to MSS attempt to send Network Address discover.

If MSS RNG-REQ included an unexpired Serving BS ID, MSS and Target BS may skip Time of day process.

If MSS RNG-REQ included an unexpired Serving BS ID, MSS may skip the SS configuration file download procedure.

If MSS received a REG-RSP message that included the New_CID, Old_CID, and Connection_Info TLVs, MSS and Target BS may skip the establish connections procedure.

Network entry/re-entry process completes with establishment of MSS normal operations.

*[Add new section **1.4.1.2.2.6 Termination of Service**:]*

1.4.1.2.2.6 Termination of Service

The final step in hand-over/network re-entry is any termination of MSS services with previous Serving BS. If Target BS had received a HO notification from Serving BS over the backbone (see section Backbone network HO procedures), or MSS RNG-REQ included an unexpired Serving BS ID, then Target BS may send a HO complete/Serving BS notification message over the backbone network to the Serving BS and any Authorizing Station. HO acknowledgement is recommended, but not required. Upon receipt of a HO complete/Serving BS notification message, Serving BS shall terminate all connections belonging to the MSS and the context associated with them (i.e. information in queues, MPDUs, ARQ state-machine, counters, timers, etc…). Regardless of transmittal of a HO complete/Serving BS notification message or its acknowledgment, Target BS now becomes the new Serving BS for all purposes.

*[In **1.4.1.2.3 Drops and corrupted HO attempts**, page 11, paragraph 2, modify as:]*

An MSS can detect a drop by its failure to demodulate the downlink, or by exceeding the RNG-REQ retries limit allowed for the periodic ranging mechanism. A BS can detect a drop by exceeding the RNG-REQ retries limit allowed for the periodic ranging mechanism. Serving BS can also detect a drop by MSS failure to communicate exceeding MSS Sleep-Aging-Timer.

*[In **1.4.1.2.4 Re-entry with the target BS**, page 12, paragraph 1, replace entire paragraph with:]*

Network re-entry is processed using the mechanics for hand-over as detailed in **1.4.1.2.2 HO process** and~~When re-entry with the target BS takes place, the target BS as well as all neighbor BS are aware of the HO in progress (except in a drop situation). At re-entry, the MSS performs the steps~~ as shown in Figure 0f.

*[Delete **1.4.1.2.4.1 Synchronize with downlink and obtain parameters** thru **1.4.1.2.4.6 Commence Normal Operation** completely; text modified and relocated to **1.4.1.2.2 HO process**]*

~~**1.4.1.2.4.1 Synchronize with downlink and obtain parameters**~~

~~For MSS that have used their scanning interval to synchronize with target BS and have decoded the MOB_NBR-ADV message, this stage should be immediate. In other situations this procedure defaults to the one specified for initial network entry.~~

~~**1.4.1.2.4.2 Obtain uplink parameters**~~

~~For MSS's that have decoded the MOB_NBR-ADV message, this stage should be immediate. In other situations this procedure defaults to the one specified for initial network entry.~~

~~**1.4.1.2.4.3 Ranging and uplink parameters adjustment**~~

~~An MSS may perform an initial network entry as specified in 6.4.9. During this stage the MSS is assigned a new basic and primary management CID in the target BS. If the MSS has used scanning interval(s) to do preliminary ranging with target BS, and if the target BS received HO notification message that contains the MAC address of the MSS, (see Section Annex C, Backbone network HO procedures) the BS may choose, instead of waiting for initial ranging request in MAINT region, to allocate non-contention transmission opportunity for the MSS.~~

~~As opposed to regular network entry, where initial ranging is performed on contention basis, here the ranging opportunity may be allocated individually based on an MSS's 48-bit MAC address assuming this identifier was forwarded to the target BS via the backbone network. Allocation of non-contention ranging opportunity is done using the Fast_UL_ranging_IE() (see Fast ranging (Paging) Information Element) in the UL-MAP.~~

~~**1.4.1.2.4.4 MSS re-authorization**~~

~~During this stage the MSS performs the re-authorization part of the PKM protocol used at initial network entry (see IEEE Standard P802.16-REVd/D1-2003, section 7.2). The BS authenticates the user and as the security context has not changed (it is transferred from the old BS via backbone, see Section Annex C, Backbone network HO procedures) the security sub-layer can continue in normal operation.~~

~~**1.4.1.2.4.5 Re-register and re-establish provisioned connections**~~

~~This stage is equivalent to several stages performed during initial network entry. In this stage the MSS reregisters with the BS, and receives on the registration response a conversion table that maps the connections it had with its pervious serving BS to a new set of connections on the current serving BS. In doing so, the MSS skips the~~
~~**establish-IP-connectivity** stage, where it is assigned an IP address for management purposes. This stage is not really skipped during HO, instead it is postponed until the normal-operation stage is reached. The **transfer-operational-parameters** and the **time-of-day establishment** stage are skipped as none of the information contained in the configuration file, nor the time-of-day is expected to change. The MSS attempts the re-registration by sending the normal REG-REQ MAC message. At this stage the MSS has already provided its 48-bit MAC address identifier, and the BS can recognize that the MSS is performing a HO. The BS REG-RSP shall therefore include TLV values for re-establishing the active provisioned connections (see Section 11.1.1.1, UCD channel encodings).~~

~~**1.4.1.2.4.6 Commence Normal Operation**~~

~~At this stage, normal operation commences. The MSS shall re-establish its IP connectivity as specified at initial network entry. Figure <TBD> shows how a complete HO process might look like in the time domain.~~

*[In IEEE P802.16-REVd/D1-2003 "Part 16: Air Interface for Fixed Broadband Wireless Access Systems", **6.4.2.3.2 Downlink Map (DL-MAP) message**, page 63, change paragraph 5 with:]*

Base Station ID

The Base Station ID is a 48 bit long field uniquely identifying the BS. The Base Station ID shall be programmable. ~~The most significant 24 bits shall be used as the operator ID. This is a network management hook that can be combined with the Downlink Channel ID of the DCD message for handling edge-of-sector and edge-of-cell situations.~~

*[In **6.4.2.3.5 Ranging Request (RNG-REQ) message**, page 17, lines 9-12, modify the existing text as shown below:]*

The following parameters ~~shall~~ may be included in the RNG-REQ message:

Serving BS ID — the BS ID of the BS to which the MSS is currently connected (has completed complete registration cycle and is in Normal Operation). Serving BS ID shall not be included if interval timer is timed-out (Serving BS ID AGING-TIMER, see **Table 275a—Parameters and Constants**). Inclusion of Serving BS ID in the RNG-REQ message signals to the Target BS that the MSS is currently connected to the network through Serving BS and is in the process of either a hand-over or network re-entry.

*[In **6.4.2.3.6 Ranging Response (RNG-RSP) message**, page 17, lines 19&20, change:]*

When a BS sends a RNG-RSP message in response to a RNG-REQ message containing an **Serving BS ID** ~~**MSS Association Channel ID**~~ **TLV**, the BS may include the following TLV parameter in the RNG-RSP message,

*[In **6.4.2.3.6 Ranging Response (RNG-RSP) message**, page 17, lines 43-58, relocate and modify as append to IEEE P802.16-REVd/D1-2003 "Part 16: Air Interface for Fixed Broadband Wireless Access Systems", **6.4.2.3.8 Registration Response (REG-RSP) message**:]*

For mobile networks, Target BS shall include New_CID, Old_CID, and Connection_Info TLVs in the REG-RSP for MSS recognized by the Target BS as performing HO or network re-entry by the presence of an unexpired Serving BS ID in the RNG-REQ.

~~The following TLVs shall be included in the REG-RSP for MSS's recognized by the BS through their 48-bit MAC address (provided in the RNG-REQ message) as MSS's that are performing HO,~~

~~CID_update – The CID_update is a~~New_CID, Old_CID, and Connection_Info TLVs ~~value that~~ provide~~s~~ a shorthand method for renewing ~~a~~ active connections used by the MSS in ~~the~~ its previous ~~serving~~ Serving BS. The TLVs specif~~ies~~y ~~a~~ CID in the ~~new serving~~Target BS that shall replace ~~a~~active CID used in the previous ~~serving~~ Serving BS. Multiple iterations of these TLVs may occur in the REG-RSP suitable to re-creating and re-assigning all active Service Flows for the MSS from its previous Serving BS including Basic, Primary and Secondary CIDs. If any of the ~~service~~ Service ~~flow~~ Flow parameters change, then those ~~service~~ Service ~~flow~~ Flow parameters and CS parameter encoding TLVs that have changed will be added. Only active Service Flows are transferred in this manner.

~~This~~ These TLVs enable~~s~~ the ~~new serving~~Target BS to renew ~~a~~ connections used in the previous ~~serving~~ Serving BS, but with different QoS settings.

~~If no traffic is pending for any MSS, the MOB_TRF-IND message shall be sent with Num-Positive field with zero value.~~

*[In **6.4.2.3.41 Sleep Request message (MOB_SLP-REQ),** modify with:]*

6.4.2.3.41 Sleep Request message (MOB_SLP-REQ)

SS supporting sleep-mode uses the MOB_SLP-REQ message to request permission from the BS to enter sleep-mode. The MOB_SLP-REQ message is sent from the SS to the BS on the SS's basic CID.

Table 84a—Sleep-Request (MOB_SLP-REQ) message format

Syntax	Size	Notes
MOB_SLP-REQ_Message_Format() {		
Management Message Type=45	8 bits	
reserved	2 bits	
initial-sleep window	6 bits	
sleep-window factor	4 bits	
final-sleep window	~~10~~ 12 bits	
sleep-window iterations	8 bits	
}		

Parameters shall be as follows:

initial-sleep window
Requested start value for sleep-window for the ~~sleep~~ sleep-interval (measured in frames).

sleep-window factor
Multiplying factor for increasing the sleep-window value through multiple sleep-window iterations.

final-sleep window
Requested maximum sleep-window ~~final~~ value for the ~~sleep~~ sleep-interval (measured in frames).

sleep-window iterations
Number of iterations of sleep-window to perform prior to completing sleep-interval.

*[In **6.4.2.3.42 Sleep Response message (M0B_SLP-RSP),** modify with:]*

6.4.2.3.42 Sleep Response message (M0B_SLP-RSP)

~~T~~The MOB_SLP-RSP message shall be sent from BS to a MSS on the SS's basic CID in response to an MOB_SLP-REQ message, or may be sent unsolicited. The SS shall enter sleep-mode using the parameters indicated in the message. In the case where sleep is denied, it is recommended that the BS provide unsolicited MOB_SLP-RSP before the expiration of the time interval specified by the duration field.

Table 84b—Sleep-Response (MOB_SLP-RSP) message format

Syntax	Size	Notes
MOB_SLP-RSP_Message_Format() {		
Management Message Type=46	8 bits	
Sleep approved	1 bit	0: Sleep-mode request denied 1: Sleep-mode request approved
If (Sleep-approved == 0) {		
After-REQ-action	3 bits	000: The MSS may retransmit the MOB_SLP-REQ message at any time 001: The MSS shall retransmit the MOB_SLP-REQ message after the time duration (REQ-duration) given by the BS in this message 010: The MSS shall not retransmit the MOB_SLP-REQ message and wait the MOB_SLP-RSP message from the BS 011:111: Reserved
REQ-duration	4 bits	Time duration for case where After-REQ-action value is 001.
} else {		
Reserved	3 bits	
Start frame	7 bits	lower byte of the frame number in which the SS shall enter into sleep mode
initial-sleep window	6 bits	
sleep-window factor	4 bits	
final-sleep window	~~10~~ 12 bits	
sleep-window iterations	8 bits	
}		
}		

Parameters shall be as follows:

Sleep approved

Response ~~The activation~~ indication whether or not SS request to enter sleep-mode has been approved by~~of the MSS when the MSS receives this message from~~ the BS.

0: Sleep-mode request denied

1: Sleep-mode request approved

After-REQ-action

On SS request to enter sleep-mode rejected by the BS, indicates recourse action.

000: The MSS may retransmit the MOB_SLP-REQ message at any time

001: The MSS shall retransmit the MOB_SLP-REQ message after the time duration (REQ-duration) given by the BS in this message

010: The MSS shall not retransmit the MOB_SLP-REQ message and wait the MOB_SLP-RSP message from the BS

011:111: Reserved

REQ-duration

Waiting value for the MOB_SLP-REQ message re-transmission (measured in ~~MAC~~ frames)

Start-frame

Lower byte of the frame number in which the SS shall enter into sleep mode.

initial-sleep window

Start value for sleep-window for the ~~sleep~~ sleep-interval (measured in frames).

sleep-window factor

Multiplying factor for increasing the sleep-window value through multiple sleep-window iterations

final-sleep window

Maximum sleep-window~~Final~~ value for the ~~sleep~~ sleep-interval (measured in frames).

sleep-window iterations

Number of iterations of sleep-window to perform prior to completing sleep-interval.

*[In **6.4.2.3.44 Neighbor Advertisement (MOB_NBR-ADV)**, page 20&21, modify as:]*

6.4.2.3.44 Beacon Network Broadcast Advisory (MOB_BEA-ADV) management ~~Neighbor Advertisement (MOB_NBR-ADV)~~ message

An MOB_BEA-ADV management message may be broadcast by a BS at a ~~If BS broadcasts NBR-ADV messages, they shall be broadcast within the~~ periodic interval (BEA-ADV ~~NBR-ADV~~ interval, see Table ~~118a2~~275a) to identify the network and define the characteristics of neighbor BS to potential MSS seeking initial network entry or hand-over, and to identify the network to foreign networks. The BS may restrict MOB_BEA-ADV to data covering only BS sharing the same Operator ID. BS may restrict MOB_BEA-ADV to data changed during BEA-ADV interval. BS may include all, select, or no TLV data in MOB_BEA-ADV. BS may vary TLV data elements included in MOB_BEA-ADV message from message to message.

Table 84d—MOB_BEA~~NBR~~-ADV Message Format

Syntax	Size	Notes
MOB_~~NBR~~BEA-ADV_Message_Format() {		
Management Message Type = 48	8 bits	
BS ID	48 bits	Base station unique identifier (Same number as that broadcasted on the DL-MAP message)
Operator ID	48 bits	Unique Network ID
Configuration Change Count	8 bits	
~~N_NEIGHBORS~~	~~8 bits~~	
~~For (j=0 ; j<N_NEIGHBORS ; j++) {~~		
~~Neighbor BS-ID~~	~~48 bits~~	
~~Physical Frequency~~	~~32 bits~~	
TLV Encoded ~~Neighbor~~ information	Variable	TLV specific, See Table 292a
~~}~~		

}		

A BS shall generate MOB_~~NBR~~BEA-ADV messages in the format shown in Table 84d. The following parameters shall be included in the MOB_~~NBR~~BEA-ADV message unless otherwise noted as an optional item in which case they may be included,

BS ID — same as the Base Station ID parameter in the DL-MAP message

Operator ID — the unique network ID shared by an association of BS

Configuration Change Count – Incremented by one (modulo 256) whenever any of the values relating to any ~~neighbor BS~~ included data element changes. If the value of this count in a subsequent MOB_~~NBR~~BEA-ADV message remains the same, the MSS can quickly ~~to~~ disregard the entire message.

All other parameters are coded as TLV values (see Table 292a~~TBD~~). All TLV items are optional.

Network Type — defines networks based on service management type and prosecution of non-affiliated MSS connection. The following encodings apply:

0=not specified
1=managed, restricted; ASA function is network managed, MSS access to the network is restricted to affiliated MSS
2=managed, provisional; ASA function is network managed, MSS access to the network is restricted to affiliated MSS, however, limited access may be provided to non-affiliated MSS
3=managed, unrestricted; ASA function is network managed, MSS access to the network is unrestricted
4=unmanaged, restricted; ASA function is either static or unmanaged, MSS access to the network is restricted to affiliated MSS
5=unmanaged, provisional; ASA function is either static or unmanaged, MSS access to the network is restricted to affiliated MSS, however, limited access may be provided to non-affiliated MSS
6=unmanaged, unrestricted; ASA function is either static or unmanaged, MSS access to the network is unrestricted
other=reserved

Time Stamp — number of milliseconds since midnight GMT

BS Next Beacon — estimated time interval in milliseconds until next BS beacon event

BS Next Contention Network Entry — estimated time interval in frames until next BS contention based SS network entry interval

BS Network Managed Handover Supported — binary value indicating support for network managed MSS hand-over at BS. 0=no; 1=yes

BS Air Interface Advertised Bandwidth —a coarse, implementation specific calculated value

BS Air Interface Available Bandwidth — a coarse, implementation specific calculated value

BS Backhaul Advertised Bandwidth — a coarse, implementation specific calculated value

BS Backhaul Available Bandwidth — a coarse, implementation specific calculated value

N_QoS_Records — Number of AvailableQoSParamSet Records

Service Class Code — Code of Service Class in AvailableQoSParamSet

N_Neighbors – Number of advertised neighbor BS

For each advertised ~~neighbor~~ Neighbor BS, the following TLV parameters may be included,

Neighbor BS-ID – Same as the Base Station ID parameter in the DL-MAP message of Neighbor BS

Neighbor Operator ID — the unique network ID shared by an association of BS; may be omitted if same as for transmitting BS

Neighbor Network Type — defines networks based on service management type and prosecution of non-affiliated MSS connection. The following encodings apply:

0=not specified
1=managed, restricted; ASA function is network managed, MSS access to the network is restricted to affiliated MSS
2=managed, provisional; ASA function is network managed, MSS access to the network is restricted to affiliated MSS, however, limited access may be provided to non-affiliated MSS
3=managed, unrestricted; ASA function is network managed, MSS access to the network is unrestricted
4=unmanaged, restricted; ASA function is either static or unmanaged, MSS access to the network is restricted to affiliated MSS
5=unmanaged, provisional; ASA function is either static or unmanaged, MSS access to the network is restricted to affiliated MSS, however, limited access may be provided to non-affiliated MSS
6=unmanaged, unrestricted; ASA function is either static or unmanaged, MSS access to the network is unrestricted
other=reserved

Neighbor Physical Frequency – DL center frequency (kHz).

Neighbor Time Stamp — number of milliseconds since midnight GMT when neighbor info created for transfer to Serving BS

Neighbor BS Next Beacon — estimated time interval in milliseconds from Time Stamp until next BS beacon event

Neighbor BS Next Contention Network Entry — estimated time interval in frames until next BS contention based SS network entry interval

Neighbor BS Network Managed Handover Supported — binary value indicating support for network managed MSS hand-over at Neighbor BS

Neighbor DCD_settings – The DCD_settings is a compound TLV value that encapsulates a DCD message that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MSS with the advertised BS downlink. The DCD settings fields shall contain only neighbor's DCD TLV values which are different from the serving BS corresponding values. For values that are not included, the MSS shall assume they are identical to the serving BSs corresponding values.

Neighbor UCD_settings – The UCD_settings is a compound TLV value that encapsulates a UCD message that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MSS with the advertised BS uplink. The UCD settings fields shall contain only neighbor's UCD TLV values which are different from the serving BS's corresponding values. For values that are not included, the MSS shall assume they are identical to the serving BS's corresponding values.

Neighbor BS Air Interface Advertised Bandwidth — a coarse, implementation specific calculated value

Neighbor BS Air Interface Available Bandwidth — a coarse, implementation specific calculated value

Neighbor BS Backhaul Advertised Bandwidth — a coarse, implementation specific calculated value

Neighbor BS Backhaul Available Bandwidth — a coarse, implementation specific calculated value

Neighbor N_QoS_Records — Number of AvailableQoSParamSet Records

Neighbor Service Class Code — Code of Service Class in AvailableQoSParamSet

*[Delete **6.4.2.3.45 Scanning Interval Allocation Request (MOB_SCN-REQ) message** in its entirety:]*

~~**6.4.2.3.45 Scanning Interval Allocation Request (MOB_SCN-REQ) message**~~

~~A MOB_SCN-REQ message may be transmitted by an MSS to request a scanning interval for the purpose of seeking neighbor BS, and determining their suitability as targets for HO.~~

~~An MSS shall generate MOB SCN-REQ messages in the format shown in Table 84e:~~

~~**Table 84e—MOB_SCN-REQ Message Format**~~

~~Syntax~~	~~Size~~	~~Notes~~
~~MOB_SCN-REQ_Message_Format() {~~		
~~—Management Message Type = ?~~	~~8 bits~~	
~~—Scan Duration~~	~~16 bits~~	~~Units are frames~~
~~}~~		

~~An MSS shall generate MOB_SCN-REQ messages in the format shown in Table 84e. The following parameters shall be included in the MOB_SCN-REQ message,~~

~~**Scan Duration**~~

~~Duration (in units of frames) of the requested scanning period.~~

*[Delete **6.4.2.3.46 Scanning Interval Allocation Response (MOB_SCN-RSP) message** in its entirety:]*

~~**6.4.2.3.46 Scanning Interval Allocation Response (MOB_SCN-RSP) message**~~

~~A MOB_SCN-RSP message shall be transmitted by the BS in response to an MOB_SCN-REQ message sent by an MSS. In addition, BS may send an unsolicited MOB_SCN_RSP. The message shall be transmitted on the basic CID.~~

~~The format of the MOB_SCN-RSP message is depicted in Table 84f.~~

~~**Table 84f—MOB_SCN-RSP Message Format**~~

~~Syntax~~	~~Size~~	~~Notes~~
~~MOB_SCN-REQ_Message_Format() {~~		
~~Management Message Type = ?~~	~~8 bits~~	
~~Length~~	~~8 bits~~	~~In bytes~~
~~For (i=0 ; i<Length/3; i++) {~~		
~~CID~~	~~16 bits~~	~~basic CID of the MSS~~
~~Duration~~	~~8 bits~~	~~in frames~~
~~}~~		
~~}~~		

~~**Length**~~

~~Length in bytes.~~

~~**CID**~~

~~Basic CID of the MSS that have sent MOB_SCN-REQ message.~~

~~**Duration**~~

~~Duration (in units of frames) where the MSS may scan for neighbor BS.~~

*[Add **6.4.2.3.51 SS_INF-REQ management message**:]*

6.4.2.3.51 SS_INF-REQ message

A BS may transmit an SS_INF-REQ message to an SS at any time to obtain SS operating information and neighbor and foreign network BS measurements. The message shall be transmitted on the MSS basic CID.

Table 84l—SS_INF-REQ message format

Syntax	Size	Notes
SS_INF-REQ_Message_Format() {		
Management Message Type = 55	8 bits	

}		

A BS shall generate SS_INF-REQ messages in the format shown in Table 84l.

*[Add **6.4.2.3.52 SS_INF-RSP management message**:]*

‘**6.4.2.3.52 SS_INF-RSP message**

A MSS shall transmit an SS_INF-RSP message to a BS in response to an SS_INF-REQ or may send an unsolicited SS_INF-RSP to a BS. The message shall be transmitted on the basic CID.

Table 84m—SS_INF-RSP message format

Syntax	Size	Notes
SS_INF-REQ _Message_Format() {		
Management Message Type = 56	8 bits	
Mobility Support Type	4 bits	What, if any, type of mobility functionality the MSS supports. 0=none; 1=portable; 2=mobile, MSS managed hand over; 3=mobile, network managed hand over; other=reserved
Power Type	4 bits	Disclosure of what current power source the MSS employs. 0=line power; 1=battery power; other=reserved
Power Status	4 bits	Disclosure of current MSS power supply status. Value provided as whole number representing the tens grouping of percentage of power remaining, in 10% increments, rounded up
TLV Encoded information	Variable	TLV specific, See Table 321a
}		

A BS shall generate SS_INF-RSP messages in the format shown in Table 84m. The following parameters shall be included in the SS_INF-REQ message unless otherwise noted as an optional item in which case they may be included,

Mobility Support Type — Disclosure of what, if any, type of mobility functionality the MSS supports. The following encodings apply:

0=none

1=portable

2=mobile, MSS managed hand over

3=mobile, network managed hand over

other=reserved

Power Type — Disclosure of what power source the MSS employs. The following encodings apply:

0=line power

1=battery power

other=reserved

Power Status — Disclosure of current MSS power supply status. Value provided as whole number representing the tens grouping of percentage of power remaining, in 10% increments, rounded up (i.e. 18% power remaining would report a value of 2; 31% power remaining would report a value of 4; 97% power remaining would report a value of 0).

All other parameters are coded as TLV values (see Table 321a). All TLV items are optional.

Home Network ID — Operator ID of default network to which MSS is associated; only include if different than Serving BS Operator ID

Authentication Server Address — Address of ASA network device that holds the MSS provisioned service profile and account status for the MSS

N_Neighbors – Number of discovered neighbor BS

For each neighbor BS, the following parameters shall be included,

Neighbor BS-ID – Same as the Base Station ID parameter in the DL-MAP message of neighbor BS

Neighbor BS Operator ID — the unique network ID shared by an association of BS; only include if different than Serving BS Operator ID

Neighbor BS Physical Frequency – DL center frequency (kHz).

Neighbor BS S/(N + I) –This parameter indicates the signal to noise and interference ratio measured by the MSS from the particular BS. The value shall be interpreted as an unsigned byte with units of 0.25dB.

Neighbor BS Service level prediction – This value indicates the level of service the MSS can expect from this BS. The following encodings apply:

0 = No service possible for this MSS; service level undetermined.

1 = Some service is available for the MSS.

2 = Service with QoS specified at ASA server (for the MSS identified by the 48-bit MAC address) is available.

*[In IEEE P802.16-REVd/D1-2003 "Part 16: Air Interface for Fixed Broadband Wireless Access Systems" section **6.4.9.5 Initial ranging and automatic adjustments**, page 173, insert the following between lines 27 & 29:]*

For SS that are employing the optional Association procedure, and to which the SS and BS are currently Associated, the SS may use its un-expired, previously obtained and retained associated Ranging values to set initial ranging values including $P_{TX_IR_MAX}$ power levels.

*[In **6.4.16 Sleep-mode for mobility-supporting SS**, **6.4.16.1 Introduction**, pages 26&27, modify with:]*

6.4.16.1 Introduction

Sleep-mode is a mode in which SS's supporting mobility may power down, scan neighbor and foreign network BS, range neighbor and foreign network BS, or perform other activities for which the MSS will be unavailable to the Serving BS for DL or UL traffic. Sleep-mode is intended to enable mobility-supporting SS's to minimize their energy usage and facilitate hand-over decision and operation while staying connected to the network, but sleep-mode use should not be narrowly interpreted. Implementation of sleep-mode is optional.

An SS that supports sleep-mode can be in one of two modes:

— Awake
— Sleep

When an SS is in awake-mode, it is receiving and transmitting PDUs as in ~~a normal~~ Normal Operation~~fashion~~. When the SS is in ~~a~~ sleep-mode, it does not send or receive PDUs. When an SS is ~~In~~ in sleep-mode, it has no obligation to listen to DL traffic and ~~the SS~~ may ~~power~~ power-down one or more physical operation components.

Two intervals are defined:

Sleep-interval
A time duration, measured in whole frames, where the SS is in sleep-mode. The sleep-interval is constructed of one or more variable-length, consecutive sleep-windows, with interleaved listening intervals, through one or more iterations. During consecutive sleep-windows comprising a single ~~sleep periods the~~ sleep-interval , sleep-window may ~~shall~~ be updated using an ~~exponentially~~ increasing algorithm with an adjustable ~~minimum and~~ maximum limit~~s~~.

Listening-interval

Length, measured in whole frames, of the listening interval. During this interval the SS shall decide whether to stay awake or go back to sleep based on an indication from the BS. The Listening-interval parameter ~~duration is negotiated between the BS and the SS.~~is reported to the SS in REG-RSP.

Before entering sleep-mode the SS shall inform the BS using MOB_SLP-REQ and obtain its approval. Serving BS shall respond with a MOB_SLP-RSP message. Serving BS may send an unsolicited MOB_SLP-RSP to SS to initiate SS sleep-interval. Upon Serving BS transmittal of an affirming MOB_SLP-RSP, Serving BS shall initiate aging timer (MSS Sleep-Aging-Timer, see Table 275a) to coincide with initiation of sleep-interval at start-frame. The BS may buffer (or it may drop) incoming PDUs addressed to the sleeping SS, and shall ~~a~~ send notification to the SS in it~~'~~s listening-~~awakening periods~~ interval about whether data has been addressed for it during a preceding sleep-window.

An SS shall awaken, enter into an interleaved listening-interval, according to the sleep-interval and check whether there were PDUs addressed for it. The listening-interval parameter defines the number of frames the SS shall remain awake waiting for a TRF-IND message. If such PDUs exist, ~~it~~ the SS shall remain awake, terminating the sleep-interval and re-entering Normal Operation. An SS may terminate sleep-mode and return to awake-mode anytime (i.e. there is no need to wait until the sleep-interval is over). If the BS receives an MPDU from an SS that is supposed to be in sleep-mode, the BS shall assume that the SS is no longer in sleep-mode. Any UL message from the SS to the Serving BS shall interrupt the sleep-interval, shall signal the Serving BS that the SS is still active and connected and has not dropped connection during its sleep-interval, and the Serving BS shall terminate the aging timer (MSS Sleep-Aging-Timer, see Table 275a).

Traffic in~~i~~dication message (TRF-IND) shall be sent by the BS on the broadcast CID during each appropriate MSS listening interval~~periodically~~. If the number of positive indications is zero, the BS sends an empty indication message, that is, TRF-IND message with num-positive=0.

Upon completion of ~~When its~~ sleep-interval ~~timeouts~~, the SS shall~~e~~ awaken and return to Normal Operation~~to listen to the DL transmissions until it receives a TRF-IND message~~. ~~If there is a positive indication to the SS, it shall remain awake. Otherwise, the SS may returns to its sleep-mode. The listening-interval parameter defines the number of frames the SS shall remain awake waiting for the TRF_IND message~~.

If the intervening interval of MSS absence exceeds the aging timer, then the Serving BS shall assume loss of connection to the MSS and process as if it had received a backbone message announcing another BS becoming the Serving BS for the specified MSS (see section Backbone network HO procedures).

*[In **6.4.16.2 Sleep-interval update algorithm**, page 34, modify with:]*

An MSS shall enter sleep-mode, at the appropriate frame proscribed by start-frame, after receiving an MOB_SLP-RSP message from the BS. The MSS shall use the following algorithm for calculating and performing the sleep-interval~~In the first time it enters sleep-mode, it shall use the initial-sleep window value for the sleep interval. If during the following listening interval the BS has not signaled that traffic has been addressed for the MSS, the MSS shall re-enter sleepmode an double the duration of the sleep-interval. This procedure shall be repeated as long as the resulting sleep-interval does not exceed the final-sleep window value. The following formula defines the calculation of the duration of k^{th} sleep-interval - I_k~~:

{	$I_k = min\{$initial-sleep window + initial-sleep window • sleep-window factor • $(k-1)\}$, final-sleep window $\}$ $k > 0$, $k <$ sleep-window iterations

Upon completion of sleep-interval, SS and BS shall return to Normal Operation~~When the MSS has reached the final-sleep window size, it shall continue in sleep mode without further increasing the sleep-interval~~.

*[In **6.4.16.3 Traffic indication signaling**, page 35, modify with:]*

A BS shall notify each SS in sleep-mode, during its listening-interval, if traffic has been addressed to the SS during any sleep-window iteration~~it~~. The indication is sent on the TRF-IND broadcast message. The SS shall examine the frame number from the PHY Synchronization Field during each listening-interval and and shall verify ~~its~~ synchronization with the BS. If the expected frame number is different than the discovered ~~found~~ frame number, the SS shall return into awake mode, Normal Operation. Similarly, if the SS does not find the expected TRF-IND broadcast message, the SS shall return to awake mode, Normal Operation.

If the SS does not find any positive indication with its CID in the TRF-IND message~~receives a TRF-IND message with 'num-positive' field = 0~~, or no CID in the TRF-IND message matches the SS's basic CID, it shall consider this as a negative indication and shall continue in sleep mode through the next sleep-window iteration. For an example of sleep mode operation, see Annex D.

*[In **10.1 Global Values**, page 39&40, change **Table 275a** to:]*

Table 275a—Parameters and Constants

System	Name	Time Reference	Min. Value	Default Value	Max. Value
SS	Min_Sleep_Interval	Minimum sleeping time allowed to SS	2 Frames		
~~SS~~	~~Max_Sleep_Interval~~	~~Maximum sleeping time allowed to SS~~			~~5 Frames~~
~~SS~~	~~Listening_Interval~~	~~The time duration during which the SS, after waking up and synchronizing with the DL transmissions, can demodulate downlink transmissions and decides whether to stay awake or go back to sleep~~			
BS	~~NBR~~BEA-~~-~~ADV interval	Nominal time between transmission of ~~NBR~~BEA-ADV messages			~~1s~~30s
BS	ASC-AGING-TIMER	Nominal time for aging of MSS	~~0.1~~100 ms		

		~~associations~~Associations			
BS	Neighbor_Info interval	Nominal time between transmission of Neighbor_Info messages			600s
BS	Neighbor-Aging-Timer	Nominal time for aging of BS neighbor association and removal from the dynamic Neighbor BS table	3600s		
SS	Serving BS ID AGING-TIMER	Nominal time for aging of Serving BS association. Timer recycles on successful Serving BS DL-MAP read			5s
SS	MSS Sleep-AGING-TIMER	Nominal time for aging of MSS Sleep disconnect.			10500s
BS	MSS Registration-TIMER	Nominal time for aging of MSS registration association with Serving BS. Timer expiration may trigger re-registration, re-broadcast of MSS/Serving BS association, or other action.			86400s

*[In **11.1.3 RNG-REQ message encodings**, modify **Table 289a—RNG-REQ Message Encodings** with:]*

‘**Table 289a—RNG-REQ Message Encodings**

Name	Type (1 byte)	Length (1 byte)	Value (Variable-length)
~~MSS Association Channel ID~~	~~4~~	~~1~~	~~An identifier of the downlink channel on which the MSS is currently registered. The downlink channel identifier is the downlink channel ID field from the DCD message.~~
Serving BS ID	4	6	the BS ID of the BS to which the MSS is currently connected (has completed complete registration cycle and is in Normal Operation)~~The unique identifier of the former serving BS~~

*[In **11.1.4 REG-RSP TLVs for connection re-establishment**, **Table 291a—REG-RSP Encodings**, page 41, modify as:]*

Table 291a—REG-RSP Encodings

Name	Type (1 byte)	Length (1 byte)	Value (Variable-length)
New_CID	TBD	2	New CID after handover to new BS.
Old_CID	TBD	2	Old CID before handover from old BS.
Connection_Info	TBD	Variable	~~The~~ Connection_Info is a compound TLV value that encapsulates the **Service Flow Parameters** and the **CS Parameter** that have changed for the service. All the rules and settings that apply to the parameters when used in the DSC-RSP message apply to the contents encapsulated in this TLV.

*[Replace **11.1.8 NBR-ADV Message Encodings**, page 41, in its entirety with:]*

11.1.8 ~~NBR~~BEA-ADV Message Encodings

Table 292a—~~NBR~~BEA-ADV Encodings

Name	Type (1 byte)	Length (1 byte)	Value (Variable-length)
Network Type	?	8 bits	0=not specified; 1=managed, restricted; 2=managed, provisional; 3=managed, unrestricted; 4=unmanaged, restricted; 5=unmanaged, provisional; 6=unmanaged, unrestricted; other=reserved
Time Stamp	?	32 bits	Number of milliseconds since midnight GMT (set to 0xffffffff to ignore)
BS Next Beacon	?	16 bits	Estimated time interval in frames until next BS beacon event
BS Next Contention Network Entry	?	8 bits	Estimated time interval in frames until next BS contention based SS network entry interval; value=0 indicates feature not supported
BS Network Managed Handover Supported	?	1 bit	Binary 0=no; 1=yes

BS Air Interface Advertised Bandwidth	?	32 bits	In bits per second
BS Air Interface Available Bandwidth	?	32 bits	In bits per second
BS Backhaul Advertised Bandwidth	?	32 bits	In bits per second
BS Backhaul Available Bandwidth	?	32 bits	In bits per second
N_QoS_Records	?	8 bits	Number of AvailableQoSParamSet Records
For (j=0 ; j<N_QoS_Records ; j++) {			
Service Class Code	?	8 bits	Code of Service Class in AvailableQoSParamSet
}			
N_Neighbors	?	8 bits	Number of advertised BS neighbors
For (j=0 ; j<N_Neighbors ; j++) {			
Neighbor BS-ID	?	48 bits	
Neighbor Operator ID	?	48 bits	Unique Network ID
Neighbor Network Type	?	8 bits	0=not specified; 1=managed, restricted; 2=managed, provisional; 3=managed, unrestricted; 4=unmanaged, restricted; 5=unmanaged, provisional; 6=unmanaged, unrestricted; other=reserved
Neighbor Time Stamp	?	32 bits	Number of milliseconds since midnight GMT (set to 0xffffffff to ignore)
Neighbor BS Next Beacon	?	16 bits	Time interval in frames until next neighbor BS beacon event
Neighbor BS Next Contention Network Entry	?	16 bits	Time interval in frames until next neighbor BS contention based SS network entry interval; value=0 indicates feature not supported
Neighbor BS Network Managed Handover Supported	?	1 bit	Binary 0=no; 1=yes
Neighbor DCD_Settings	?	Variable	DCD_settings is a compound TLV that encapsulates an entire DCD message (excluding the generic MAC header). All the rules and settings that apply to the DCD message apply to the contents encapsulated in this TLV.
Neighbor UCD_Settings	?	Variable	UCD_settings is a compound TLV value that

			encapsulates an entire UCD message (excluding the generic MAC header). All the rules and settings that apply to the UCD message apply to the contents encapsulated in this TLV.
Neighbor BS Air Interface Advertised Bandwidth	?	32 bits	In bits per second
Neighbor BS Air Interface Available Bandwidth	?	32 bits	In bits per second
Neighbor BS Backhaul Advertised Bandwidth	?	32 bits	In bits per second
Neighbor BS Backhaul Available Bandwidth	?	32 bits	In bits per second
Neighbor N_QoS_Records	?	8 bits	Number of AvailableQoSParamSet Records
For (h=0 ; h<N_QoS_Records ; h++) {			
Neighbor Service Class Code	?	8 bits	Code of Service Class in AvailableQoSParamSet
}			
}			

*[Add **11.1.9 INF-RSP Message Encodings**:]*

11.1.9 INF-RSP Message Encodings

Table 321a— INF-RSP Encodings

Name	Type (1 byte)	Length (1 byte)	Value (Variable-length)
Home Network ID	?	48 bits	Operator ID of default network to which MSS is associated
Authentication Server Address	?	48 bits	Address of ASA network device that holds the MSS provisioned service profile and account status for the MSS
N_Neighbors	?	8 bits	Number of discovered neighbor BS
For (j=0 ; j<N_NEIGHBORS ; j++) {			
Neighbor BS-ID	?	48 bits	Same as the Base Station ID parameter in the DL-MAP message of neighbor BS
Neighbor BS Operator ID	?	48 bits	the unique network ID shared by an association of BS
Neighbor BS Physical	?	32 bits	DL center frequency (kHz).

Frequency			
Neighbor BS S/(N + I)	?	8 bits	This parameter indicates the signal to noise and interference ratio measured by the MSS from the particular BS. The value shall be interpreted as an unsigned byte with units of 0.25dB
Neighbor BS Service level prediction	?	8 bits	This value indicates the level of service the MSS can expect from this BS. 0 = No service possible for this MSS/service level undetermined; 1 = Some service is available for the MSS; 2 = Service with QoS specified at ASA server (for the MSS identified by the 48-bit MAC address) is available
}			

*[Add TLV to **11.3 Configuration file encodings**:]*

11.3.7 MSS Home Attachment address:

For mobile enabled networks, MSS Home Attachment address defines the static reference address location for traffic forwarding mobility models

Type	Length	Value
??	4 or 16	IP Address

*[In **C.1 Backbone network services**, page 44, change **Table C1**:]*

Table C1—Backbone Network Services

Service	Possible Method for Providing service	Comments
Backhaul for traffic	-	Default transport protocol is UDP.
Provide a BS with the identity of its neighbors	(1) Get info from ASA server (2) Configuration (network management) (3) Build list from SS_INF-RSP obtained from MSS	Options (1) and (2) are really the same, the only difference is where the configuration is done
Provide a BS with the identity of the ASA server	(1) ASA server publishes its presence (2) Configuration (network management)	Message format and transport protocol need to be specified for interoperability
Advertise the fact that a certain MSS has registered	(1) BS notifies ASA server	Message format and transport protocol need to be specified for

with a certain BS	(2) BS notifies neighbor BS	interoperability
Provide a BS information about a certain MSS	(1) ASA server provides information (2) Serving BS provides information (or network management if serving BS cannot be found)	Message format and transport protocol need to be specified for interoperability
Information exchange during HO	(1) ASA server is in the middle (2) BS to BS direct exchange	Message format and transport protocol need to be specified for interoperability
Provide Neighbor Notification request	Sending BS notifies affiliated BS that Sending BS considers affiliated BS a Neighbor for Neighbor BS purposes	Message format and transport protocol need to be specified for interoperability.
Provide Neighbor Notification response	Affiliated BS response to Sending BS request for Neighbor BS designation	Message format and transport protocol need to be specified for interoperability.
Provide Neighbor Notification confirmation	Sending BS confirmation of Affiliated BS response to Sending BS request for Neighbor BS affiliation	Message format and transport protocol need to be specified for interoperability.

*[In **C.2.2 I-am-host-of message**, page 45, paragraph 1, modify paragraph as:]*

C.2.2 HO complete/Serving BS notification message ~~**C.2.2 I-am-host-of message**~~

This message is sent by a BS to notify other BS (or the ASA server) that a certain MSS is registered with it. The primary use is to notify previous Serving BS and/or ASA or other network services access control administrator that MSS has successfully completed network entry or hand-over and that the BS originating the HO complete/Serving BS notification message is now the Serving BS for the MSS. The message ~~shall~~ may be sent upon MSS establishment of normal operation~~registration~~, and periodically on timer interval (MSS Registration-TIMER~~TBD period~~). The message might trigger a ~~neighbor~~ Neighbor BS to request more information on the MSS (either directly from the ~~sender~~ Serving BS, or from ~~the~~ an ASA server). The message contains the following information,

Table C3—HO complete/Serving BS notification message
~~**Table C3—I-am-host-of Message**~~

*[In **C.2.4 MSS-info-response message**, **Table C5—MSS-info-response Message**, page 46, modify as:]*

Table C5—MSS-info-response Message

Field	Size	Notes
Global Header	152 bits	
For (j=0; j<Num Records; j++) {		
~~MSS unique identifier~~SS MAC Address	48 bits	48-bit unique identifier used by MSS ~~(as provided by the MSS or by the *I-am-host-of message*)~~

Current Basic CID	16 bits	Basic CID assigned by current Serving BS at initial ranging
Current Primary Management CID	16 bits	Primary Management CID assigned by current Serving BS at initial ranging
Current Secondary Management CID	16 bits	Secondary Management CID assigned by current Serving BS at registration
Current MSS Network Address	48 bits	MSS Network Address assigned by current Serving BS at establish IP connectivity
N_NSIE	8 bits	Number of Network Service Information Elements
For (k=0; k<N_NSIE; k++) {		
Field Size	16 bits	Size of TLV encoded information field below
TLV encoded information	Variable	TLV information as allowed on a ~~DSA~~DSx ~~-REQ~~ xxx MAC message consistent with parameters necessary for Target BS to issue an unsolicited DSA-RSP to MSS during re-registration and to build Connection_Info
}		
N_SAIE	8 bits	Number of Security Association Information Elements
For (k=0; k<N_SAIE; k++) {		
Field Size	16 bits	Size of TLV encoded information field below
TLV encoded information	Variable	TLV information as allowed on a PKM-xxx MAC messages
}		
N_SS_CAP	8 bits	Number of SS Capabilities
For (k=0; k<N_~~SAIE~~SS_CAP; k++) {		
Field Size	16 bits	Size of TLV encoded information field below
TLV encoded information	Variable	TLV information as allowed on a SBC-REQ MAC message
}		
N_REG		Number of Registration Items
For (k=0; k<N_REG; k++) {	8 bits	
Field Size	16 bits	Size of TLV encoded information field below
TLV encoded information	Variable	TLV information as allowed on a ~~SBC~~REG-~~REQ~~ xxx MAC message consistent with parameters necessary for Target BS to issue an unsolicited REG-RSP to MSS during re-
}		
}		
Security Field	TBD	A means to authenticate this message
CRC field	32 bits	IEEE CRC-32

*[In **C.2.7 HO-notification-confirm message**, page 48, entire section, modify as:]*

C.2.7 HO complete/Serving BS notification acknowledge message

~~**C.2.7 HO-notification-confirm message**~~

A BS may send a HO complete/Serving BS notification acknowledge message to acknowledge receipt of a HO complete/Serving BS notification message.~~This message is sent from one BS to another BS, typically in response to an HO-notification-response message. The message servs to provide the BS that sent the HO-notification-response message with information about the level of service and capability.~~

The message contains the following information:

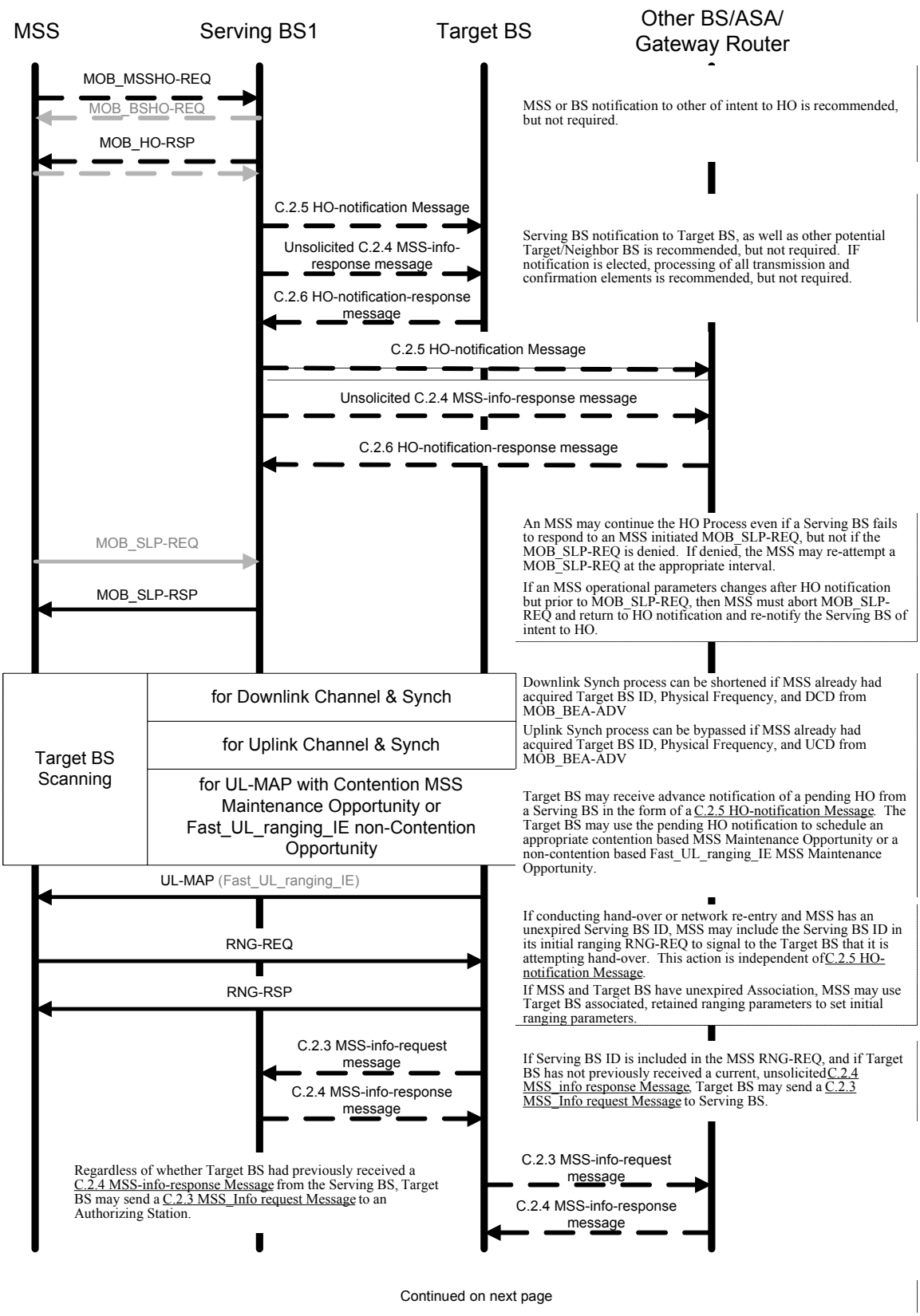
Table C8— HO complete/Serving BS notification acknowledge message

~~**Table C8—HO-notification Message**~~

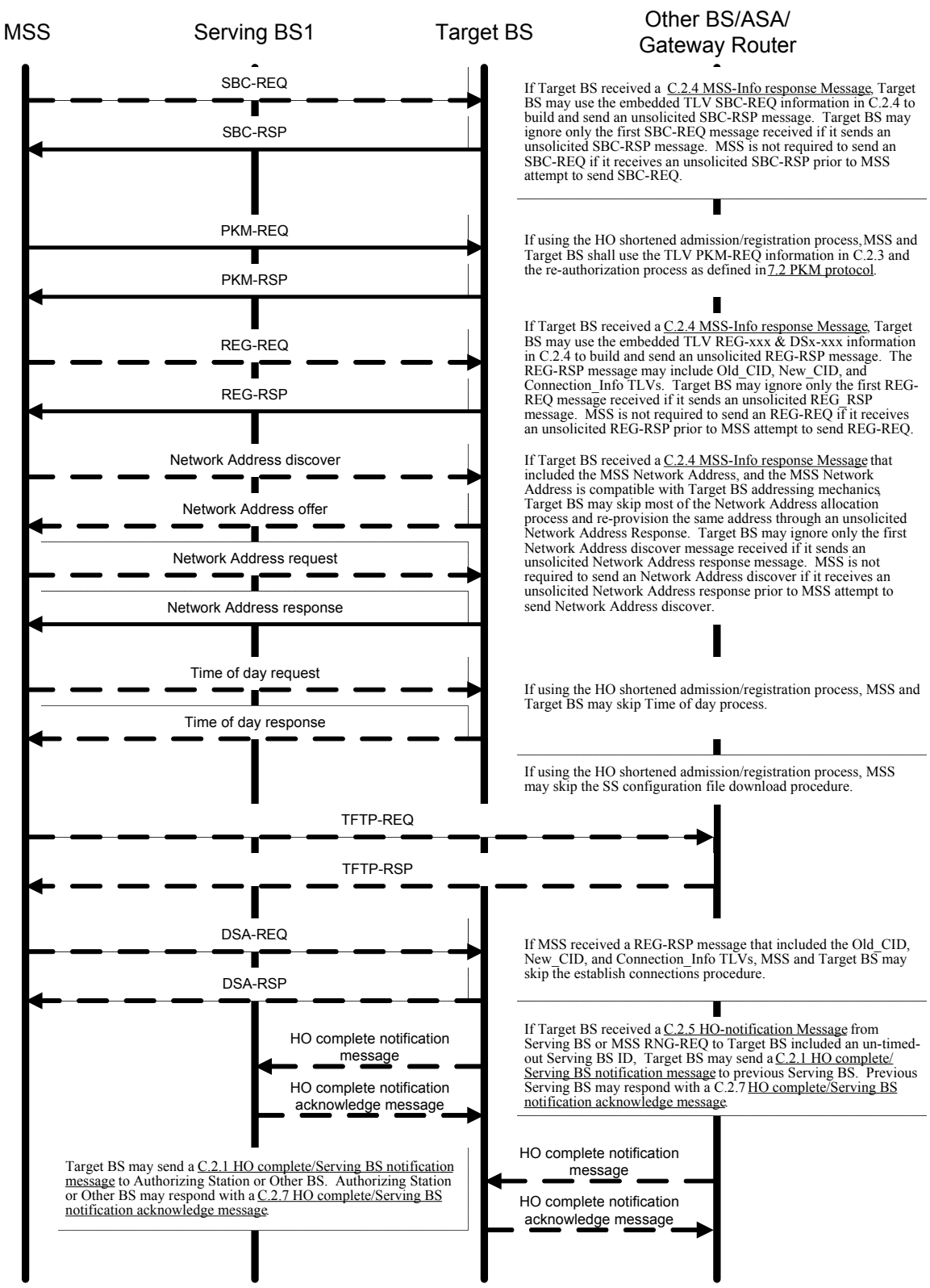
Field	Size	Notes
Global Header	152 bits	
~~For (j=0; j<Num Records; j++) {~~		
~~- MSS unique identifier~~	~~48 bits~~	~~48-bit universal MAC address of the MSS (as provided to the BS on the RNG-REQ message)~~
~~- QoS Estimated~~	~~8 bits~~	~~Bandwidth which is provided by BS (to guarantee minimum packet data transmission) TBD how to set this field~~
~~- BW Estimated~~	~~8 bits~~	~~Quality of Service level — Unsolicited Grant Service (UGS) — Real-time Polling Service (rtPS) — Non-real-time Polling Service (nrtPS) — Best Effort Service (BE)~~
~~}~~		
Security Field	TBD	A means to authenticate this message
CRC Field	32-bits	IEEE CRC-32

*[In **C.2.8 Example of Backbone Network HO procedure**, pages 48-50, delete **Figure C.2—Example of HO call flow by BS** entirely and replace **Figure C.1—Example of HO call flow by MS** with:]*

Figure C.1—Example of HO Process Flow



Continued on next page



*[Add new sub-sections to **C.2 Inter-base station message formats**:]*

C.2.9 Neighbor_Notification.request message

An originating BS may send a Neighbor_Notification.request to another BS indicating it considers the BS a Neighbor BS.

Table C9—Neighbor_Notification request message

Field	Size	Notes
Global Header	152 bits	
Security Field	TBD	A means to authenticate this message
CRC Field	32 bits	IEEE CRC-32

*[Add new sub-sections to **C.2 Inter-base station message formats**:]*

C.2.10 Neighbor_Notification.response message

A notified BS shall respond with a Neighbor_Notification.response message confirming or denying a Neighbor_Notification request. If the neighbor relationship is affirmed, both BS shall place each other on their dynamic Neighbor BS tables and begin aging timer (Neighbor-Aging-Timer, see Table 275a).

Table C10—Neighbor_Notification response message

Field	Size	Notes
Global Header	152 bits	
ACK/NACK	1 bit	Acknowledgement or Negative acknowledgement. 0=Negative acknowledgement which means that the notified BS refuses to accept neighbor association with the originating BS 1=Acknowledgement which means that the notified BS accepts neighbor association with the originating BS
Security Field	TBD	A means to authenticate this message
CRC Field	32 bits	IEEE CRC-32

*[Add new sub-sections to **C.2 Inter-base station message formats**:]*

C.2.11 Neighbor_Notification confirmation message

The originating BS shall confirm acknowledgement of receipt of the Neighbor_Notification.response using a Neighbor_Notification confirmation message.

Table C11—Neighbor_Notification confirmation message

Field	Size	Notes
Global Header	152 bits	
Security Field	TBD	A means to authenticate this message
CRC Field	32 bits	IEEE CRC-32

*[Add new sub-sections to **C.2 Inter-base station message formats**:]*

C.2.12 Neighbor_Info message

Each BS may send a Neighbor_Info message on periodic intervals (Neighbor_Info interval, see Table 275a) to each other BS on its Neighbor BS table. Also, immediately following sending of a positive Neighbor_Notification.response message, the notified BS shall send a Neighbor_Info message to the originating BS of the Neighbor_Notification request message.

Table C12—Neighbor_Info message

Field	Size	Notes
Global Header	152 bits	
BS ID	48 bits	Base station unique identifier (Same number as that broadcasted on the DL-MAP message)
Operator ID	48 bits	Unique Network ID
Network Type	8 bits	0=not specified; 1=managed, restricted; 2=managed, provisional; 3=managed, unrestricted; 4=unmanaged, restricted; 5=unmanaged, provisional; 6=unmanaged, unrestricted; other=reserved
Time Stamp	32 bits	Number of milliseconds since midnight GMT (set to 0xffffffff to ignore)
BS Next Beacon	16 bits	Time interval in frames until next BS beacon event
BS Next Contention Network Entry	8 bits	Time interval in frames until next BS contention based SS network entry interval; value=0 indicates feature not supported
BS Network Managed Handover Supported	1 bit	Binary 0=no; 1=yes
BS Air Interface Advertised Bandwidth	32 bits	In bits per second
BS Air Interface Available Bandwidth	32 bits	In bits per second

BS Backhaul Advertised Bandwidth	32 bits	In bits per second
BS Backhaul Available Bandwidth	32 bits	In bits per second
N_QoS_Records	8-bits	Number of AvailableQoSParamSet Records
For (j=0 ; j<N_QoS_Records ; j++) {		
Service Class Code	8 bits	Code of Service Class in AvailableQoSParamSet
}		
Security Field	TBD	A means to authenticate this message
CRC Field	32 bits	IEEE CRC-32

*[In **Annex D.2**, page 61, replace **Figure D.10**, **D.11**, and **D.12** entirely with:]*

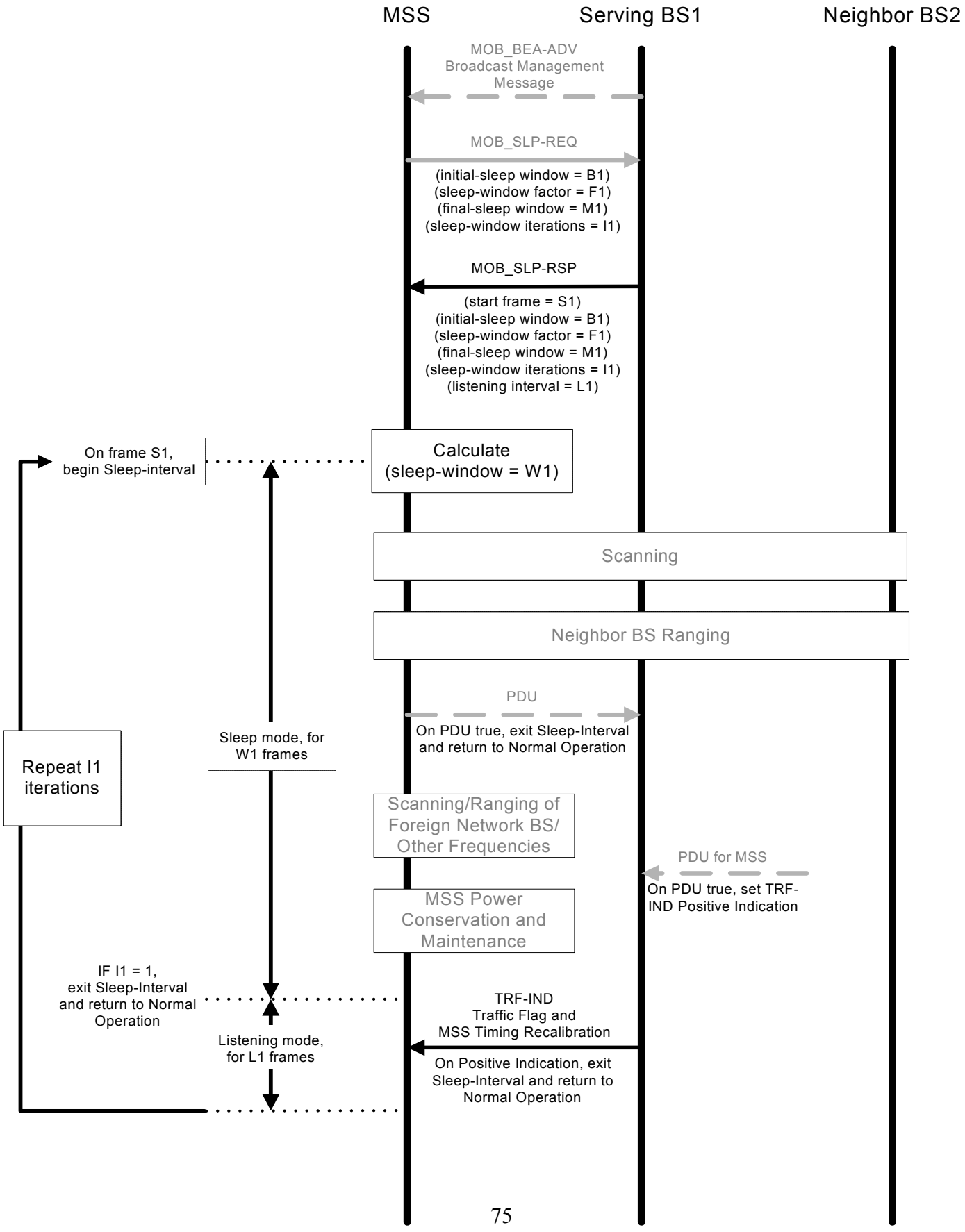

MSS
Serving BS1
Neighbor BS2
MOB_BEA-ADV
Broadcast Management
Message
MOB_SLP-REQ
(initial-sleep window = B1)
(sleep-window factor = F1)
(final-sleep window = M1)
(sleep-window iterations = I1)
MOB_SLP-RSP
(start frame = S1)
(initial-sleep window = B1)
(sleep-window factor = F1)
(final-sleep window = M1)
(sleep-window iterations = I1)
(listening interval = L1)
On frame S1,
begin Sleep-interval
Calculate
(sleep-window = W1)
Scanning
Neighbor BS Ranging
PDU
On PDU true, exit Sleep-Interval
and return to Normal Operation
Repeat I1
iterations
Sleep mode, for
W1 frames
Scanning/Ranging of
Foreign Network BS/
Other Frequencies
PDU for MSS
On PDU true, set TRF-
IND Positive Indication
MSS Power
Conservation and
Maintenance
IF I1 = 1,
exit Sleep-Interval
and return to Normal
Operation
TRF-IND
Traffic Flag and
MSS Timing Recalibration
Listening mode,
for L1 frames
On Positive Indication, exit
Sleep-Interval and return to
Normal Operation

Figure D.10—Sleep mode