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Baseline Document for Draft Standard for
Local and Metropolitan Area Networks

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

Multihop Relay Specification

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Prepared by the Relay Task Group of IEEE 802.16

Abstract: This document specifies OFDMA physical layer and medium access control layer enhancements to IEEE Std. 802.16 for licensed bands to enable the operation of relay stations.

Keywords:

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Introduction

(This introduction is not part of the IEEE P802.16j, Draft amendment to IEEE Standard for Local and Metropolian Networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems - Multihop Relay Specifications).

Participants

~~This document was developed by the IEEE802.16 Working Group on Broadband Wireless Access, which develops the WirelessMAN™ Standard for Wireless Metropolitan Area Networks.~~

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~~Primary development was carried out by the Working Group's Relay Task Group.~~

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Baseline Document for Draft Standard for
Local and Metropolitan Area Networks

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

Multihop Relay Specification

NOTE-The editing instructions contained in this amendment define how to merge the material contained herein into the existing base standard and its amendments to form a comprehsive standard.

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

1. Overview

1.1 Scope

This document specifies OFDMA physical layer and medium access control layer enhancements to IEEE Std 802.16 for licensed bands to enable the operation of relay stations. Subscriber station specifications are not changed.

1.2 Purpose

The purpose of this amendment is to enhance coverage, throughput and system capacity of 802.16 networks by specifying 802.16 multihop relay capabilities and functionalities of interoperable relay stations and base stations.

1.3 Frequency bands

1.3.4 Air interface nomenclature and PHY compliance

Change Table 1 as indicated:

Table 1—Air interface nomenclature

Designation	Applicability	PHY specification	Options	Duplexing alternative
WirelessMAN-SC™	10–66 GHz	8.1	—	TDD FDD
WirelessMAN-SCa™	Below 11 GHz licensed bands	8.2	AAS (6.3.7.6) ARQ (6.3.4) STC (8.2.1.4.3) mobile	TDD FDD
WirelessMAN-OFDM™	Below 11 GHz licensed bands	8.3	AAS (6.3.7.6) ARQ (6.3.4) Mesh (6.3.6.6) STC (8.3.8) mobile	TDD FDD
WirelessMAN-OFDMA	Below 11 GHz licensed bands	8.4	AAS (6.3.7.6, 8.4.4.6) ARQ (6.3.4) HARQ (6.3.17) STC (8.4.8) mobile Multihop relay (1.4.2)	TDD FDD
WirelessHUMAN™	Below 11 GHz license-exempt bands	[8.2, 8.3 or 8.4] and 8.5	AAS (6.3.7.6) ARQ (6.3.4) Mesh (6.3.6.6) (with 8.3 only) STC (8.2.1.4.3/8.3.8/8.4.8)	TDD

1.4 Reference model

Insert new subclause 1.4.3:

1.4.3 MR protocol

The R-MAC sub-layer provides efficient MAC PDU relaying/forwarding and control functions. This sub-layer is applicableto the links between MR-BS and RSs and between RSs. Two example data protocol stacks are shown in Figure XX and Figure XXX. Figure XX shows an example protocol stack for MS traffic relaying where the MS connection and privacy managements is on an end-to-end basis (between MR-BS and MS). Figure XXX shows the another example protocol stack for MS traffic relaying where the MS connection and privacy management are managed by the RS and the RS connection and privacy management are controlled by MR-BS.

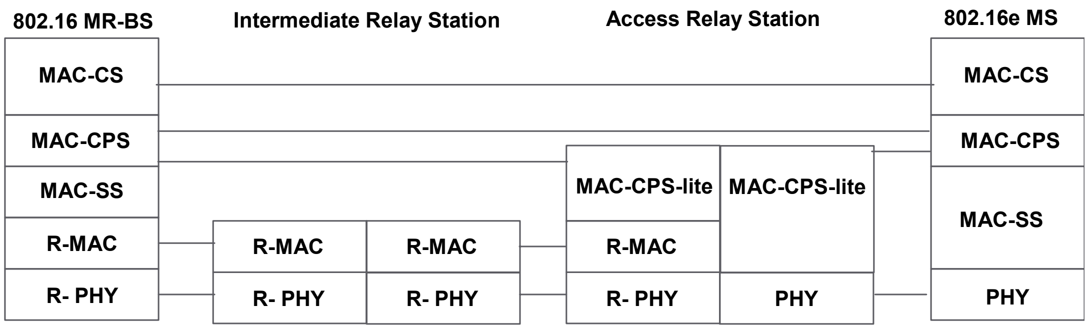


Figure 2a—Example MR data protocol stack for simple RS (MS traffic relaying).

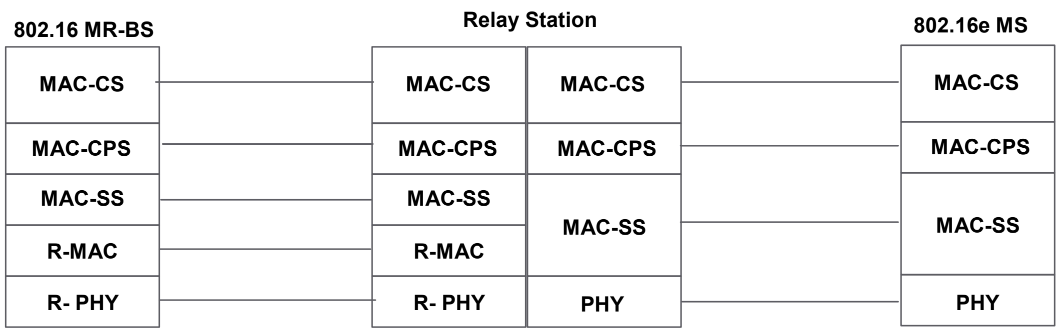


Figure 2b—Example MR Data Protocol stack for moving RS in moving BS mode (MS traffic relaying)

The R-MAC provides the concatenation and fragmentation of forwarded MAC PDU and control functions, such as scheduling, routing, flow control and etc. The R-MAC supports the use of the generic MAC header.

The R-PHY layer provides definition of physical layer design, such as, sub-channelization, modulation and code set and etc, for links between MR-BS and RS and between RSs.

The CPS-lite block includes functions such as scheduling on access link and etc.

A relay station may implement the R-MAC sub-layer, or MAC CPS function and MAC CS function.

The transport connection(s) of an MS can be established between the MR-BS and MS (end-to-end connection) or established between its serving station (MR-BS or relay station) and the MS.

2. References

3. Definitions

Insert the following at the end of section 3:

3.88 MR-BS frame: Frame structure for DL transmission/UL reception by MR-BS

3.89 RS frame: Frame structure for DL transmission/UL reception by RS.

3.90 DL access zone: A portion of the DL sub-frame in the MR-BS/RS frame used for MR-BS/RS to MS or transparent RS transmission

3.91 UL access zone: A portion of the UL sub-frame in the MR-BS/RS frame used for MS to MR-BS/RS transmission

3.92 DL relay zone: A portion of the DL sub-frame in the MR-BS/RS frame used for MR-BS/RS to RS transmission

3.93 UL relay zone: A portion of the UL sub-frame in the MR-BS/RS frame used for RS to MR-BS/RS transmission

3.94 tunnel CID (T-CID): An identifier taken from the connection identifier (CID) address space that uniquely identifies a transport tunnel connection between an MR-BS and an RS.

3.95 management tunnel CID (MT-CID): An identifier taken from the connection identifier (CID) space managed by an MR-BS that uniquely identifies a management tunnel connections between the MR-BS and an access RS.

3.96 access link: An 802.16 radio link that originates or terminates at an MS. The access link is either an uplink or downlink as defined in IEEE Std. 802.16-2004 and IEEE Std. 802.16e-2005.

3.97 relay link (R-link): An IEEE Std. 802.16j radio link between an MR-BS and a RS or between a pair of RSs. This can be a relay uplink or downlink.

3.98 RS receive/transmit transition gap (RSRTG): A gap between the last sample of the uplink burst in access zone and the first sample of the subsequent uplink burst in relay zone at the antenna port of the relay station (RS) in a time division duplex (TDD) transceiver. This gap allows time for the relay station (RS) to switch from receive to transmit mode. Not applicable for frequency division duplex (FDD) systems.

3.99 RS transmit/receive transition gap (RSTTG): A gap between the last sample of the downlink burst in access zone and the first sample of the subsequent downlink burst in relay zone at the antenna port of the relay station (RS) in a time division duplex (TDD) transceiver. This gap allows time for the relay station (RS) to switch from transmit to receive mode. Not applicable for frequency division duplex (FDD) systems.

3.100 R-RTG: RS receive/transmit transition gap between a received mode access zone or relay zone and a transmit mode access or relay zone in an RS frame. It shall be an integer number of OFDM symbols. The R-RTG shall be calculated by following equation:

$$R\text{-}RTG = \lceil OFDMSymbolUnit(RSRTG + (RTD)/2) \rceil$$

3.101 R-TTG: RS transmit/receive transition gap between a transmit mode access or relay zone and a receive mode access or relay zone in an RS frame. It shall be an integer number of OFDM symbols. The R-TTG shall be calculated by following equation:

$$R\text{-}TTG = \begin{cases} 0 & \text{if } RTD/2 \geq RSTTG \\ \lceil OFDMSymbolUnit(RSTTG - RTD/2) \rceil & \text{if } RTD/2 < RSTTG \end{cases}$$

3.102 non-transparent RS: A non-transparent RS transmits DL frame-start preamble, FCH, DL-MAP/UL-MAP and DCD/UCD.

3.103 transparent RS: A transparent RS does not transmit DL frame-start preamble, FCH, DL-MAP/UL-MAP, and DCD/UCD.

3.104 multihop relay base station (MR-BS): A generalized equipment set providing connectivity, management, and control of relay stations. *See also:* **base station (BS)**, **relay station (RS)**.

3.105 security zone key (SZK): A group key shared by the MR-BS and a group of RS within the same security zone.

3.106 group key encryption key (GKEK):

4. Abbreviations and acronyms

Insert the following at the end of section 4:

R-TTG	relay transmit/receive transition gap
R-RTG	relay receive/transmit transition gap
R-FCH	relay zone frame control header
R-MAP	relay zone MAP
R-Zone	relay zone
FRS	fixed relay station
MRS	mobile relay station
NRS	nomadic relay station
MR-BS	multihop relay base station
RS	relay station

6. MAC common part sublayer

6.1 PMP

Insert new subclause 6.1.1:

6.1.1 Relaying extension

6.3 Data/Control plane

6.3.1 Addressing and connections

Insert new subclause 6.3.1.3:

6.3.1.3 Addressing and connections for relay support

Addressing and connections as perceived by the SS/MS are defined in the same manner as in the PMP mode, as described in 6.3.1.1. This subclause specifies the additional addressing and connection definitions that apply to relay functions. Each RS shall have a 48-bit universal MAC address, as defined in IEEE Std 802®-2001. This address uniquely defines the air interface of the RS from within the set of all possible vendors and equipment types. It is used during the initial ranging process to establish the appropriate connections for an RS. It is also used as part of the authentication process by which the MR-BS and RS each verify the identity of the other.

RSs that broadcast a preamble, FCH, and DL Map shall be assigned a unique Base Station ID. The format of the Base Station ID is defined in section 6.3.2.3.2.

In MR networks, connections can span multiple hops. Connections shall be identified by the connection ID (CID) as specified in section 6.3.1.1. CIDs are unique within an MR cell. In MR networks all connection types specified in PMP mode shall be supported between the MR-BS and MS. In MR networks, these connections may pass through one or more RSs.

Basic and primary management connections shall be established between the MR-BS and all RSs within the MR cell. These connections shall be used for the exchange of management messages between the MR-BS and RS and may pass through one or more intermediate RSs.

An additional type of connection called a tunnel connection may be established between the MR-BS and an RS. Tunnel connections shall be used for transporting MPDUs from one or more connections that terminate in the MR-BS and pass through the RS. It is not required that all connections must pass through a tunnel connection. MPDUs from connections that do not pass through a tunnel are forwarded based on the CID of the connection. Tunnel connections may pass through one or more intermediate RSs. There shall be two types of tunnel connections. Management tunnel connections shall be used for transporting MPDUs from management (basic, primary, or secondary) connections. Management tunnel connections shall not be used to transport MPDUs from transport connections. Management tunnel connections shall be identified using the MT-CID. Transport tunnel connections shall be used for transporting MPDUs from transport connections. Transport tunnel connections shall not be used to transport MPDUs from management connections. Transport tunnel connections shall be identified using the T-CID. MT-CID is bidirectional and T-CID is unidirectional.

Insert new subclause 6.3.1.3.1:

6.3.1.3.1 Addressing Scheme for Relaying

In the procedure of network entry and initialization for a new RS, the MR-BS may non-systematically or systematically assign CIDs, e.g. basic CIDs, MT-CIDs, and T-CIDs, for a RS. Systematic CID assignment is described in 6.3.25.1.

6.3.2 MAC PDU formats

Insert the following paragraph at the end of 6.3.2:

For MAC PDUs sent on relay link, they can be of the form illustrated in Figure 18a. Each PDU can begin with a fixed length relay MAC PDU header. The relay MAC header may be followed by the Payload. If Payload is present after the relay MAC PDU header, the Payload shall consist of zero or more extended subheader, zero or more subheader, zero or more IEEE 802.16e MAC PDUs and zero or more relay MAC PDUs. A relay MAC PDU may contain a CRC.

Relay MAC Header	Payload (optional)	CRC (optional)

Figure 21a—Relay MAC PDU Format

6.3.2.1 MAC header formats

Insert new subclause 6.3.2.1.1.1:

6.3.2.1.1.1 Relay MAC PDU header format

Relay MAC PDU shall be of the format defined in Table 6a and further illustrated in Figure 19b and 19c, respectively.

The 3-bit "priority field" may be used in the relay MAC header to indicate the priority of the associated tunneled MPDU.

Table 7a—Relay MAC PDU header

Syntax	Size	Notes
MAC Header() {		
HT	1 bit	
if(HT==0){		
Reserved	1 bit	Currently reserved. Content is subject to further discussion
RMI	1 bit	Relay mode indication(RMI) is used to indicate whether this MAC header is GMH or Relay MAC header RMI=0; use GMH RMI=1; use relay MAC header
Reserved	7 bits	Currently reserved. Content is subject to further discussion
Priority	3 bits	Priority of the associated tunneled MPDU
LEN	11 bits	
CID	16 bits	May be tunnel CID or basic CID of the RS
HCS	8 bits	Header Check Sequence
}else {		
Use legacy 802.16e or 802.16j format	39 bits	
HCS	8 bits	
}		
}		
}		

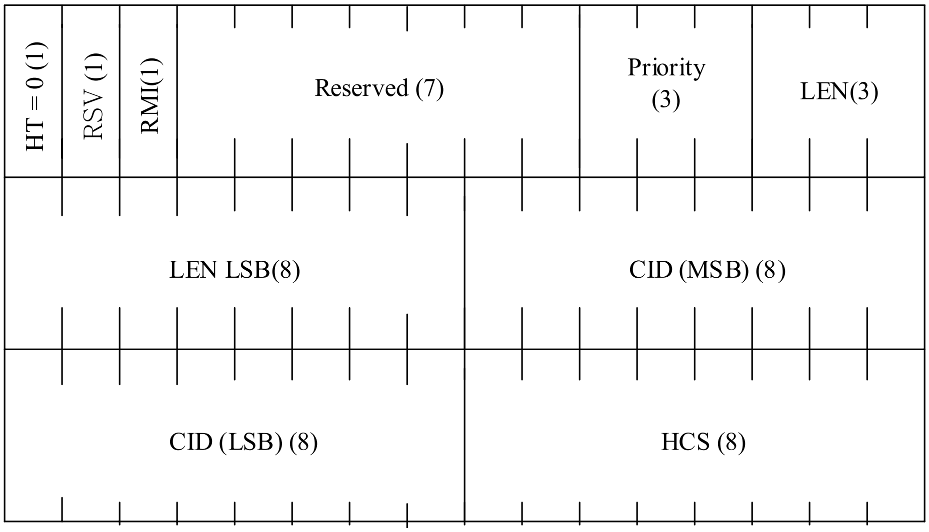


Figure 22a—Header format of relay MAC PDU with payload

The location of the CE field in the MAC header is to be determined.

6.3.2.1.2.2 MAC signaling header type II

Change Table 7g(.16e)/Table 16(Rev2) as indicated:

Table 16—Type field encodings for MAC signaling header type II

Type field	MAC header Type (with HT/EC=0b11)	Reference figure	Reference table
0	Feedback header, with another 4 bit type field, see Table 7i for its type encodings.	20h, 20i	7h
1	~~Reserved~~Extended MAC Signaling Header Type II		

Insert new subclause 6.3.2.1.2.2.2:

6.3.2.1.2.2.2 Extended MAC Signaling Header Type II

This type of MAC header is UL specific. There is no payload following the MAC header. The Extended MAC signaling header type II is illustrated in Figure XX. Table X1 describes the encoding of the 3-bit extended type field following the type field.

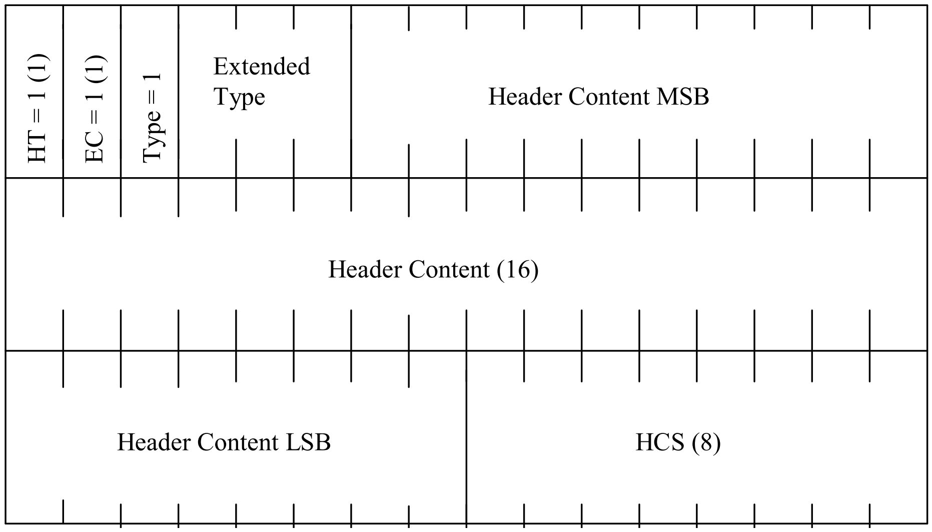


Figure 35a—Extended MAC Signaling Header Type II Format

Table 19a—Extended Type field encodings for Extended MAC signaling header type II

Extended Type field	MAC header type	Reference figure	Reference table
0	RS BR header	XX	XX
1	RS UL_DCH request header		
2	Acknowledgment header		
3	HARQ RS error report header		
4-7	*Reserved*		

Insert new subclause 6.3.2.1.2.2.2.1:

6.3.2.1.2.2.2.1 RS bandwidth request header (RS BR)

RS BR header may be sent by the RS to the MR-BS to request bandwidth for its access link for the purposes of transmitting a RNG_RSP message. The RS BR header is illustrated in Figure xxx.

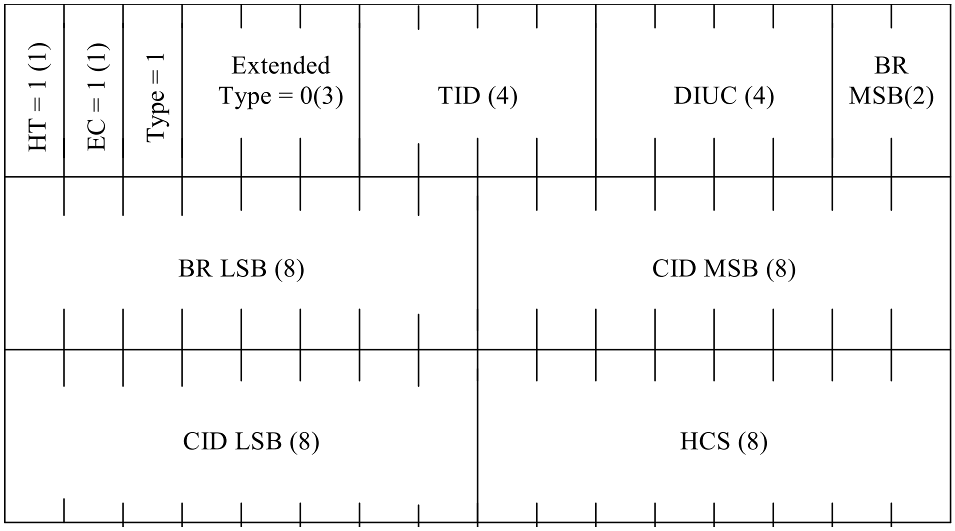


Figure 35b—RS BR header format

Table 19b—Description of fields in RS BR header

Name	Length	Description
TID	4	Transaction Identifier. MR-BS when allocating resources for RNG-RSP message in response to an RS BR header shall include the same TID in the RS-RNG_RSP_ALLOC_IE as in the RS BR header.
DIUC	4	Indicates the DIUC used by RS to transmit RNG_RSP. MR-BS allocates sufficient resources to send RNG_RSP from RS using RS-RNG_RSP_ALLOC_IE.
BR	10	Requested amount of bandwidth
CID	16	Basic CID of the RS for which the RS bandwidth request header is sent
HCS	8	Header Check Sequence (same usage as HCS entry in Table 5).

Insert new subclause 6.3.2.1.2.2.2.2:

6.3.2.1.2.2.2.2 RS UL DCH request header (RS UL_DCH)

The RS requests a dedicated uplink resource through the RS UL_DCH request header. The format of this header is illustrated in Figure uuu and described in Table <xxx>.

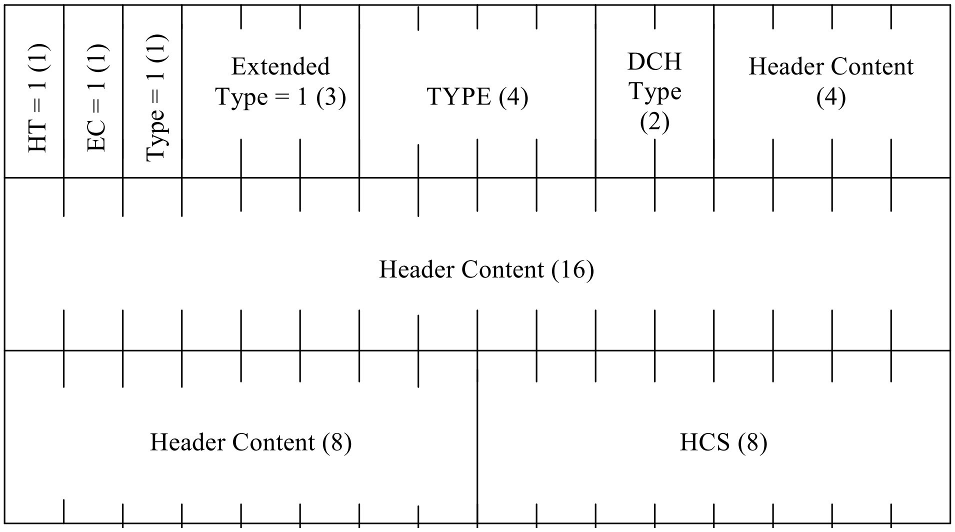


Figure 35c—RS UL_DCH request header

Table 19c—RS UL_DCH request header

Syntax	Size	Notes
MAC Header() {		
HT	1 bit	Shall be set to 1
EC	1 bit	Shall be set to 1
Type	1 bit	Shall be set to 1
Extended TYPE	3 bits	Shall be set to 001 for RS UL_DCH request header
TYPE	4 bits	0000 = DCH Request 0001 - 1111 = *Reserved*
if(TYPE == 0000){		DCH Request
DCHTYPE	2 bits	00 = DCH Request Incremental 01 = DCH Request Aggregate 10 = DCH Request Rate Based 11 = Reserved
if(DCHTYPE == 00){		DCH Request Incremental
Bandwidth request	16 bits	Number of bytes requested by the RS. Zero in this field indicates DCH release request.
N	4 btis	Allocation repeats once every N frames
}elseif (DCH TYPE == 01){		DCH Request Aggregate
Bandwidth Request	16 bits	Number of bytes requested by the RS. Zero in this field indicates DCH release request
N	4 bits	Allocation repeats once every N frames
}elseif (DCH TYPE == 10){		DCH Request Rate Based

Table 19c—RS UL_DCH request header

Syntax	Size	Notes
Average rate	20 bits	Average data rate in units of bytes per second 18 MSB bits: magnitude 2 LSB bits: base-10 exponent
}		
RS CID	8 bits	Reduced Basic CID of RS
}		
HCS	8 bits	Header check sequence
}		

Insert new subclause 6.3.2.1.2.2.2.3:

6.3.2.1.2.2.2.3 Acknowledgment header

An acknowledgment header is sent by an RS as a response to a MAC management messages received from the MR-BS or its superordinate RS that requires acknowledgment. The RS sends this header to the MR-BS or its superordinate RS as an indication of the message reception. The acknowledgment header shall be sent on RS's basic CID. The acknowledgment header is illustrated in Figure 20l. The support of acknowledgement header is optional for both MR-BS and RS and shall be negotiated during network entry of a RS using REG-REQ and REG-RSP message.

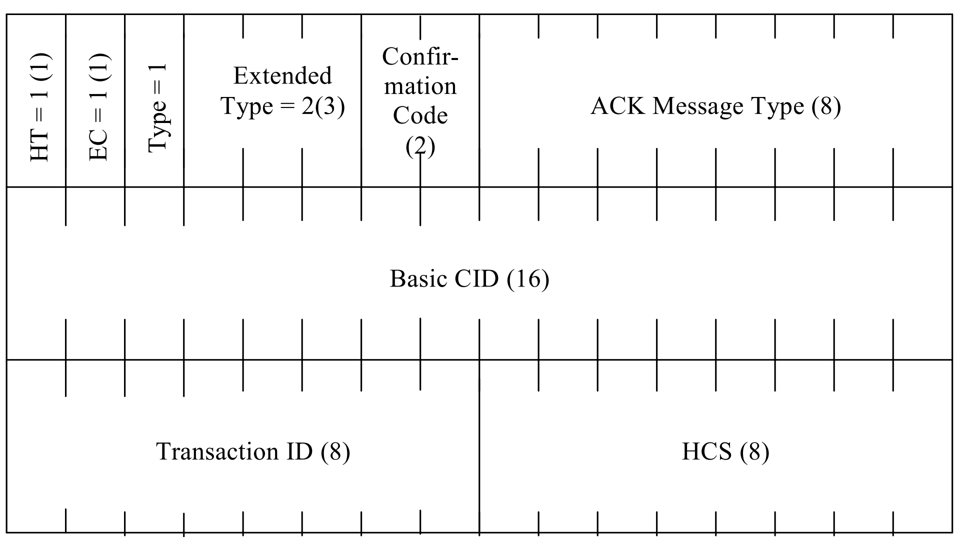


Figure 35d—Acknowledgement header

The Acknowledgment header shall have the following properties:

a. This is a MAC signaling header type II. The length of the header shall always be 6 bytes.

b. The Type field of this header shall be set to 1.

c. The Extended Type field of this header shall be set to 0b010

d. The content of the header is listed in table 7k.

Table 19d—Acknowledgement header fields

Name	Size	Description
Confirmation Code	2 bits	An indication that MAC message received by RS 0b00: Received successfully 0b01 – 0b11: *Reserved*
ACK Message Type	8 bits	The MAC message type of the message receivedby the RS from the MR-BS or its superordinate RS
Basic CID	16 bits	The basic CID of the RS
Transaction ID	8 bits	Transaction ID included in the MAC managementmessage received from the BS. If Transaction ID is not included, set this field to zero.
HCS	8 bits	Header Check Sequence (same usage as HCS entry in Table 5).

Insert new subclause 6.3.2.1.2.2.2.4:

6.3.2.1.2.2.2.4 HARQ RS Error Report Header

The RS HARQ Error Report header is used for RS to provide ACK/NAK when RS is unable to decode HARQ DL data successfully. The RS can send this header to MR-BS or parent RS as an unsolicited feedback in UL relay zone. The header format is illustrated in Figure xxx.

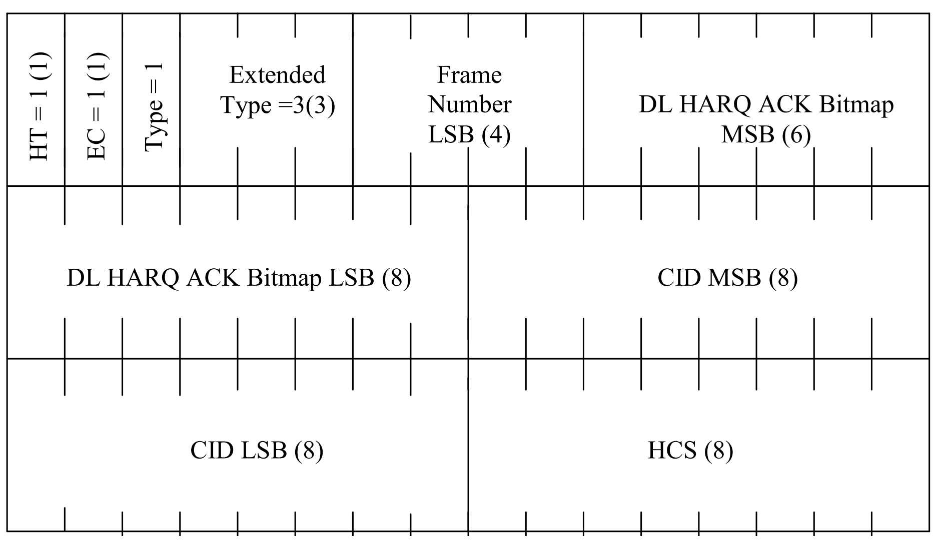


Figure 35e—HARQ RS Error Report Header Format

Table 19e—Description of fields in HARQ RS Error Report Header

Name	Length (bits)	Description
DL HARQ ACK/NAK bitmap	14	RS transmits ACK/NAK Bitmap of DL HARQ data of previous frame. The order of Bitmap from MSB to LSB follows the order of DL HARQ sub-burst
Frame Number	4	Least significant 4 bits of frame number where the DL HARQ burst is received by the RS
CID	16	Basic CID of the RS for which the RS bandwidth request header is sent.
HCS	8	Header Check Sequence (same usage as HCS entry in Table 5).

6.3.2.2 MAC subheaders and special payloads

6.3.2.3 MAC management messages

Change Table 14(.16e)/Table 38(Rev2) as indicated:

Table 38—MAC management messages

Type	Message name	Message description	Connection
0	UCD	Uplink Channel Descriptor	Fragmentable Broadcast or RS Primary Management or Multicast Management
1	DCD	Downlink Channel Descriptor	Fragmentable Broadcast or RS Primary Management or Multicast Management
2	DL-MAP	Downlink Access Definition	Broadcast or RS Basic
3	UL-MAP	Uplink Access Definition	Broadcast or RS Basic
67	RS-CDC	RS cooperative diversity configuration	Basic
68	MR_NBR-INFO	MR_NBR-INFO	Basic
69	MR_Code-REP	MR code report	Basic
70	CID_ALLOC-IND	CID allocation	Basic
71	RS_Config-RCM	RS configuration recommendation	Basic
72	RS_Config-REQ	RS configuration request	Basic
73	RS_NBR-MEAS-REP	RS neighbor station measurement report	Basic
74	MR_LOC-REQ	MR location information request	TBD

Table 38—MAC management messages

75	MR_LOC-RSP	MR location information response	TBD
76	MS_SCN-INF	MS scanning inform	TBD
77	MS_SCN-ACK	MS scanning acknowledgement	TBD
78	MS_SCN-CLT	MS scanning completion	Basic
79	MS_INFO-DEL	MS context information delete	TBD
80	MS_DEL-ACK	MS context information delete acknowledgement	TBD
81	RS-CD	Relay configuration description	Basic
82	CLK-SYNC	RS clock synchronization	TBD
83	ASC-REQ	TBD	TBD
84	ASC-RSP	TBD	TBD
85	MOB_RSSCN-REP	TBD	Basic
86	MOB_RSSCN-RSP	TBD	Basic
87	HARQ_Chase_ER-REP	Chase HARQ error report	TBD
88	HARQ_IR_ER-REP	IR HARQ error report	TBD
89	MR_SLP-INFO	MS sleep mode information	Basic
90	SLP_INF-ACK	MS sleep mode information acknowledge	Basic
91	STA-INFO	Station information	TBD
92	STA-ACK	Station information acknowledge	TBD
93	RS_Path-REQ	RS path selection request message sent by MR-BS	Basic
94	RS_Path-RSP	RS path selection response message sent by RS	Basic
95	RS-SCH	RS scheduling information	Basic
96	RS_Member_List_Update	TBD	TBD
97	MR_PBBR-INFO	MR piggybacked bandwidth request information	Basic
~~67~~97-255		*Reserved*	

6.3.2.3.1 Downlink channel descriptor (DCD) message

Insert the following text at the end of 6.3.2.3.1:

The following parameter, which are coded as TLV tuples as defined in 11.4, may be included in the DCD message.

ETE Metric

The ETE metric of the path between the RS transmitting the DCD and the BS it is associated to.

6.3.2.3.5 Ranging Request(RNG-REQ) message

Change 'Reserved' field in Table 19(.16e)/Table 43(Rev2) as indicated:

MS ranging Indicator	1 bit	0: Normal RNG message 1: Relayed RNG message containing received CDMA code attributes
Reserved	~~8~~7 bits	Shall be set to zero

Insert the following text at the end of 6.3.2.3.5:

The following parameter may be included in the RNG-REQ message when the RS is attempting to perform network entry, re-entry, association or handover:

RS Type TLV (see 11.5)

The following parameter shall be included in the RNG-REQ message when the RS is attempting to perform Paging Group Update:

RS MAC Address
RS MAC Address shall be included

Ranging Purpose Indication
Presence of item in message indicates RS action as follows: If Bit #2 is set to 1, in combination with RS Paging Group ID indicates the RS is currently attempting to Paging Group Update process.

Paging Group ID (16 bit)
One or more logical affiliation grouping of MRS (see 6.3.2.3.56).

The following parameter may be included in the RNG-REQ message when the RS is attempting to perform Paging Group Update and the RS has a valid HMAC/CMAC Tuple necessary to expedite security authentication.

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

6.3.2.3.6 Ranging Response(RNG-RSP) message

Change the 'Reserved' field in Table 20(.16e)/Table 44(Rev2) as indicated:

MS ranging Indicator	1 bit	0: Normal RNG message 1: Relayed RNG message containing received CDMA code attributes
Reserved	~~8~~7 bits	Shall be set to zero

Insert the following text at the end of 6.3.2.3.6:

When a MR-BS sends RNG-RSP message in response to a RNG-REQ message containing MRS Paging Group ID, the MR-BS shall include the following TLV parameter in the RNG-RSP message:

Paging Group Update Response

Response to Paging Group Update Request:
0b00=Failure of Paging Group Update. The MRS shall perform Network Re-entry
0b01=Success of Paging Group Update
0b10, 0b11: Reserved

The following parameter may be included in the RNG-RSP message for the purpose of assigning RS CDMA ranging codes to an RS:

RS CDMA Codes TLV (see 11.19)

The following TLV parameter shall be included in the RNG-RSP message when the RS is attempting to perform network re-entry or handover and the target MR-BS wishes to identify re-entry process management messages that may be omitted during the current HO attempt:

RS HO Optimization (see 11.6)

Identifies re-entry process management messages that may be omitted during the current HO attempt due to the availability of RS service and operational context information obtained by means that are beyond the scope of this standard, and the RS service and operational status post-HO completion. The RS shall not enter Normal Operation with Target MR-BS until completing receiving all network reentry, MAC management message responses as indicated in RS HO Process Optimization.

The following parameter may be included in the RNG-RSP message when the MRS is attempting to perform network re-entry, or handover:

CID List TLV (see 11.5)

The following TLV parameter shall be included in the RNG-RSP message when the RS is attempting to perform network entry or re-entry and the target MR-BS wishes to identify entry or re-entry process management messages that may be omitted during the current entry or re-entry process

RS Network Entry Optimization (see 11.6)

Identifies entry or re-entry process management messages that may be omitted during the current entry or re-entry attempt.

The following parameter may be included in the RNG-RSP message when the MRS is attempting to perform network re-entry or handover:

Tunnel CID List TLV (see 11.6.x)

The RNG-RSP message may contain the following TLVs:

Path-Addition (see 11.21.1)

Specification of the path addition operations

Path-CID-Binding-Update (see 11.21.2)

Specification of the path/CID binding operations including adding the binding between CIDs to the specific path.

HMAC/CMAC Tuple (see 11.1.2)

The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the RNG-RSP message attribute list.

6.3.2.3.7 Registration request (REG-REQ) message

Insert following text at the end of 6.3.2.3.7:

When an RS enters the network, the REG-REQ may contain the following TLVs:

RS frame offset (11.7.27)

Multicast management support (11.7.28)

6.3.2.3.8 Registration Response (REG-RSP) message

Insert following text at the end of 6.3.2.3.8:

In response to REG-REQ from an RS, the REG-RSP may contain the following TLVs:

RS frame offset(11.7.27)

Multicast management support(11.7.28)

If RS frame offset is not included in REG-RSP, RS shall use same frame number as the MR-BS transmits.

6.3.2.3.10 DSA-REQ message

Insert the following text after the second paragraph of 6.3.2.3.10:

Before admitting a service flow, the MR-BS shall send a DSA-REQ to all the RSs on the path. The CID associated with the service flow needs to be included in the Service Flow CID TLV field in this DSA-REQ message. The CID could be a transport CID for an individual MS or a tunnel CID.

Insert the following text at the end of 6.3.2.3.10:

In multihop relay network, a DSA-REQ is also sent by MR-BS to populate the path information to every RS on the path and/or distribute the binding information between connections and a selected path. The MR-BS shall generate DSA-REQs in the form shown in Table 38. When a RS receives a DSA-REQ and it is not the last hop on the relay path, it shall also generate a DSA-REQ in the form shown in Table 38 and sends it to the next RS on the path.

The DSA-REQ message may contain the following TLVs:

Path Addition (see 11.21.1)
Specification of the path addition operations

Path CID Binding Update (see 11.21.2)
Specification of the path/cid binding operations including adding the binding between CIDs to the specific path.

6.3.2.3.11 DSA-RSP message

Insert the following text after the second paragraph of 6.3.2.3.11:

Upon receiving a DSA-REQ from MR-BS, the access RS replies with a DSA-RSP directly to MR-BS using its basic CID.

Insert the following text at the end of 6.3.2.3.11:

In multihop relay network, a DSA-RSP is also sent by a RS to confirm the path management operation requested in the correspondent DSA-REQ. The access RS on the last hop on a specific path should generate the DSA-RSP in the form shown in Table 39a. When a RS receives a DSA-RSP, it shall update the confirmation code and generate a DSA-RSP in the form shown in Table 39a and sends it to the previous RS on the path.

Table 81a—DSA-RSP message format

Syntax	Size	Notes
DSA-RSP() {		
Management Message Type = 12	8 bits	
Transaction ID	16bits	
PM Confirmation Code	8 bits	
TLV Encoded Information	*Variable*	TLV specific
}		

Parameters shall be as follows:

Transaction ID
Transaction ID from corresponding DSA-REQ

PM Confirmation Code (see 11.21.8)
The appropriate Path Management Confirmation Code for the entire correspondent DSA-REQ.

6.3.2.3.12 DSA-ACK message

Insert the following text after the second paragraph of 6.3.2.3.12:

Upon receiving a DSA-RSP from an access RS, the MR-BS may send a DSA-ACK to all the RSs on the path. The CID associated with the service flow needs to be included in the Service Flow CID TLV field in this DSA-ACK message together with the admitted service flow parameter. The CID could be the transport CID for an individual MS or a tunnel CID.

6.3.2.3.13 DSC Request (DSC-REQ) message

Insert the following text after the second paragraph of 6.3.2.3.13:

Before admitting changes to a service flow, the MR-BS shall send a DSC-REQ to all the RSs on the path. The CID associated with the service flow needs to be included in the Service Flow CID TLV field in this DSC-REQ message. The CID could be the transport CID for an individual MS or a tunnel CID.

Insert the following text at the end of 6.3.2.3.13:

In multihop relay network, a DSC-REQ is also sent by MR-BS to update the binding between CIDs to a specified path, or to distribute the updated service flow parameter for a connection that is bound to the specified path. The MR-BS shall generate DSC-REQs in the form shown in Table 41. When a RS receives a DSC-REQ and it is not the last hop on the relay path, it shall also generate a DSC-REQ in the form shown in Table 41 and sends it to the next RS on the path.

The DSC-REQ message may contain the following TLVs:

Path CID Binding Update (see 11.21.2)

Specification of the path/cid binding operations including changing of service flow parameter of the CIDs bound to the specific path.

6.3.2.3.14 DSC Response (DSC-RSP) message

Insert the following text after the second paragraph of 6.3.2.3.14:

Upon receiving DSC-REQ from MR-BS, the access RS replies with a DSC-RSP directly to MR-BS using its basic CID.

Insert the following text at the end of 6.3.2.3.14:

In multihop relay network, a DSC-RSP is also sent by a RS to confirm the path management operation requested in the correspondent DSC-REQ. The access RS on the last hop on a specific path should generate the DSC-RSP in the form shown in Table 42a. When a RS receives a DSC-RSP, it shall update the confirmation code and generate a DSC-RSP in the form shown in Table 42a and sends it to the previous RS on the path.

Table 84a—DSC-RSP message format

Syntax	Size	Notes
DSC-RSP() {		
Management Message Type = 15	8 bits	
Transaction ID	16bits	
PM Confirmation Code	8 bits	
TLV Encoded Information	*Variable*	TLV specific
}		

Parameters shall be as follows:

Transaction ID
Transaction ID from corresponding DSC-REQ

PM Confirmation Code (see 11.21.8)
The appropriate Path Management Confirmation Code for the entire correspondent DSC~~A~~-REQ.

6.3.2.3.15 DSC-ACK message

Insert the following text after the second paragraph of 6.3.2.3.15:

Upon receiving a DSC-RSP from an access RS, the MR-BS may send a DSC-ACK to all the RSs on the path. The CID associated with the service flow needs to be included in the Service Flow CID TLV field in this DSC-ACK message together with the admitted service flow parameter. The CID could be the transport CID for an individual MS or a tunnel CID.

6.3.2.3.16 DSD-REQ message

Insert the following text after the second paragraph of 6.3.2.3.16:

While deleting a service flow, the MR-BS shall also send a DSD-REQ to all the RSs on the path between the MR-BS and the MS. The CID associated with the service flow needs to be included in the Service Flow CID TLV field in this DSD-REQ message.

Insert the following text at the end of the 6.3.2.3.16:

In multihop relay network, a DSD-REQ is also sent by MR-BS to remove a path and/or remove the binding between connections and a selected path. The MR-BS shall generate DSD-REQs in the form shown in Table 44. When a RS receives a DSD-REQ and it is not the last hop on the relay path, it shall also generate a DSD REQ in the form shown in Table 44 and sends it to the next RS on the path. The DSD-REQ message may contain the following TLVs:

Path ID (see 11.21.4)
Specification of the path to be completely removed

Path CID Binding Removal (see 11.21.3)
Specification of the path/cid binding operations including removing the binding between CIDs to the specific path.

6.3.2.3.17 DSD-RSP message

Insert the following text after the second paragraph of 6.3.2.3.17:

Upon receiving DSD-REQ from MR-BS, the access RS replies with a DSD-RSP directly to MR-BS using its basic CID.

Insert the following text at the end of 6.3.2.3.17:

In multihop relay network, a DSD-RSP is also sent by a RS to confirm the path management operation requested in the correspondent DSD-REQ. The access RS on the last hop on a specific path should generate the DSD-RSP in the form shown in Table 44a. When a RS receives a DSD-RSP, it shall update the confirmation code and generate a DSD-RSP in the form shown in Table 44a and sends it to the previous RS on the path.

Table 87a—DSD-RSP message

Syntax	Size	Notes
DSD-RSP() {		
Management Message Type = 18	8 bits	
Transaction ID	16bits	
PM Confirmation Code	8 bits	
TLV Encoded Information	*Variable*	TLV specific
}		

Parameters shall be as follows:

Transaction ID
Transaction ID from corresponding DSD~~A~~-REQ

PM Confirmation Code (see 11.21.8)

The appropriate Path Management Confirmation Code for the entire correspondent DSD-REQ.

6.3.2.3.23 SS and RS basic capability request (SBC-REQ) message

Change the text in the first paragraph of 6.3.2.3.23 as indicated:

The SS SBC-REQ shall be transmitted by the SS or RS during initialization. An SS or RS shall generate SBC-REQ messages in the form shown in Table 51.

Insert the following at the end of 6.3.2.3.23:

An RS shall generate SBC-REQs including the following parameter:

Basic CID *(in the MAC Header)*

The CID in the MAC Header is the Basic CID for this RS, as assigned in the RNG-RSP message.

All other parameters are coded as TLV tuples.

Basic Capability Requests contain those RS Capabilities Encodings (11.8) that are necessary for effective communication with the RS during the remainder of the initialization protocols.

The following parameter may be included:

Mobile RS Mode

This parameter is sent by a mobile RS to indicate its capability of support moving RS mode or moving BS mode.

6.3.2.3.24 SS and RS basic capability response (SBC-RSP) message

Insert the following text before the last sentence of 6.3.2.3.24:

An MR-BS shall generate SBC-RSPs in the form shown in Table 52, including both of the following parameters:

CID *(in the MAC Header)*

The CID in the MAC Header is the Basic CID for this RS, as appears in the RNG-REQ message.

The following parameters shall be included in the SBC-RSP if found in the RS SBC-REQ:

Physical Parameters Supported (see 11.8.3)

Bandwidth Allocation Support (see 11.8.1)

The MR-BS response to the subset of RS capabilities present in the SBC-REQ message. The MR-BS responds to the RS capabilities to indicate whether they may be used. If the MR-BS does not recognize an RS capability, it may return this as “off” in the SBC-RSP.

Only capabilities set to “on” in the SBC-REQ may be set “on” in the SBC-RSP, as this is the handshake indicating that they have been successfully negotiated.

Insert the following at the end of 6.3.2.3.24:

The following parameter may be included:

Mobile RS Mode

This parameter is sent by a MR-BS as a response to SBC-REQ to confirm the mode of a mobile RS.

6.3.2.3.26 De/Re-register command (DREG-CMD) message

Change Table 55(.16e)/Table 97(Rev2) as indicated:

Table 97—Action codes and actions

Action codes (hexadecimal)	Action
00	SS/RS immediately terminate service with the BS and should attempt network entry at another BS
01	SS/RS shall listen to the current BS but shall not transmit until an RES-CMD message or DREG-CMD with Action Code 02 or 03 is received.
02	SS/RS shall listen to the current BS but only transmit on the Basic, and Primary Management Connections.
03	SS/RS shall return to normal operation and may transmit on any of its active connections.
04	SS shall terminate current Normal Operations with the BS; the BS shall transmit this action code only in response to any SS DREG-REQ message. RS shall terminate current Normal Operations with the BS.
05	MS shall immediately begin de-registration from serving BS and request initiation of MS Idle Mode.
06	The MS/RS may retransmit the DREG-REQ message after the time duration (REQduration) provided in the message.
07	The MS/RS shall not retransmit the DREG-REQ message and shall wait the DREG-CMD message. BS transmittal of a subsequent DREG-CMD with Action Code 03 shall cancel this restriction.

Change the explanation text of the "REQ-duration" field as indicated:

REQ-duration

Waiting value for the DREG-REQ message re-transmission (measured in frames) If serving BS includes REQ-duration in a message including an Action Code = 0x05, the MS may initiate an Idle Mode request through a DREG-REQ with Action Code = 0x01, request for MS De-Registration from serving BS and initiation of MS Idle Mode, at REQ-duration expiration.

If the RS receives the DREG-CMD message with Action Code = 0x06, it resends DREG-REQ message after REQ-duration timer expiry.

6.3.2.3.43.4 HARQ control IE

Insert new field in Table 94 (.16e)/Table 136 (Rev2) (HARQ control IE format) as indicated:

Syntax	Size	Notes
RSH	1 bit	0=RS-assisted HARQ is enabled 1=RS-assisted HARQ is disabled

Insert new subclause 6.3.2.3.43.6.10:

6.3.2.3.43.6.10 Compact_DL-MAP MONITOR IE

In RS-assisted relay case, MR-BS sends the Compact DL-MAP MONITOR IE to RS. The Compact DL-MAP MONITOR IE provides the list of CIDs of the MS whose transmissions need to be monitored in the DL part of the current frame and relayed in the next frame to the MS.

Table 149a—Compact DL-MAP MONITOR IE format

Syntax	Size	Notes
Compact DL-MAP_IE(){		
DL-MAP Type = 7	3 bits	
DL-MAP subtype	5 bits	
N_CID_encoded	4 bits	Number of CIDs for which RS uses the encoded ACK/NACK
N_CID_direct	4 bits	Number of CIDs for which RS uses the direct feedback
For(i=0; i<N_CID_encoded + N_CID_direct; i++){		
RCID_IE(i)	16 bits	The CIDs of the connections that RS shall monitor in the current frame
}		
}		

N_CID_encoded

This field specifies the number of CIDs to use the encoded ACK/NACK among CIDs list in this IE. The CIDs from the beginning of the list to the value of this filed use the encoded ACK/NACK.

N_CID_direct

This field specifies the number of CIDs to use the direct ACK/NACK among CIDs list in this IE. The CIDs from the N_CID_encoded to the end of the list use the direct ACK/NACK.

Insert new subclause 6.3.2.3.43.6.11:

6.3.2.3.43.6.11 Compact_UL-MAP_MONITOR_IE

The Compact_UL-MAP MONITOR IE provides the list of CIDs of the MS whose transmissions need to be monitored in the UL part of the current frame and relayed in the next frame to the MS.

Table 149b—Compact UL-MAP MONITOR IE format

Syntax	Size	Notes
Compact UL-MAP_IE(){		
UL-MAP Type = 7	3 bits	
UL-MAP subtype	5 bits	
Number of CIDs	4 bits	Number of CIDs in the IE
For(i=0; i<Number of CIDs; i++){		
CID(i)	16 bits	The CIDs of the connections that RS shall monitor in the current frame
}		
}		

6.3.2.3.52 BS HO Request(MOB_BSHO-REQ) message

Insert the following at the end of 6.3.2.3.52:

The MOB_BSHO-REQ message shall include the following parameter encoded at TLV tuple for MRS:

Preamble Index (see 11.15.x)

6.3.2.3.53 MS HO Request(MOB_MSHO-REQ) message

Insert the following at the end of 6.3.2.3.53:

The following parameter may be included in the MOB_MSHO-REQ message when the MRS Paging Group ID is changed and is attempting to perform handover:

Paging group ID
One or more logical affiliation grouping of MRS(see 6.3.2.3.56)

6.3.2.3.54 BS HO Response (MOB_BSHO-RSP) message

Insert the following at the end of 6.3.2.3.54:

When a MR-BS sends MOB_BSHO-RSP message in response to a MOB_MSHO-REQ message containing MRS_PGID the MR-BS shall include the following TLV parameter in the RNG-RSP message:

Paging Group Update Response
0b00 = Failure of Paging Group Update. The MRS shall perform Network Re-entry
0b01= Success of Paging Group Update

0b10, 0b11= Reserved

The MOB_BSHO-RSP message shall include the following parameter encoded as TLV tuple for MRS:

Preamble Index (see 11.15.x)

6.3.2.3.56 BS/RS Broadcast Paging (MOB_PAG-ADV) message

Change Table 109p(.16e)/Table 174(Rev2) as indicated:

Table 174—MOB_PAG-ADV message format

Syntax	Size	Notes
MOB_PAG-ADV_Message_format() {	—	—
Management Message Type=62	8 bits	—
Num_Paging_Group_IDs	16 bits	Number of Paging Group IDs in this message
For (i=0; i<Num_Paging_Group_IDs; i++) {	—	—
Paging Group ID	16 bits	—
}	—	—
Num_MACs	8 bits	Number of MS MAC addresses
For (j=0; j<Num_MACs; j++) {	—	—
MS MAC Address hash	24 bits	The hash is obtained by computing a CRC24 on the MS 48-bit MAC address. The polynomial for the calculation is 0x1864CFB
Action Code	2 bits	Paging action instruction to MS 0b00=No Action Required 0b01=Perform Ranging to establish location and acknowledge message 0b10=Enter Network 0b11=Reserved
Stop Paging	1 bit	0b0= paging start command 0b1= paging stop command
PLI Count	3 bits	The number that PLI has been elapsed since the first time MR-BS sending out the MOB_PAG-ADV message
Reserved	~~6~~2 bits	—
}	—	—
padding	variable	Padding bits to ensure octet aligned
TLV Encoded Information	variable	TLV specific
}	—	—

Insert the following text into the parameter list following Table 109p(.16e)/Table 174(Rev2):

Stop Paging

When this bit is set to 1, the RS shall stop sending Broadcast Paging message.

Paged Count

This field indicates the number that PLI has been elapsed since the first time MR-BS sending out the MOB_PAG-ADV message. That is equal to the value that the Paging Retry Count of MR-BS has been decreased. The RS will determine its own paging retry count according to the "PLI Count" and the "Paging Retry Count" of MR-BS. When a RS relay the MOB_PAG-ADV message to its subordinate RSs, the "PLI Count" value shall be increased by one if the receiving RS will miss one more PLI.

Insert new subclause 6.3.2.3.62:

6.3.2.3.62 Cooperative diversity configuration for RS (RS-CDC) message

An RS CDC is sent by a MR-BS to an RS to configure the cooperative diversity mode.

Table 183a—RS-CDC message format

Syntax	Size	Notes
RS-CDC_Message_Format() {		
Management Message Type=67	8 bits	
Antenna Assignment	4 bits	Bit#0: Antenna #0 Bit#1: Antenna #1 Bit#2: Antenna #2 Bit#3: Antenna #3
Reserved	4 bits	Shall be set to zero
}		

An MR-BS shall generate RS-CDC message in the form shown in Table 109z. The parameters shall be effective in STC DL zones where STC is not "0b00" in the corresponding STC_DL_Zone_IE.

Antenna Assignment

Indicates which antenna the corresponding RS should play the role of. For example, if this field is a 0b1000, the relay station shall be playing the role of Antenna #0. As another example, in case the RS has two antennas and this field is 0b1100, two antennas of the RS shall take the roles of Antenna #0 and #1. Each antenna will transmit pilots based on the permutation number of antennas as indicated in STC_DL_Zone_IE and antanna assignment. The MR-BS shall indicate the effective number of antennas being used for cooperative relaying.

In a STC_DL Zone where STC is not 0b00, the RS shall take data from the BS and perform local STC encoding as specified by its antenna assignment(s) and STC Matrix in use as defined by STC_DL_Zone_IE, MIMO DL Basic IE, or MIMO DL Enhanced IE.

Insert new subclause 6.3.2.3.63:

6.3.2.3.63 MR_NBR-INFO message

The MR_NBR-INFO shall be transmitted by the MR-BS to an RS. The message shall be transmitted on the primary management CID. The message format for the MR_NBR-INFO message shall be in accordance with Table 3.

Table 183b—MR_NBR-INFO message format

Syntax	Size	Notes
MR_NBR-INFO_Message_Format(){	-	-
Management Message Type = 68	8 bits	-
Action Type bitmap	4 bits	Bit [0]: if set to 1, information about all the neighboring stations is present Bit [1]: if set to 1, the neighbors listed here should be appended to the existing neighbor list. Bit [2]: if set to 1, neighbors listed here should be deleted from the existing neighbor list. Bit [3]: if set to 1, information about neighbors listed here should be updated as indicated.
if(Action Type bitmap [0] == 1){	-	-
Skip-optional-files bitmap	8 bits	Bit [0]: if set to 1, omit Operator ID field. Bit [1]: if set to 1, omit NBR BS ID field. Bit [2]: if set to 1, omit HO process optimization field. Bit [3]: if set to 1, omit QoS related fields. Bit [4]: if set to 1, omit RS zone offset Bit [5]–[7]: *Reserved*.
if (Skip-optional-fields-[0]=0){		
Operator IE	24 bits	Unique ID assigned to the operator
}	-	-
Fragmentation Index	4 bits	Indicates the current fragmentation index
Total Fragmentation	4 bits	Indicates the total number of fragmentations.
N_Neighbors	8 bits	Number of neighbors for this RS
for(j=0; j<N_NEIGHBORS;j++){	-	-
Length	8 bits	Length of messag information within the iteration ofN_NEIGHBOR in bytes.
PHY Profile ID	8 bits	Aggregated IDs of Co-located FA Indicator, FA Configuration Indicator, FFT size, Bandwidth, Operation Mode of the starting subchannelization of a frame and Channel Number.
if(FA Index Indicator == 1){		
FA Index	8 bits	This field, Frequency Assignment Index, is present only the FA Index Indicator in PHY Profile ID is set. Otherwise, the neighbor Station has the same FA Index or the center frequency is indicated using the TLV encoded information.
}		

Table 183b—MR_NBR-INFO message format

if(Station EIRP Indicator ==1){		
Station EIRP	8 bits	Signed Integer from –128 to 127 in unit of dBm This field is present only if the Station EIRP indicator is set in PHY Profile ID. Otherwise, the Station has the same EIRP as the serving Station.
}	-	-
if(Skip-iptional-fields[1]==0){	-	-
Neighbor BSID	24 bits	This is an optional field for OFDMA PHY and it is omitted or skipped if Skip optional fields Flag = 1.
}	-	-
Preamble Index/Subchannel Index	8 bits	This parameter defines the OFDMA PHY specific preamble
if(Skip-optional-field[2]==0){	-	-
HO Process Optimization	8 bits	HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated reentry management messages shall be required, a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the target Station may send unsolicited SBC-RSP and/ or REGRSP management messages: Bit #0: Omit SBC-REQ/RSP management messages during reentry processing Bit #1: Omit PKM Authentication phase except TEK phase during current re-entry processing Bit #2: Omit PKM TEK creation phase during re-entry processing Bit #3: Omit REG-REQ/RSP management during current re-entry processing Bit #4: Omit Network Address Acquisition management messages during current re-entry processing Bit #5: Omit Time of Day Acquisition management messages during current reentry processing Bit #6: Omit TFTP management messages during current re-entry processing Bit #7: Full service and operational state transfer or sharing between serving station and target station (ARQ, timers, counters, MAC state machines, etc…)
}	-	-
if(Skip-optional-field[3]==0){	-	-

Table 183b—MR_NBR-INFO message format

Scheduling Service Supported	8 bits	Bitmap to indicate if Station supports a particular scheduling service. 1 indicates support, 0 indicates not support: Bit #0: Unsolicited Grant Service (UGS) Bit #1: Real-time Polling Service (rtPS) Bit #2: Non-real-time Polling Service (nrtPS) Bit #3: Best Effort Bit #4: Extended real-time Polling Service (ertPS) If the value of bit 0 through bit 4 is 0b00000, it indicates no information on service available. Bits #5–7: Reserved; shall be set to zero.
}	-	-
If (Skip-optional-field[4]==0){		
RS zone offset	8 bits	The offset of the RS zone that has the FCH, DL-MAP and ULMAP, offset measured in number of symbols after the preamble.
}		
DCD Configuration Change Count	4 bits	This represents the 4 LSBs of the Neighbor Station current DCD configuration change count.
UCD Configuration Change Count	4 bits	This represents the 4 LSBs of the Neighbor Station current DCD configuration change count.
TLV Encoded Neighbor information	variables	TLV specific
}	-	-
}		
if(Action Type bitmap[1]==1){	-	-
Skip-optional-files bitmap	8 bits	Bit [0]: if set to 1, omit Operator ID field. Bit [1]: if set to 1, omit NBR BS ID field. Bit [2]: if set to 1, omit HO process optimization field. Bit [3]: if set to 1, omit QoS related fields. Bit [4]: if set to 1, omit RS zone offset Bit [5]–[7]: *Reserved*.
if(Skip-optional-fields[0]=0){	-	-
Operator ID	24 bits	Unique ID assigned to the operator.
}	-	-
Fragmentation Index	4 bits	Indicates the current fragmentation index.
Total Fragmentation	4 bits	Indicates the total number of fragmentations.
New N_NEIGHBORS	8 bits	Number of new neighbors for this RS
for(j=0;j<New N NEIGHBORs;j++){	-	-
Length	8 bits	Length of message information within the iteration of New_N_NEIGHBOR in bytes.

Table 183b—MR_NBR-INFO message format

PHY Profile ID	8 bits	Aggregated IDs of Co-located FA Indicator, FA Configuration Indicator, FFT size, Bandwidth, Operation Mode of the starting subchannelization of a frame and Channel Number.
if(FA Index Indicator==1){	-	-
FA Index	8 bits	This field, Frequency Assignment Index, is present only the FA Index Indicator in PHY Profile ID is set. Otherwise, the neighbor Station has the same FA Index or the center frequency is indicated using the TLV encoded information.
}	-	-
if(Station EIRP Indicator ==1){	-	-
Station EIRP	8 bits	Signed Integer from –128 to 127 in unit of dBm This field is present only if the Station EIRP indicator is set in PHY Profile ID. Otherwise, the Station has the same EIRP as the serving Station.
}	-	-
if(Skip-optional-field[1]=0){	-	-
Neighbor BSID	24 bits	This is an optional field for OFDMA PHY and it is omitted or skipped if Skip optional fields Flag = 1.
}	-	-
Preamble Index/Subchannel Index	8 bits	This parameter defines the OFDMA PHY specific preamble
if(Skip-optional-field[2]=0){	-	-

Table 183b—MR_NBR-INFO message format

HO Process Optimization	8 bits	HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated reentry management messages shall be required, a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the target Station may send unsolicited SBC-RSP and/ or REGRSP management messages: Bit #0: Omit SBC-REQ/RSP management messages during reentry processing Bit #1: Omit PKM Authentication phase except TEK phase during current re-entry processing Bit #2: Omit PKM TEK creation phase during re-entry processing Bit #3: Omit REG-REQ/RSP management during current re-entry processing Bit #4: Omit Network Address Acquisition management messages during current re-entry processing Bit #5: Omit Time of Day Acquisition management messages during current reentry processing Bit #6: Omit TFTP management messages during current re-entry processing Bit #7: Full service and operational state transfer or sharing between serving station and target station (ARQ, timers, counters, MAC state machines, etc…)
}	-	-
if(Skip-optional-field[3]=0){	-	-
Schedulilng Service Supported	8 bits	Bitmap to indicate if Station supports a particular scheduling service. 1 indicates support, 0 indicates not support: Bit #0: Unsolicited Grant Service (UGS) Bit #1: Real-time Polling Service (rtPS) Bit #2: Non-real-time Polling Service (nrtPS) Bit #3: Best Effort Bit #4: Extended real-time Polling Service (ertPS) If the value of bit 0 through bit 4 is 0b00000, it indicates no information on service available. Bits #5–7: Reserved; shall be set to zero.
}	-	-
If (Skip-optional-field[4]==0){		
RS zone offset	8 bits	The offset of the RS zone that has the FCH, DL-MAP and ULMAP, offset measured in number of symbols after the preamble.
}		
DCD Configuration Change Count	4 bits	This represents the 4 LSBs of the Neighbor Station current DCD configuration change count.

Table 183b—MR_NBR-INFO message format

UCD Configuration Change Count	4 bits	This represents the 4 LSBs of the Neighbor Station current DCD configuration change count.
TLV Encoded Neighbor information	variables	TLV specific
}	-	-
}		
if (Action Type bitmap[2] = =1){	-	-
Delete_N_NEIGHBORS	8 bits	Number of neighbors shall be deleted for this RS
for (j=0; j<Delete_N_NEIGHBORS;j++){	-	-
Preamble Index	8 bits	Indicates the deleted neighbors
}	-	-
}	-	-
if (Action Type bitmap [3]= =1){	-	-
Skip-optional-files bitmap	8 bits	Bit [0]: if set to 1, omit RS zone offset Bit [2]–[7]: Reserved.
Update_N_NEIGHBORS	8 bits	Number of updated neighbors for this RS
for (j=0; j< Update_N_NEIGHBORS;j++) {	-	-
Length	8 bits	Length of message information within the iteration of Update_N_NEIGHBOR in bytes
Preamble Index	8 bits	Indicates the updated neighbor
if (Skip-optional-field[0]==0){	-	-
RS zone offset	8 bits	The offset of the RS zone that has the FCH, DL-MAP and UL-MAP, offset measured in number of symbols after the preamble.
}		
TLV Encoded Information	variable	TLV specific
}	-	-
}		

RS zone offset

The offset of the RS zone that has the FCH, DL-MAP and UL-MAP, offset measured in number of symbols after the preamble.

The following TLV parameters can be included:

DCD Configuration Change Count

Represents the 4 LSBs of the Neighbor access station current DCD configuration change count.

UCD Configuration Change Count

Represents the 4 LSBs of the Neighbor access station current UCD configuration change count.

For each advertised Neighbor access station, the following TLV parameters may be included:

Mobility Feature Supported

Same as in 11.7.14.1.

The following TLV parameters may be included:

DCD_settings

The DCD_settings is a TLV value that encapsulates a DCD message (excluding the generic MAC header and CRC) that may be transmitted in the advertised access station downlink channel. This information is intended to enable fast synchronization of the MS with the advertised access station downlink. The DCD settings fields shall contain only neighbor's DCD TLV values that are different from the current access station corresponding values. For values that are not included, the MS shall assume they are identical to the corresponding values of the current access station. The duplicate TLV encoding parameters within a Neighbor access station shall not be included in DCD setting.

UCD_settings

The UCD_settings is a TLV value that encapsulates a UCD message (excluding the generic MAC header and CRC) that may be transmitted in the advertised access station downlink channel. This information is intended to enable fast synchronization of the MS with the advertised access station uplink. The UCD settings fields shall contain only neighbor's UCD TLV values that are different from the current access station's corresponding values. For values that are not included, the MS shall assume they are identical to the current access station's corresponding values. The duplicate TLV encoding within a Neighbor access station shall not be included in UCD setting.

PHY Mode ID (see 11.18.1)

a 16-bit value that specifies the PHY parameters, including channel bandwidth, FFT size, cyclic prefix, and frame duration.

Insert new subclause 6.3.2.3.64:

6.3.2.3.64 MR_Code-REP message

This message is used by an RS to notify the MR-BS that it has successfully received CDMA ranging codes.

This message is transmitted using the RS's basic CID. See 11.X for MR_CODE-REP TLV

Table 183c—MR code report (MR_CODE-REP) message format

Syntax	Size	Note
MR_Code-REP_Message_Format() {		
Management Message Type = 69	8 bits	TBA
MR_CODE-REP TLVs	Variable	
}		

Insert new subclause 6.3.2.3.65:

6.3.2.3.65 RS CID Allocation Indication (CID_ALLOC-IND) message

The CID_ALLOC-IND message may be transmitted by the MR-BS to the RS during network entry/re-entry processes. When the network topology is changed or CID (re-)allocation is required, the MR-BS may also transmit this message to related RSs to update CIDs. Upon receiving CID_ALLOC-IND, the RS shall (re-)configure CID allocation accordingly. The message format is shown in Table XX.

Table 183d—CID_ALLOC-IND message format

Syntax	Size	Note
CID_ALLOC-IND_Message_Format() {		
Management Message Type = 70	8 bits	
CID_Alloc_method	3 bits	0 : contiguous method 1 : bit partition method 2-7: reserved
CID_type	3 bits	0: basic CID 1: primary CID 2: T-CID 3: MT-CID 4-7: reserved
If (CID_Alloc_method = =0) {		
Start number of CID	16 bits	Starting point of the CID number
End number of CID	16 bits	End point of the CID number
}		
If (CID_Alloc_method = =1) {		
New CID for the RS	16 bits	
Hop count	8 bits	The new hop count of the RS to the MR-BS
K_Code	8 bits	The new maximum number of subordinate RSs that a RS could have
}		
}		

The CID_ALLOC-IND shall contain the following TLVs:

HMAC/CMAC Tuple (see 11.1.2)

The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender).

The HMAC Tuple attribute shall be the final attribute in the CID_ALLOC-IND messageís attribute list.

Insert new subclause 6.3.2.3.66:

6.3.2.3.66 RS configuration recommendation (RS_Config-RCM) message

This message may be transmitted by an RS to request some physical layer operation parameters. An RS may use this message to report information to facilitate the determination of an MR-BS on configuration of RS operation parameters. An RS may transmit this message unsolicited for the following two purposes, (i) to request removal from an RS group, (ii) to request preamble configuration.

Table 183e—RS_Config-RCM message format

Syntax	Size	Note
RS_Config-RCM_Message_Format {		
Management Message Type = 71	8 bits	
Configuration_para_type	8 bits	b0 = 1: preamble configuration is included; b1 = 1: request to be removed from RS group; b2 - b7: reserved
If (b0 of Configured_para_type == 1) {		
reserved	1 bits	Shall be zero
Preamble_index	7 bits	Preamble index
}		
}		

Configuration_para_type
The first bit is used as preamble index indicator to indicate the preamble_index field is present in this message. The second bit is used as indicator to indicate the intent to be removed from the current RS group.

Preamble_index
This field is used to indicate the preamble index.

Insert new subclause 6.3.2.3.67:

6.3.2.3.67 RS configuration request (RS_Config-REQ) message

This message may be transmitted by an MR-BS for the purpose of RS configuration. An MR-BS may use this message to set operation parameters for an RS. MR-BS may transmit this message as a response to an RS_Config-RCM or as an unsolicited message.

Table 183f—RS_Config-REQ message format

Syntax	Size	Note
RS_Config-REQ_Message_Format {		
Management Message Type = 72	8 bits	

Configuration_para_type	8 bits	b0 = 1: preamble configuration is included;
		b1 = 1: remove multicast RSID to disassociate from the RS group;
		b2 = 1: Unicast RSID is included;
		b3 = 1: Multicast RSID is included;
		b4 = 0; Do not transmit preamble; 1: transmit the assigned preamble.
		b5 = 1: R-amble configuration is included
		b6 - b7: *reserved*

If (b0 of Configuration_para_type == 1) {		
Preamble_index	8 bits	Assign a preamble index value to the potential RS
}		
If (b2 of Configuration_para_type == 1) {		
Unicast RSID	8 bits	Unicast RSID
}		
If (b3 of Configuration_para_type == 1) {		
Multicast RSID	8 bits	Multicast RSID as the RS Group ID
}		
If (b5 of Configuration_para_type == 1) {		
R-amble_index	8 bits	R-amble index
}		
TLV Encoded Information	*variable*	TLV specific
}		

Configuration_para_type

The first bit is used as preamble index indicator to indicate that the Preamble_index field is present in this message. The second bit is used as the indicator to instruct the RS to remove its multicast RSID so that it is disassociate from the current RS group. The third bit is used as the Unicast RSID indicator to indicate the Unicast RSID field is present in this message. The fourth bit is used as the Multicast RSID indicator to indicate the Multicast RSID field is present in this message.

Preamble_index

This field is used to indicate the preamble index.

Unicast RSID

This field is used to indicate the Unicast RSID.

Multicast RSID

This field is used to indicate the Multicast RSID for RS group operations.

R-amble_index

This field is used to indicate the R-amble index for transparent RSs.

The RS_Config_REQ message shall contain the following TLVs:

HMAC/CMAC Tuple (see 11.1.2)

The HMAC/CMAC Ttuple shall be the last attribute in the message.

Insert new subclause 6.3.2.3.68:

6.3.2.3.68 RS neighbor station measurement report (RS_NBR-MEAS-REP) message

This message may be transmitted by an RS to the MR-BS or superordinate RS on its basic connection.

Table 183g—RS_NBR-MEAS-REP message format

Syntax	Size	Notes
RS_NBR-MEAS-REP_Message_Format(){		
Management Message Type =73		
N_Preamble_Index	8 bits	Number of preamble of neighboring RS/BS
Begin PHY Specific Section {		
for (i=0, i< N_Preamble_Index, i++){		
Preamble Index	8 bits	Scan the preamble index and RSSI values in the neighboring list
Report Response TLVs	Variable	TLV specific
}		
}		
TLV Encoded Information	Variable	TLV specific
}		

The Report Response TLV shall include physical CINR or RSSI of the preamble index.

N_Preamble_Index

Number of preamble of neighboring RS/BS.

This message shall include following TLV:

Preamble with the least signal strength

This TLV is used for a RS to report the preamble index with the least signal strength. This information will help a MR-BS to assign a preamble to a RS which would cause the least interference to its neighborhood.

Insert new subclause 6.3.2.3.69:

6.3.2.3.69 Location information request and response messages

The location information defined in 6.3.2.3.71.3 is based on the World Geodetic System of 1984 (WGS84) datum.

Insert new subclause 6.3.2.3.69.1:

6.3.2.3.69.1 MR location information request (MR_LOC-REQ) message

The MR_LOC-REQ message may be transmitted by an MR-BS to an RS to request the location information of the RS. This message can also be transmitted by an RS to the MR-BS to request the location of other RSs. The MR_LOC-REQ message shall be generated in the format shown in Table X1.

The MR_LOC-REQ message can be set to any report type as specified in Table X1. When an RS sends the MR_LOC_REQ message, the report type field shall be set to '0b00' (meaning non-periodic).

Table 183h—MR_LOC-REQ message format

Syntax	Size	Notes
MR_LOC-REQ_ Message_Format() {	-	-
Management Message Type = 74	8 bits	-
Report Mode	2 bits	0b00: Once 0b01: Periodic report 0b10~11: reserved
Neighbor Location Req Flag	1 bit	0b0: Location request of the receiving RS only 0b1: Request message contains location request for neighboring access stations
if(Report Mode = 0b01) {	-	Available when the value of Report Mode is set to 0b01.
Report period	12 bits	Report period in units of frame, a value between 0 to 4095 corresponding to a range of 1 frame to 4096 frame.
}	-	-
If (Neighbor Location Req Flag != 0) {	-	If this message is transmitted by an RS to MR-BS
N_RS	8 bits	Number of neighboring stations for which the RS wants to know the location information.
For (j=0;j<N_RS; j++) {	-	-
RSID	48 bits	The 48 bit MAC address of the neighboring station (BS or RS) whose location is requested..
}	-	-
}	-	-
Padding	*variable*	Padding bits to ensure byte aligned.
TLV Encoded Message	*variable*	TLV Encoded Message
}	-	-

The following parameters shall be included in the MR_LOC_REQ message:

Report mode
Action code for an RS's report of location information:
0b0: The RS only sends a single response to the location request message.
0b1: The RS reports the location periodically

Neighbor Location Req Flag
Flag, when set, indicates that this message contains a request for the location of neighboring access stations.
The flag is set to 0 by the MR-BS when requesting the location of the receiving RS
The flag is set to 1 by the RS when requesting the location of the neighboring stations from the MR-BS.

Report period
This field represents the period with which an RS shall report the location information, if the Report mode option is set to periodic reporting.

N_ RS
Number of neighboring stations (BSs as well as RSs) whose location is requested.

The following TLV parameters may be included in the MR_LOC-REQ message:

Short-HMAC/CMAC Tuple (see 11.1.2)
The Short-HMAC/CMAC Tuple shall be the last attribute in the message.

Insert new subclause 6.3.2.3.69.2:

6.3.2.3.69.2 MR_LOC-RSP message

The MR_LOC-RSP message shall be transmitted in response to a MR_LOC-REQ message. The transmitter sends MR_LOC-RSP message based on the report mode indicated in the MR_LOC-REQ message. The transmitter of this message shall generate the MR_LOC-RSP message in accordance with the format shown in Table X2.

Table 183i—MR_LOC-RSP message format

Syntax	Size	Notes
MR_LOC-RSP_ Message_Format() {	-	-
Management Message Type = 75	8 bits	-
Report Mode	2 bits	0b00: Once 0b01: Periodic report 0b10~11: reserved
Neighbor Location Req Flag	1 bit	0b0: Location request of the receiving RS only 0b1: Request message contains location request for neighboring access stations
if (Neighbor Location Req Flag == 0)) {	-	If this message is transmitted by an RS to MR-BS
LLA_IE()	64 bits	Specifies the location of relay station in LLA format defined in section 6.3.2.3.62.3.
} else {	-	If this message is transmitted by an MR-BS to RS
N_RS	8 bits	Number of stations whose location information is included in the current MR_LOC-RSP message.
for (j=0;j<N_RS;j++) {	-	-
RSID	48 bits	The 48 bit MAC address of the neighboring station (BS or RS)
LLA_IE()	64 bits	Specifies the location of neighbor access station in LLA format defined in section 6.3.2.3.62.3.
}	-	-
}	-	-
Padding	*variable*	Padding bits to ensure byte aligned.
TLV Encoded Message	*variable*	TLV Encoded Message
}	-	-

The following parameters shall be included in the MR_LOC_RSP message:

Report Mode

Action code for an RS's report of location information:

The RS only sends a single response to the location request message.

The RS reports the location periodically

Neighbor Location Req Flag

Flag, when set, indicates that this message contains a response for the location of neighboring access stations.

The flag is set to 0 by the RS when responding to the location request from the MR-BS.

The flag is set to 1 by the MR-BS when responding to the location request from the RS about the neighboring stations.

N_RS
Number of neighboring stations (BSs as well as RSs) whose location the receiver responses.

The following TLV parameter shall be included in the MR_LOC-RSP when the BS or RS wishes to acknowledge a valid Short-HMAC/CMAC Tuple in the acknowledged MR_LOC-REQ management message:

Short-HMAC/CMAC Tuple (see 11.1.2)
The Short-HMAC/CMAC Tuple shall be the last attribute in the message.

Insert new subclause 6.3.2.3.69.3:

6.3.2.3.69.3 Location information request and response IE

Table 183j—LLA_IE format

Syntax	Size	Notes
LLA_IE(){		
Latitude	24 bits	Specifies the latitude of a position in units of 0.0625 seconds, a value between -5184000 to 5184000 corresponding to a range of -90° to +90° whereby the positive values signify the North latitudes.
Longitude	24 bits	Specifies the longitude of a position in units of 0.125 seconds, a value between -5184000 to 5184000 corresponding to a range of -180° to +180° whereby the positive values signify the East longitudes.
Altitude	16 bits	Specifies the altitude of a position in units of m, a value between -32768 and 32767 corresponding to a range of -32768m to 32767m.
}		

Latitude
Specifies the latitude of a position in units of 0.0625 seconds, a value between -5184000 to 5184000 corresponding to a range of -90° to +90°.

Longitude
Specifies the longitude of a position in units of 0.125 seconds, a value between -5184000 to 5184000 corresponding to a range of -180° to +180°.

Altitude
Specifies the altitude of a position in units of m, a value between -32768 and 32767 corresponding to a range of -32768 to 32767m.

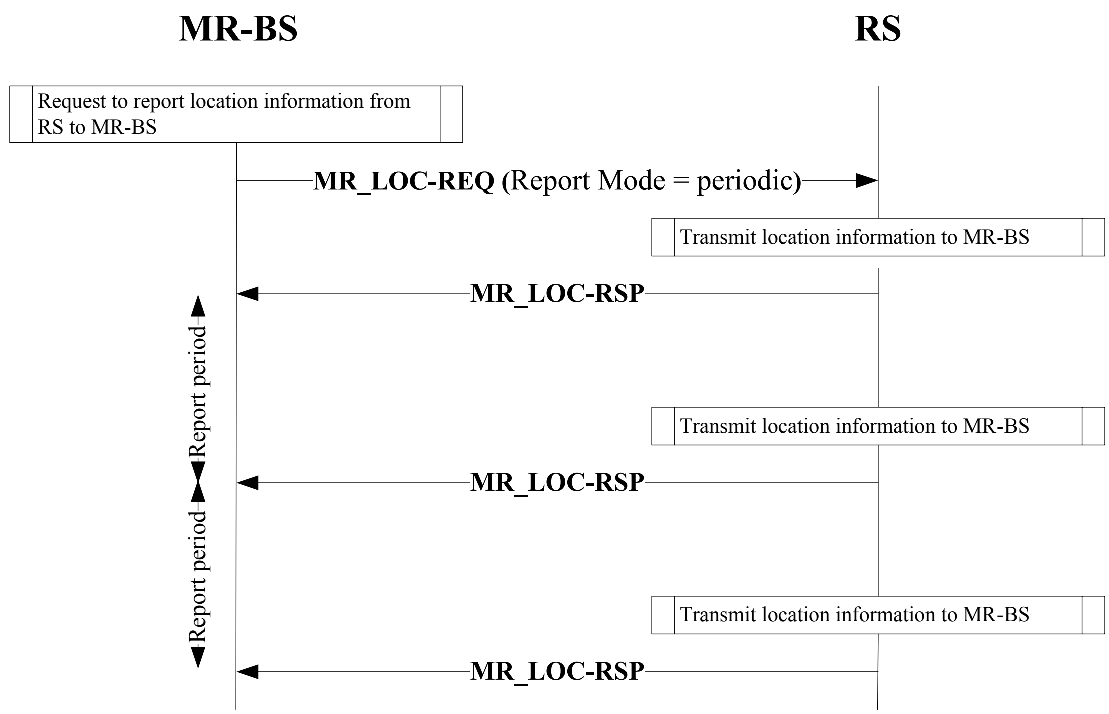


Figure 40a—Relay location report (part 1)

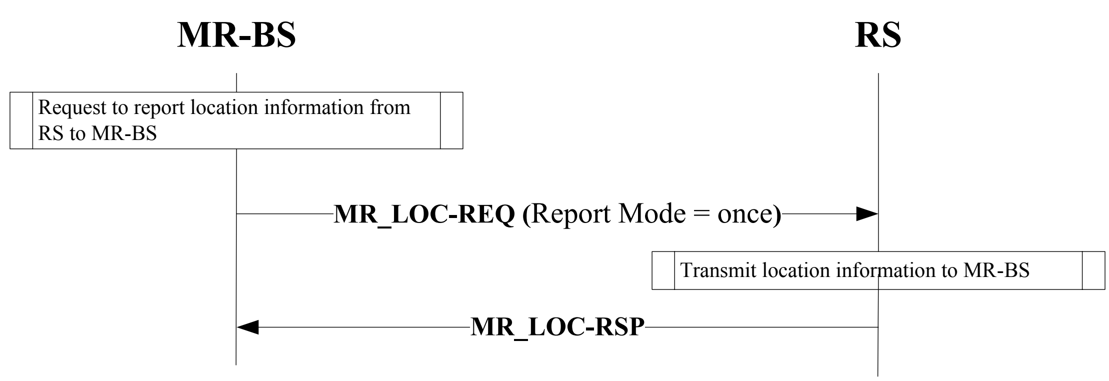


Figure 40b—Relay location report (part 2)

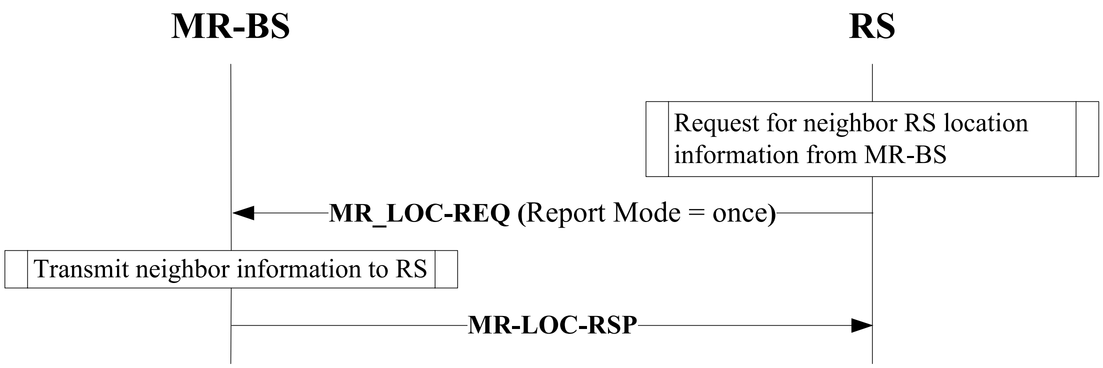


Figure 40c—Relay location report (part 3)

Insert new subclause 6.3.2.3.70:

6.3.2.3.70 MS scanning inform (MS_SCN-INF) message

A MS_SCN-INF message may be transmitted by an MR-BS to inform an access RS of MS scanning operation. An MR-BS includes the information of scanning intervals of MS(s) in a MS_SCN-INF message. An MR-BS shall generate MS_SCN-INF message in the format shown in Table x. The MS_SCN-INF message shall be transmitted on the RS's basic CID.

Table 183k—MS_SCN-INF message format

Syntax	Size	Notes
MS_SCN-INF_Message_Format(){		
Management Message Type = 76		
Transaction ID	16 bits	
N_MS	8 bits	Number of MSs
for (i=0, i< N_MS, i++){		
MS_CID	16 bits	Basic CID of MS
Start frame	4 bits	Start frame number from which the MS start the first scanning interval
Scan duration	8 bits	Duration (in units of frames) where the MS may perform scanning
Interleaving interval	8 bits	Duration in frames. The period interleaved between scanning intervals when MS shall perform normal operation
Scan iteration	8 bits	The number of iterating scanning interval
Padding	4 bits	Shall be set to zero
}		
}		

Insert new subclause 6.3.2.3.71:

6.3.2.3.71 MS scanning acknowledgement (MS_SCN-ACK) message

An RS sends MS_SCN-ACK message as a response of MS_SCN-INF message to an MR-BS. An RS shall generate MS_SCN-ACK messages in the format shown in Table y. MS_SCN-ACK message shall be transmitted on the RS's basic CID.

Table 183l—MS_SCN-ACK message format

Syntax	Size	Notes
MS_SCN-ACK_Message_Format(){		
Management Message Type = 77	8 bits	
Transaction ID	16 bits	Transaction ID in corresponding MS SCN-INF message
}		

Insert new subclause 6.3.2.3.72:

6.3.2.3.72 MS scanning completion (MS_SCN-CLT) message

A MS_SCN-CLT message may be transmitted by an MR-BS to inform an access RS that the group of intervals of MS is terminated. An MR-BS shall generate MS_SCN-CLT messages in the format shown in Table z. MS_SCN-CLT message shall be transmitted on the RS's basic CID.

Table 183m—MS_SCN-CLT message format

Syntax	Size	Notes
MS_SCN-CLT_Message_Format(){		
Management Message Type = 78	8 bits	
N_MS	8 bits	Number of MSs
for (i=0, i< N_MS, i++){		
MS_CID	16 bits	Basic CID of MS
}		
}		

Insert new subclause 6.3.2.3.73:

6.3.2.3.73 MS context information delete (MS_INFO-DEL) message

An MR-BS may transmit an MS_INFO-DEL message to an RS which is an old access station and controlled by the MR-BS when the MR-BS recognizes that MS attaches to a new access station or that Resource retain timer expires.

An MR-BS shall generate MS_INFO-DEL messages in the format shown in Table x.

Table 183n—MS_INFO-DEL message format

Syntax	Size	Notes
MS_INFO-DEL_Message_Format(){		
Management Message Type = 79	8 bits	
Transaction ID	16 bits	
MS_ID	16 bits	Basic CID of MS
}		

Insert new subclause 6.3.2.3.74:

6.3.2.3.74 MS context information delete acknowledgement (MS_DEL-ACK) message

An RS transmits a MS_DEL-ACK message to an MR-BS as a response of MS_INFO-DEL message. An RS shall generate MS_DEL-ACK messages in the format shown in Table y.

Table 183o—MS_DEL-ACK message format

Syntax	Size	Notes
MS_DEL-ACK_Message_Format(){		
Management Message Type = 80	8 bits	
Transaction ID	16 bits	The same Transaction ID in the corresponding MS_INFO-DEL
}		

Insert new subclause 6.3.2.3.75:

6.3.2.3.75 RS configuration (RS-CD) message

This message may be used by MR-BS to broadcast RS operation configurations to all associated RSs or used by MR-BS or RS to multicast configuration to its child RSs. This message can also be unicast to a RS during initial network entry to inform the configuration parameter to this RS.

Table 183p—RS configuration description (RS-CD) message format

Syntax	Size	Notes
RS-CD_Message_Format(){		
Management Message Type = 81	8 bits	
Configuration_para_type	8 bits	b0 = 1, Frame Structure-Configuration is included. b1 = 1, R-amble transmission/monitoring parameters are included. b2 - b7: reserved
If(b0 of Configuration_para_type == 1){		
Frame Number	4 bits	Frame number to take effect
DL indicator	1 bit	1 : indicates DL subframe configuration are included
UL indicator	1 bit	1: indicates UL subframe configuration is included
Reserved	2 bits	
if(DL indicator == 1) {		
Number of frame	8 bits	
for(i=0; i<Number of frame; i++){		
Number of relay zones	2 bits	
reserved	6 bits	
for(j = 0; j<Number of relay zone; j++){		
Transceiver mode	2 bits	00: Tx mode 01: Rx mode 11: Idle mode
OFDMA Symbol Offset	8 bits	
Frame_Config_Duration	6 bits	
}		
}		
}		
if(UL indicator == 1){		
Number of frame	8 bits	
for(i =0; i<Number of frame; i++){		
Number of relay zone	2 bits	

Table 183p—RS configuration description (RS-CD) message format

reserved	6 bits	
for(j = 0; j<Number of relay zone; j++){		
Transceiver mode	2 bits	00: Tx mode 01: Rx mode 11: Idle mode
OFDMA Symbol Offset	8 bits	
Frame_Config_Duration	6 bits	
}		
}		
}		
If(b1 of Configuration_para_type == 1){		
Start Frame Number	8 bits	8 LSB bits of the frame number
Monitoring_Duration	8 bits	Units are frame
Prefix	2 bits	00: The R-amble transmission and reception is instructed by MR-BS. 01: The R-amble transmission and measurement shall be performed autonomously 10: The RSs shall report its neighbor measurement results 11: reserved
if(Prefix == 00) {		
Interleaving Interval	8 bits	Units are frame
Iteration Number	8 bits	Units are frame
N_stations	8 bits	Number of stations received this message
For(i=0; i<Iteration; i++){		
Transmitter	8 bits	Number of stations to transmit the R-amble
for(j=0;j<N_Transmitter;j++){		
Amble Index	8 bits	The RS with the amble index in this list shall transmit the R-amble
}		
for(j=0;j<N_stations - N_Transmitter; j++){		
Amble Index	8 bits	The RS with the amble index in this list shall receive the R-amble
}		
}		
}	8 bits	
If(Prefix = 01){		

Table 183p—RS configuration description (RS-CD) message format

Config_type	3 bits	Bit [0] = 1: R-amble for synchronization is present. Bit [0] = 0: R-amble for synchronization is not transmitted. Bit [1] = 1: R-amble for random monitoring is present; Bit [1] = 0: any current monitoring operation is to be stopped by all RSs. Bit [2] = 1: any RS which does not support subordinate RSs should transmit the R-amble for advertisement purpose Bit [2] = 0: any RS which does not support subordinate RSs should not transmit the R-amble
if(Config_type[0] == 1){		
Synchronization cycle	8 bits	N, Units are frame (see subsection 8.4.6.1.1.3.1)
Synchronization frame offset	4 bits	Ks, Units are frame (see subsection 8.4.6.1.1.3.1)
}		
If(Config_type[1] == 1){		
Neighbor monitoring cycle	4 bits	M, Units are frame (see subsection 8.4.6.1.1.3.2)
Neighbor monitoring frame offset	4 bits	Km, Units are frame (see subsection 8.4.6.1.1.3.1)
Neighbormonitoring frame repetition	8 bits	L, Units are frame (see subsection 8.4.6.1.1.3.1)
}		
}		
Report Request	1 bit	0:RSSI 1:CINR
}		
Encoded TLV	*variable*	
}		

Frame number

This is the frame number for the frame configuration to take effect. The system applies the frame configuration in the message starting from the frame number.

DL indicator

1 indicates that the message include DL subframe configuration.

UL indicator

1 indicates that the message include UL subframe configuration.

Transceiver mode

Transceiver mode in the relay zone is one of either Tx mode, Rx mode, or Idle mode. When the transceiver mode is idle mode, it does not transmit nor receive.

OFDMA symbol Offset

The relay zone starts at the OFDMA symbol Offset.

Frame Configuration Duration

The relay zone ends after the duration starting from the OFDMA symbol offset. The unit of duration is OFDMA symbol.

Number of frame

This field indicates the number of frames in a multi-frame.

Start Frame Number

The RS shall start transmitting/receiving the R-amble from this designated frame number

Monitoring_Duration

Duration (in units of frames) of the measurement/monitoring/transmission process. If the Monitoring_Duration value is set to 0x00 and prefix is 0b01 monitoring is to be continued until further notice

Interleaving Interval

The period (in units of frames) which is interleaved between the consecutive R-amble transmission/reception opportunity

Iteration

The requested number of iterating intervals

N_Transmitter

Number of stations instructed to transmit R-amble, the station may be RS or MR-BS.

N_Receiver_RS

Number of RSs instructed to receive R-amble

Amble index

R-amble means preamble, midamble or postamble transmitted in relay zone. It will be determined by R-amble location in downlink relay zone.

Synchronization Cycle Length, N

This field is used to indicate the synchronization R-amble period if present

Synchronization Frame Offset, Ks

The offset of the second R-amble in the synchronization cycle

Neighbor Monitoring Frame Repetition Rate, L

This field is used to indicate the neighbor monitoring R-amble period if present

Neighbor Monitoring Frame Offset, Kmn

The offset of the R-amble in the neighbor monitoring cycle

Neighbor Monitoring Cycle Length, M

This defines the number of neighbor monitoring R-amble frames in an R-amble monitoring cycle

The RS-CD message may include the following TLV:

UL allocation start time

This TLV indicates the effective start time of the uplink allocation defined by the R-MAP on R-link. If the effective start time is defined as 0, the uplink allocation defined by the R-MAP is effective in the current frame; if the value of this TLV is set to N, the uplink allocation defined by the R-MAP in frame i is effective in frame i + N.

When the Prefix is set as "00", the RS shall follow the pattern instructed by MR-BS to transmit/receive the R-amble. The pattern is composed by the amble index, and the RS shall transmit/receive the R-amble according to the field where its amble index is. Start Frame Number is the 8 LSB bits of frame number index used to indicate the starting point of subsequent R-amble transmission/reception opportunities. In order to coordinate the R-amble transmission/reception in different MR-cell, a coordinator in backhaul network is needed to ensure the Start Frame Number parameters sent in different MR-cell will align to the same time. The transmission opportunities are identified by Monitoring Duration and Interleaving Interval for each iteration. An example is given in Figure xxx, where the Duration = 2, Interleaving Interval = 3 and the Iteration = 2. When the Iteration is more than one, the pattern for each iteration will be carried in this message. After the last iteration, the RSs shall report the measurement results by RS_NBR-MEAS-REP message defined in 6.3.2.3.63.

If the Prefix is set "01", the RS will autonomously transmit/receive the R-amble without periodic instruction from MR-BS by defining R-amble repetition patterns and monitoring patterns. The deactivation or activation of the functionalities of individual RSs can be done by sending (unicast) this message during initial entry of an RS. In the case of conflict, broadcast message parameters shall supersede the unicast message parameters except for the case of the parameter M which shall be set only by the unicast message. The detail design of the associated parameters is stated in 8.4.6.1.1.4. When the RS is instructed to transmit/receive the R-amble transmission autonomously, the RS shall send the measurements using standard measurement reporting mechanisms already defined in this document. Alternatively, MR-BS can instruct the RS to report its measurement results by this message with the prefix set as "10".

Insert new subclause 6.3.2.3.76:

6.3.2.3.76 RS clock synchronization (CLK-SYNC) message

In MR network systems that require the MR-BS and non-transparent RSs to transmit frame-start DL preamble synchronously, CLK-SYNC message may be broadcasted on the relay link by the MR-BS.

Table 183q—CLK-SYNC message format

Syntax	Size	Notes
CLK-SYNC_Message_Format(){		
Management Message Type = 82	8 bits	
Fraction GPS time	16 bits	Fraction GPS time for frame-start DL preamble of current frame in unit of 1 micro second, where fraction GPS time is defined as: $fractionGPStime = GPStime - frameduration \times \left\lfloor \frac{GPStime}{frameduration} \right\rfloor$
}		

Insert new subclause 6.3.2.3.77:

6.3.2.3.77 ASC-REQ

A MR-BS may send this message to negotiate the association parameters over relay links.

Table 183r—ASC-REQ message format

Syntax	Size	Notes
ASC-REQ_Message_Format(){		
Management Message Type = 83	8 bits	
MS MAC Address	48 bits	
Association Level	2 bits	0b00: Scanning with Association level0; 0b01: Scanning with Association level1; 0b10: Scanning with Association level2; 0b11: reserved
Padding	Variable	If needed for alignment to byte boundary
}		

The following parameters shall be included in the ASC-REQ:

MS MAC Address

Association Level

Insert new subclause 6.3.2.3.78:

6.3.2.3.78 ASC-RSP

A RS transmits this message to respond to the ASC-REQ message.

Table 183s—ASC-RSP message format

Syntax	Size	Notes
ASC-RSP_Message_Format(){		
Management Message Type = 84	8 bits	
MS MAC Address	48 bits	
Association Level	2 bits	0b00: Scanning with Association level0; 0b01: Scanning with Association level1; 0b10: Scanning with Association level2; 0b11: reserved
if(Associatioin Level > 0){		
Rendezvous time	8 bits	The offset is calculated from the frame where ASC RSP is transmitted by the neighbor RS
CDMA code	8 bits	
Transmission opportunity offset	8 bits	
}		
Padding	Variable	If needed for alignment to byte boundary
}		

The following parameters shall be included in the ASC-RSP:

MS MAC Address

Association Level

Insert new subclause 6.3.2.3.79:

6.3.2.3.79 MOB_RSSCN-REP message

RS in VG may use MOB_RSSCN-REP message to report the measurement results to MR-BS. The message shall be transmitted on the Basic Management CID of the RS.

The format of the MOB_RSSCN-REP message is depicted in Table A.

Table 183t—MOB_RSSCN-REP message format

Syntax	Size	Notes
MOB_RSSCN-REP_Message_Format(){		
Management Message Type = 85	8 bits	
N_MS	8 bits	Number ofMSs to be reported
Report metric	3 bits	Bitmap indicating presence of certain metrics: Bit 0: MS RSSI mean Bit 1: MS CINR mean Bit 2: Timing Adjust
Padding	5 bits	
for(j=0;j<N_MS; j++){		
MS CID	16 bits	Basic CID of the MS to be reported
if(Report metric [Bit0] == 1)		
MS RSSI mean	8 bits	The value shall be interperted as an unsigned byte with units of 0.24dB, such that 0x00 is interpreted as -103.75 dBm, an RS shall be able to report values in the range -103.75dBm to -40 dBm
if(Report metric [Bit1] == 1)		
MS CINR mean	8 bits	<Note: The range and encoded value of CINR is TBD>
if(Report metric [Bit2] == 1)		
Timing Adjust	32 bits	Tx timing offset adjustment (signed 32-bit). The amount of time required to adjust MS transmission so the bursts will arrive at the expected time instance at the MR-BS or RS. Units are PHY specific (see 10.3)
}		
}		

Insert new subclause 6.3.2.3.80:

6.3.2.3.80 MOB_RSSCN-RSP message

If the reporting Mode 1 is used, an MR-BS shall transmit MOB_RSSCN-RSP message to request all or part of RSs in the same VG for reporting their measurement results. This message shall be transmitted by multi-cast manner for all RSs in the same VG.

The format of the MOB_RSSCN-RSP message is depicted in Table B.

Table 183u—MOB_RSSCN-RSP message format

Syntax	Size	Notes
MOB_RSSCN-RSP_Message_Format(){		
Management Message Type = 86	8 bits	
MS CID	16 bits	Basic CID of the MS that requested to report its measurement
Report metric	3 bits	Bitmap indicating presence of certain metrics: Bit 0: MS RSSI mean Bit 1: MS CINR mean Bit 2: Timing Adjust
Report Frame	4 bits	The measurement result is reported from the frame in which this message was received. A value of zero means that MOB_RSSCN-REP is sent in the next frame.
RS_Report_Type	1 bit	“0”: Part of RSs in the same VG shall report “1”: All RSs except for the access RS in the same VG shall report
if(RS_Report_Type==0){		
N_RS	8 bits	Number of RSs thqat need to report the measurement results
for(j=0;j<N_RS;j++){		
RSCID	16 bits	Basic CID of the RS that needs to report the measurement result for the specified MS
}		
}		
}		

Insert new subclause 6.3.2.3.81:

6.3.2.3.81 HARQ error report messages for multihop relay

When an RS receives an HARQ burst in error, the RS may report the error using the HARQ error report message. To specify the burst that is in error, the RS shall include CID as well as the ACID in case of Chase HARQ, and include the CID, ACID and the SPID in case of IR HARQ, in the MAC message.

HARQ error report messages are shown in Table xxx and Table yyy. Table xxx is the HARQ_CHASE_ER-REP message format. Table yyy is the HARQ_IR_ER-REP message format.

Table 183v—HARQ_CHASE_ER-REP message format

Syntax	Size	Notes
HARQ_Chase_ER-REP_Message_Format(){		
Management Message Type = 87	8 bits	
Num_HARQ_Data	4 bit	
for(i=0; i<Num_HARQ_Data; i++){		
RCID()	*variable*	
ACID	4 bit	
}		
Padding	*variable*	
}		

Table 183w—HARQ_IR_ER-REP message format

Syntax	Size	Notes
HARQ_IR_ER-REP_Message_Format(){		
Management Message Type = 88		
Num_HARQ_Data	4 bits	
For(i=0; i<Num_HARQ_Data; i++){		
RCID()	*variable*	
ACID	4 bits	
SPID	2 bits	
}		
Padding	*variable*	
}		

Insert new subclause 6.3.2.3.82:

6.3.2.3.82 MS sleep mode information message (MR_SLP-INFO)

An MR-BS sends the MR_SLP-INFO message to RS for informing about its subordinate MS sleep mode. This message conveys sleep mode information for the MSs attached through the RS. If any of an MS's connection is removed from the sleep mode to idle mode, the MR-BS sends MR_SLP-INFO with Definition=0 and Operation=0 for that particular CID. This removes only the corresponding sleep information from the RS.

Table 183x—MR_SLP-INFO message format

Syntax	Size	Notes
MR_SLP-INFO_Message_Format() {	-	-
Management Message Type = 89	8 bits	-
Transaction ID	16 bits	-
Number of MS	8 bits	Number of MSs included in the message.
for (i=0; i<Number of MS; i++) {		
MS Basic CID	16 bits	Identification of an MS
Number of Classes	8 bits	Number of power saving classes
for (i=0; i<Number of Classes; i++) {	-	-
Definition	1 bit	-
Operation	1 bit	-
Power_Saving_Class_ID	6 bits	-
if (Operation == 1) {	-	-
Start_frame_number	6 bits	-
Reserved	2 bits	-
}	-	-
if (Definition == 1) {	-	-
Power Saving Class Type	2 bits	
Direction	2 bits	
Traffic_triggered_wakening_flag	1 bit	
TRF_IND required	1 bit	
Reserved	2 bits	[Editor's Note: Why 2bits here?]
Initial sleep window	8 bits	
Listening window	8 bits	
Final-sleep window base	10 bits	
Final-sleep window exponent	3 bits	
Number_of_Sleep_CIDs	3 bits	
for (i=0; i<Number_of_Sleep_CIDs; i++ {		
CID	16 bits	
}		
}		

Table 183x—MR_SLP-INFO message format

If (TRF-IND required) {		
SLPID	10 bits	
Reserved	6 bits	
}		
}		
}		
TLV encoded information	*variable*	TLV specific
}		

The following parameters shall be included in the message:

Transaction ID
Unique identifier set by the sender for identifying this transaction.

Number of MS
Total number of MS in the message.

Definition
0 = Definition of Power Saving Class absent; in this case the message shall request activation or deactivation of Power Saving Class identified by Power_Saving_Class_ID.
1 = Definition of Power Saving Class present.

Operation
0 = Deactivation of Power Saving Class (for types 1 and 2 only).
1 = Activation of Power Saving Class.

Power_Saving_Class_ID
Assigned Power Saving Class identifier. The ID shall be unique within the group of Power Saving Classes associated with the MS. This ID may be used in further MR_SLP-INFO messages for activation / deactivation of Power Saving Class.

Start_frame_number
Start frame number for first sleep window.

Power Saving Class Type
Power Saving Class Type of a connection.

Direction
Defines the directions of the class's CIDs.
0b00 = Unspecified. Each CID has its own direction assign in its connection creation. Can be DL, UL, or both (in the case of management connections).
0b01 = Downlink direction only.
0b10 = Uplink direction only.
0b11 = Reserved.

Traffic_triggered_wakening_flag (for Type I only)
0 = Power Saving Class shall not be deactivated if traffic appears at the connection as described in 6.3.19.2.
1 = Power Saving Class shall be deactivated if traffic appears at the connection as described in 6.3.19.2.

TRF-IND_Required

For Power Saving Class Type I only.

1 = BS shall transmit at least one TRF-IND message during each listening window of the Power Saving Class.

This bit shall be set to 0 for other types.

Initial-sleep window

Assigned initial duration for the sleep window (measured in frames). For Power Saving Class type III, it is not relevant and shall be encoded as 0.

Listening window

Assigned Duration of MS listening window (measured in frames). For Power Saving Class type III, it is not relevant and shall be encoded as 0.

Final-sleep window base

Assigned final value for the sleep interval (measured in frames). For Power Saving Class type II, it is not relevant and must be encoded as 0. For Power Saving Class type III, it is the base for duration of single sleep window requested by the message.

Final-sleep window exponent

Assigned factor by which the final-sleep window base is multiplied in order to calculate the final-sleep window. The following formula is used: final-sleep window = final-sleep window base × 2(final-sleep window exponent)

For Power Saving Class type III, it is the exponent for the duration of single sleep window requested by the message.

SLP_ID

This is a number assigned by the BS whenever an MS is instructed to enter sleep mode.

The MR_SLP-INFO message shall include the following parameters encoded as TLV tuples:

HMAC/CMAC Tuple (see 11.1.2)

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

Insert new subclause 6.3.2.3.83:

6.3.2.3.83 SLP_INF-ACK message

After successfully receiving the a MR_SLP-INFO message sent by MR-BS on RS' basic CID, the RS shall transmit SLP_INF-ACK message on its basic CID to MR-BS to acknowledge that it got the information about the sleep context of the CIDs indicated.

Table 183y—SLP_INF-ACK message format

Syntax	Size	Note
SLP_INF-ACK_Message_Format(){		
Management message type = 90	8bits	
Transaction ID	16bits	
TLV encoded information	Variable	TLV specific
}		

The following parameters shall be included in the message:

Transaction ID
Transaction ID from corresponding MR_SLP-INFO message.

All other parameters are coded as tuples:

HMAC/CMAC Tuple (see 11.1.2)
The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the message.

Insert new subclause 6.3.2.3.84:

6.3.2.3.84 Station information (STA-INFO) message

The STA-INFO message shall be transmitted by the RS to identify a new station (MS or RS) is ready to enter to the network. RS shall include MS's information along with assigned primary and basic CIDs. The message format is shown in Table XX.

Table 183z—STA-INFO message format

Syntax	Size	Note
STA-INFO_Message_Format() {		
Management Message Type = 91	8 bits	
MAC ID	48 bit	Station’s MAC address
Primary management CID	16 bits	Primary management CID assigned from RS to the networkentering station (MS/RS)
Basic CID	16 bits	Basic CID assigned from RS to the station (MS/RS)
Message number	4 bits	Message identification number in case of multiple messages
TLV Encoded Information	*variable*	
}		

Basic CID (in the MAC header)
The CID in the MAC header is the Basic CID for this RS, as assigned in the RNG-RSP message.

Insert new subclause 6.3.2.3.85:

6.3.2.3.85 Station Information Acknowledge (STA-ACK) message

The STA-ACK message shall be transmitted in response to STA-INFO by the MR-BS to notify the RS that new station's (MS/RS) information is received successfully. The message format is shown in Table XX.

Table 183aa—STA-ACK message format

Syntax	Size	Note
STA-ACK_Message_Format() {		
Management Message Type = 92	8 bits	
Message number	4 bits	Message identification numberin case of multiple messages
TLV Encoded Information	*variable*	
}		

Basic CID (in the MAC header)

The CID in the MAC header is the Basic CID for this RS, as appears in the STA-INFO message.

Insert new subclause 6.3.2.3.86:

6.3.2.3.86 RS path selection request (RS_Path-REQ) message

This message shall be transmitted by a MR-BS to a RS to indicate the access station the RS shall attach to.

Table 183ab—RS_path-REQ message format

Syntax	Size	Notes
RS_Path-REQ_Message_Format {		
Management Message Type = 93	8 bits	
Preamble Index	8 bits	Preamble Index of the access station the RS shall attach to.
RS network re-entry optimization	8 bits	For each bit location, a value of '0' indicates the associated reentry management messages is required, a value of '1' indicates the reentry management message is omitted. Bit #0: Omit SBC-REQ/RSP management messages if set to '1' Bit #1: Omit PKM Authentication phase except TEK phase if set to '1'. Bit #2: Omit PKM TEK creation phase if set to '1'. Bit #3: Omit REG-REQ/RSP management if set to '1'. Bit #4: Omit neighbor station measurement report if set to '1'. Bit #5: Omit path selection phase if set to '1' Bit #6: Omit relay station operational parameter configuration if set to '1' Bit #7: *Reserved*
}		

Preamble Index

Preamble Index of the access station the RS shall attach to

RS network re-entry optimization

For each bit location, a value of ‘0’ indicates the associated reentry management messages is required, a value of ‘1’ indicates the reentry management message is omitted.
Bit #0: Omit SBC-REQ/RSP management messages if set to ‘1’.
Bit #1: Omit PKM Authentication phase except TEK phase if set to ‘1’.
Bit #2: Omit PKM TEK creation phase if set to ‘1’.
Bit #3: Omit REG-REQ/RSP management if set to ‘1’.
Bit #4: Omit neighbor station measurement report if set to ‘1’.
Bit #5: Omit path selection phase if set to ‘1’. When ETE is broadcasted in DCD, this bit shall be set to ‘1’.
Bit #6: Omit relay station operational parameter configuration if set to ‘1’.
Bit #7: *Reserved*

Insert new subclause 6.3.2.3.87:

6.3.2.3.87 RS path selection response (RS_Path-RSP) message

This message may be transmitted by a RS to acknowledge the reception of the RS_Path-REQ message.

Table 183ac—RS_Path-RSP message format

Syntax	Size	Notes
RS_Path-RSP_Message_Format {		
Management Message Type = 94	8 bits	
}		

Insert new subclause 6.3.2.3.88:

6.3.2.3.88 RS-SCH

This message specifies the uplink allocation for the receiving RS used for relaying bursts in the distributed scheduling, and is not applicable to MS/SS.

Table 183ad—–RS-SCH message format

Syntax	Size	Notes
RS-SCH_Message_Format() {		
Management Message Type = 95	8bits	TBD
CID	16 bits	The CID for the MS
RS UL Allocation Frame Offset	8 bits	In terms of number of frames
Bandwidth	8 bits	In number of bytes
}		

CID

Indicates the CID, for which the allocation will be used.

RS UL Allocation Frame Offset

Indicates the number of frame, starting from the next frame, in which the bandwidth grant for RS is valid.

Bandwidth

Indicates the size of the allocation, in units of bytes

Insert new subclause 6.3.2.3.89:

6.3.2.3.89 RS_Member_List_Update message format

The virtual RS group parent may transmit RS_Member_List_Update message as a multicast message to update the virtual group members with the details of the traffic burst they shall forward. This message is transmitted whenever there is a change in the connection list of the RS group members due to their movement or movement of their subordinate nodes.

Table 183ae—RS_Member_List_Update message format

Syntax	Size	Notes
RS_Member_List_Update_Message_Format {		
Management Message Type = 96	8 bits	
Configured_para_type	4 bits	b0 = 1: data forwarding on a per CID basis b0 = 0: data forwarding on a per terminal basis b1 – b3: reserved
If (b0 of Configured_para_type == 1) {		
Number_RS	8 bits	Number of RS group members involved with the CID list update
for (i=0;i<Number_RS;i++) {		
RS Basic CID	16 bits	Basic CID of the RS group member
N_CID	8 bits	If b0 of Configured_para_type=1, number of CIDs whose data is to be forwarded by the RS group member If b0 of Configured_para_type=0, number of terminals (the first hop MSs or RSs from the group member) involved with the list update
for (j=0;j<N_CID;j++) {		
CID	16 bits	If b0 of Configured_para_type = 1, transport CIDs involved with the list update If b0 of Configured_para_type = 0, the basic CIDs involved in the list update
Add_Remove	1 bit	b0 = 1: Add CID/terminal to the forwarding list b0 = 0: Remove CID/terminal from the forwarding the list
}		
}		
}		
}		

Configured_para_type

The LSB bit indicates whether selective forwarding is enabled on a per CID basis, or on a per terminal basis.

Number_RS

This field indicates the number of RS group members for which there is an update of the connection list.for selective forwarding

N_CID

If b0 of Configured_para_type equals 1, this field indicates the total number connections that need to be added to and/or removed from the CID list of the indicated group member. If b0 of Configured_para_type=0, this field indicates the total number subordinate terminal nodes that need to be added to and/or removed from the CID list of the indicated group member.

CID

If b0 of Configured_para_type equals 1, this field indicates the transport CID to be added to and/or removed from the CID list of the indicated group member. If b0 of Configured_para_type=0, this field indicates the basic CID of the subordinate terminal nodes to be added to and/or removed from the CID list of the indicated group member.

Add_Remove

This field indicates whether the CID of the burst will be added to or removed from the current CID list of the RS group member

Insert new subclause 6.3.2.3.90:

6.3.2.3.90 MR piggybacked bandwidth request information (MR_PBBR-INFO) message

This message is used to notify encrypted piggybacked BW request information to RS. This message is transmitted by MR-BS with using the RS's basic CID.

Table 183af—MR_PBBR-INFO message format

Syntax	Size	Note
MR_PBBR-INFO_Message_Format(){		
Management Message Type = 97	8 bits	TBA
N_PB-BR_INFO	8 bits	Number of PB-BR Information
for (i=0; i<N_PB-BR_INFO; i++) {		
CID	16 bits	The CID shall indicate the connection for which uplink bandwidth is requested.
PN_Flag	1 bit	0: indicates Packet Number field is invalid 1: indicates Packet Number field is valid
Packet Number	31 bits	Packet Number which is attached to MAC-PDU containing the grant management subheader
Grant Management Subheader Information	16 bits	See Table 9.
}		
TLV Encoded Information	*variable*	TLV Specific
}		

The MR_PBBR-INFO message shall include the following parameter encoded as TLV tuples:

HMAC/CMAC Tuple (See 11.1.2.)

6.3.3 Construction and transmission of MAC PDUs

6.3.3.2 Concatenation

Insert the following after the first paragraph of 6.3.3.2:

In MR networks, multiple MAC PDUs may be concatenated into a single transmission in either the uplink or downlink directions.

Insert new subclause 6.3.3.8:

6.3.3.8 MR construction and transmission of MAC PDUs

MPDUs from connections that are not assigned to traverse a tunnel are constructed according to the sections 6.3.3.1 - 6.3.3.7 RSs forward MPDUs from connections that are not assigned to a tunnel based on the CID of the connection.

When the CID encapsulation scheme is used, the MAC header of the PDU from the MS to the MR-BS via the RS shall be encapsulated by the access RS, and the MAC header of the PDU from the MR-BS to the MS via the RS shall be decapsulated by the access RS.

Insert new subclause 6.3.3.8.1:

6.3.3.8.1 Transmission using Tunnels

All MPDUs from a connection that is assigned to traverse a tunnel must be transmitted through that tunnel. There are two modes for constructing and forwarding MPDUs from connections that traverse a tunnel. In the first mode, called Tunnel Packet Mode, MPDUs that traverse a tunnel are encapsulated in an MPDU header which carries the T-CID ~~f~~or MT-CID of the tunnel. This header along with the encapsulated MPDUs is called a tunnel packet. Multiple MPDUs from connections that traverse the tunnel can be concatenated into a tunnel packet for transmission. The station at the ingress of the tunnel is responsible for encapsulating the MPDUs into tunnel packets, and the station at the egress of the tunnel is responsible for removing the tunnel header and forwarding the encapsulated MPDUs based on their individual CIDs. Stations through which a tunnel traverses may forward the tunnel packets based on the TCID or MT-CID in the tunnel header. When tunnel packets are transmitted in tunnel packet mode, the RSs can determine the T-CID or MT-CID of a packet by parsing the tunnel header. When a tunnel traverses more than one RS, separate IEs may be used to describe the bursts allocated to this tunnel at different RSs. In this mode, multiple tunnel packets, potentially from different tunnels traversing an RS can be concatenated into a single PHY burst.

In the second mode, called Tunnel Burst Mode, MPDUs transmitted through a tunnel are concatenated together into PHY bursts and transmitted without appending a tunnel header, in order to save bandwidth and reduce the MPDU processing time. In this mode, the T-CID or MT-CID of the tunnel is specified in the DL-MAP IE to identify the tunnel on which the PHY burst is transmitted. In the UL-MAP IE, the basic CID shall be used to indicate UL burst allocation. In this mode, all MPDUs in a PHY burst must be from connections that traverse the tunnel. The station at the ingress of the tunnel that operated in tunnel burst mode is responsible for concatenating the MPDUs into from individual tunnels into PHY bursts, and the station at the egress of the tunnel is responsible for forwarding the concatenated MPDUs based on their individual CIDs. Stations through which a tunnel traverses may forward the tunnel packets based on the T-CID or MT-CID in the map IE.

When the CID encapsulation scheme is used to carry tunneled data, MR-BS shall be responsible for creating relay MAC PDU with T-CID in each nested relay MAC headers. Once the MAC PDU arrives at the egress of the tunnel, the station at the egress shall remove the outermost relay MAC header and relays the payload. The payload of MAC PDU may contain one or more relay MAC PDUs and/or one or more 16e MAC PDUs. The Relay MAC PDUs shall be relayed according to T-CID included in the relay MAC headers. In addition, the station at the egress may calculate and attach CRC at the end of the payload before the payload is relayed.

If a tunnel PDU constructed in the tunnel packet mode will be processed by parallel HARQ channels, the tunnel PDU then shall contain a PDU SN extended Subheader after the tunnel header.

Insert new subclause 6.3.3.8.1.1:

6.3.3.8.1.1 Centralized tunnel management

In centralized tunnel management mode, the tunnel is created within a single routing domain. After a new access RS finishes network entry process, the tunnel should be created from MR-BS to the designated access RS. To create a tunnel, MR-BS should select a path as an explicit route to navigate the end-to-end tunnel creation. The MR-BS selects an appropriate forwarding criterion to determine a path subject to the following constrains:

- QoS constrains of the connection
- Type of connection (data or management)
- Available radio resources in MR cell
- Current R-link status and topology of MR cell

When tunnel is used to relay data traffic between MR-BS and access RS, the data packets are aggregated and encapsulated into tunnel PDUs. The data forwarding is done at each intermediate RS by checking tunnel CID against the routing table to determine the next hop

Different from per-service-flow QoS management, tunnel supports per-class-based QoS processing at MR-BS and all RS. Tunnel should be able to differentiate/classify the data packets and prioritize them properly, and aggregate the same class packets into the same tunnel MAC PDU over R-link.

Insert new subclause 6.3.3.8.2:

6.3.3.8.2 Transmission using station CID

There are two schemes for RS to forward received data. One is the MPDU-based forwarding and the other is burst-based forwarding. In MPDU-based forwarding scheme, the forwarding of MPDUs by each RS is performed based on the CID contained in the MPDU header. An RS is informed about the next hop station during the setup of the service flow. The inclusion of CID in the DL-MAP is optional.

Optionally, under centralized scheduling, forwarding of MPDUs by each RS is performed based on burst described in MAP IEs, namely burst-based forwarding. The burst-based forwarding rules are encoded in the MAPs sent by MR-BS. Data bursts that are scheduled to be relayed by burst-based forwarding mechanism and destining to stations other than the receiving RS are described by MAP IEs with RS primary management CID. If burst-based forwarding is used, DL_Burst_Transmit_IE and UL_Burst_Receive_IE defined in 8.4.5.3.29, and 8.4.5.4.29, respectively, shall be used, where DL_Burst_Transmit_IE is used to describe DL data relaying information and UL_Burst_Receive_IE is used to describe UL data relaying information.

6.3.4 ARQ mechanism

6.3.4.6 ARQ operation

Insert new subclause 6.3.4.6.4:

6.3.4.6.4 ARQ modifications for relaying

6.3.5 Scheduling services

6.3.5.2 Uplink request/grant scheduling

6.3.5.2.1 UGS

Insert the following text at the end of 6.3.5.2.1:

In the MR system with distributed scheduling, to meet a UGS service flow's need, the MR- BS and RSs along the path shall grant fixed size bandwidth to its subordinate node on a real-time periodic basis.

In the multihop relay system with distributed scheduling, the MR-BS may send RS scheduling information (RS-SCH management message) in advance to its subordinate RS to indicate when and how much bandwidth it will schedule for the service in the future.

6.3.5.2.2 rtPS

Insert the following at text at the end of 6.3.5.2.2:

In the MR system with distributed scheduling, to meet an rtPS service flow's need, the MR- BS and RSs along the path shall poll its subordinate node on a real-time periodic basis. The MR-BS may send RS scheduling information (RS-SCH management message) to its subordinate RS to indicate when it will schedule a poll in the future.

6.3.5.2.2.1 Extended rtPS

Insert the following text at the end of 6.3.5.2.2.1:

In the MR system with distributed scheduling, to meet an Extended rtPS service's need, the MR- BS and RSs along the path shall grant dynamic size bandwidth to its subordinate node on a real-time periodic basis. The MR-BS may send RS scheduling information (RS-SCH management message) to its subordinate RS to indicate when and how much bandwidth it will schedule for the service in the future.

6.3.6 Bandwidth allocation and request mechanisms

Insert the following text after the second paragraph of 6.3.6:

An RS may request a dedicated uplink resource with the RS UL_DCH request header.

Insert new subclause 6.3.6.7:

6.3.6.7 Relay bandwidth request and allocation mechanisms

Insert new subclause 6.3.6.7.1:

6.3.6.7.1 Distributed bandwidth request and allocation

In relay systems with distributed bandwidth request and allocation, each MR-BS and RS individually determines the bandwidth allocations on the links it controls (i.e. downlinks to and uplinks from its immediate downstream stations) and creates its own MAPs reflecting these decisions.

The following subclauses specify bandwidth request and allocation procedures for the relay link (i.e. between an RS and its upstream RS or MR-BS) in relay systems with distributed control. <Section note: additional BW request and allocation mechanisms may be defined for the relay link to improve its BW utilization. This is TBD.>

An access RS receives various types of bandwidth requests from MSs, such as signaling header, grant management subheader, CDMA bandwidth request code and so on. Among those request types, only Grant Management subheader may be encrypted and cannot be derived by the RS. Therefore, depending on RS capability of decrypting MAC-PDUs, there are two different ways to handle the Grant Management subheader.

RS capable of decrypting MAC-PDUs shall locally handle all kinds of bandwidth requests from MS. Meanwhile, RS incapable of decrypting MAC-PDUs shall locally handle all kinds of bandwidth requests except for grant management subheader from MS. For this type of RS, the encrypted Grant Management header is decrypted by the MR-BS, and then forwarded to the RS using MR_PBBR-INFO message. In a case that AES-CCM is used as encryption algorithm, MR-BS shall set PN_Flag=1 and Packet Number in the message. The Packet Number is taken from the encrypted MAC-PDU which contains the Grant Management Subheader. When other encryption algorithms are used, PN_Flag and Packet Number shall be set to zero. When the RS receives MR_PBBR-INFO, it confirms whether content of the message is superseded by a standalone BW request header (aggregate) with checking Packet Number if PN_Flag is set to 1 (valid). When Grant management Subheader information is not superseded by a standalone BW request header or PN_Flag is set to 0 (invalid), the RS add the quantity of bandwidth requested to its current perception of the bandwidth needs of the connection. When a RS incapable of decrypting MAC-PDUs detects Grant Management subheader on UGS connection from the type field of the GMH, it may allocate a small amount of bandwidth to the MS sending the subheader.

Alternatively, MR-BS may disable a MS, which attaches to an access RS incapable of MAC-PDU decryption, from using piggybacked request by sending Capabilities for Construction and Transmission of MAC PDUs TLV in a SBC-RSP message or Request/Transmission Policy TLV in a DSA-REQ/RSP.

[Task group note: These procedures require the distributed security model where the TEK for the MS is distributed from the MR-BS to the access RS.]

Insert new subclause 6.3.6.7.1.1:

6.3.6.7.1.1 Bandwidth requests

The bandwidth request from an RS may come as a stand-alone bandwidth request header or piggybacked on other MAC PDUs. If it is a stand-alone bandwidth request header, it may come as a response to a poll (see 6.3.6.7.1.~~1~~.3) or as a result of a contention-based CDMA bandwidth request process (see 6.3.6.7.1.~~1~~.4). Because the uplink profile can change, all requests shall be made in terms of the number of bytes needed to carry the MAC header and payload, but not the PHY overhead. The bandwidth request header may be transmitted during any relay uplink allocation, except during initial ranging.

An RS may combine the bandwidth requests that arrive from downstream stations during a given period of time along with the bandwidth needs of packets in queue into one BW request header per QoS class. When resources are available, the upstream station will allocate bandwidth using the RS's Basic CID. The upstream station shall expect to receive concatenated (see Section 6.3.3.2) MAC PDUs with CIDs of transport or tunnel connections from stations further down the tree.

In addition, the RS can transmit an aggregate or incremental bandwidth request. When the upstream station receives an incremental bandwidth request, it shall add the quantity of bandwidth requested to its current perception of the bandwidth needs of the connection. When the upstream station receives an aggregate bandwidth request, it shall replace its perception of the bandwidth needs of the connection with the quantity of bandwidth requested. The Type field in the bandwidth request header indicates whether the request is incremental or aggregate. Since piggybacked bandwidth request do not have a type field, they shall always be incremental.

The RS may transmit a BW request header soon after it receives a BW request header from one of its downstream stations (timed to yield an uplink allocation sequential to the arrival of those packets) instead of waiting for the actual packets to arrive in order to reduce delay in relaying traffic (see Figure x.1). <Section note: the BW request headers defined for the relay link may be different from those defined for the access link to improve its BW utilization. This is TBD.>

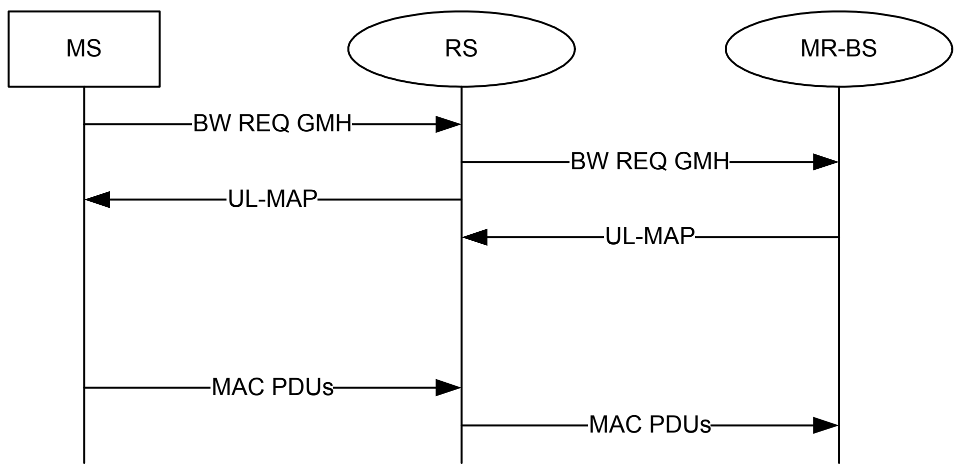


Figure 60a—Reducing latency in relaying traffic by transmitting BW req. header on R-UL before packets arrive

Insert new subclause 6.3.6.7.1.2:

6.3.6.7.1.2 Grants

RS bandwidth requests may reference specific connections, while each bandwidth grant an RS receives from its upstream station is addressed to the RS identifier. <Section note: identifier is TBD.>. The RS can schedule any MAC PDU on the bandwidth allocations it receives from its upstream station.

In MR system with distributed scheduling, the MR-BS or a RS may send its RS scheduling information (RS-SCH management message) in advance to its subordinate RS, to indicate when and how much bandwidth it will schedule for the real time service in the future. The RS scheduling information (RS-SCH management message) includes the CID on which the user traffic is carried, the frame offset to indicate when the bandwidth will be granted and the size of bandwidth allocation. The actual grant is issued using Data Grant IE as defined for single hop case. For periodical bandwidth grant, RS scheduling information (RS-SCH management message) could be sent just once.

RS scheduling information (RS-SCH management message) is generated by the MR-BS and sent to its subordinate RS until the MS's access station is reached. Figure <XX> illustrates the bandwidth grant procedure using RS scheduling information (RS-SCH management message).

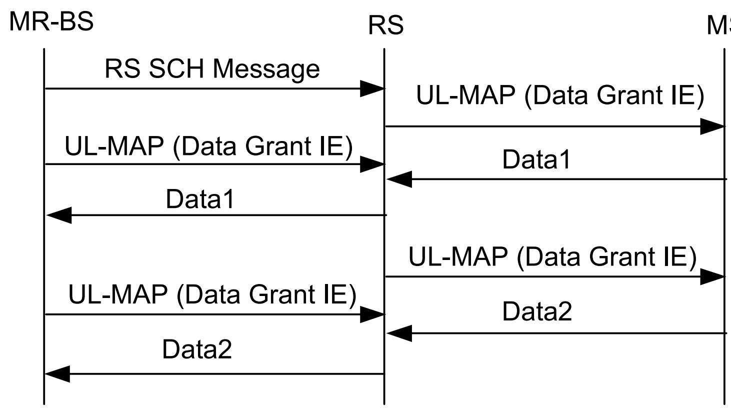


Figure 60b—Periodic bandwidth grant with RS scheduling information

Insert new subclause 6.3.6.7.1.3:

6.3.6.7.1.3 Polling

MR-BSs and RSs can allocate bandwidth to a downstream RS or a group of downstream RSs for the purpose of transmitting a bandwidth request header. This polling process on the relay link is the same as that defined for the access link in 6.3.6.3.

If the RS is regularly polled, it can transmit a bandwidth request header on the relay uplink as soon as it senses the lack of bandwidth for its subordinate MSs and RSs, thereby reducing relaying delay (see Figure x.2).

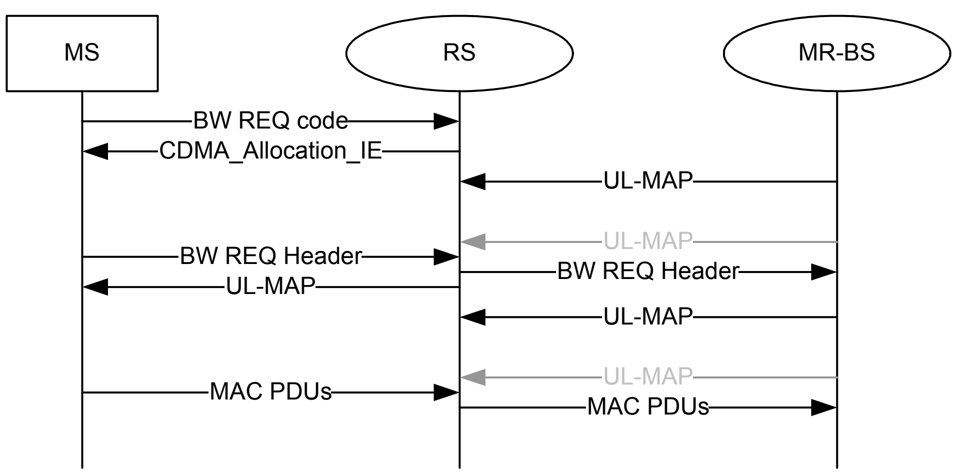


Figure 60c—Reducing latency in relaying traffic via RS polling

Similar to the bandwidth grant, the periodic polls issued by the MR-BS or a RS to its subordinate RS may be accompanied with RS scheduling information (RS-SCH management message). The RS scheduling information (RS-SCH management message) is generated by the MR-BS and sent to its subordinate RS until the access RS is reached. Figure YYY illustrates the polling procedure using RS scheduling information.

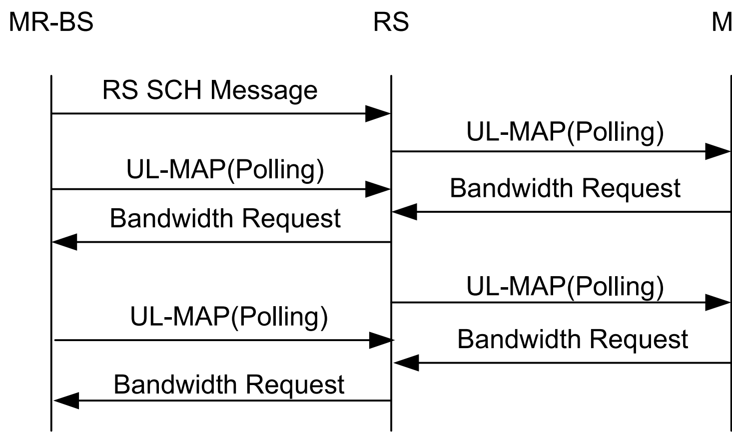


Figure 60d—Periodic Polling with RS scheduling information

Insert new subclause 6.3.6.7.1.4:

6.3.6.7.1.4 Contention-based CDMA bandwidth requests

The contention-based CDMA bandwidth request process on the relay link is the same as that on the access link detailed in 6.3.6.5. The set of ranging codes used for bandwidth request on the relay link is the same as that used for the access link.

Upon needing bandwidth, the RS shall select a ranging code with equal probability from the code subset allocated for bandwidth requests. This ranging code shall be modulated onto the ranging subchannels and transmitted during the appropriate relay uplink allocation.

Upon detection of the ranging code, the RS's upstream station shall provide a relay uplink allocation using a CDMA_Allocation_IE specifying the transmit region and ranging code used by the RS. Once the RS determines it has been given an allocation by matching the transmit region and code it used against those specified by the CDMA_Allocation_IE, it shall use the allocation to transmit a bandwidth request header and/or data. If the upstream station does not issue a relay uplink allocation or if the bandwidth request header does not result in a bandwidth allocation, the RS shall assume a collision took place and follow the contention resolution specified in 6.3.8.

The RS may reduce the latency of relaying traffic by sending a bandwidth request CDMA ranging code as soon as it receives one from a downstream station instead of waiting for the actual packets to arrive (see Figure x.3).

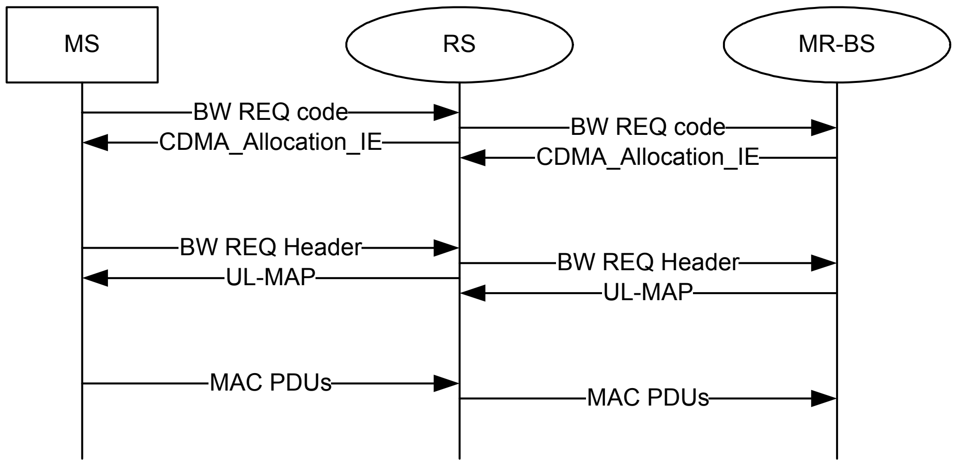


Figure 60e—Reducing latency in relaying traffic by early transmission of BW request ranging code on the R-UL

Insert new subclause 6.3.6.7.2:

6.3.6.7.2 Centralized bandwidth request and allocation

In systems with centralized bandwidth allocation, the MR-BS shall determine the bandwidth allocations for all links (access and relay) in its MR-cell. Thus, before a station can transmit a packet to the MR-BS, that station's bandwidth request must first reach the MR-BS, which then creates bandwidth allocations on the links along the path from the station to the MR-BS.

Insert new subclause 6.3.6.7.2.1:

6.3.6.7.2.1 Contention-based CDMA Bandwidth Requests for Relay

The MR-BS shall assign unique RS CDMA ranging codes to each RS in its MR-cell in order to reduce the overhead and latency of various ranging processes in relay networks with centralized control (see subclause 6.3.10.3.5~~x~~). RS CDMA ranging codes are assigned to an RS during its initial ranging process by sending an RS_CDMA_Codes TLV in the RNG-RSP.

A set of these RS CDMA ranging codes may be reserved for the purpose of informing the MR-BS that an SS attached to the originating RS is requesting to forward a BW request header to the MR-BS. When the MR-BS receives such a code, it shall create BW allocations on the access link and the relay links along the path to the MR-BS for the purpose of forwarding a BW request header from the SS to the MR-BS. This requires that the MR-BS not only know the path from the RS but also the processing time at each RS in the MR-cell.

Thus, when an RS receives a BW request CDMA ranging code from one of its SSs, it shall send the appropriate RS CDMA ranging code toward the MR-BS indicating that one of its SSs is requesting to forward a

BW request header to the MR-BS. Each intermediate RS along the path to the MR-BS relays this code in the uplink direction. Upon receiving this code, the MR-BS shall respond by allocating uplink bandwidth to the RS along the relay path so that the RS can send the MR-Code-REP message to the MR-BS. CDMA code information in the MR_Code-REP is used by the MR-BS to generate UL-MAP allocating uplink bandwidth to the MS. See figure <XXX>.

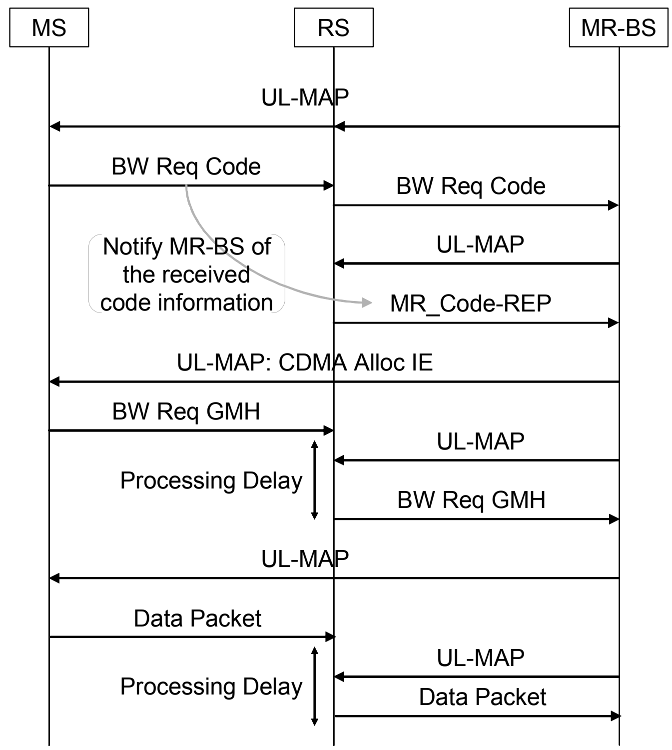


Figure 60f—BW request/allocation signaling in centralized scheduling

Another set of RS CDMA ranging codes may be reserved for the purpose of informing the MR-BS that the originating RS is requesting to forward a BW request header to the MR-BS. Although RSs do not create data traffic, they may need to request bandwidth for management messages or for queued SS data if previous BW allocations did not suffice due to unsuccessful transmissions, changes in modulation/coding rate, etc. The MRBS responds to this type of code in a manner similar to the one described above except that there is not access uplink allocation.

Insert new subclause 6.3.6.7.2.2:

6.3.6.7.2.2 Continuous bandwidth allocation mechanism

MR-BSs and RSs shall support the continuous bandwidth allocation mechanism specified in this subclause. When an MR-BS allocates bandwidth to forward a packet to/from a given station, it shall allocate bandwidth on all links (relay and access) that make up the path to/from that station taking into account the processing delay at each RS along the path as well as the multihop frame structure.

To create this continuous forwarding of a packet, the MR-BS shall allocate bandwidth on consecutive links along a path by creating an allocation for the second link at the first opportunity after the allocation of the first link plus the intermediate station's processing time. Each RS's uplink processing delay is notified to the MR-BS using the SBC-REQ message during the RS's network entry process.

Insert new subclause 6.3.6.7.3:

6.3.6.7.3 Dedicated relay uplink channel allocation

After the RS network entry and initialization, the RS may be assigned an uplink dedicated channel (RS UL_DCH) resource by its upstream serving station (MR-BS or RS). If the MR-BS does not allocate an uplink dedicated channel to an RS, the RS may request an allocation.

The minimum size is large enough for a signaling message, it is available once every N frames. This initial resource is used by the RS to initiate the continuous operations of the dedicated channel. For example, the size can be updated, when appropriate, to a larger (or smaller) size according to the traffic requirement of the relay. The traffic requirement can be computed, periodically or as needed by events, by the RS to ensure adequate flows. For centralized resource management, the initial assignment and all subsequent updates may be done by the MR-BS only. In distributed resource management, the dedicated channel assignment may be done jointly by the MR-BS and the RS.

The dedicated channel allocation is assigned through MAP IE within the RS-Zone, i.e. R-MAP. The allocation is available starting in the same frame when the R-MAP IE is received by the RS.

Insert new subclause 6.3.6.7.3.1:

6.3.6.7.3.1 Dedicated channel between MR-BS and RS

An RS or MR-BS may allocate a dedicated channel using RS_UL_DCH assignment IE (see 6.3.2.1.2.2.2.2, 8.4.5.9.2). A dedicated channel is a periodic allocation of uplink bandwidth.

To reduce the overhead of allocating a dedicated channel to an RS, a dedicated channel can be allocated, changed, and released based on the expected demand of the uplink bandwidth.

MR-BS may allocate a dedicated channel to an RS without an explicit request from the RS by sending a RS_UL_DCH assignment IE (see 6.3.2.1.2.2.2.2, 8.4.5.9.2).

If necessary, an MR-BS can terminate or decrease the bandwidth and/or the allocation interval of the dedicated channel without request from an RS.

If the uplink path from an RS to an MR-BS includes other RSs, the MR-BS allocates a dedicated channel for each hop within the path in response to an RS UL_DCH request header.

An RS may estimate the average data rate of its relayed uplink connections and request to be allocated a rate based dedicated channel (RS UL_DCH with DCH TYPE 10). Bandwidth requests from SSs may be filtered by the RS to reduce the number of bandwidth requests transmitted on the relay links.

Insert new subclause 6.3.6.7.3.2:

6.3.6.7.3.2 Service flow based dedicated resource update

The ongoing dynamic adaptation of the dedicated channels may be in response to the events of service flow creation, change and deletion of the MS. As the per-link dedicated resource requirement is a function of the established service flows of each MS, each service flow change imposes resource changes to all the intermediate RSs that are supporting it. The creation, deletion or change of each service flow sets the change in resources needed for each affected relay link. By using the service flow creation, change, and delete events to update the size of the dedicated channel, all necessary links that require update can be adjusted accordingly. This assures a smooth transition to the new required size promptly without the need for detection using other means such as through traffic analysis. Minor dynamic update after the service flow creation or change allows the final convergence to the new appropriate size for the normal operation of the dedicated channel.

The MR-BS determines the size of the update to the dedicated channels based on the service traffic information TLVs in the signaling exchange of DSA, DSC or DSD process. The MR-BS adjusts the allocation to the affected first hop RS by sending the corresponding RS_UL_DCH assignment IE. Within the assignment IE, the RS is also provided with the actual throughput size of the update and the CID of the access RS that is serving the specific MS. With this information the RS can determine which subordinate link needs to be updated and by how much. Upon receiving the assignment IE, in the next frame, the RS can adjust its allocation to its next hop link and so on until all the links to the specific access RS are updated.

6.3.7 MAC support of PHY

Change subclause 6.3.7.3 as indicated:

6.3.7.3 DL-MAP

The DL-MAP message defines the usage of the downlink intervals on the access links for a burst mode PHY.

Change subclause 6.3.7.4 as indicated:

6.3.7.4 UL-MAP

The UL-MAP message defines the uplink usage on the access link in terms of the offset of the burst relative to the Allocation Start Time (units PHY-specific)

6.3.7.7 Optional MAC support of the PHY for relaying

Insert new subclause 6.3.7.7:

6.3.7.7 Optional MAC support of the PHY for relaying

6.3.8 Contention resolution

6.3.9 Network entry and initialization

Change the first paragraph of 6.3.9 as indicated:

Systems shall support the applicable procedures for entering and registering a new SS or RS or a new node to the network. All network entry procedures described hereunder through and including 6.3.9.13 apply only to PMP operation and PMP operation with MR support. The network entry procedure for Mesh operation is described in 6.3.9.14.

Insert the following text after the second paragraph of 6.3.9:

The procedure for initialization of an RS shall be as shown in Figure xxx. For the RS the stages g), h), i) and j) in the figure 55 are not required, for all other stages the RS shall behave in the same manner as an SS during network entry unless otherwise specified in the subclauses of 6.3.9. The more detailed finite state machine representations of the individual sections (including error paths) and the timeout values shall be the same as those provided for the SS, unless otherwise specified.

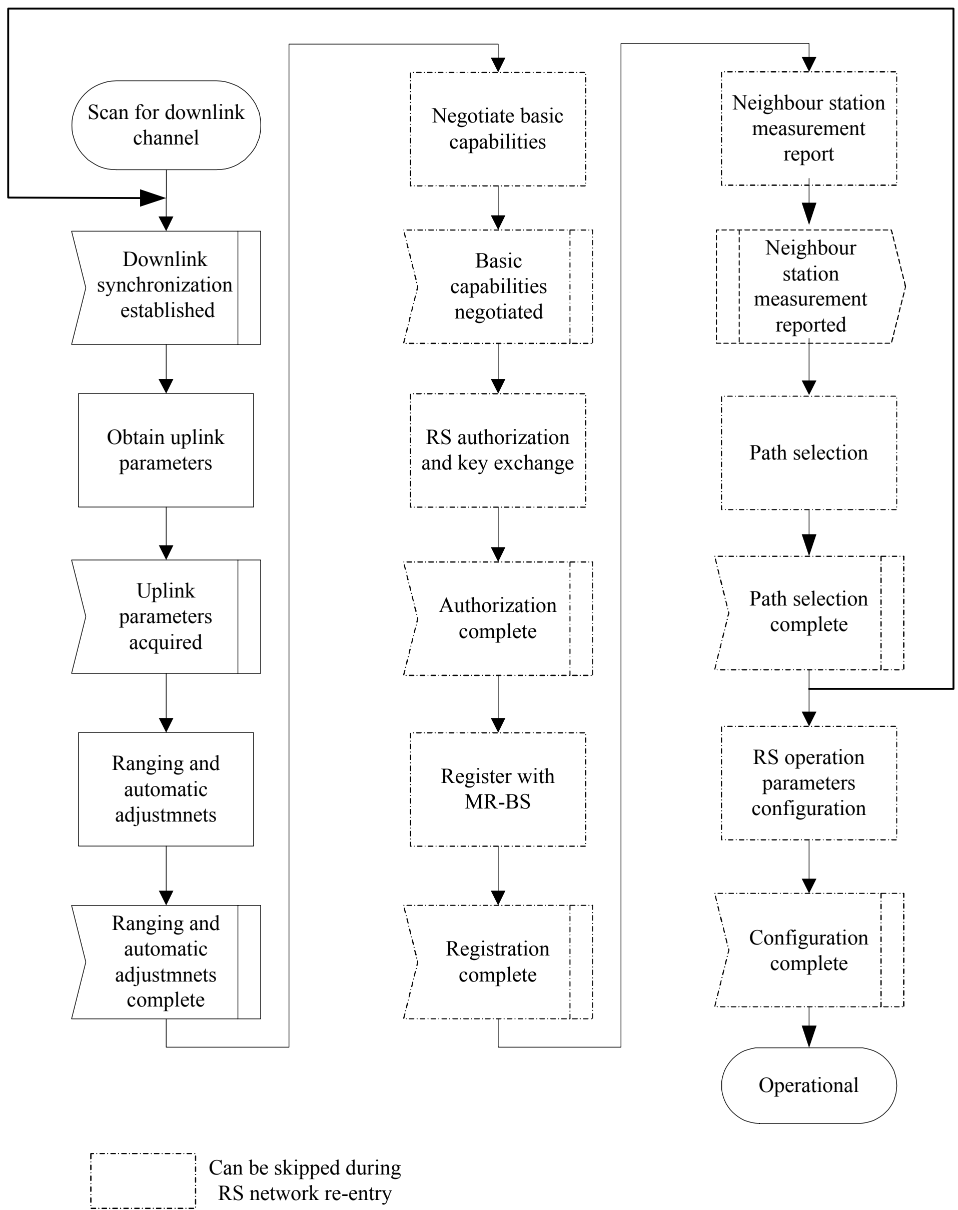


Figure 72a—RS initialization overview

6.3.9.1 Scanning and synchronization to the downlink

Insert the following text at the end of 6.3.9.1:

RS follows the scanning and synchronization procedure similar to that of the SS. In addition, however, the RS may store preamble index and signal strength in order to report the stored values to the serving MR-BS after registration.

Insert new subclause 6.3.9.16:

6.3.9.16 Support for network entry and initialization in relay mode

Insert new subclause 6.3.9.16.1:

6.3.9.16.1 MS network entry procedures in transparent RS systems

In network entry procedure in transparent RS systems, MS scans for downlink channel and establish synchronization with the MR-BS, then obtains transmit parameters from UCD message as described in 6.3.9.1 through 6.3.9.4.

The initial ranging process shall begin by sending initial-ranging CDMA codes on the UL allocation dedicated for that purpose (for more details see 6.3.10.3). The RS shall monitor ranging channel assigned by the MR-BS.

The code may be received by the MR-BS and some RSs near the MS. RSs receiving the code with sufficient signal quality shall transmit a RNG-REQ to the MR-BS with the RS basic CID. The RNG-REQ message contains ranging status, code attributes and adjustment information such as frequency, timing and transmission power. When a RS receives multiple codes in a frame, the RS sends a RNG-REQ message which contains information of multiple codes which are received with sufficient signal quality.

When the MR-BS receives ranging code, it shall wait for RNG-REQ with the same ranging code from its subordinate RSs for T48 timer. Once T48 timer expired, the MR-BS compares measured signal information at each station to decide the most appropriate path to communicate with the code originating MS, according to channel measurement information. Algorithms to select a path are out of scope of this document.

When the ranging status at the selected path is continue, the MR-BS transmits a RNG-RSP to the MS directly with initial ranging CID. The RNG-RSP shall contain adjustment information measured at the RS on the selected path. If the ranging code has been successfully received at the access RS on the selected path and the MR-BS decides to apply uplink and downlink relaying to the MS, the RS receives and relays a RNG-REQ message transmitted on a burst specified with CDMA_Allocation-IE in UL-MAP after decoding the UL-MAP or optionally R-MAP in the same frame. The MAP messages and IEs are defined in 8.4.5. If the direct communication is selected, the MR-BS follows sequence described in 6.3.10.3.

Once the RS receives a RNG-REQ containing MS MAC address with initial ranging CID, it forwards the message to the MR-BS with the RS basic CID, so that the MR-BS can identify the RS with which the MS connects.

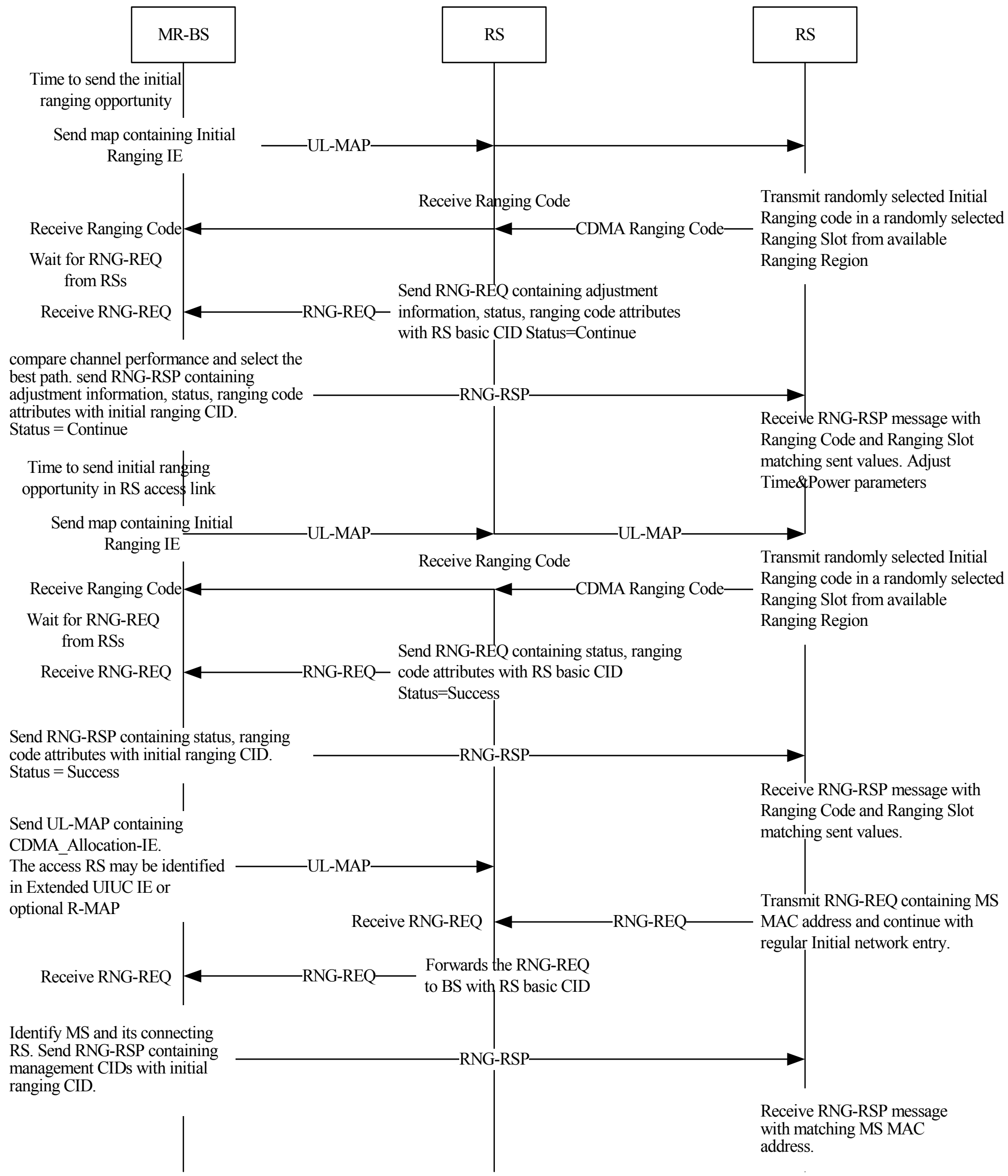
Receiving the RNG-REQ, the MR-BS assigns basic and primary CIDs to the MS and sends the RNG-RSP, which contains just assigned CIDs of MS, to the MS directly with the initial ranging CID.

After assigning the basic and primary CID to the MS, the MS and the MR-BS continue network entry process as described in the 6.3.9.7 through 6.3.9.13 using the MS's management CIDs. The RS on the selected path shall relay messages between them. The RS may monitor management messages and derive some information for some purpose which is out of scope of this document.

The message sequences chart (Figure xxx) and flow charts (Figure xxx, Figure xxx, and Figure xxx) on the following pages define the ranging and adjustment process that shall be followed by compliant RSs and ~~M~~MR-BSs. For CDMA ranging process between RS and MS, these details can be found in 6.3.10.3.

Optionally, the MS network entry process in transparent RS system will proceed with relaying of messages and data on uplink only, while relying on the direct MR-BS to MS transmissions on the downlink. The message sequence chart for this process is the same as the one of DL/UL relaying described in Table xxx.

Table 199a—Ranging and automatic adjustments procedure in MR mode



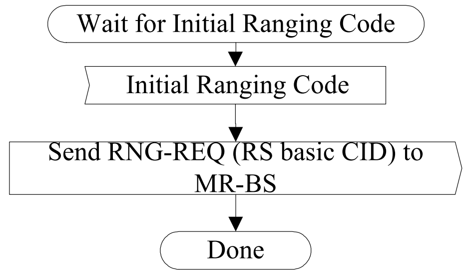


Figure 95a—MS CDMA Initial Ranging -- Access Transparent RS

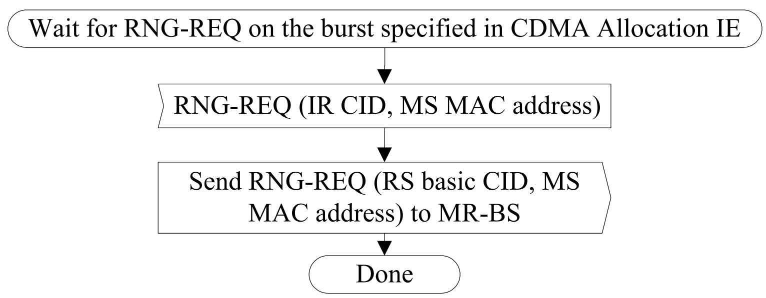


Figure 95b—MS Initial Ranging -- Access Transparent RS

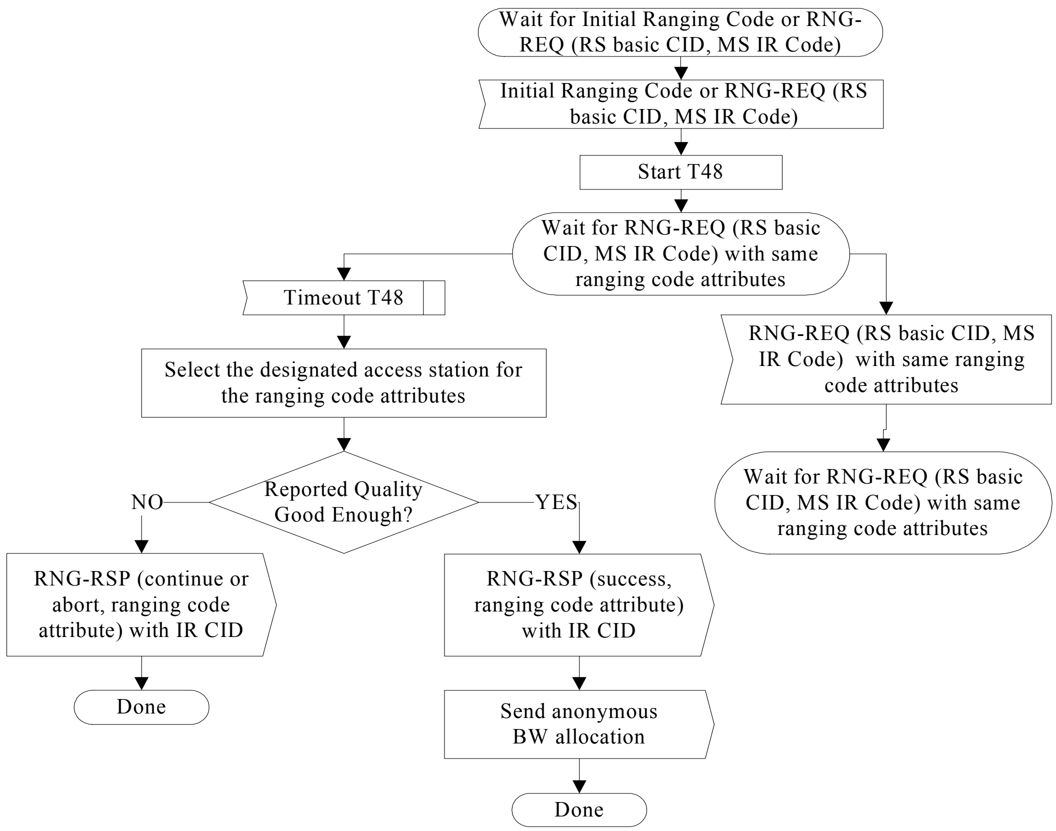


Figure 95c—MS CDMA Initial Ranging with Transparent RS -- MR-BS

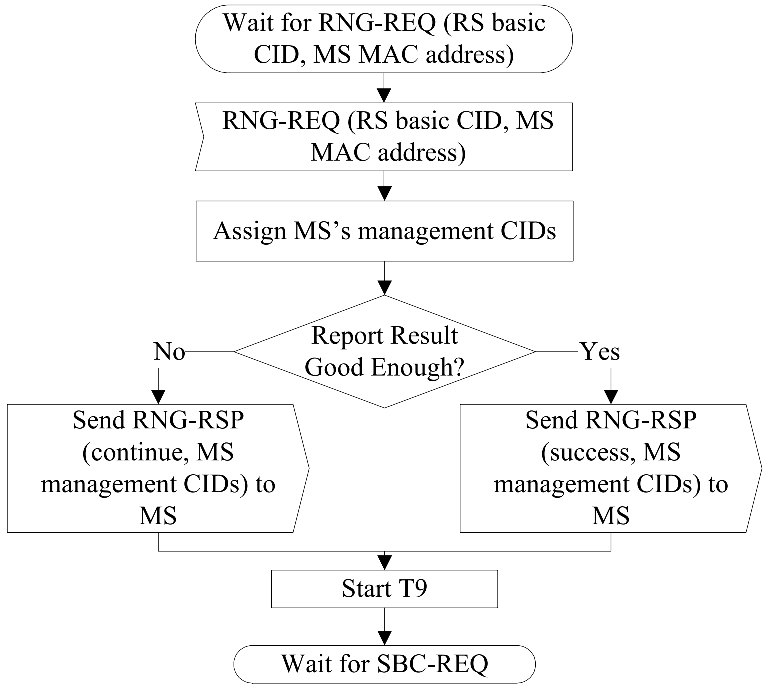


Figure 95d—MS Initial Ranging with Transparent RS-- MR-BS

Insert new subclause 6.3.9.16.2:

6.3.9.16.2 MS network entry procedures in non-transparent RS systems

Insert new subclause 6.3.9.16.2.1:

6.3.9.16.2.1 Non-transparent RS with Centralized scheduling

In MS network entry procedures in non-transparent RS systems, MS scans for downlink channel and establish synchronization with the non-transparent RS, then obtains transmit parameters from UCD message as described in 6.3.9.1 through 6.3.9.4.

The initial ranging process shall begin by sending an initial-ranging CDMA codes on the UL allocation dedicated for that purpose (for more details see 6.3.10.3).

When an RS receives a CDMA code that results in continue status, the RS shall locally send a RNG_RSP message to the MS on the access link. In order to send the RNG_RSP to the MS, it sends an RS BR header to the MR-BS. Upon receipt of the RS BR header at the MR-BS, the MR-BS will allocate resources for the transmission of the RNG_RSP message and indicate to the RS the resource allocated with RS_RNG_RSP_ALLOC-IE in the DL-MAP. This procedure shall also be used for the case of periodic ranging and handover ranging. Furthermore, the above procedure shall also be used for the case of periodic ranging where the RS receives the CDMA code resulting in success status.

When the RS receives multiple codes in a frame resulting in continue status, the RS sends a RS BR header which requests bandwidth to send RNG-RSPs messages for the received codes.

Once a RS receives the CDMA code resulting in success status , it transmits a RNG-REQ with the RS basic CID to the MR-BS, containing ranging status and ranging code attributes. In addition, the value of MS ranging indicator of the RNG-REQ is set to 1. The RNG-REQ may also contain adjustment information, such as frequency, timing and power if necessary. When the RS successfully receives multiple codes in a frame, the RS sends a RNG-REQ message which contains information of multiple received codes.

When the MR-BS receives the RNG-REQ with success status, it sends a RS UL-MAP to the RS including a CDMA_Allocation-IE as well as a RNG-RSP containing success status with the value of MS ranging indicator equal to 1.

After receiving the RNG-RSP, which the value of MS ranging indicator is equal to 1, the RS sets the value of MS ranging indicator to zero and then relays the message with the initial ranging CID.

When the MS receives success status in the RNG-RSP, it sends a RNG-REQ message using uplink bandwidth allocated by CDMA_Allocation-IE.

Receiving the RNG-REQ with the initial ranging CID, the RS relays it to the MR-BS with the RS basic CID.

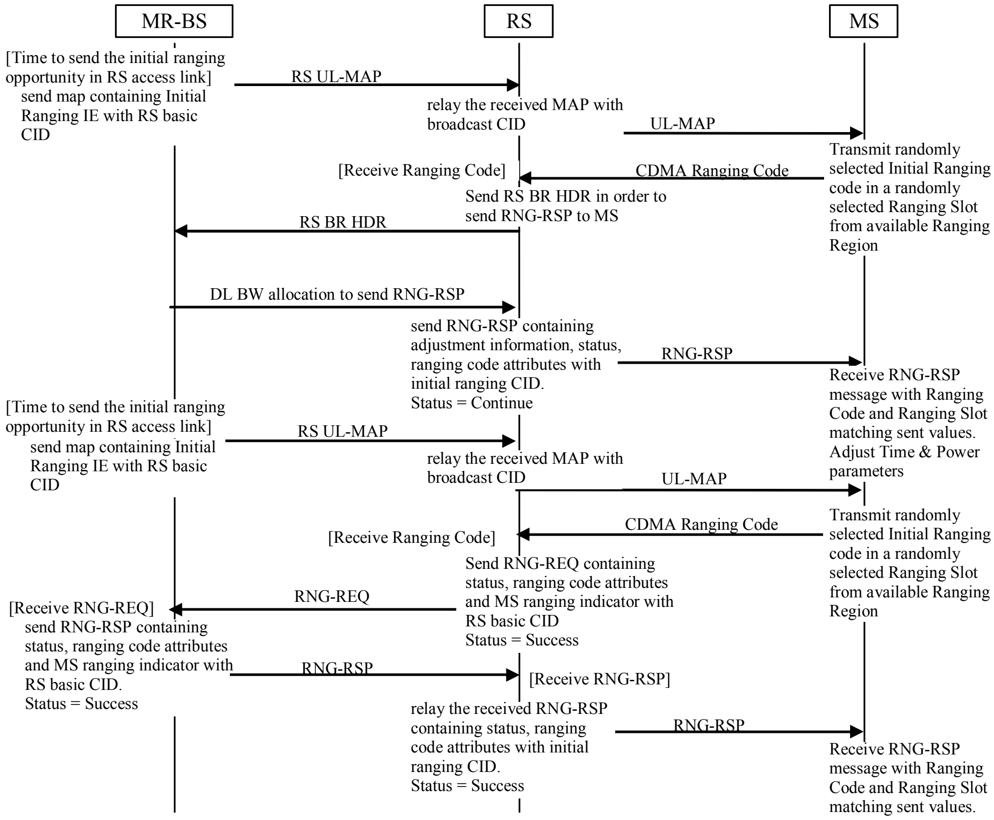
Once the MR-BS receives the RNG-REQ containing MS MAC Address with the RS basic CID, the MR-BS shall assign Basic and Primary management CIDs to the MS, and transmit a RNG-RSP containing those management CIDs and MS MAC Address with the RS basic CID.

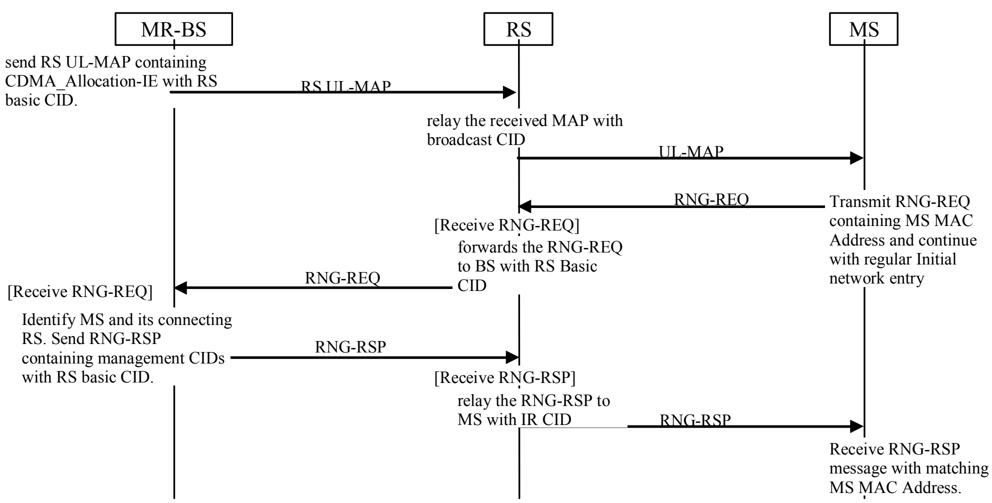
The RS receiving the RNG-RSP containing the management CIDs and MS MAC Address relays it to the MS with the initial ranging CID.

After assigning the basic and primary management CID to a MS, the MS and MR-BS continue network entry process as described in the 6.3.9.7 through 6.3.9.13 using MS's management CIDs. The RS shall relay management messages between them.

The message sequences chart (Table xxx-1) on the following pages defines the ranging and adjustment process that shall be followed by compliant RSs and MR-BSs. For CDMA ranging process between RS and MS, these details can be found in 6.3.10.3.

Table 199b—Ranging and automatic adjustments procedure in MR mode





Insert new subclause 6.3.9.16.2.2:

6.3.9.16.2.2 Non-transparent RS with Distributed scheduling

In MS network entry procedures to non-transparent RS systems, MS scans for downlink channel and establish synchronization with the non-transparent RS, then obtains transmit parameters from UCD message as described in 6.3.9.1 through 6.3.9.4.

The initial ranging process shall begin by sending an initial-ranging CDMA codes on the UL allocation dedicated for that purpose (for more details see 6.3.10.3). RS and MS continue CDMA code transmission and reception as defined in 6.3.10.3 until RS receives the CDMA code successfully unless the MS receives abort status in RNG-RSP or the retry count exceeds the maximum number.

When the RS receives the CDMA code resulting in success status, it sends a RNG-RSP containing success status to the MS. And the RS also provides bandwidth allocation to the MS with CDMA_Allocation-IE in UL-MAP, so that the MS can send a RNG-REQ containing MS MAC Address with initial ranging CID.

Receiving the RNG-REQ containing the MS MAC Address, the RS may decide which TLV is managed by itself in the RNG-RSP.If there is any field to be managed by the RS such as Downlink Operational Burst Profile, the RS omit the TLV from the RNG-REQ and recompose the RNG-REQ message. The RS transmit the RNG-REQ message with the RS basic CID instead of IR CID in the header to MR-BS.

Once the MR-BS receives the RNG-REQ containing MS MAC Address with the RS basic CID, the MR-BS shall assign Basic and Primary management CIDs to the MS, and transmit a RNG-RSP containing those management CIDs and MS MAC Address with the RS basic CID.

The RS receiving the RNG-RSP containing the management CIDs and MS MAC Address may add the TLV field which is managed by RS and shall transmit it to the MS with the initial ranging CID.

After assigning the basic and primary management CID to a MS, the MS and MR-BS continue network entry process as described in the 6.3.9.7 through 6.3.9.13 using MS's management CIDs. The RS shall relay management messages between them.

Optionally, the RS may send a RNG-REQ message containing New MS Indication ID TLV with the RS's basic CID to the MR-BS upon receiving the CDMA code successfully before it sends a RNG-RSP to the MS. In this case, when receiving the RNG-REQ containing New MS Indication ID TLV, the MR-BS confirms whether it can accept a new MS entry request. If it can accept the request, it sends a RNG-RSP containing success status to the RS, otherwise a RNG-RSP with abort status. When the RS receives the RNG-RSP with ranging status from the MR-BS, it sends a RNG-RSP containing the same ranging status as in the received RNG-RSP and the ranging code attributes with initial ranging CID. If the ranging status in the RNG-RSP is success, the RS provides bandwidth allocation with CDMA_Allocation-IE in UL-MAP, so that the MS can send a RNG-REQ containing MS MAC Address with initial ranging CID.

When the RS relays the received RNG-REQ to the MR-BS, it shall add the New MS Indication ID same as the one used in the previous RNG-REQ transmitted upon successful reception of CDMA ranging code, so that the MR-BS can recognize the two RNG-REQ messages containing the same New MS Indication ID are used for the same MS network entry process.

The message sequences charts (Table 199c and Table 199d) on the following page defines the ranging and adjustment process that shall be followed by compliant RSs and MR-BSs. For CDMA ranging process between RS and MS, these details can be found in 6.3.10.3.

Table 199c—Ranging and automatic adjustments procedure in MR mode

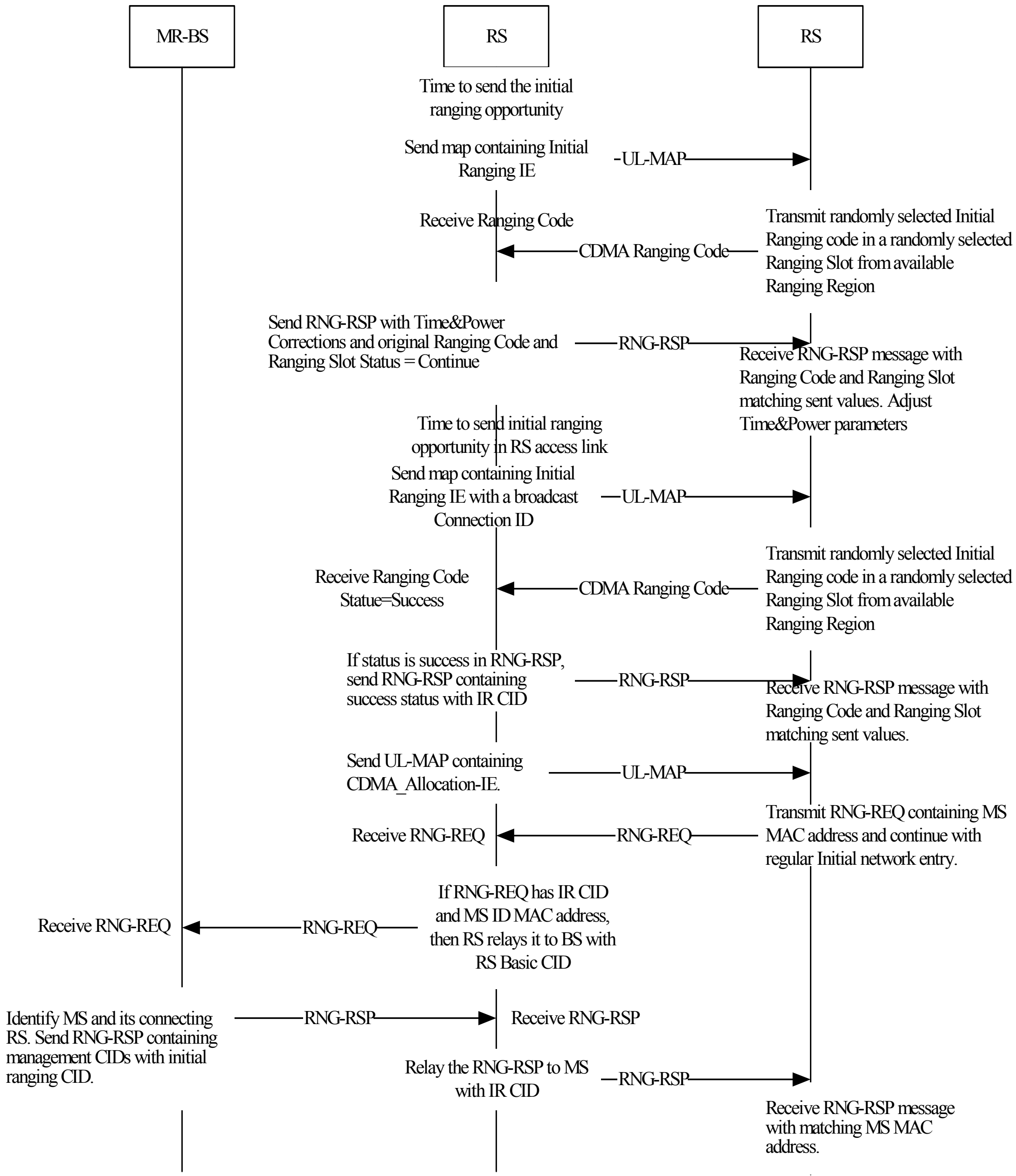
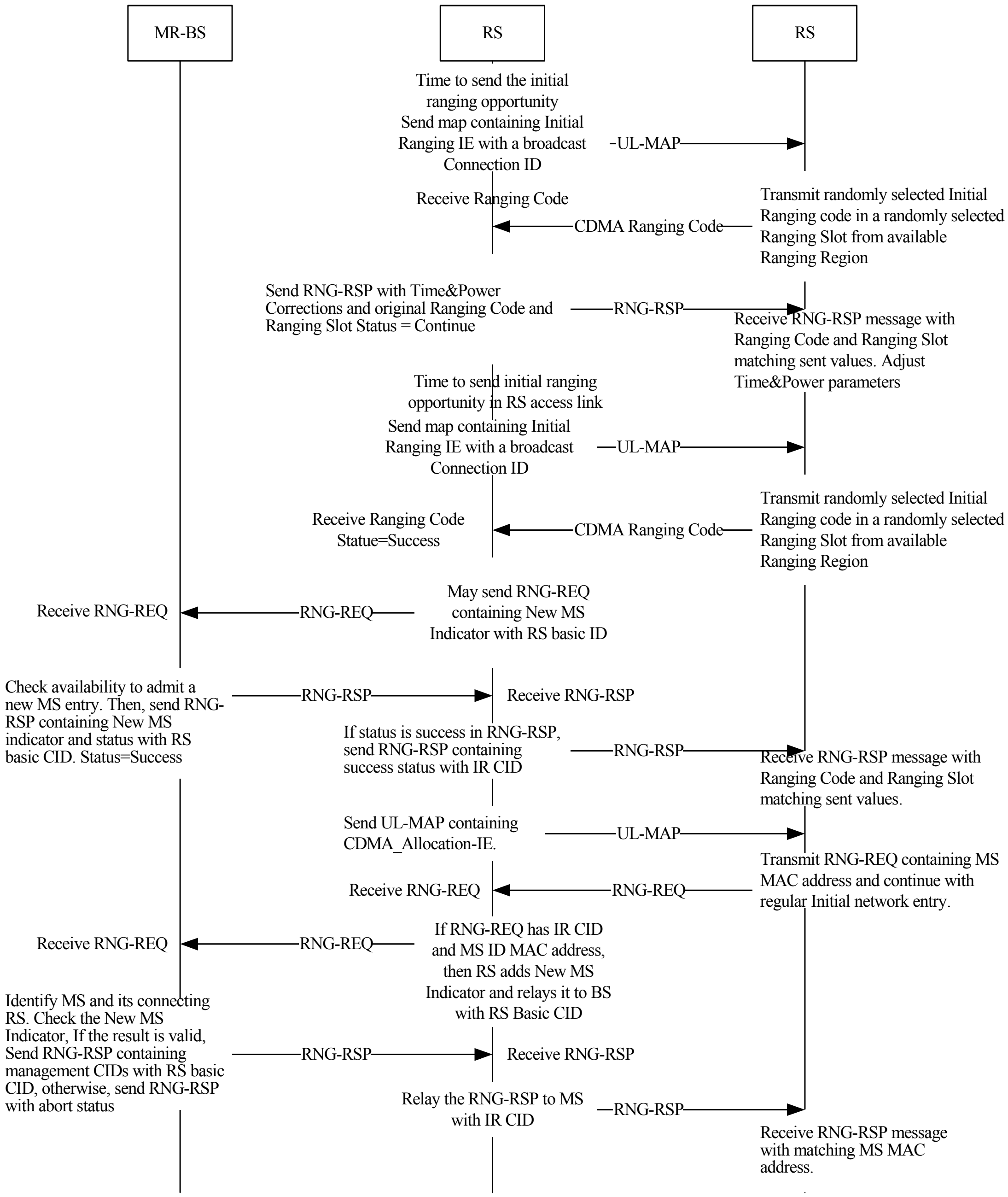


Table 199d—Ranging and automatic adjustments procedure with optional availability

check at MR-BS in MR mode



Insert a new subclause in 6.3.9.16.2.3:

6.3.9.16.2.3 Resource request for ranging

In order to minimize latency during the ranging procedure with centralized scheduling, two CDMA ranging codes may be assigned to an RS for requesting resources for ranging during RS's network entry. One CDMA ranging code is for ranging with "continue" status. Second CDMA ranging code is for ranging with "success" status. When RS receives a CDMA ranging code for initial ranging, it shall perform the following step for resource allocation:

When the RS determines that it needs to send RNG-RSP with continue status, it sends the RS Ranging Code assigned for requesting bandwidth on the access link to transfer RNG-RSP towards MS.

Insert new subclause 6.3.9.16.3:

6.3.9.16.3 RS network entry and initialization

When an RS enters the network, the RS may negotiate the difference between frame numbers used by the MR-BS and the RS by transmitting REG-REQ including RS frame offset TLV. The MR-BS shall respond to the RS by including RS frame offset TLV in REG-RSP when RS shall use a different frame number offset from the number which the MR-BS transmits. If RS frame offset TLV is included in REG-RSP, the RS shall start with the frame number as indicated by RS frame offset TLV in REG-RSP. If RS frame offset TLV is not included in REG-RSP, RS shall start with the same frame number as the MR-BS transmits.

When an RS starts transmitting its frame, the RS shall keep the difference to the frame number used by MR-BS as indicated RS frame offset TLV in REG-RSP.

Insert new subclause 6.3.9.16.3.1:

6.3.9.16.3.1 RS grouping

RS grouping method includes the following characteristics:

- A group of RSs form a Virtual RS group as decided by the MR-BS based on criteria (e.g. potential interference that they cause to each other) which is implementation dependent. The virtual group may include the MR-BS.
- Each RS is assigned an individual unicast RSID and a multicast RSID as the RS group ID. The multicast RSID is the same for all members in the group. With these two separate IDs, the RS can be managed individually or as a group. These IDs are unique within the associated MR-BS.
- When the virtual RS group includes an MR-BS, all the RSs in the virtual group shall either transmit the same preamble, FCH and MAP as the MR-BS or they all do not transmit any preamble, FCH or MAP. When an MR-BS is not included in the virtual group, one of the RSs in the virtual group is a non-transparent RS and all the others shall either transmit the preamble, FCH and MAP of the said non-transparent RS or they all do not transmit preamble, FCH and MAP. The radio resources may be shared by these RSs for data burst transmission. The existence of the group is totally transparent to its MS(s).
- Removal of an RS from the group: During normal operation of the RS group, each RS continues to monitor the radio environment (e.g. the interference). One example is that for an RS that is located at the edge of the group coverage area, it could detect strong segment interference from other nearby RS(s) or RS groups. When this happens, it can request to be removed from the RS group and operate on its own using a different segment.
- Addition of an RS to an existing group or forming a new group: An RS, at network entry, can a) operate on its own, i.e., it selects or is assigned a dedicated preamble index (implying the segment), b) form a new group or c) join an existing group. The RS can perform measurements such as radio signals from the neighbors and then report to MR-BS regarding the preferred preamble index (implying the segment). The MR-BS replies by either confirming the preamble sequence index selected by the RS or assigning a different one, indicating whether it should transmit the preamble, and at the same time, providing the corresponding RS group ID.
- Data forwarding within RS group: For DL, the members of an RS group may be configured to forward traffic data for only specific subordinate terminal nodes. This may be done on a per-terminal or per-transport connection basis. In this way, by specifying scheduling times, two RSs belonging to the same RS group may transmit to two different MSs/SSs at the same time. In addition, transmissions may be scheduled such that multiple RSs in the RS group may transmit to the same MS to exploit macro-diver-

sity. This scheduling may be achieved under a centralized scheduling scheme by keeping an MS list or CID list associated with each RS. Each RS would look for the data bound to its subordinated stations or data coming from the subordinate stations in the uplink and forward in the assigned times indicated in the MAP. The list may be updated by the RS_Member_List_Update message defined in 6.3.2.3.89.

- For the UL, diversity combining of the information received by the members of RS group can be performed, or the UL signaling can be designed such that several member RSs may receive data from multiple MS at the same time. This scheduling may be achieved under a centralized scheduling scheme by keeping an MS list or CID list associated with each RS and forwarding those messages in a specified resource unit (time and frequency). When the MS is same and the resources are the same, it is equivalent to macro-diversity. When the resources are same but the MSs are different, it is equivalent to parallel transmission occurring at different locations.
- Each time a handover occurs or a new terminal joins an RS group, the RSs CID/Terminal list is updated to keep track of the connections/terminals which are associated with a particular member RS.

Insert new subclause 6.3.9.16.3.1.1:

6.3.9.16.3.1.1 MS network entry procedures

Each RS group member shall monitor the CDMA ranging codes from subordinate nodes. If the group parent is not a member of the RS group, then RS group members shall follow the procedures in 6.3.9.16.1. If the group parent is a member of the RS group, then the RS group members other than the parent shall follow the procedure in 6.3.9.16.1, and the parent (if not MR-BS) shall follow the procedures in 6.3.9.16.2.

Insert new subclause 6.3.9.16.3.1.2:

6.3.9.16.3.1.2 RS network entry procedures

If the RS is in MS mode of operation, it shall start network entry with the MS network entry procedures in 6.3.9.16.3.1.1. During network entry or during normal operation, the MR-BS may configure the RS using RS_Configuration_REQ/RSP messages.

Insert new subclause 6.3.9.16.3.2:

6.3.9.16.3.2 Moving RS preamble selection

During the initial network entry, a moving RS shall obtain parameter “preamble indexes reserved for moving RSs’ from MR-BS broadcast RS_CD message. The moving relay station shall measure the strength of preambles reserved for moving RS and report to MR-BS through RS_NBR-MEAS-REP (see 6.3.2.3.68) message the preamble index with the least signal strength. MR-BS shall assign the preamble index based on the report from the moving RS and any additional available information.

Insert new subclause 6.3.9.16.3.3:

6.3.9.16.3.3 Neighbor station measurement report

During network entry or re-entry, an RS may be required, as indicated in the RS network entry optimization TLV in the RNG-RSP message, to report the signal strength and preamble index of neighbor stations. If required, the RS shall send the RS_NBR-MEAS-REP message (6.3.2.3.68) to the MR-BS to report the neighbor station measurements after completion of registration.

Insert new subclause 6.3.9.16.3.4:

6.3.9.16.3.4 Relay station operational parameter configuration

In MR networks, a RS operational parameter configuration procedure may required after RS registration procedure. This procedure allows a RS to obtain necessary operational configuration parameters that must be configured over-the-air. One example of such parameters is the frame start preamble index configuration since the configuration of such parameters usually requires radio environmentmeasurement of a RS. During this procedure, RS and MR-BS shall use RS configuration request /response message (6.3.2.3.66 and 6.3.2.3.67) to negotiate the configuration. A MR-BS shall determine the parameter configurations and indicate to the RS using RS configuration request message. After configuration, the RS responds MR-BS configuration response message to the MR-BS. Before this relay station operational parameter configuration procedure, MR-BS may need to authenticate the entering RS by admission control.

The parameters configured during this procedure include:

- Frame start preamble index for a relay station which is configured to transmit a frame start preamble

Insert new subclause 6.3.9.16.3.5:

6.3.9.16.3.5 Initial path selection procedure

An initial path selection procedure may be performed either before “RS operation parameter configuration” procedure or before “obtain uplink parameters” procedure in Fig. XXX.

The path selection procedure performed prior to “RS operation parameter configuration” is an optional procedure as indicated by the RS network entry optimization TLV in the RNG-RSP message. This operation happens after neighbor station measurement report and before RS operation parameter configuration. During this operation, the MR-BS shall determine the path (i.e. access station) of this RS based on the reported neighbour station measurements and other information such as path loading. The MR-BS shall send the RS_Path-REQ message to the RS to indicate the preamble index of the selected access station and RS network re-entry optimization parameters to assist the RS network (re)-entry process. The RS shall respond with the RS_Path-RSP message. If the access station indicated in the RS_Path-REQ message is not the access station the RS currently attaches to, the RS shall perform network re-entry as described in 6.3.9.

If the path selection is processed prior to “obtain uplink parameters”, the MR-BS and the RS may transmit the TLV encoded parameter ETE Metric in the DCD message to support initial RS path selection in the MR network.

The use of these TLV encodings is defined in section 11.4 in Table 385. The RS attempting network entry may obtain the DCD TLV encodings sent by neighbouring RSs and MR-BS to select a desired access station to enter the MR network through it. The RS shall then proceed with the rest of the network entry procedure as defined in Figure XXX with the desired access station.

Insert new subclause 6.3.9.16.4:

6.3.9.16.4 Optional network entry procedure with localized RS

Insert new subclause 6.3.9.16.4.1:

6.3.9.16.4.1 CID pre-allocation to localized RS

The MR-BS may allocate a part of management CID range systematically or non-systematically to its subordinate RS by using CID_Alloc-IND messages. Systematic range assignment means each superordinate RS has a range as the superset of the union of CIDs of all its subordinate RSs. Systematical CID allocation could embed network topology into CIDs to help RSs to find routing paths without storing all CIDs of subordinate RSs in the routing table.

Insert new subclause 6.3.9.16.4.2:

6.3.9.16.4.2 MS network entry procedure for localized non-transparent RS

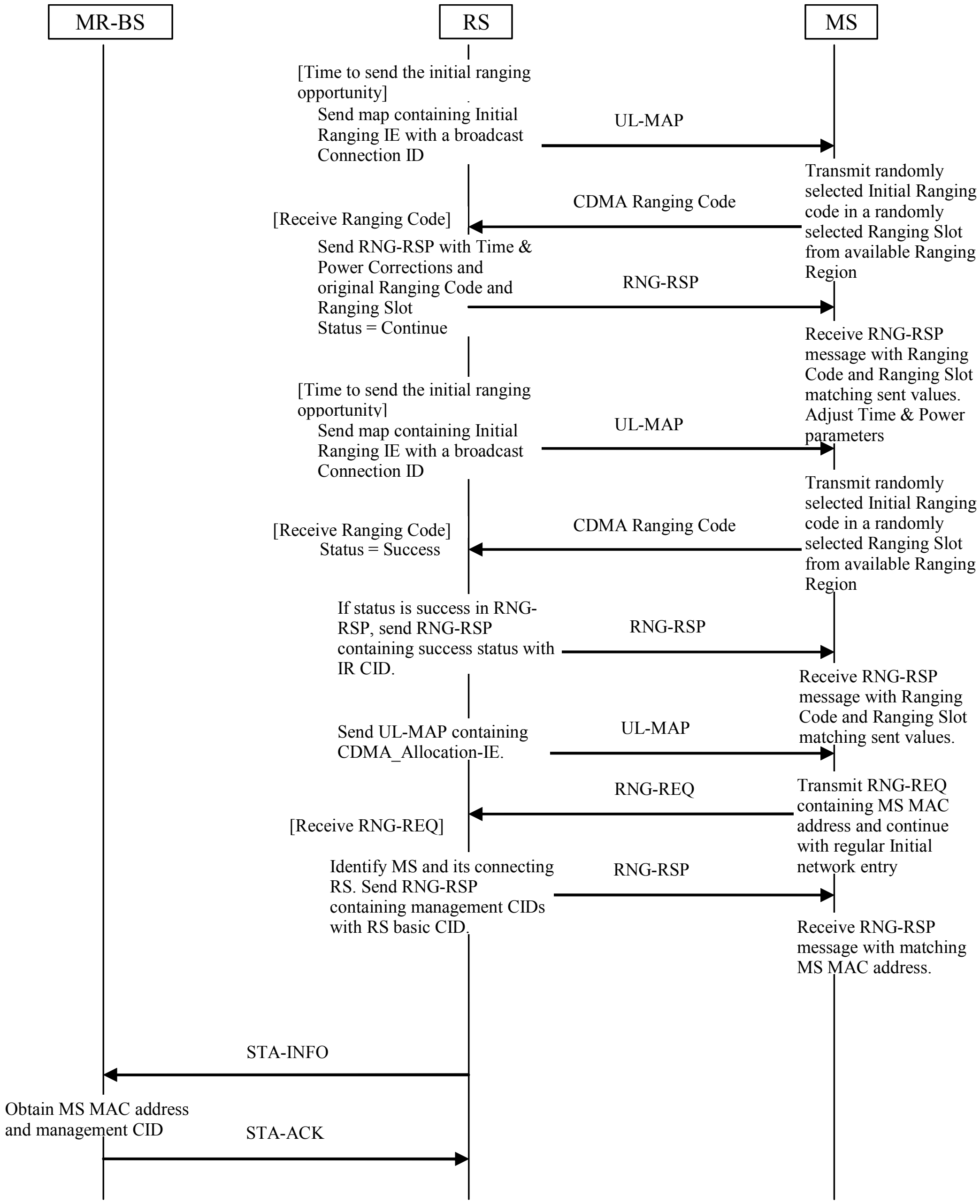
This MS network entry process is almost same as described in 6.3.9.16.2.1, except that RS is assigned range of management CIDs by its super-ordinate node in advance. This section states that the RS assigns the management CIDs to its subordinate nodes (MS or RS) during initial ranging process. RS may pre-allocate CID range to subordinate RS using CID_Alloc-IND messages on behalf of the MR-BS.

When the time and power correction is finished between RS and MS, and the RS receives the RNG-REQ containing MS MAC address, the RS may reply the RNG-RSP containing the management CID that is assigned by the RS. In addition, the RS may inform the BS that a new station (MS or RS) is ready to enter to the network using STA-INFO/ACK message.

After assigning the basic and primary management CID to an MS, the MS and MR-BS continue network entry process as described in the 6.3.9.7 through 6.3.9.13 using MS's management CIDs. The RS shall relay management messages between them.

Table 199e—Ranging and automatic adjustments procedure with optional availability check

at RS in MR mode



Insert new subclause 6.3.9.17:

6.3.9.17 Interference report of neighboring stations to MR-BS

After registration with an MR-BS, the RS sends RS_NBR-MEAS-REP messages (see 6.3.2.3.68), containing the signal strength measurement from other stations, to the MR-BS.

6.3.10 Ranging

6.3.10.3 OFDMA based ranging

6.3.10.3.1 Contention-based initial ranging and automatic adjustments

Insert the following text at the end of 6.3.10.3.1:

The RS initial ranging procedure shall follow the same procedure of the MS. Upon receiving UCD message containing RS_Initial_Ranging_Code TLV, the RS should use “RS Initial Ranging” code instead of the “Initial Ranging” code.

After receiving RS Initial Ranging code, MR-BS may send a RNG-RSP containing status = 2 (abort) with preamble indexes of candidate neighbor access stations. Upon receiving RNG-RSP containing status abort with preamble indexes, RS shall scan for DL channel of candidate neighbor access stations and perform initial ranging.

Insert new subclause 6.3.10.3.4:

6.3.10.3.4 Relaying support for OFDMA based ranging

Insert new subclause 6.3.10.3.4.1:

6.3.10.3.4.1 MS periodic ranging and automatic adjustments in transparent RS systems

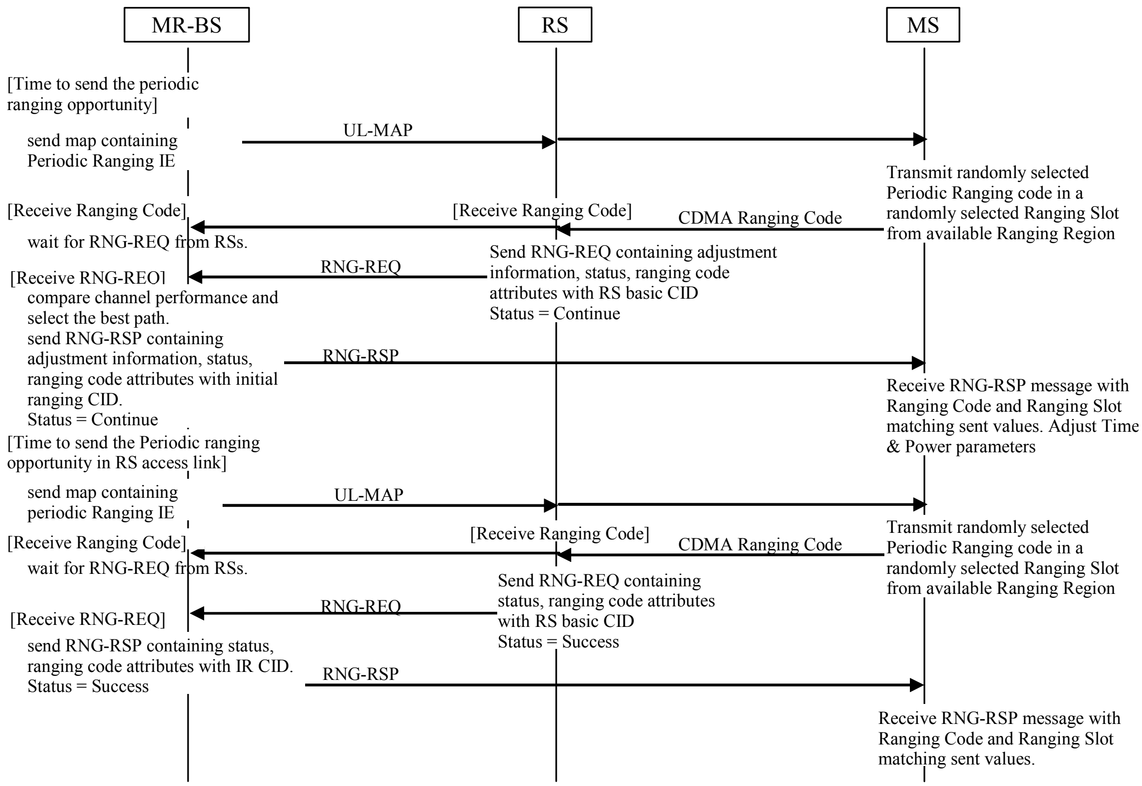
The periodic ranging process shall begin by sending a periodic-ranging CDMA codes on the UL allocation dedicated for that purpose.

The code may be received by the MR-BS and RSs near the MS. RSs receiving the code shall transmit a RNG-REQ message with the RS basic CID to the serving MR-BS through the relay path. When RS receives multiple codes in the ranging subchannel of a frame, the RNG-REQ message sent by the RS to serving MR-BS may contain information of multiple received codes.

When the MR-BS receives ranging code, it shall wait for RNG-REQ message containing the same ranging code attribute from its subordinate RSs for T48 timer. Once T48 timer expired, the MR-BS could compare the measured signal information at each access station to decide adjustment information for RNG-RSP. Algorithms to decide adjustment information are out of scope of this specification. Afterward, the MR-BS shall transmit an RNG-RSP to the MS directly.

The message sequence charts (Table 364 and Table xxx) and flow charts (Figure xxx and Figure yyy) define the ranging and adjustment process that shall be followed by compliant RSs and MR-BSs.

Table 201a—Ranging and automatic adjustment procedure in transparent RS system



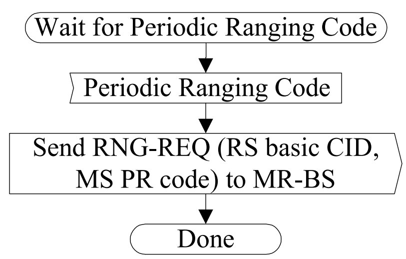


Figure 108a—MS CDMA-based periodic ranging in transparent RS systems - Access Transparent RS

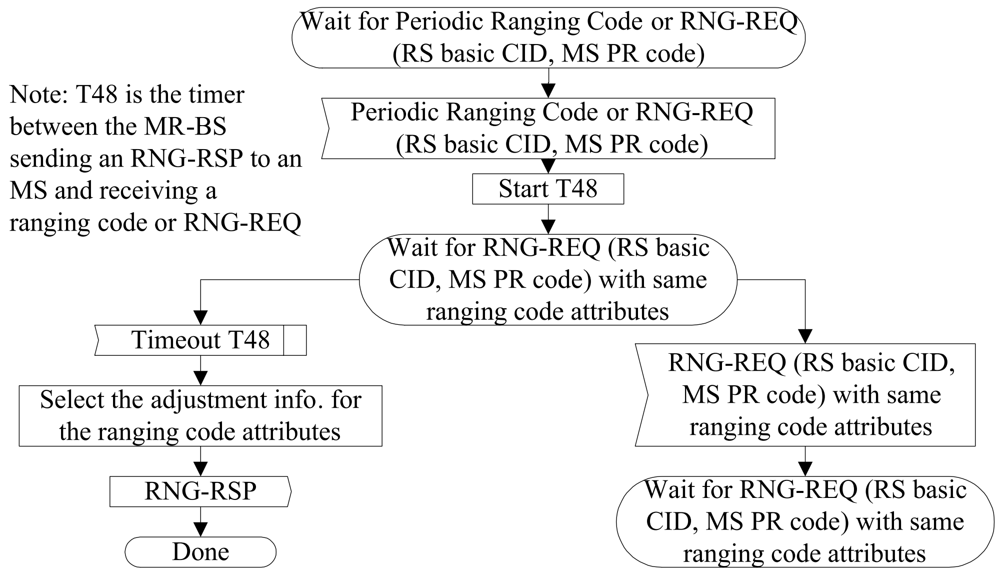


Figure 108b—MS CDMA-based periodic ranging in transparent RS systems- MR-BS

Insert new subclause 6.3.10.3.4.2:

6.3.10.3.4.2 MS periodic ranging and automatic adjustments in non-transparent RS systems

The periodic ranging process shall begin by sending a periodic-ranging CDMA ranging code on the UL allocation dedicated for that purpose.

Insert new subclause 6.3.10.3.4.2.1:

6.3.10.3.4.2.1 Non-transparent RS with Centralized Scheduling

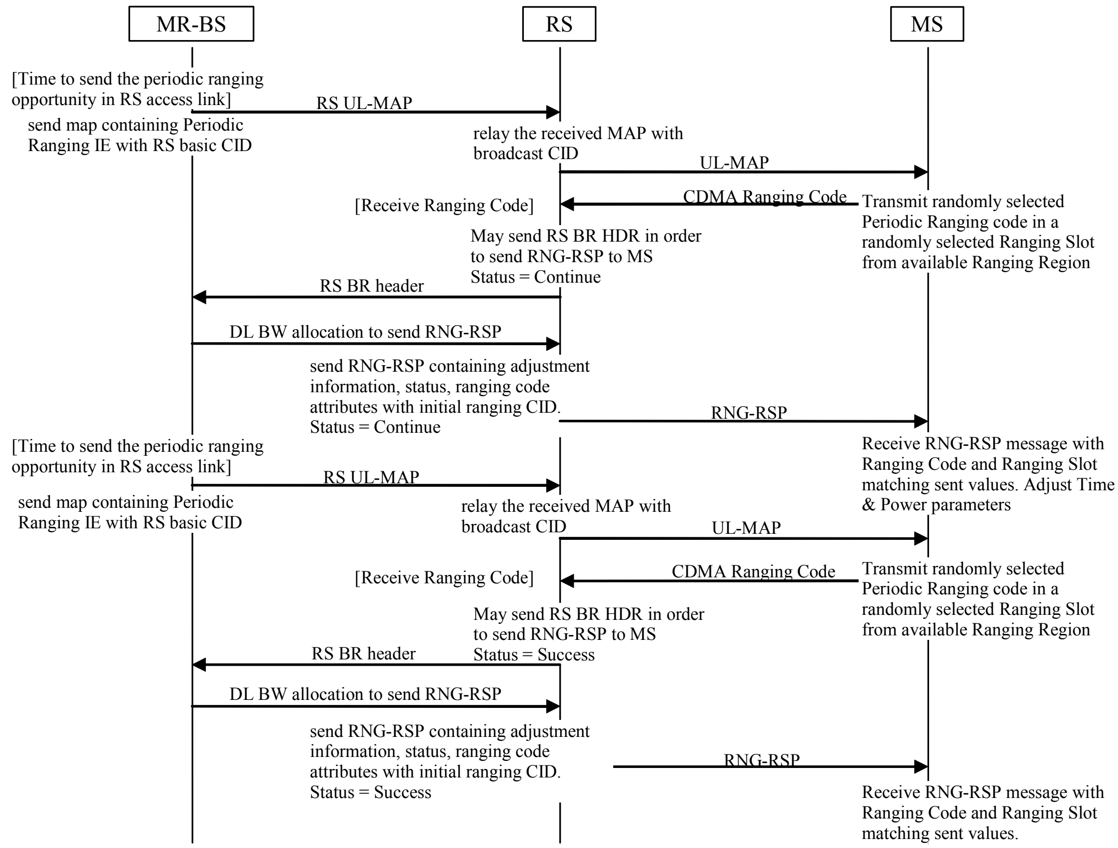
When RS receives the CDMA code, RS shall locally send RNG-RSP to MS on the access link. In order to send RNG-RSP to MS on the access link, it sends a RS BR header to the MR-BS. Upon receipt of RS BR header at MR-BS, MR-BS will allocate resources for RNG-RSP and indicate to RS with RS_DL_MAP-IE in DL-MAP.

When the RS receives multiple codes in a frame resulting in continue status, the RS sends a RS BR header which requests bandwidth to send RNG-RSPs for the received codes.

The message sequence charts (Table 364 and Table xxx) and flow charts (Figure xxx and Figure yyy) define the periodic ranging and adjustment process that shall be followed by compliant RSs and MR-BSs.

Table 201b—Ranging and automatic adjustment procedure in non-transparent RS sys-

tems(centralized)



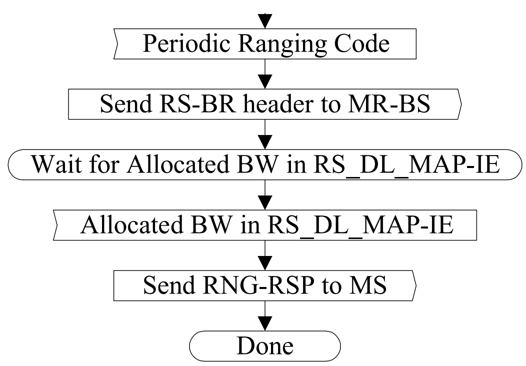


Figure 108c—MS CDMA-based periodic ranging in non-transparent RS systems - Access Non-transparent RS

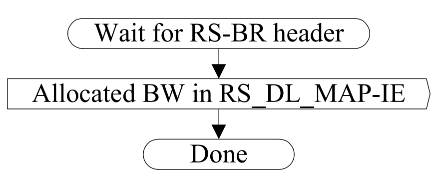


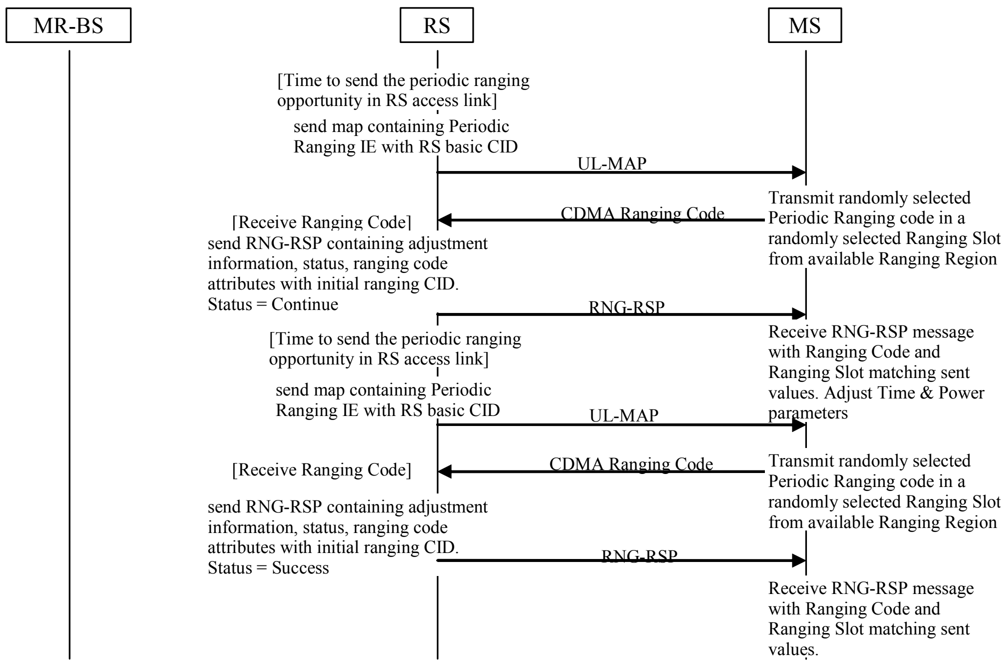
Figure 108d—MS CDMA-based periodic ranging in non-transparent RS systems - MR-BS

Insert new subclause 6.3.10.3.4.2.2:

6.3.10.3.4.2.2 Non-transparent RS with Distributed Scheduling

When RS receives the CDMA ranging code, RS shall locally send RNG-RSP to MS on the access link. The message sequence charts (Table 364 and Table yyy) and flow charts (Figure zzz) define the periodic ranging and adjustment process that shall be followed by compliant RSs and MR-BSs.

Table 201c—Ranging and automatic adjustment procedure in non-transparent RS systems under distributed scheduling



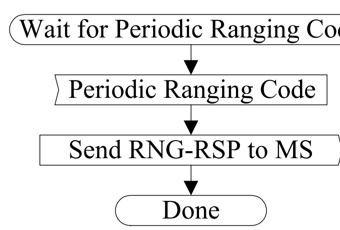


Figure 109e—MS CDMA-based periodic ranging in non-transparent RS systems - Access Non-transparent RS

Insert new subclause 6.3.10.3.4.3:

6.3.10.3.4.3 Unsolicited RNG-RSP in transparent RS systems

When the offsets of frequency, power, and timing for any other data transmission from the MS are beyond the tolerance defined in this specification, RSs shall transmit a RNG-REQ message with the RS basic CID containing the MS basic CID to the serving MR-BS through the relay path.

Upon receiving the RNG-REQ message from a subordinate RS, the MR-BS may send an unsolicited RNG-RSP message with this MS basic CID to the MS.

After RS receives a bandwidth request CDMA ranging code, it should transmit an RNG-REQ message with the RS basic CID containing the CDMA BR ranging code to the serving MR-BS through the relay path with adjustment information of frequency, power, and timing corrections. When RS receives multiple codes in the ranging subchannel of a frame, the RNG-REQ message sent by the RS to serving MR-BS may contain information of multiple received codes.

When the MR-BS receives a bandwidth request CDMA ranging code, it shall wait for RNG-REQ with the same ranging code from its subordinate RSs for T48 timer. Once T48 timer expired, the MR-BS compares measured signal information at each station to decide the most appropriate path to communicate with the code originating MS, according to channel measurement information. When it needs to do adjustment for the code, the MR-BS shall broadcast an unsolicited RNG-RSP with associated code attribute.

The message sequence charts (Table xxx and Table yyy) and flow charts (Figure xxx and Figure yyy) define the unsolicited RNG-RSP process that shall be followed by compliant RSs and MR-BSs.

Table 201d—Unsolicited RNG-RSP triggered by upstream traffic in ~~non-~~transparent RS system

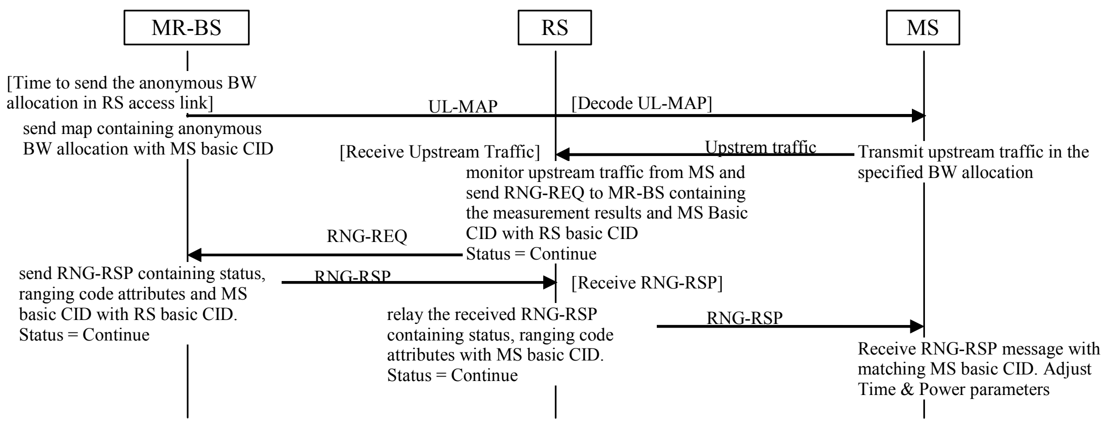
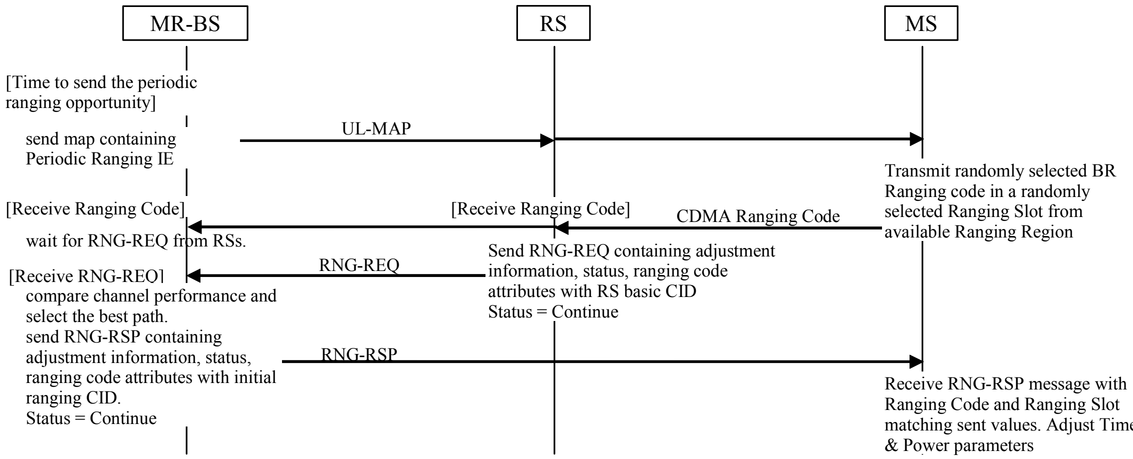


Table 201e—Unsolicited RNG-RSP procedure triggered by CDMA BR ranging code in trans-

parent RS system



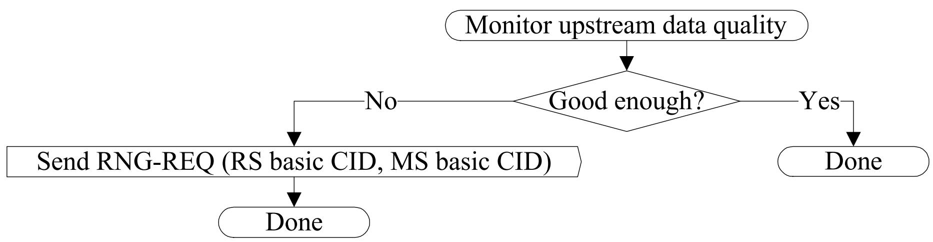


Figure 108f—Unsolicited RNG-RSP in transparent RS system- Transparent Access RS

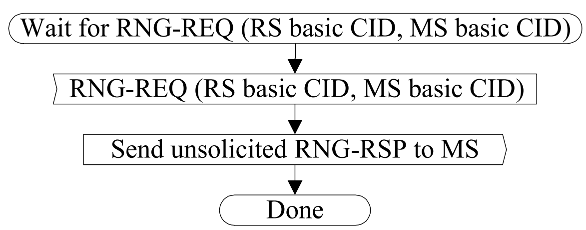


Figure 108g—Unsolicited RNG-RSP in Transparent RS system-MR-BS

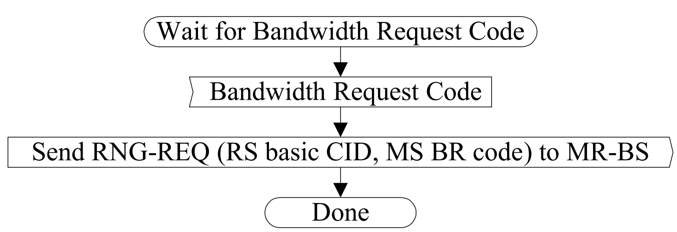


Figure 108h—Unsolicited RNG-RSP triggered by CDMA BR ranging code in Transparent RS system - Transparent Access RS

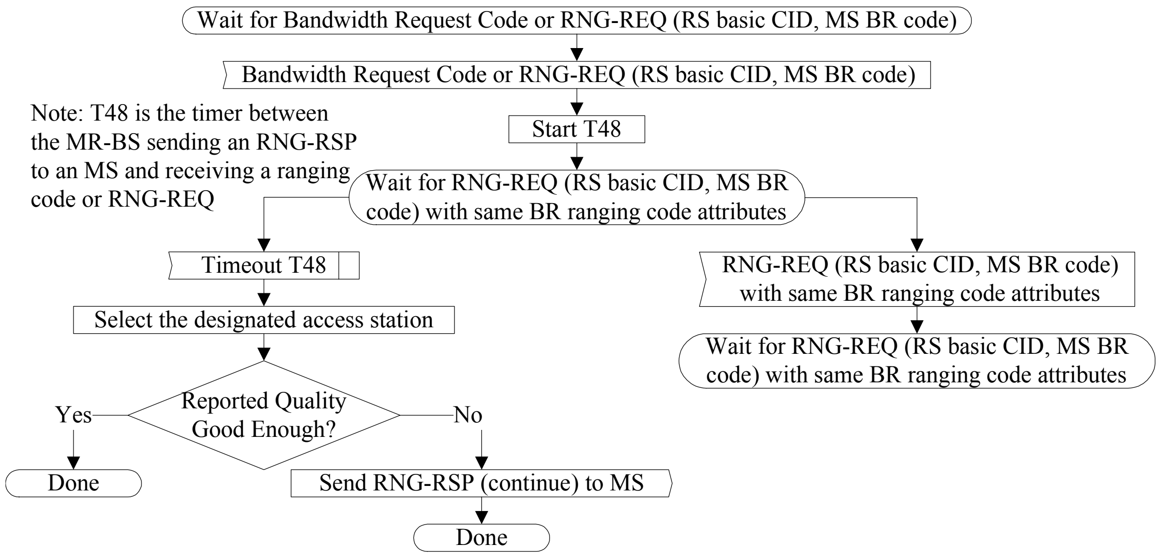


Figure 108i—Unsolicited RNG-RSP triggered by CDMA BR ranging code in Transparent RS system - MR-BS

Insert new subclause 6.3.10.3.4.4:

6.3.10.3.4.4 Unsolicited RNG-RSP in non-transparent RS systems

Insert new subclause 6.3.10.3.4.4.1:

6.3.10.3.4.4.1 Non-transparent RS with Centralized Scheduling

When the offsets of frequency, power, and timing for any data transmission from the MS are beyond the tolerance defined in this specification, RS may transmit an unsolicited RNG-RSP with continue status to MS on access link. In order to send RNG-RSP to MS on the access link, RS sends a RS BR header to MR-BS.

The message sequence charts (Table 364, Table uuu) and flow charts (Figure uuu and Figure vvv) define the unsolicited RNG-RSP process that shall be followed by compliant RSs and MR-BSs.

The RS should send an unsolicited RNG-RSP as a response to a CDMA-based bandwidth-request from MS, which results in continue status.

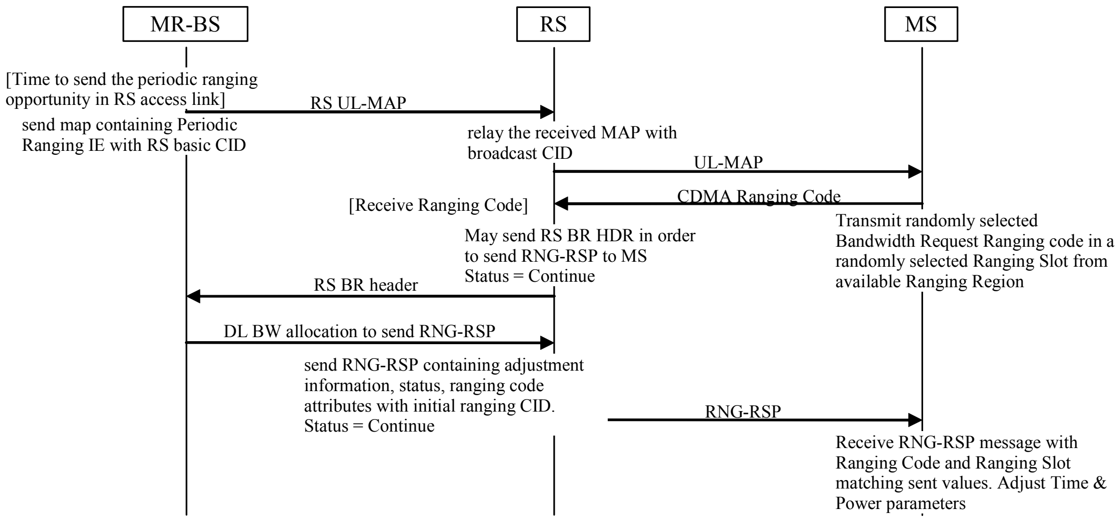
When RS receives the BR CDMA code resulting in continue status, RS shall locally send RNG-RSP to MS on the access link. In order to send RNG-RSP to MS on the access link, it sends a RS BR header to the MR-BS.

Upon receipt of RS BR header at MR-BS, MR-BS will allocate resources for RNG-RSP and indicate to RS with RS_DL_MAP-IE in DL-MAP.

When the RS receives multiple codes in a frame resulting in continue status, the RS sends a RS BR header which requests bandwidth to send RNG-RSPs for the received codes.

The message sequence charts (Table 364, Table xxx) and flow charts (Figure xxx and Figure yyy) define the unsolicited RNG-RSP process that shall be followed by compliant RSs and MR-BSs.

Table 201f—Unsolicited RNG-RSP triggered by BR ranging code in non-transparent RS system



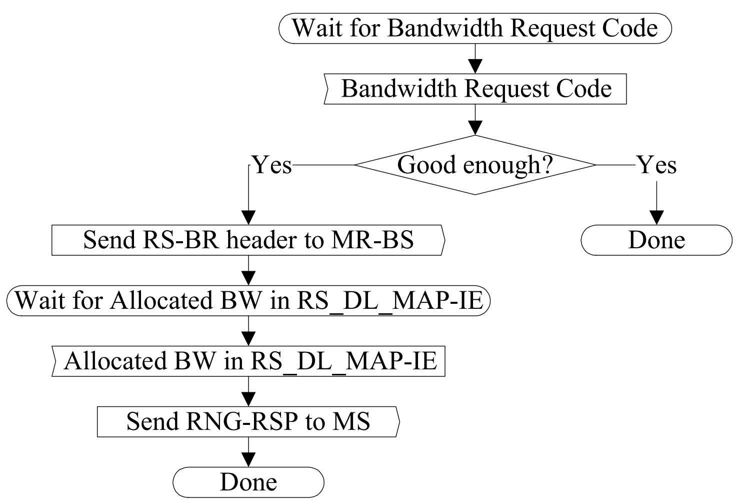


Figure 108j—Unsolicited RNG-RSP triggered by BR ranging code in non-transparent RS system - Access non-transparent RS

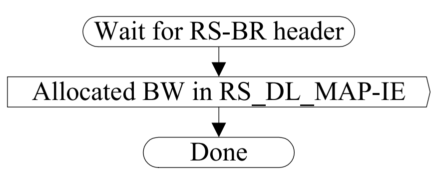


Figure 108k—Unsolicited RNG-RSP tirggered by BR ranging code in non-transparent RS system - MR-BS

Insert new subclause 6.3.10.3.4.4.2:

6.3.10.3.4.4.2 Non-transparent RS with Distributed Scheduling

When the offsets of frequency, power, and timing for any data transmission from the MS are beyond the tolerance defined in this specification, RS may send an unsolicited RNG-RSP message to the MS.

The message sequence charts (Table 364, Table vvv) and flow charts (Figure www) define the unsolicited RNG-RSP process that shall be followed by compliant RSs and MR-BSs. The RS should send an unsolicited RNG-RSP as a response to a CDMA-based bandwidth-request from MS, which results in continue status. When RS receives the BR CDMA ranging code resulting in continue status, RS shall locally send RNG-RSP to MS on the access link.

The message sequence charts (Table 364, Table yyy) and flow charts (Figure zzz) define the unsolicited RNG-RSP process that shall be followed by compliant RSs and MR-BSs.

Table 201g—Unsolicited RNG-RSP triggered by upstream traffic in non-transparent RS system under distributed scheduling

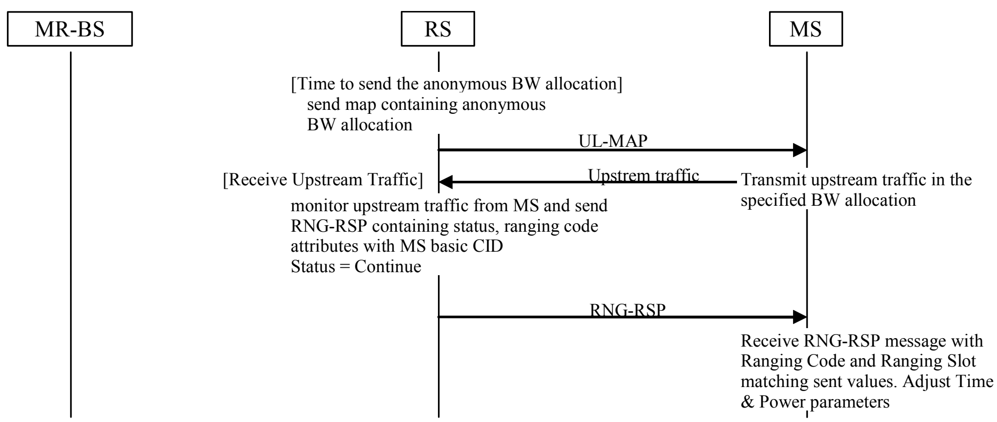
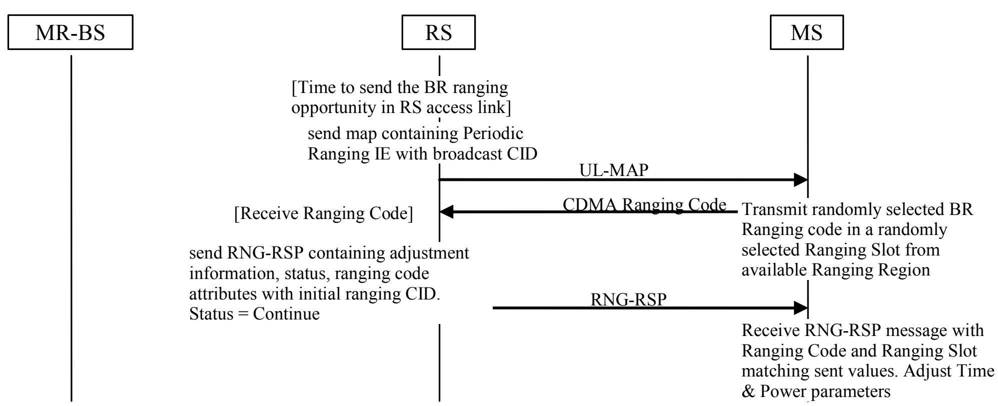


Table 201h—Unsolicited RNG-RSP triggered by BR ranging code in non-transparent RS system under distributed scheduling



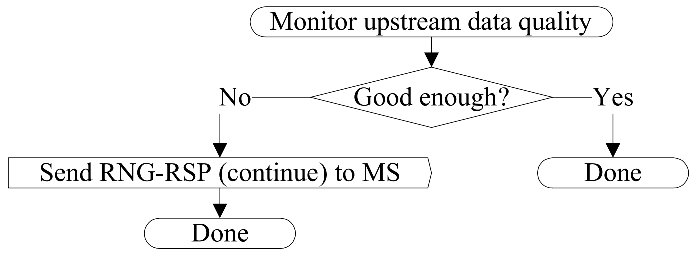


Figure 108l—Unsolicited RNG-RSP triggered by upstream traffic in non-transparent RS system - Access non-transparent RS

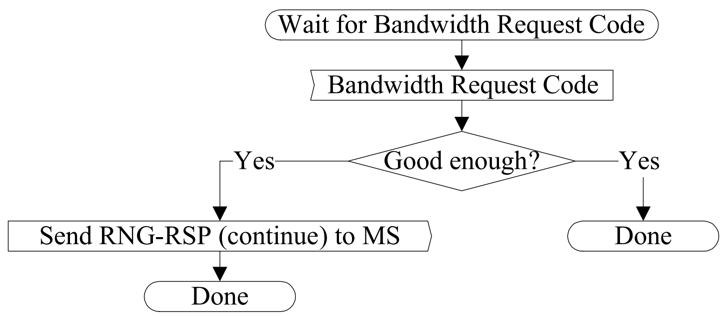


Figure 108m—Unsolicited RNG-RSP triggered by BR ranging code in non-transparent RS system - Access non-transparent RS

Insert new subclause 6.3.10.3.4.5:

6.3.10.3.4.5 MS CDMA handover ranging and automatic adjustment in RS system

An RS that supports MS handover ranging shall take a process similar to that defined in section 6.3.9.16.1 (MS network entry procedures in transparent RS systems) with the following modifications.

In CDMA handover ranging process, the CDMA handover ranging code is used instead of the initial ranging code. The code is selected from the handover-ranging domain as defined in 8.4.7.3.

Alternatively, if the RS is pre-notified by the serving MR-BS for the upcoming handover MS, MR-BS may provide BW allocation information for MS by transmitting an RS UL-MAP to the RS. Afterward, the RS should construct Fast_Ranging_IE and send to MS for transmitting an RNG-REQ message.

Insert new subclause 6.3.10.3.4.6:

6.3.10.3.4.6 RS periodic ranging and automatic adjustments with the access station

An RS that wishes to perform periodic ranging shall take the same steps described in 6.3.10.3.2, 6.3.10.3.4.1 and 6.3.10.3.4.2.

In an MR system with transparent RSs, the MR-BS may assign a dedicated periodic ranging code to a RS during network entry. In the CDMA periodic ranging process, the dedicated periodic ranging code is used instead of the (MS) periodic ranging code.

When the RS receives an unsolicited RNG-RSP message during network (re-)entry or handover procedure, it shall take the same steps described in 6.3.10.3.2, 6.3.10.3.4.3 and 6.3.10.3.4.4.

Insert new subclause 6.3.10.3.5:

6.3.10.3.5 Ranging in relay networks with centralized bandwidth allocation

In relay networks with centralized bandwidth allocation, the MR-BS shall assign unique CDMA ranging codes to each RS in its MR-cell so that it can immediately determine the purpose and the originator of the code. These codes allow the RS to quickly inform the MR-BS that it is engaged in a ranging process with one of its downstream stations and receive bandwidth from the MR-BS on which to continue or complete the process.

The RS may be assigned several unique CDMA ranging codes for the purpose of supporting various ranging processes. The codes that may be assigned to the RS to communicate different requests to the MR-BS are:

1) Indicate that the RS needs BW on its access downlink on which to transmit a RNG-RSP message with “continue” status
2) Indicate that the RS needs a BW allocation on the relay uplinks along the path to the MR-BS on which to transmit a BW request message
3) Indicate that the RS needs BW on its relay downlink (i.e. to its downstream RS) on which to transmit a RNG-RSP message with “continue” status
4) Indicate that the RS needs BW allocations on the relay uplinks along the path to the MR-BS on which to forward a BW request header

6.3.11 Update of channel descriptors

6.3.12 Assigning SSs to multicast groups

6.3.13 Establishment of multicast and broadcast transport connections

6.3.14 QoS

6.3.14.2 Service flows

Insert the following text at the end of 6.3.14.2:

In MR networks, a service flow may traverse one or more RSs.

6.3.14.9 Service flow management

6.3.14.9.3 DSA

6.3.14.9.3.1 SS-initiated DSA

Insert the following text at the end of 6.3.14.9.3.1:

In MR network with distributed scheduling, before MR-BS admitting the service flow and sending DSA-RSP to the requesting station which could be an MS or an access RS, the MR-BS shall send a DSA-REQ to all the RSs on the path. Such DSA-REQ is first sent from MR-BS to its subordinate RS using its basic CID. If its resource condition cannot support the requested SF parameter, it may update the SF parameter with the one it can support. It then sends the DSA-REQ to its subordinated neighboring RS using the basic CID of the subordinate RS. This procedure is repeated by each RS, until the DSA-REQ reaches the access RS. After processing the DSA-REQ, the access RS replies with a DSA-RSP using its own basic CID directly to the

MR-BS. If MR-BS receives DSA-RSP from the access RS within T50, it shall send DSA-RSP to the requesting station. Meanwhile MR-BS shall also send a DSA-ACK with the admitted service flow parameter to all the RSs on the path.

6.3.14.9.3.2 BS-initiated DSA

Insert the following text at the end of 6.3.14.9.3.1:

In MR network with distributed scheduling, before MR-BS sending DSA-REQ to an MS or an access RS, the MR-BS shall send DSA-REQ to all the RSs on the path. Such DSA-REQ is first sent from MR-BS to its subordinate RS using its basic CID. If its resource condition cannot support the requested SF parameter, it updates the SF parameter with the one it can support. It then sends the DSA-REQ to its subordinated neighboring RS. This procedure is repeated by each RS, until the DSA-REQ reaches the access RS. After processing the DSA-REQ, the access RS replies with a DSA-RSP using its own basic CID directly to the MR-BS. The MR-BS then shall send DSA-REQ to the MS or access RS. Meanwhile MR-BS shall also send a DSA-ACK with the admitted service flow parameter to all the RSs on the path.

6.3.14.9.4 DSC

6.3.14.9.4.1 SS-initiated DSC

Insert the following text at the end of 6.3.14.9.4.1:

In MR network with distributed scheduling, before MR-BS admitting the changes and sending DSC-RSP to the requesting station which could be an MS or an access RS, the MR-BS shall send DSC-REQ to all the RSs on the path. Such DSC-REQ is first sent from MR-BS to its subordinate RS using its basic CID. If its resource condition cannot support the requested SF parameter, it updates the SF parameter with the one it can support. It then sends the DSC-REQ to its subordinated neighboring RS. This procedure is repeated by each RS, until the DSC-REQ reaches the access RS. After processing the DSC-REQ, the access RS replies with a DSC-RSP using its own basic CID directly to the MR-BS. If MR-BS receives DSC-RSP from the RS within T50, it shall send DSC-RSP to the requesting station. Meanwhile MR-BS shall also send a DSC-ACK with the admitted service flow parameter to all the RSs on the path.

6.3.14.9.4.2 BS-initiated DSC

Insert the following text at the end of 6.3.14.9.4.2:

In MR network with distributed scheduling, before MR-BS sending DSC-REQ to an MS or an access RS, the MR-BS shall send DSC-REQ to all the RSs on the path. Such DSC-REQ is first sent from MR-BS to its subordinate RS using its basic CID. If its resource condition cannot support the requested SF parameter, it updates the SF parameter with the one it can support. It then sends the DSC-REQ to its subordinated neighboring RS. This procedure is repeated by each RS, until the DSC-REQ reaches the access RS. After processing the DSC-REQ, the access RS replies with a DSC-RSP using its own basic CID directly to the MR-BS. The MR-BS then shall send DSC-REQ to the MS or access RS. Meanwhile MR-BS shall also send a DSC-ACK with the admitted service flow parameter to all the RSs on the path.

6.3.14.9.5 Connection release

6.3.14.9.5.1 SS-initiated DSD

Insert the following text at the end of 6.3.14.9.5.1:

In MR network with distributed scheduling, upon receiving a DSD-REQ from an MS or an access RS, the MR-BS shall delete the service flow on relay link (MR-BS - RS) as well as the access link (RS-SS). The

MR-BS shall send DSD-REQ to all the RSs on the path. Such DSD-REQ is first sent from MR-BS to its subordinate RS using its basic CID. The RS processes it and forwards it to its subordinate neighboring RS. This procedure is repeated by each RS, until the DSD-REQ reaches the access RS. After processing the DSD-REQ, the access RS replies with a DSD-RSP using its own basic CID directly to the MR-BS.

6.3.14.9.5.2 BS-initiated DSD

Insert the following text at the end of 6.3.14.9.5.2:

In MR network with distributed scheduling, the MR-BS shall delete the service flow on relay link (MR-BS - RS) as well as the access link (RS-SS). The MR-BS shall send DSD-REQ to all the RSs on the path. Such DSD-REQ is first sent from MR-BS to its subordinate RS using its basic CID. The RS processes it and forwards it to its subordinate neighboring RS. This procedure is repeated by each RS, until the DSD-REQ reaches the access RS. After processing the DSD-REQ, the access RS replies with a DSD-RSP using its own basic CID directly to the MR-BS.

Insert new subclause 6.3.14.10:

6.3.14.10 Tunnel Service Flows

In MR networks, a tunnel connection may be established to carry MPDUs from individual service flows. A tunnel connection is a unidirectional connection between the MR-BS and an RS (in either direction) that is used to carry MPDUs from a set of service flows assigned to traverse the tunnel. Each tunnel shall be assigned a Service Flow identifier (SFID) and a connection identifier (CID). The SFID is 32 bits and uniquely identifies the tunnel and its QoS parameters within the MR Cell. The CID is assigned in the same way as CIDs are assigned to service flows and is drawn from the same space as CIDs assigned to individual service flow, however, a specific range of CIDs is assigned to support tunnels.

A service flow established between the MR-BS and MS may traverse a tunnel between the MR-BS and the Access RS. (The access RS is the RS with which the MS communicates over an access link). A service flow which traverses a tunnel shall be assigned an SFID and a CID, as specified in sections 6.3.14.1 through 6.3.14.9. In addition, the QoS parameters of the service flow are included in the QoS parameters of the tunnel. The QoS parameters of the tunnel are an aggregate of the QoS parameters of the service flows that have been assigned to traverse the tunnel.

When a new service flow is created, use of a tunnel is optional. If use of a tunnel is specified, then the MR-BS determines whether the service flow should traverse a tunnel that exists between them (if such a tunnel has been established). If the service flow is to traverse the tunnel, the MR-BS or Access RS modifies the QoS parameters of the tunnel to include QoS requirements of the service flow. The QoS parameters of both the tunnel and service flow are sent as part of the connection setup messages (DSx messages). The Access RS and MR-BS use the QoS parameters of both the individual service flow and the tunnel in performing admission control and resource reservation. The QoS parameters of a tunnel are an aggregate of the QoS requirements of the individual service flows admitted into the tunnel. Intermediate RSs only deal with supporting the aggregate QoS requirement of the tunnel. They do not have knowledge of the requirements for individual service flows, and therefore may ignore them.

6.3.17 MAC support for HARQ

Insert new subclause 6.3.17.4:

6.3.17.4 DL HARQ support for relay in centralized scheduling

MR-BS schedules an initial transmission of HARQ packet on all the links between MR-BS and MS. DL transmission failure on a relay link is indicated by an encoded ACK/NAK on the UL ACK Channel.

Burst allocations for DL HARQ retransmissions shall be signaled to the intermediate RSs on the N-hop path between a MR-BS and MS in the HARQ DL MAP IE defined in Section 8.4.5.3.21. It also schedules the bandwidth for relaying upstream ACK/NACK on the UL ACK channel for all the hops from MS to MR-BS.

If a packet fails at any of the intermediate RSs, the RS transmits code C1 defined in the table xxx as a NAK back to the previous IS and transmits to the next hop station the pilot subcarriers and may transmit null data subcarriers. It shall not reencode the erroneous packet to transmit to the next hop station. Subsequently, the MR-BS may schedule a retransmission on the failed link as well as on all the subsequent links. The RS replaces the CID in the corresponding HARQ sub burst IE with its own basic CID.

Insert new subclause 6.3.17.4.1:

6.3.17.4.1 DL HARQ for non-transparent RS

DL transmission failure on a relay link shall be indicated by the orthogonal code on the UL ACK Channel. The MR-BS identifies the RS for retransmission with the help of ACK/NACK encoding suggested in table xxx. This does not require each RS on the path and MS to send separate ACK/NAK signals back to the MR-BS. Thus, conserves the bandwidth by utilizing the same ACK channel.

When MR-BS sends the first HARQ attempt, it allocates bandwidth over all the links from the MR-BS to the MS. Each RS on the relay path receives the downlink HARQ packet, and decodes it. If the decoding succeeds, it forwards the HARQ packet to the next hop and waits for the UL ACK from the next-hop RS or MS.

When a RS receives code C0, indicating that the HARQ packet is successfully received by the next station, it sends code C0 to the previous IS on its UL ACK channel. When a RS receives code Ck, $k \neq 0$, it sends UL ACK code= Ck+1 on its UL ACK channel. MR-BS upon receipt of kth hop code sequence (Ck) in UL ACK Channel assumes that packet is lost on the link that is the kth hop, and it will schedule retransmission from (k-1)th RS. If MR-BS receives code C0, it indicates that the HARQ packet is successfully received by SS. If MR-BS receives code C1, it indicate that the HARQ packet is failed on the first hop.

When the orthogonal encoded UL ACK scheme is employed, the UL ACK channel resources must be assigned so that the UL ACK channel from MS to its previous RS first and upto MR-BS in reverse order of the DL transmission path. If, the MR-BS does not receive ACK code sequence (C0), in the prescribed number of re-transmissions, both RS and MR-BS will discard the packet and clear the queue. BS can then perform normal signaling as if the packet is not received by MS.

Insert new subclause 6.3.17.4.1.1:

6.3.17.4.1.1 ACK / NAK Encoding for multihop relay

MR-BS needs to identify the failed link over the multihop chain in case of HARQ. Therefore new sequences based on Table xxx in section 8.4.5.4.13.1 are defined in order to uniquely identify the failed link. Further, it should be noted that BS only needs to identify the failed link, i.e. if the HARQ attempt is failed between RSj and its downstream RS RSj+1, then BS should identify RSj. For two hop case, only C0 to C2 are needed.

Insert new subclause 6.3.17.4.2:

6.3.17.4.2 DL HARQ for transparent RS

Insert new subclause 6.3.17.4.2.1:

6.3.17.4.2.1 RS Hop-by-Hop HARQ

When MR-BS or RS sends a HARQ sub burst to MS through RS, the RS shall receive the HARQ sub burst from the MR-BS for relaying the burst to the MS. If the RS receives the HARQ sub burst correctly, then the RS sends an ACK signal to the MR-BS and saves it for the event that there may be a retransmission to MS. Subsequently, the RS forwards the sub burst to the MS. If the RS does not receive the HARQ sub burst successfully, the RS shall send a NACK signal to the MR-BS. Upon receiving the NACK from the RS, the MR-BS shall retransmit the HARQ sub burst to the RS. When HARQ sub-burst is successfully received at RS, MS-BS request RS to transmit HARQ sub-burst. When the MR-BS receives a NACK from the MS, the MR-BS notifies the RS to retransmit the HARQ sub burst to the MS, and the RS shall retransmit the stored correct HARQ sub burst to the MS.

Insert new subclause 6.3.17.4.2.2:

6.3.17.4.2.2 RS assisted HARQ

In a case where the MR-BS sends a HARQ sub-burst to the MS directly, the MR-BS informs the RS that it needs to monitor that particular transmission by Compact DL-MAP MONITOR IE and also allocate HARQ ACK region allocation IE on the relay link for sending ACK/NACK from RS. The RS, having information on the downlink resource allocations sent in the DL MAP for the MS and Compact DL-MAP MONITOR IE, monitors the HARQ sub burst transmission sent to MS by MR-BS directly and attempts to decode it. When the RS receives the HARQ sub burst correctly, the RS saves it for a possible retransmission.

When MR-BS receives ACK/NACK from MS directly, MR-BS informs RS to reply ACK/NACK signal after RS receives the HARQ sub-burst. In this case, MR-BS receives ACK/NACK from RS and MS separately. When MR-BS receives NACK from both RS and MS, MR-BS retransmits the HARQ sub-burst. If MR-BS receives ACK from RS and NACK from MS, MS-BS makes the RS retransmits the HARQ sub-burst.

MR-BS may also configure RS to listen the ACK/NACK from the MS using Compact DL-MAP MONITOR IE. After the RS receives ACK/NACK from the MS, the RS replies using an encoded ACK/NACK defined in Table xxx through ACK channel prepared by MR-BS. RS shall clear the HARQ sub-burst depending upon the ACK/NACK information received from MS. If the RS received the HARQ sub-burst correctly and receives a NACK from MS, the RS replies the C2 to MR-BS. In this case, the MR-BS requests the RS to retransmit the HARQ sub-burst saved at the RS. When the RS fails to receive the HARQ sub-burst and receives a NACK from the MS, the RS sends a NACK to the MR-BS. Then the MR-BS retransmits the burst by itself. When the RS receives an ACK from MS then irrespective of whether RS receives the HARQ sub-burst correctly or not, the RS replies ACK to the MR-BS. RS will send the encoded ACK/NACK in the UL ACKCH according to the order of CID in the compact DL-MAP MONITOR IE.

Multiple transparent RSs can also be involved in the HARQ process. The schedule of source station transmitting a sub-burst to multiple transparent RSs can be signaled by using DL_COMPACT_MONITOR_IE Compact DL-MAP MONITOR IE which points to the burst to be received by the RSs. If an RS fails to decode the burst correctly, it shall not reencode the erroneous packet to transmit to the next hop station. In case of hop-by-hop HARQ involving multiple RSs, HARQ data is scheduled and forwarded to the next hop when MR-BS receives an ACK from at least one of the RSs, and the MR-BS shall schedule one or more RSs that sent ACK to forward the data to the next hop. In case of multiple RSs when the resource is prescheduled for all the links, one of the RSs can be selected as designated RS per hop, which is responsible for forwarding and reporting status to MR-BS in addition to the data forwarding. The designated RS waits for the UL ACK from the next-hop RS or MS after it forwards the HARQ packet or transmits the pilots to the next hop.

If MS sends an ACK, the designated RS reports a C0 code; otherwise the designated RS replies by choosing C2 from Table xxx.

Insert new subclause 6.3.17.4.3:

6.3.17.4.3 UL HARQ for transparent RS

When the MR-BS chooses to receive an HARQ sub-burst from the MS through the RS, it shall inform the RS and allocate UL transmission for the RS to relay the burst to the MR-BS. If an RS receives a HARQ sub-burst from an MS correctly, the RS saves it for any possible retransmission, and sends an ACK signal to the MR-BS using the ACK channel prepared by MR-BS. Then the MR-BS allocates bandwidth for the RS to relay the HARQ sub-burst. If the MR-BS receives ACK signal from the RS, it sends an ACK on HARQ ACK Bitmap IE to the MS directly. If the MR-BS cannot decode the sub burst relayed by the RS correctly, the MR-BS sends a NAK to the RS and allocates bandwidth for the RS to retransmit the saved sub burst. If an RS fails to receive the HARQ sub-burst from MS correctly, the RS sends a NAK signal to the MR-BS and the MR-BS sends a NAK to the MS. Subsequently, the MR-BS may request the MS to retransmit the HARQ sub-burst.

It is also possible for the MR-BS to receive the first transmission from an MS directly. In such a case, the MR-BS informs the RS using the Compact_UL MAP MONITOR IE that it needs to monitor the transmission. The RS, having the information on uplink resource allocations sent in the UL MAP for the MS, monitors the HARQ sub burst transmission sent by the MS to the MR-BS directly and attempts to decode it. When the RS receives the HARQ sub burst correctly, the RS saves it for a possible retransmission and sends an ACK to the MR-BS. On receiving the ACK from RS, MR-BS sends an ACK on HARQ ACK Bitmap IE to the MS directly. If the burst is received incorrectly at the RS the RS sends a NAK to MR-BS. If MR-BS did not receive the HARQ sub-burst from the MS correctly and received a NAK from the RS, the MR-BS sends NAK on HARQ ACK Bitmap IE to the MS. Subsequently, the MR-BS may request the MS to retransmit the HARQ sub-burst.

If MR-BS receives the HARQ sub-burst from the MS correctly then regardless of the ACK/NAK received from the RS, the MR-BS sends ACK on HARQ ACK Bitmap IE to the MS.

Multiple transparent RSs can also be involved in the HARQ process. The schedule of source station transmitting a sub-burst to multiple transparent RSs can be signaled by using UL_COMPACT_MONITOR_IE Compact_UL MAP MONITOR IE which points to the burst to be received by the RSs.If an RS fails to decode the burst correctly, it shall not reencode the erroneous packet to transmit to the next hop station. In case of hop-by-hop HARQ involving multiple RSs, HARQ data is scheduled and forwarded to the next hop when MR-BS receives an ACK from at least one of the RSs. In case of multiple RSs when the resource is prescheduled for all the links, one of the RSs can be selected as designated RS, which is responsible for forwarding and reporting status to MR-BS in addition to the data forwarding.

If MS sends an ACK, the designated RS reports a C0 code; otherwise the designated RS replies by choosing C2 from Table xxx.

Insert new subclause 6.3.17.4.4:

6.3.17.4.4 Resource request for HARQ error report

If the intermediate RS detects an error, it may transmit either HARQ RS Error report header or HARQ Error Report message. In case of HARQ RS Error report header, the order of Bitmap from MSB to LSB follows the order of sub-burst. In case of HARQ Error Report message, CID, ACID and SPID (in case of IR) will be reported to the MR-BS. Using this message, the failed transmission can be reported to the MR-BS without any additional delay as long as there is UL data to be transmitted.

The HARQ Error Report is sent by an RS in an unsolicited manner using UL bandwidth grant that may be available at the time of the report transmission.

If the RS does not have any UL bandwidth available for sending the error report, then CDMA bandwidth ranging method is used for requesting the UL bandwidth from the MR-BS. The MR-BS allocates a specific RS CDMA ranging code to a RS during initial ranging for the purpose of requesting bandwidth for transmitting HARQ error report. The code is granted by sending RS_CDMA_Codes TLV in RNG-RSP. When an RS needs to send a HARQ Error Report, it sends the allocated CDMA ranging code towards the MR-BS. The MR-BS recognizes the RS with the help of the assigned RS code. Subsequently, it assigns uplink allocation for sending the report.

Insert new subclause 6.3.17.5:

6.3.17.5 Relay support for UL HARQ in centralized scheduling

MR-BS schedules an initial transmission of HARQ packet on all the links between MR-BS and MS. UL transmission failure on a relay link is indicated by an encoded ACK/NAK on the UL ACK Channel.

Burst allocations for UL HARQ retransmissions shall be signaled to the intermediate RSs on the N-hop path between a source MS and the MR-BS in the HARQ UL MAP IE defined in Section 8.4.5.4.24. It also schedules the bandwidth for relaying upstream ACK/NACK on the UL ACK channel from RS to MR-BS.

If a packet fails at any of the intermediate RSs, the RS transmits code C1 defined in the table xxx as a NAK back to the previous IS and transmits to the next hop station the pilot subcarriers and may transmit null data subcarriers. It shall not reencode the erroneous packet to transmit to the next hop station. Subsequently, the MR-BS may schedule a retransmission on the failed link as well as on all the subsequent links.

Every ACK/NACK on UL ACK channel is forwarded by upstream RS(s) and finally to the MR-BS.

MR-BS identifies the multihop link(s) of UL transmission failure by checking the received encoded ACK/NACK.

Insert new subclause 6.3.17.5.1:

6.3.17.5.1 UL HARQ for non-transparent RS

When MR-BS schedules a HARQ attempt, it allocates bandwidth over all the links from the MS to the MR-BS. It also allocates bandwidth for the ACK/NAK channel on the relay links between access RS and MR-BS. Each RS on the relay path receives the uplink HARQ burst, and decodes it. If the decoding succeeds, it forwards the HARQ burst to the next IS along with an ACK. If the decoding fails, the RS only sends an encoded NAK to the next IS. In case of multiple hop, each subsequent RS in the path places encoded NAK according to table xxx. In case of two hops, encoded NAK is not needed. Encoded NAK informs MR-BS where the packet transmission was unsuccessful. If RS receives the encoded NAK Cx (x not equal to 0) than it will send the encoded NAK Cx+1 to next hop RS/MR-BS. If MR-BS receives encoded NAK Cx than it knows that packet is failed on x+1 hop from MR-BS, therefore it will schedule retransmission only on the failed links. The MR-BS sends UL-MAP accordingly, allowing retransmission from the last RS onwards, thus, retransmitting only on the links that didn't relay the HARQ burst successfully.

The receiving RS first looks at the per hop ACK channel. If it receives encoded NAK, it discards any information received in the HARQ, and sends encoded NAK to the next Infra Station (IS). If it receives ACK, it decodes the HARQ burst.

The ACK/NAK is sent in HARQ ACK Bitmap IE. Each RS also generates per hop HARQ ACK bitmap IE for its received HARQ bursts. Each receiving RS/MR-BS keeps its mapping, and generates its HARQ ACK bitmap accordingly. The MR-BS allocates the resource to transmit HARQ ACK bitmap IE from each RS. The receiver of the bitmap clears the buffer corresponding to the ACK bits in the bitmap, and saves the buffer corresponding to the NAK bits.

6.3.18 DL CINR report operation

Insert new subclause 6.3.18.3:

6.3.18.3 Relay station DL CINR report operations

6.3.19 optional Band AMC operations using 6-bit CQICH encoding

6.3.21 Sleep mode for mobility-supporting MS

Insert new subclause 6.3.21.7:

6.3.21.7 Relay support for MS sleep mode

In MR networks, the sleep mode shall be centrally controlled by the MR-BS in the presence of centralized or distributed scheduling.

For MR, to guarantee the sleep-mode MS receiving traffic indication in time in the presence of processing delay of RS, which is D_R, the MR-BS may transmit MOB_TRF-IND over R-link and access link separately. If multiple RSs exist, the MR-BS find the cumulative processing delay of RSs, which is D_C, for the path between the MR-BS and the MS. If RS uses same frame number which MR-BS uses, the MR-BS may sends MOB_TRF-IND over the R-DL as a pre-transmission D_R or D_C frame earlier than the normal MOB_TRF-IND transmission time over access link. The RS delay, D_R, is given to MR-BS as a capability parameter of SBC-REQ message. If RS uses different frame number from the number which MR-BS uses, MR-BS may schedule transmission time at the RS in consideration of D_R or D_C and RS frame offset.

When the MR-BS transmits a MOB_TRF-IND message to an MS via an RS, the MR-BS shall schedule the transmission of the MOB_TRF-IND message in consideration of the RS's processing delay, D_R, and RS frame offset so that the RS has sufficient time to decode and transmit the MOB_TRF-IND message.

Insert new subclause 6.3.21.7.1:

6.3.21.7.1 MS sleep mode support for centralized scheduling approach

For an MS attached to the MR-BS through an RS, MS sleep mode operates as defined in section 6.3.21. All MOB_SLP-REQ messages generated by MSs attached to an RS shall be relayed to the MR-BS. The MR-BS shall be responsible for generating MOB_SLP-RSP messages, which will be relayed by RSs, either in response to a MOB_SLP-REQ or unsolicited. The MR-BS shall take the additional relay delay into account while it forwards the packets through RS.

Insert new subclause 6.3.21.7.2:

6.3.21.7.2 MS sleep mode support for distributed scheduling approach

In MR networks, the sleep mode of MS shall be centrally controlled by the MR-BS in the presence of distributed scheduling i.e. The MR-BS shall be responsible for generating MOB_SLP-RSP, DL sleep control extended subheader, or RNG-RSP with power-saving class parameters (Table 364a) messages, which will be relayed by RSs.

In the distributed scheduling case, before MR-BS instructing the MS sleep mode parameters by sending MOB_SLP-RSP, DL sleep control extended subheader, or RNG-RSP with power-saving class parameters to the RS' subordinate MSs, the MR-BS shall send an MR_SLP-INFO message to the access RS on the RS's basic CID to inform the RS the corresponding MS sleep mode parameters. After receiving this MR_SLP-INFO message, the access RS shall send SLP_INF-ACK message to MR-BS to acknowledge that it got the information about the sleep context of the CIDs indicated. The MB-RS shall retransmit the MR_SLP-INFO message to the access RS on the RS's basic CID, if it does not receive the SLP_INF-ACK message from the corresponding access RS within the T49 timer. MR-BS may do retransmission for a maximum of SLP-INFO Retry Count. Once MR-BS receives the SLP_INF-ACK message, it shall send a messages, such as MOB_SLP-RSP, DL sleep control extended subheader, or RNG-RSP with power-saving class parameters, which will be relayed by RSs, to the RS' subordinate MS.

6.3.22 MAC layer handover procedures

6.3.22.1 Network topology acquisition

6.3.22.1.1 Network topology advertisement

Insert the following at the end of 6.3.22.1.1:

The MR-BS and the RS shall broadcast information about the infrastructure stations that are present in the network using the MOB_NBR-ADV message defined in 6.3.2.3.47. The MR-BS and the RS may obtain the information to be included in the MOB_NBR-ADV message over the backbone network or over the relay links. Each non-transparent RS can broadcast a different MOB_NBR-ADV message that is suitable for its service area. For transparent RS, the MOB_NBR-ADV message shall be broadcasted by the MR-BS.

To facilitate each non-transparent RS to transmit a MOB_NBR-ADV message suitable for its service area, the MR-BS shall transmit a MR_NBR-INFO message to the RSs. The MR_NBR-INFO is a customized, unicast message that is composed by the MR-BS according to the specific neighborhood of the receiving RS. The MR_NBR-INFO message is transmitted by the MR-BS to the RSs over the relay links. In order to compose the MR_NBR-INFO customized for the subordinate RSs, the MR-BS can use location information or the interference measurement reports received from the infrastructure stations. Under centralized scheduling, the RS may request bandwidth on the access link to broadcast MOB_NBR-ADV. Under distributed scheduling, the RS may autonomously broadcast MOB_NBR-ADV on the access link.

An RS, depending on its capability and depending on the messages that it receives, can choose between one of the following options in generating the MOB_NBR-ADV message:

(a) An RS may broadcast the MOB_NBR-ADV message without modifying the neighbor list of the MR_NBRINFO message, received from the MR-BS.

(b) An RS may further customize and compose a MOB_NBR-ADV message that is suitable for its service area by utilizing the information present in the MR_NBR-INFO messages received from the MR-BS as well as any additional information that the RS itself may have obtained, for instance by scanning or measurement.

6.3.22.1.2 MS scanning of neighbor BSs

Insert the following at the end of 6.3.22.1.2:

In MR network MR-BS shall control MS scanning. An RS relays MOB_SCN-REQ, MOB_SCN-RSP and MOB_SCN-REP messages between an MS and the MR-BS in centralized scheduling or distributed scheduling.

In the case of distributed scheduling, the MR-BS sends MS_SCN-INF message to inform the access RS of MS scanning related information after the MR-BS determines the scanning intervals of MS. The access RS shall transmits MS_SCN-ACK message or ACK header (as defined in 6.3.2.1.2.2.3) as an acknowledgement of MS_SCN-INF. In the case of distributed scheduling, the MR-BS shall transmit MOB_SCN-RSP to the

MS after it receives MS_SCN-ACK from the access RS. Based on MS_SCN-INF message, the access RS schedules MS data transmission.

The MR-BS shall transmit MS_SCN-CLT message to inform an access RS that the group of intervals of MS is terminated. The access RS shall assume that the MS is no longer in scanning mode when the access RS receives MS_SCN-CLT message or a MAC PDU of MS.

Insert new subclause 6.3.22.1.4:

6.3.22.1.4 Association procedure in an MR network

Insert new subclause 6.3.22.1.4.1:

6.3.22.1.4.1 Association parameter acquisition

In a centralized MR system with distributed scheduling, when the serving MR-BS decides to recommend the MS to scan neighbor stations with association level 1 or 2, it should obtain association parameters allocated by the neighbor stations before sending the MOB_SCN-RSP message.

If the neighbor stations are in different MR-cells, the serving MR-BS shall request association parameters from the neighbor MR-BS via backbone network. Then the neighbor MR-BS can obtain the association parameters of its subordinate recommended RSs and respond to the serving MR-BS. If the neighbor RSs are served by the serving MR-BS, the serving MR-BS can directly request the association parameters from the neighbor RSs.

The MR-BS may respectively send an association request (ASC-REQ) message to its subordinate recommended neighbor RS, requesting the association level. The recommended neighbor RS shall response with an association response (ASC-RSP) message to indicate the association level allocated to the MS. If the allocated association level is 1 or 2, the ASC-RSP should include the association parameters (i.e. Rendezvous time, CDMA code, and Transmission opportunity offset) and further.

The serving MR-BS may determine whether the responded association parameters are satisfied or not. If not, the serving MR-BS may request the association parameters for more times.

Insert new subclause 6.3.22.1.4.2:

6.3.22.1.4.2 Association level 0

When this association level is chosen, the MS may perform association with level 0.

After the scanned RS successfully receives the ranging code, it will provide uplink allocation of adequate size for the MS to transmit RNG-REQ message with TLV parameters (Serving BS ID, MS MAC address) related to the association ranging. The RNG-REQ message is sent by the MS and relayed to the MR-BS, then the MR-BS responds with RNG-RSP message, which is relayed to the MS.

Insert new subclause 6.3.22.1.4.3:

6.3.22.1.4.3 Association level 1

When this association level is chosen, the MS may perform association with level 1.

After the scanned RS successfully receives the ranging code, it will provide uplink allocation of adequate size for the MS to transmit RNG-REQ message with TLV parameters (Serving BS ID, MS MAC address) related to the association ranging. The RNG-REQ message is sent by the MS and relayed to the MR-BS, then the

MR-BS responds with RNG-RSP message.

Insert new subclause 6.3.22.1.4.4:

6.3.22.1.4.4 Association level 2

During the scanning with association level 2, the MS is required to transmit the CDMA ranging code to the scanned neighbor RS. The MS does not have to wait for RNG-RSP from the scanned neighbor RS. Instead, the neighbor RS shall send the RNG-RSP to its serving MR-BS (the MS's neighbor MR-BS). The neighbor MR-BS should send the ranging information to the serving MR-BS via backbone network. Then the MS's serving MR-BS shall incorporate the RNG-RSP information from all the neighbor MR-BSs into a single MOB_ASC_REP message. If the neighbor RS is served by the serving MR-BS, it will directly send the RNG-RSP to the serving MR-BS.

6.3.22.2 HO process

Insert the following text at the end of 6.3.22.2:

In centralized control MR network MR-BS shall control handover process. An RS shall relay handover associated messages between an MS and the MR-BS in centralized scheduling or distributed scheduling.

Insert new subclause 6.3.22.4:

6.3.22.4 Mobile relay station handover

This section defines the RS HO process in which an RS migrates from the air-interface provided by one access station to the air-interface provided by another access station. The RS HO process is depicted in Figure xxx.

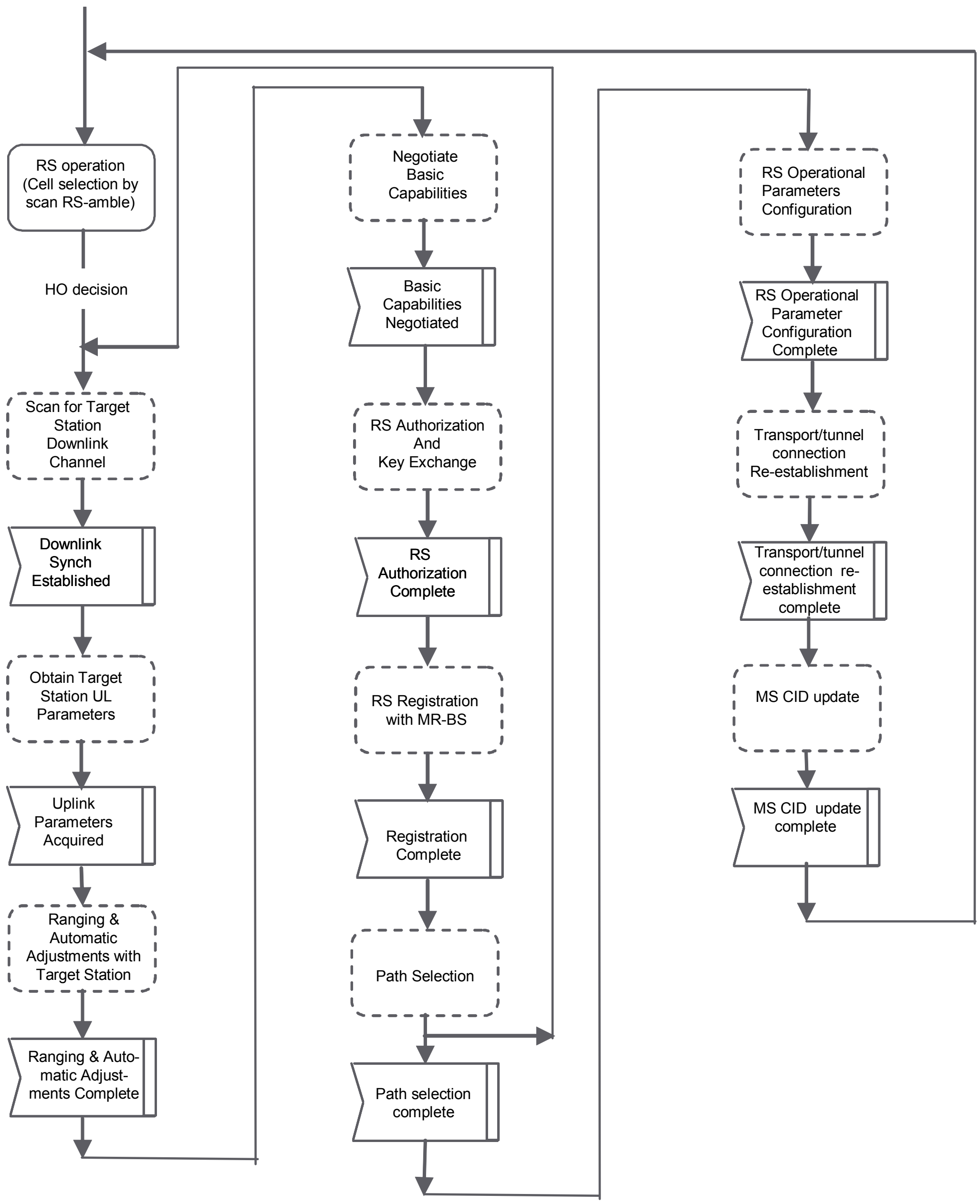


Figure 156a—RS HO process

The RS HO process consists of the same stages as those defined for MS HO process with the following additional stages:

- Path selection. This stage enable the target MR-BS to indicate a path reselection. The target MR-BS may decide to skip this step if the bit #0 in RS HO optimization TLV of RNG-RSP is set.

- RS operational parameter configuration. This stage enables the target MR-BS to reconfigure RS operational parameters. The target MR-BS may decide to skip this step if the bit #1 in RS HO optimization TLV of RNG-RSP is set.

- Transport/tunnel connection re-establishment. This stage enables the target MR-BS to re-establish transport/tunnel connections for an RS. The target MR-BS may decide to skip this step if the bit #2 in RS HO optimization TLV of RNG-RSP is set.
- MS CID update. This stage is used to support the connection re-establishment between the child MSs and the target MR-BS if the MS handover procedure as described in 6.3.22.5 is not invoked between the MS and the Target MR-BS, i.e. there is full service and operational state transfer or sharing between Serving MR-BS and Target MR-BS. Otherwise, this stage shall be omitted and the MS handover procedure as described in 6.3.22.5 shall be invoked. MS CID update process is only needed when MS CID based data forwarding scheme is used and when a CID of a child MS collides with the CID of another MS served by the target MR-BS. In this case, this stage is used for the target MR-BS to inform the RS, which is performing the handover, regarding the new CIDs of its child MSs, in order for the RS o swap the new CIDs of its child MSs to the old CIDs before forwarding the MAC PDUs to the child MSs. For non-MS CID based data forwarding schemes, this step shall be omitted since the data forwarding from the MR-BS to the access RS is based on established routes, e.g. tunnel, destination RS basic CID, source routing.

Insert new subclause 6.3.22.4.1:

6.3.22.4.1 Operation modes of mobile relay station

A mobile RS can operate in two different modes: moving RS mode and moving BS mode.

Insert new subclause 6.3.22.4.1.1:

6.3.22.4.1.1 Moving RS mode

An RS, when operating in moving RS mode, this RS may implement only a subset of physical layer and MAC layer functions defined in IEEE802.16e-2005. No MAC convergence sub-layer function is implemented. For a MS who selects a mobile RS in moving RS mode as its access station, the connection and privacy of this MS shall be established and maintained by the serving MR-BS and this MS. Most of the operations of a mobile RS in moving RS mode are similar to those of a fixed RS, except the handover operation. During a handover, a mobile RS in moving RS mode may need to initiate handover procedure of all attached MSs.

Insert new subclause 6.3.22.1.4.1.2:

6.3.22.4.1.2 Moving BS mode

An RS, when operating in moving BS mode, the RS shall implement a full set of physical layer and MAC layer functions defined in IEEE802.16e-2005. For an MS, who selects a mobile RS in moving BS mode as its access station, the connection and privacy of the MS shall be established and maintained by this mobile RS. The mobile RS is also the serving station of the MS. The mobile RS shall perform handover per 6.3.22.2. After the mobile RS handovers to a new target MR-BS, if the mobile RS enters into a new IP subnet, the IP addresses of all the MSs served by this mobile RS need to be re-established. A dedicated transport connection shall be established between the mobile RS and its serving MR-BS to relay the IP address re-establishment related signaling between the MS and the MR-BS.

The operation mode of a mobile RS can be negotiated through basic capability messages exchange at RS initial network entry and re-entry.

At RS initial network entry, during the basic capability negotiation, the RS uses SBC-REQ message to indicate to the associated MR-BS the operation mode of this mobile RS. The MR-BS uses SBC to confirm the operation mode.

Insert new subclause 6.3.22.4.2:

6.3.22.4.2 Mobile RS Handover Process without Preamble Change

The MRS Handover process hands off all the MS attached to itself, along with the MRS, to a target BS. It follows the same procedures as described for an MS handover in section 6.3.22.2. The procedures, where certain steps are different, are described in this section.

Insert new subclause 6.3.22.4.2.1:

6.3.22.4.2.1 HO Decision and Initiation

When MRS makes a decision for handover, it sends MOB_MSHO-REQ message on its basic CID to the Serving MR-BS. The MR-BS, knowing that the basic CID belongs to a MRS, sends MOB_BSHO-RSP message. The serving MR-BS may send the MAC address of the MRS, alongwith the MAC addresses, SFIDs and CIDs of the MSs attached to the MRS, to the target MR-BS using the backbone message. The backbone message definition is beyond the scope of this specification. In the tunneling case, the tunnel information should also be carried, which includes CID(s) and QoS parameter(s) of the tunnel(s).

The serving MR-BS initiates handoff for a MRS by sending MOB_BSHO-REQ message on the MRS basic CID.

Insert new subclause 6.3.22.4.2.2:

6.3.22.4.2.2 Network Entry/re-Entry

During network entry/re-entry, the MRS informs the MR-BS that it is an MRS. The serving MR-BS may exchange backbone messages with the target MR-BS to pass the MAC addresses, SFIDs and CIDs of all the MSs attached to the MRS. The details of the backbone messages are beyond the scope of this specification.

In the non-tunneling case, the target MR-BS may allocate new CIDs to MSs during ranging procedure with the MRS. If new CIDs are assigned, then MR-BS shall send old and new CID pairs to the MRS in RNG-RSP. The MRS creates mapping between old and new CID. It replaces old CID with the new CID in the UL MPDUs. Similarly, it replaces new CID with the old CID in the DL MPDUs.

In the tunneling case, the target MR-BS may allocate new CIDs to tunnels during the ranging procedure and then send old and new tunnel CID pairs to the MRS in RNG-RSP. After getting the relationship of old and new tunnels, MRS can route MS MAC PDU according to the combination of Tunnel CID and MS CID.

Insert new subclause 6.3.22.4.3:

6.3.22.4.3 Mobile RS Handover with Preamble Change (Inter MR-BS)

This subclause describes the MRS handover (Inter MR-BS), which hands over an MRS as well as all the MS attached to it, with a detection of a preamble change. Both of the MR-BS and the MRS would maintain a list of MSs which are served through an MRS. An MRS HO begins with a decision for an MRS to handover itself and to make MSs to handover from a serving MR-BS to a target MR-BS. The decision may originate either at the MRS or the serving MR-BS.

The operation of MRS Handover is divided into two steps: a negotiation between an MRS and a serving MR-BS for MRS Handover, and a procedure for MS Handover.

MRS initiates handover by sending MOB_MSHO-REQ message to the serving MR-BS with its basic CID.

The serving MR-BS recognizes that an MRS is requesting HO from the basic CID in MAC header. Upon reception of MOB_MSHO-REQ message, the MR-BS sends MOB_BSHO-RSP message to the MRS.

If the target MR-BS decides to change the MRS' preamble after the handover it sends a preamble index to the serving MR-BS over the backbone. Then the serving MR-BS sends it to the MRS using, the Preamble Index TLV in the MOB_BSHO-REQ/RSP messages.

The serving MR-BS may set "Action Time" for fast handover ranging of the MRS using MOB_BSHO-REQ/RSPmessages, which is similar to the MS Handover process in 6.3.22.2.

The serving MR-BS exchanges handover decision and initiation stage signaling (6.3.22.2.2) with each MS before the MRS conducts handover and preamble change. The MOB_BSHO-REQ message is sent to the subordinate MSs with the "HO operation mode" set to 1. In addition, the serving MR-BS may set "Action Time" in order to assign dedicated transmission opportunity for RNG-REQ message to be transmitted by the MS using Fast_Ranging_IE.

When the serving MR-BS attempts a handover, it sends a MOB_BSHO-REQ message to the MRS. The subsequent procedures are same as MRS initiated handover.

Insert new subclause 6.3.22.4.4:

6.3.22.4.4 MRS handover with preamble index changes (Intra MR-BS)

During the movement of a moving RS, if there is a preamble collision or co-channel interference strength measured is higher than the preamble (segment) reselection threshold and the interference lasts longer than the duration threshold, the moving RS may re-select the preamble (segment) within the preamble-reselection window. The parameters governing the preamble (segment) reselection procedure of moving RSs is broadcasted in the RS configuration description (RS_CD) message as TLV of Preamble (segment) reselection threshold.

When MRS coverage area overlaps with another RSs/BSs coverage area, MR-BS may initiate MRS preamble reassignment procedures as define in section 9.4, using RS_Config_REQ/RSP. If MRS preamble is changed then all the active MS connections are handed over to the same physical MRS using procedures in 6.3.22. All the associated MSs within the MRS's serving coverage are switched to the newly assigned preamble index at pre-determined action time via MOB_BSHO_REQ/RSP. The action time allows MRS time to switch newly assigned preamble index. The MRS preamble is changed using the RS_Config_REQ/RSP before the Action time.

The MOB_BSHO-REQ message may carry the same BSID as the serving BS ID in the "Neighbor BSID" field while the "Preamble index/Subchannel index" field is changed to the newly preamble index, under mode=0b000.

After sending out MOB_BSHO-REQ message, the MRS segment reassignment procedure is executed using RS_Config-REQ/RSP messages. Alternatively, one MRS may request to join another MRS with the same preamble to form a virtual RS group. The virtual RS group then serves all the MSs which are served by these two MRSs. The procedure to form or delete a virtual RS group is explained Section 6.3.9.16.3.1.

Insert new subclause 6.3.22.4.5:

6.3.22.4.5 MS drops during handover

In MR network, a MRS moves along with its attached MSs. All MS in the same vehicle may consist of two parts: MSs which connect with BS directly and MSs which connect with BS through MRS.

MSs which connect with BS directly can detect a drop using the method defined in 6.3.22.2.6. MRS has the ability of transmitting its own control information such as Preamble/FCH/MAP. Those MS can monitor MRS' downlink information and perform parameter negotiation and synchronization in advance. Upon MS drops arising, it can communicate with MRS immediately and then the MRS reports corresponding MS information to its serving station.

Insert new subclause 6.3.22.4.6:

6.3.22.4.6 MRS drops during handover

MRS can detect its drop by its failure demodulate the downlink, and the attached MSs can detect its drops for they cannot receive correct downlink information from its current MRS. As MS which connect with BS directly, the attached MSs can also receive control information from serving BS.

When MRS detects its drop before sending the MAC message MOB_HO_IND, MRS may try to resume communication with current serving station by sending the MAC message MOB_HO_IND with HO_type=0b01(or 0b10) to cancel(or reject) handover. If MRS detects its drop after sending the MAC message MOB_HO_IND with HO_type=0b00 (resource release), and serving BS does not receive the successful network attachment at target station over backbone, MRS may transmit new MOB_HO_IND with HO_type=0b01 (or 0b10) to cancel (or reject) handover. The old MOB_HO_IND message will be neglected if the new MOB_HO_IND message is received by serving BS before resource-retain-time timer expiration. On the contrary, the new MOB_HO_IND message will be neglected if it is received after resource-retain-time timer expiration. Under such circumstance, MRS still performs handover ranging with its preferred target BS in term of normal handover operation. During MRS drops interval, the attached MSs connect to current serving BS temporary.

When serving BS detects a drop, it shall react as if a MOB_HO_IND message has been received with HO_IND_type=0b00, which is similar to IEEE 802.16e. The following procedure may adopt the scheme for the latter case.

Target BS may send RNG_RSP with 'ranging status'=continue and time, power, frequency adjustment information when MRS is unable to perform handover ranging with its target BS successfully. If MRS cannot establish correct connection with its target BS during network reentry, MRS shall attempt to resume communication with serving BS, and search for appropriate target BS at the same time through cell reselection.

Insert new subclause 6.3.22.5:

6.3.22.5 MS handover procedure involving RS

An MS, connected through an RS or MR-BS, shall follow the same procedures as described for an MS handover in section 6.3.22.2.

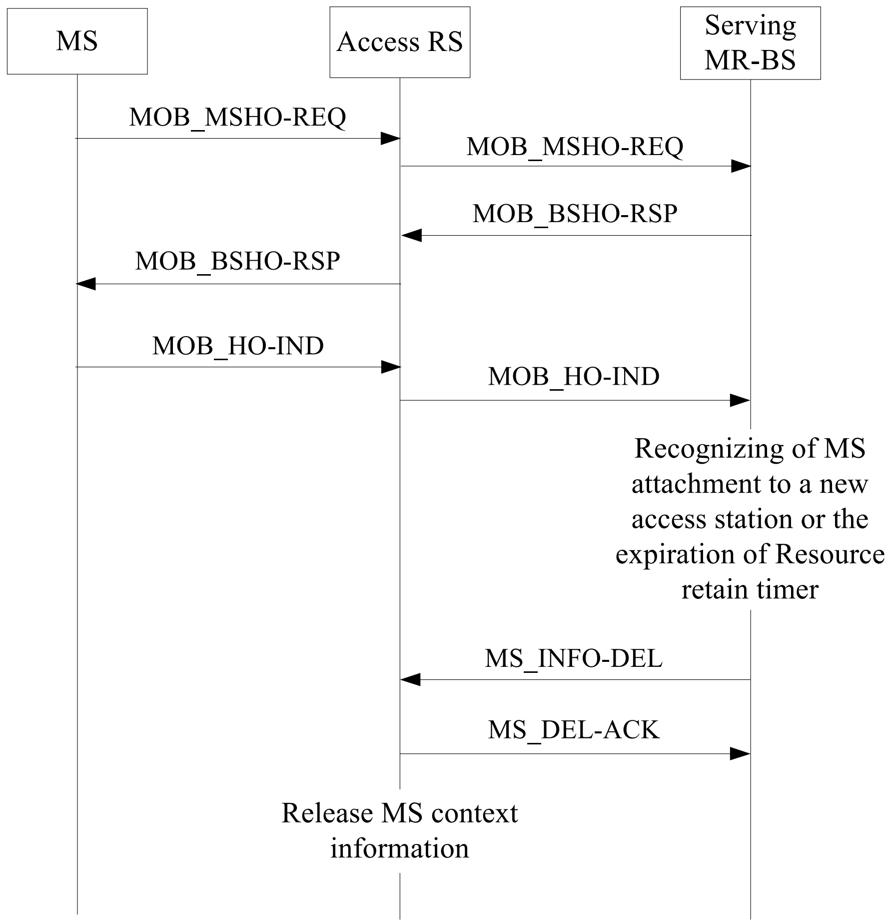
Insert new subclause 6.3.22.5.1:

6.3.22.5.1 MS Movement among access stations with different preamble/FCH/MAP

The fixed RS or nomadic RS shall relay HO related management messages between MS and MR-BS.

If a serving MR-BS recognizes that MS attaches to a new access station or Resource retain timer expires, and the MS's old access station is an RS which is controlled by the MR-BS, the MR-BS may send the MS_INFO-DEL message to make the RS discard MS context information. Upon receiving the MS_INFO-DEL message, the RS shall transmit MS_DEL-ACK or ACK header (as defined in 6.3.2.1.2.2.3) as a reply and remove the MS context information

Table 220a—Handover procedure involving RS with centralized HO control from MR-BS



Insert new subclause 6.3.22.5.2:

6.3.22.5.2 MS Movement among access stations with same preamble/FCH/MAP

In this case, MS is not aware of the HO. Therefore, RS and MR-BS shall perform measurement of MS signal quality to assist MS movement among stations (RSs, MRBS) that share the same preamble/FCH/MAP.

The stations (RS or MR-BS) which share the same preamble/FCH/MAP form a virtual group (VG). All stations (RSs and MR-BS) in the VG shall measure the signal quality (RSSI, CINR) and the Timing Adjust (TA) for each active MS served by this VG to support MS mobility within the VG. All RSs shall use MOB_RSSCN-REP to provide MR-BS with the selected report metrics (RSSI and/or CINR and TA) for each active MS when needed.

The MOB_RSSCN-REP is sent to the MR-BS using the reporting modes specified by MR-BS. Two reporting modes shall be supported by RSs.

<Section note: the configuration of the reporting mode is specified by MR-BS during RS initiation. This is TBD.>

Insert new subclause 6.3.22.5.2.1:

6.3.22.5.2.1 Mode 1

In Mode 1, the access RS shall automatically report its measurement result to MR-BS in an event-triggered or periodic way.

For event-triggered reporting, the access RS shall report its measurement results if the power or timing requirement for the specific MS is not satisfied. The access RS may use the RS bandwidth request and allocation mechanism defined in section 6.3.6.7 to request uplink resource for sending MOB_RSSCN-REP.

For periodic reporting, the access RS shall send MOB_RSSCN-REP every REP_INT and the MR-BS shall periodically allocate uplink resource for the access RS to report the latest measurement result for each active MS.

<Section note: REP_INT is the reporting interval specified in the RS configuration. This is TBD.>

In Mode 1, non-access RSs shall report their measurement results only if MOB_RSSCN-RSP message is received. The MR-BS shall send MOB_RSSCN-RSP message to request all or part of RSs in the same VG to report their measurement results for a specific MS. The MR-BS shall allocate uplink resource for the selected non-access RSs to send their MOB_RSSCN-REPs at the frame specified in MOB_RSSCN-RSP.

Insert new subclause 6.3.22.5.2.2:

6.3.22.5.2.2 Mode 2

In Mode 2, all RSs (access RS and non-access RSs) in the same VG shall automatically report the measurement results to MR-BS in an event-triggered way. Each RS shall send an MOB_RSSCN-REP to MR-BS if the measured RSSI/CINR going-up cross T_ADD[i] (i=0,...,max), or going-down cross the T_DEL[i] (i=0,...,max), or the difference between the current measured TA and the previous reported TA exceeds TA_DIFF. The RS may use the RS bandwidth request and allocation mechanism defined in section 6.3.6.7 to request uplink resource for sending their MOB_RSSCN-REP. The MR-BS shall maintain the measurement reports for each active MS and use those information to speedup optimal target access station selection.

<Section note: T_ADD[i], T_DEL[i] (i=0,...,max), and TA_DIFF are threshold values specified in the configuration of the reporting mode during RS initiation. This is TBD.>.

MR-BS may select a new target RS based on the measurement results and use RNG-RSP to adjust the timing and the power level of the MS, in order to fulfill the handover procedure.

6.3.23 Multicast and broadcast services (MBS)

6.3.23.1 Single-BS access

6.3.23.2 Multi-BS access

Insert new subclause 6.3.23.3:

6.3.23.3 MBS in MR network

For MR networks, MBS transmission within an MBS zone shall be synchronized. In Multi-MR-BS-MBS case, MR-BSs should be synchronized in network level as described in section 6.3.23.2.

If there is only one RS connecting with the MR-BS, that RS shall report its processing delay (in units of a frame), D_R, to the MR-BS as a capability parameter in the SBC-REQ message. When an MBS transmission is necessary, the MR-BS shall first send the MBS data over the relay downlink as a pre-transmission, and then after D_R frames, the MR-BS and RS shall synchronously transmit this MBS data over the access link.

If there are multiple RSs in the MBS zone at various hop counts from the MR-BS and/or with different processing delays, each RS shall report its processing delay, D_R, to the MR-BS as a capability parameter in the SBC-REQ message. The MR-BS shall determine the maximum cumulative delay, D_M, of all RSs in the MBS zone based on their positions in the tree and their individual processing delays. The MR-BS shall then calculate the required waiting time, W_i, for each RS based on the value of D_M and each RS's cumulative delay and notify each RS of its waiting time via an SBC-RSP message. If the MR-BS detects that the waiting time has changed for a particular RS, it may send an unsolicited SBC-RSP message to that RS to update its waiting time.

When an MBS transmission is necessary, the MR-BS shall forward the MBS data over the relay downlink as a pre-transmission D_M frames before transmitting this MBS data over the access link. Each RS in the MBS zone shall forward the MBS data it receives over the relay downlink. Finally, once the MR-BS has waited D_M frames and each RS has waited its specified waiting time, W_i, the MR-BS and RSs shall synchronously transmit the MBS data over the access link.

6.3.24 MS Idle Mode (optional)

Insert the following text after the third paragraph of 6.3.24:

FRS and NRS may have same or different Paging Groups compared to controlling MR-BS. MRS shall be assigned one or more Paging Groups, which shall be different from MR-BS.

6.3.24.1 MS Idle Mode Initiation

Insert the following text after the last paragraph of 6.3.24.1:

In the MR-cell, the intermediate RS will relay the DREG-REQ/CMD message between the MR-BS and MS.

6.3.24.5 MS Paging Listening Interval

Insert the following text at the end of 6.3.24.5:

For MR, all the idle-mode MSs which have same PLI within same paging group shall receive the MOB_PAG-ADV at the same time. The RS delay, D_R, is given to MR-BS as a capability parameter of SBC-REQ message. If RS uses same frame number which MR-BS uses, MR-BS may sends MOB_PAGADV over the R-~~DL~~Link as a pre-transmission D_R frame earlier than the normal MOB_PAG-ADV transmission time. MR-BS shall wait for D_R frames, and then sends MOB-PAG-ADV data again over the access link. If RS uses different frame number from the number which MR-BS uses, MR-BS may instruct transmission time at the RS by including RS tx frame number TLV in MOB-PAG-ADV.

If multiple RSs with different delay performance existing, MR-BS shall firstly examine the cumulative processing delay "D_C" of each path between the MR-BS and the MS, then finds the maximum of "D_C", which is "D_M". The MR-BS decides modified beginning frame of PLI for itself with "D_M". Then MR-BS examine the waiting time "W" for each RS. Such the waiting time will be notified in SBC-RSP message.

If RS uses same frame number which MR-BS uses, the MR-BS may sends MOB_PAG-ADV over the RDL as a pre-transmission D_M frame earlier than the normal MOB_PAG-ADV transmission over access link.

The MR-BS shall wait for D_M frames, and the RS which is notified waiting time by the MR-BS shall wait for W frames, and then sends MOB-PAG-ADV again over the access link. If RS uses different frame number from the number which MR-BS uses, MR-BS may instruct transmission time at the RS by including RS tx frame number TLV in MOB-PAG-ADV.

If the MR-BS detects that the waiting time for some RS needs to be changed, MR-BS may send unsolicited SBC-RSP message and notifies RS which needs to change the waiting time of it.

6.3.24.6 BS Broadcast Paging message

Insert new subclause 6.3.24.6.1:

6.3.24.6.1 RS Broadcast Paging message

When a paging is need to some MS's in a Paging Group, RSs belonging to the Paging Group shall be involved to transmit MOB_PAG-ADV to the MSs. The paging information shall be transmitted by MR-BS to RSs in a relay link. When MR-BS need to transmit paging information to RSs, MR-BS shall calculate the time to transmit in consideration of RS's processing delay, D_R, and RS frame offset so that RSs have enough time to decode and transmit MOB_PAG-ADV and paging delay will be minimized. When MR-BS transmits a paging information to RSs, it may transmit MOB_PAG-ADV including RS tx frame number TLV to RSs. When a RS receive PAG-ADV including RS tx frame number TLV in a relay link, the RS shall restructure and transmit PAG-ADV by extracting the TLV and updating the length field at the frame number as specified by the TLV.

When a RS receives MOB_PAG-ADV message from MR-BS or its upstream RS in the relay link, the RS shall forward the message to its subordinate RSs in the relay link. As described in 6.3.24.5, the transmission time shall be compensated based on the processing delay in each RSs.

After transmitting the broadcast paging message with Action Code 'Perform Ranging' or 'Enter Network', if the RS does not receive RNG-REQ from the MS paged until the next MS Paging Listening Interval, the RS shall retransmit the Broadcast Paging message. Every time the RS retransmits the broadcast paging message, it decreases the predefined paging retry count by one.

In order to let each RS's paging retry count decrease to zero at the same time with MR-BS, a "PLI Count" indication field shall be included in the MOB_PAG-ADV message transmitted in the relay link, which is described in 6.3.2.3.56. This field is used for indicating the RS how many PLI has been elapsed since the first time MR-BS sending out the MOB_PAG-ADV message. That is equal to the value that the Paging Retry Count of MR-BS has been decreased. The RS will determine its own paging retry count according to the "PLI Count" and the "Paging Retry Count" of MR-BS defined in Table 342.

When a RS relay the MOB_PAG-ADV message to its subordinate RSs, the "PLI Count" value shall be increased by one if the receiving RS will miss one more PLI.

When a RS receives the RNG-REQ for location updating or network reentry, it shall relay the RNG-REQ to the MR-BS, and stop sending Broadcast Paging message messages. At the same time, it shall generate and send paging stop command to its subordinate RSs who is still sending the broadcast paging message. The paging stop command is fulfilled by setting the 'Stop Paging' bit in MOB_PAG-ADV described in 6.3.2.3.56. When a RS receives the paging stop command, it shall stop sending Broadcast Paging message, and relay the paging stop command to its subordinate RSs who is still sending the Broadcast Paging message.

When intermediate RSs receive the relayed RNG-REQ message, they shall stop sending Broadcast Paging messages. At the same time, it shall generate and send a MOB_PAG-ADV with paging stop command to its subordinate RSs who is still sending the Broadcast Paging message.

When a MR-BS receives the RNG-REQ, it shall stop sending Broadcast Paging message messages. It shall generate and send paging stop command to its subordinate RSs who is still sending the broadcast paging message.

When a MR-BS receives paging stop announcement from paging controller, the MR-BS shall generate and send paging stop command to its subordinate RSs who is still sending the broadcast paging message.

If MR-BS has not received the RNG-REQ after the paging retry count decrease to zero, the MR-BS shall startup a new waiting timer, which is based on the transmission delay from the last hop RS to the MR-BS. If the RNG-REQ is not received after the expiration of the timer, the MR-BS regards the MS to be unavailable.

6.3.24.8.2 Location Update Process

Insert the following text after the first paragraph of 6.3.24.8.2:

When MS initiate location update process via Mobile RS, MR-BS may allocate PG ID to MS same as MRS.

Insert the following text after the second paragraph of 6.3.24.8.2:

In the MR-cell, the intermediate RS will relay the RNG-REQ/RSP message between the MR-BS and MS.

6.3.24.9 Network Re-Entry from Idle Mode

Insert the following text after the last paragraph of 6.3.24.9:

In the MR-cell, the intermediate RS will relay the RNG-REQ/RSP message between the MR-BS and MS.

Insert new subclause 6.3.24.10:

6.3.24.10 MRS Paging Group Update

This process is only applicable to MRS. In principle, triggers and process for MRS Paging Group Update is similar to MS location update. However, MS location update is performed in idle mode where as MRS does not have idle mode. MRS shall perform the paging group update procedure with MR-BS when the MRS detects a change in paging group. MRS shall detect the change of paging group by monitoring the paging group identifier, PG_ID, which is transmitted by the preferred BS in the DCD message or MOB_PAG_ADV broadcast message. If the PG_ID detected does not match the Paging Group to which MRS belongs, the RS shall perform the Paging Group update process with MR-BS.

Insert new subclause 6.3.24.10.1:

6.3.24.10.1 Paging Group Update process

If MRS determines to update its location, depending on the security association the MRS shares with the target ~~M~~MR-BS, the MRS shall use one of the two processes: Secure MRS Paging Group Update Process or Unsecured MRS Paging Group Update Process.

Insert new subclause 6.3.24.10.1.1:

6.3.24.10.1.1 Secure Paging Group Update process

If the MRS shares a valid security context with the target BS such that the MRS may include a valid HMAC/ CMAC Tuple in the RNG-REQ, then the MRS shall conduct initial ranging with the target BS by sending a RNG-REQ including Ranging Purpose Indication TLV with Bit #2 set to 1, Paging Group Update Request and RS Paging Group ID TLVs and HMAC/CMAC Tuple. If the target BS evaluates the HMAC/CMAC Tuple as valid and can supply a corresponding authenticating HMAC/CMAC Tuple, and wants to add RS PG_ID to its PG_ID list based on the policy out of the scope of standard, target BS may exchange backbone messages with the other BSs in its PG to request the addition of RS PG_ID to their PG_ID list. Upon successful response from all of the BSs, the target BS shall reply with the RNG-RSP including the Paging Group Update Response TLV and HMAC/CMAC Tuple completing the Paging Group Update process. If the target BS responds with a successful Paging Group Update Response=0x01, Success of Paging Group Update, the target BS shall notify the Paging Controller via the backbone of the MRS new location information, and the Paging Controller may send a backbone message to inform the BSs to which the MRS was earlier attached that the MRS has transitioned to a different Paging Group. If the target BS evaluates the HMAC/CMAC Tuple as invalid, cannot supply a corresponding authenticating HMAC/CMAC Tuple, or otherwise elects to direct the MRS to use Unsecured Paging Group Update, then the target BS shall instruct the MRS to continue network reentry using the Unsecured Paging Group Update process by inclusion of Paging Group Update Response TLV in RNG-RSP with a value of 0x00= Failure of Paging Group Update.

Insert new subclause 6.3.24.10.1.2:

6.3.24.10.1.2 Unsecured Paging Group Update process

For an MRS and target BS that do not share current, valid security context, they shall process Paging Group Update using the Network Re-Entry.

Insert new subclause 6.3.24.10.2:

6.3.24.10.2 Network Re-Entry for MRS Paging Group Update

For the Network Re-Entry, the MRS shall initiate network re-entry with the target BS by sending a RNG-REQ including Ranging Purpose Indication TLV with Bit #2 set to 1, Paging Group Update Request and RS Paging Group ID TLVs.

If the MRS shares a valid security context with the target BS such that the MRS may include a valid HMAC/CMAC Tuple in the RNG-REQ, then the MRS shall conduct initial ranging with the target BS by sending a RNG-REQ including HMAC/CMAC Tuple.

If MRS RNG-REQ includes a Ranging Purpose Indication TLV with Bit #2 set to 1 and Paging Group ID TLVs, and target BS had not previously received MRS information over the backbone, then target BS may make an MRS information request to Paging Controller over the backbone network and Paging Controller may respond. Regardless of having received MRS information from Paging Controller, target BS may request MRS information from another network management entity via the backbone network.

Network re-entry proceeds per 6.3.9.5 except as may be shortened by target BS possession of MRS information obtained from Paging Controller or other network entity over the backbone network. Rest of the network entry procedure for MRS is similar to MS as defined in section 6.3.24.9.

Insert new subclause 6.3.24.10.3:

6.3.24.10.3 MRS Paging Group Update during handover

When MRS enters into the coverage of a new MR-BS and decides to make handover, it may send the MOB_MSHO-REQ message with Paging Group ID parameter to serving MR-BS. serving MR-BS may exchange backbone messages with the other BSs in new PG to request the addition of RS PG_ID to their PG_ID list. Upon successful response from all of the BSs, the target BS shall reply with the MOB_BSHO-RSP message, which contain the Paging Group Response parameter informing whether the Paging Group Update request is accepted. If the MRS can't finish the whole HO initiation process, or this update request is refused, the MRS needs to perform Paging Group Update procedure while network re-entry (as defined in section 6.3.24.10).

Insert new subclause 6.3.25:

6.3.25 Relay path management and routing

Based on the topology information obtained from topology discovery or update process, MR-BS makes centralized calculation for the path between MR-BS and an access RS for both uplink and downlink direction. The path creation is subject to the constraints such as the availability of radio resource, radio quality of the link, load condition of an RS, etc. The path calculation algorithm is out of scope of this specification.

Either embedded path management or explicit path management may be used.

Insert new subclause 6.3.25.1:

6.3.25.1 Embedded Path Management for Relay

When the systematic CID allocation is used, the MR-BS shall update the CID range assigned to its subordinate RSs via the CID_ALLOC-IND message. There are two CID assignment methods: contiguous integer blocks as in Figure xxx.1 (a) and bit partition as in Figure xxx.1 (b). In the bit partition assignment, the MR-BS sets the lowest *k* bits in ascending order to RSs for RSs associated to the MR-BS directly where the maximum number of RSs the MR-BS or a RS could serve is *2k*. For other level-n RSs, which need *n* hops to reach the MR-BS, the MR-BS left shifts *k* bits of its parent CID and sets the lowest *k* bits according to the arriving sequence of the RS.

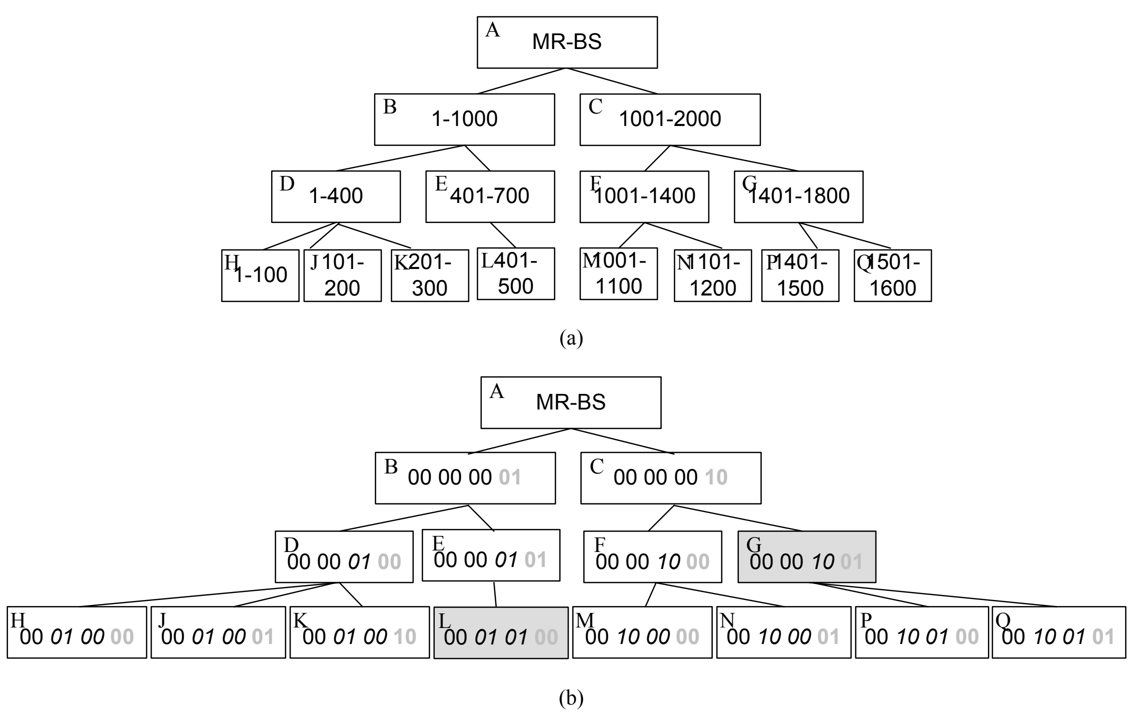


Figure 157a—CID range allocation example, (a) contiguous integer block, (b) bit partition method.

The MR-BS shall be responsible for managing the entire CID allocations within the MR-cell. By assigning systematic CIDs to RSs, the MR-BS already specifies the relay routing path of the connection and is not required to provide end-end signalling. With CID information contained in MAP-IE or MAC header, RS can perform data forwarding to its subordinate RS.

To accommodate temporary topology changes due to mobility or path update, CID encapsulation may be required to route a packet that does not correspond to the routing path implied by the systematic CID assignment. If CID encapsulation is not required, then the packet is transmitted and routed via the embedded path information contained in the systematic CID assignment.

If CID encapsulation is required, the initial packet is taken as payload, and another header is prefixed (i.e., the tunnel header is an MPDU header which carries the T-CID of the tunnel). This is repeated as many times as necessary to reroute a packet that differs from the systematic CID assignment scheme. Packets are relayed depending on the CID in the outermost tunnel header. Once the packet arrives at the egress of the tunnel, the station at the egress removes the tunnel header and relays the payload, which may itself contain another tunnel header.

When a relay station receives a MAC PDU with the CE field set in the MAC header, it shall remove the current MAC header and forward the payload as the new PDU. If CRC is used, the BS calculates the CRC for each packet.

Insert new subclause 6.3.25.2:

6.3.25.2 Explicit Path Management for Relay

After MR-BS discovers the topology between a newly attached MS or RS and itself, or detects a topology update due to events such as mobility, MR-BS may remove an old path, establish a new path and inform the new path information to all the RSs on the path.

When connections are established or removed, MR-BS may distribute the mapping information between the connection and the path to all the RSs on the path. The connection could be a regular connection established for a MS (as defined in 802.16e) or a connection established for a RS (e.g., basic/primary management CID and tunnel connection). The path management procedures are specified below.

Insert new subclause 6.3.25.2.1:

6.3.25.2.1 Path Establishment, Removal and Update

After a new path is discovered and calculated as specified in section 6.3.25.2 and a new MS/RS complete the registration process, MR-BS sends a path establishment command to distribute the path information to all the RSs on that path by sending a DSA-REQ message. The explicit path information and an uniquely assigned path id are included. The CIDs to be routed on this path and their associated service flow parameters are also included for path/CID binding operation.

If DSA-REQ is issued from an access RS, the explicit path path-ID and/or associated CIDs are included in the DSA-RSP message sent from the MR-BS.

If the MR-BS decides to remove an existing path (e.g. after an MRS handover), it sends DSD-REQ message with the Path-ID. The RSs receiving the DSD-REQ message should remove all the information related to the path, including the entry in the routing table, the binding between CIDs to the path, etc.

Upon receiving the DSA/DSD-REQ, the RS performs the operation as requested in the message, and then sends the request to the next RS on the path. The next hop on the path is obtained from the explicit path information included in the DSA/DSD-REQ message, or derived from the path information obtained from previous operation. Such process is repeated until the last RS on the path is reached. The last RS on the path then replies with an DSA/DSD-RSP to the previous hop to report its operation status. The previous hop will update the response with its own operation status and forwards the DSA/DSD-RSP to its previous hop on the path, until it reaches the MR-BS.

The MR-BS may aggregate multiple path management commands into one DSA/DSD-REQ message to save bandwidth. When the paths of different path management commands in the same message divaricates in an RS, the RS separates the path establishment or removal commands into different messages and transmits them to the appropriate next-hop RSs.

The MR-BS may establish the path in the following ways:

- Distributing the complete path information (including ids of all the RSs on the path) to the RSs on path
- Instructing the RSs how to generate the detailed path information based on the existing path. With this approach, each RS on the path forwards the instruction to the next hop RS on the path, as long as the next hop is aware of the existing path information; otherwise, the RS needs to generate the complete or remaining path information and send to the next hop RS. In the second case, when a RS receives a DSA/DSD-REQ message, if there are further hops on the path updated by the DSA/DSD-REQ message, the RS will regenerate a DSA/DSD-REQ message by deleting unused information in the old one, and send it to the next hop RS.

When a new path is determined by MR-BS during MS/RS network entry, relay path management for forwarding the management messages of other MS/RS network entry procedures can be conducted as defined below.

- After processing the RNG-REQ with RS basic CID originated from MS or the RS having the RS basic CID, the MR-BS replies a RNG-RSP with the RS basic CID, associated with relay path information, to RS and may protect the message with HMAC/CMAC tuple using the Group Key associated with the path ID.
- When an RS receives RNG-RSP message with RS basic CID, it may verify the message using the HMAC/CMAC tuple with Group Key. If the message is valid, it should bind with basic CID and primary CID containing in the message with the path ID and start a timer Txx associated with the path ID. If the RS is the endpoint of the path, it should remove the HMAC/CMAC tuple, replace RS basic CID with initial ranging CID, and forward to the MS or RS originating RNG-REQ.
- If Txx expires before the RS receiving DSA-REQ, the RS shall remove the path ID and associated basic CID and primary CID. Otherwise, the RS shall stop Txx when receiving DSA-REQ with the same path ID.

Insert new subclause 6.3.25.2.2:

6.3.25.2.2 CID to Path Binding

A routing table that contains the mapping between a CID and one or more given paths needs to be updated when a new tunnel (identified by a Tunnel CID) is generated between the MR-BS and an access RS, or when a new connection (identified by a individual CID) is established for an RS or MS and the new connection is not put into a tunnel. The MR-BS selects one or more path to carry the traffic for the new connection, and informs all the RSs on the path of the binding between the path id and the supported CIDs by sending a DSA-REQ message to all the RSs on the specified path. Such DSA-REQ message contains the CIDs of the connections that will be routed through the specified path, the path-id and optionally the SFID and the service flow parameter for the connection. If the connection is a tunnel connection, the service flow is the aggregate service flow parameter for all the connections put into the tunnel.

When a RS on the path receives such DSA-REQ message, it retrieves the CIDs and path id information and builds up the routing table, which will be used to route the traffic in the future for the specified CIDs. If the SFID and the QoS requirement are also present for certain connection, the RS saves them for scheduling the traffic for the specified CID. This process is repeated until the last RS along the path is reached. The last access RS then replies with the DSA-RSP.

If the MR-BS decides to cancel an existing binding between a path and one or more CID (e.g., after MS or MRS handover to another RS, or MS deregistration, or service flow deletion), it sends a DSD-REQ message with the Path-Id and the affected CIDs to the associated RSs. The RSs receiving such DSD-REQ should remove the record of the correspondent mapping in the routing table as well as the other context of the affected MS or MRS.

If the MR-BS decides to update the service flow parameter associated with a connection along a specific path, it sends a DSC-REQ message with Path-ID together with the updated service flow parameter. As an example, as new transport connections are included into a tunnel, the MR-BS needs to recalculate the aggregate QoS for the tunnel and distribute the new service flow parameter to every RS on the path by sending a DSC-REQ message.

Upon receiving a DSA/DSC/DSD-REQ, the RS performs the operation as requested in the message, and then sends the request to the next RS on the path. The next hop on the path is obtained from the explicit path information included in message if available, or derived from the path information obtained from previous operation. Such process is repeated until the last RS on the path is reached. The last RS on the path then replies with an DSA/DSC/DSD-RSP to the previous hop to report its operation status. The previous hop will update the response with its own operation status and forwards the DSA/DSC/DSD-RSP to its previous hop on the path, until it reaches the MR-BS.

Multiple DSA-REQ can be sent for the same CID to establish multiple paths to MS. This can be utilized for dynamic switching of traffic among multiple paths based on traffic condition or in case of macro diversity handoff.

The MR-BS may aggregate multiple CID to path binding commands in one DSx-REQ message to save bandwidth. In addition, when a path is established for one or more connection, the CID to path binding/unbinding procedure can be conducted together with path establishment procedure by sending a single DSA-REQ or DSD-REQ to save bandwidth.

Insert new subclause 6.3.25.3:

6.3.25.3 Relaying support for Combined Ranging and Initial Topology Discovery

A combined initial ranging and initial topology discovery procedure can be conducted as defined below:

- When a MS or RS (termed as RSi in this section) conducts its initial ranging, it sends an initial RNGREQ.
- When a selected RS (termed as RSj in this section) receives an initial RNG-REQ, depending on the operational mode (i.e., tunnel or non-tunnel) to be used, the follow procedures apply.
    - If the forwarding mode is non-tunnel, RSj puts its basic CID into MAC header, protects the message with HMAC/CMAC tuple using the security association shared between MR-BS and itself, and then sends it to the MR-BS.

- If the forwarding mode is tunnel, RSj puts a tunnel CID into MAC header, protects the message with HMAC/CMAC tuple using the security association shared between MR-BS and itself, and then sends it to the MR-BS.

- When a RS receives a RNG-REQ message with the CID value not equal to the Initial ranging CID, it simply forwards it to the MR-BS.
- When a MR-BS receives an initial RNG-REQ from a MS or RSi, it determines that the MS or RSi sending the RNG-REQ directly attaches to MR-BS and is just one hop away.
- When a MR-BS receives a RNG-REQ message with the CID set to the basic CID of an RS, it verifies its validity and replaces the basic CID with the initial ranging CID. When a MR-BS receives initial RNG-REQs from a tunnel, it de-caps the tunnel message and handles the initial RNG-REQ one-by-one. MR-BS then determines that the MS or RSi attached to the system via RSj. Since MR-BS is already aware of the topology between RSj and itself, by using the same mechanism as defined in this section, it establishes the topology between the MS or RSi and itself.
- After processing the initial RNG-REQ from MS or RSi, the MR-BS generates a RNG-RSP message. Depending on the forwarding scheme to be used, the follow procedures apply.
    - If the forwarding mode is non-tunnel, MR-BS uses the basic CID of RSj in the MAC header, protects the message with HMAC/CMAC tuple using the security association shared between RSj and itself, and sends RNG-RSP to RSj.
    - If the forwarding mode is tunnel, MR-BS uses tunnel CID of RSj in the tunnel header, then sends the response to RSj.
- When a RS receives RNG-RSP message with the CID value not equal to the Initial ranging CID, it simply forwards it to target station.
- When a RS receives a RNG-RSP message with its basic CID, it replaces it with the initial ranging CID. When a RS receives initial RNG-REQs from a tunnel, it de-caps the tunnel and get all the individual RNG-RSP messages. It then further sends the individual RNG-RSP to the MS/RS accordingly.

Insert new subclause 6.3.25.4:

6.3.25.4 R-link monitoring and reporting procedure for relay path management

Computation at the MR-BS of the end-to-end route quality metric for the multihop path between the MR-BS and an RS in its cell may, optionally, be enabled. Optionally, the stability of link quality may be considered as a metric for multihop path selection. A route quality metric may be derived at the MR-BS based on link measurements obtained from a CQI fast-feedback channel (CQICH) and/or from a REP-RSP message carrying an R-link TLV.

In the case of centralized scheduling, MR-BS may allocate CQICH to an RS in its cell for reporting CQI on DL transmissions originating at RS's ancestor RS or MR-BS. Allocation of CQICH for RSs is performed in the relay zone.

In the case of distributed scheduling, MR-BS and each RS in an MR cell may allocate CQICH to a downstream RS. Allocation of CQICH for an RS is performed in the relay zone.

To report R-UL, R-DL and R-Link neighbor measurements, REP-RSP messages with R-Link TLV may optionally be used. An MR-BS may send a REP-REQ message to an RS in its cell requesting RSSI mean and standard deviation or CINR mean and standard deviation measurements. The RS may respond with a REP-RSP message containing R-Link TLV and requested measurements. MR-BS may use the reported measurements for route quality calculations, and optionally for computing the stability of a route.

Insert new subclause 6.3.25.4.1:

6.3.25.4.1 Access-link monitoring and reporting procedure for MS path management

Computation at the MR-BS of the overall quality metric for the multihop path between the MR-BS and an MS in its cell may, optionally, be enabled. The multihop path between the MR-BS and an MS can be decomposed into two path segments. The first path segment is the multihop path between the MR-BS and the access RS of the MS. The second path segment is the access link between the MS and the access RS. To enable routing metric computation at the MR-BS, R-link metrics shall be reported to the MR-BS in REP-RSP message containing R-Link TLV, and access link metrics may optionally be reported to the MR-BS in the REP-RSP message containing Access-Link TLV. The REP-RSP message may be sent to the MR-BS in response to REP-REQ message or by sending an unsolicited REP-RSP message. Access-link measurements at an MS may optionally be triggered by sending a MOB_SCN-RSP message (Section 6.3.2.3.49) to the MS. The access-link measurements shall be reported by the MS to the access RS or MR-BS in the MOB_SCN-REP message (Section 6.3.2.3.50).

To enable DL CQI reporting, MR-BS may allocate CQICH to MSs in its cell. CQICH is allocated in the access zone on the access link hop, and may optionally be allocated in the relay zone on subsequent hops. Therefore, an RS may send to MR-BS CQI received from an MS in the access zone through a corresponding CQICH in the relay zone. A fast feedback region for reporting MS CQI values in the relay zone to the MR-BS may be allocated by sending, in a unicast manner, a FAST-FEEDBACK allocation IE (subclause 8.4.5.4.9) to an RS. Fast feedback slot assignments in this region shall be the same as those in the CQI fast feedback region in the RS access zone.

The UL and DL routes may optionally be different for the same MS.

Insert new subclause 6.3.25.5:

6.3.25.5 Connection management for multicast and broadcast services

The MR-BS may initiate a multicast distribution tree for the MBS. When a MS wants to initiate a MBS, it sends a DSA-REQ message to MR-BS to specify that it wants the MBS. The procedures for establishing multicast distribution tree are as follows.

When a MR-BS initiates a MBS or receives a MBS request from a MS, it checks whether the requested MBS has been created. If not, the MR-BS creates a multicast distribution tree for this MBS and allocates a multicast CID (MCID) to it. The MR-BS also determines the path(s) to carry this multicast service flow. The MR-BS creates the mapping between the determined path and the MCID. The MR-BS informs all the RSs on the path of the binding between the path ID and MCID by sending a DSD-REQ message along path as specified in Section 6.3.25.2. Each RS along the path stores the path ID and MCID binding information for forwarding multicast data with the MCID. The MR-BS adds this path to the multicast distribution tree and records the number and identification information of the MSs using the path for multicast communications. A multicast distribution tree may consist of multiple paths.

If the multicast distribution tree has been created and an MCID has been allocated to this MBS, the MR-BS determines the path to carry this multicast service flow. If the path is not in the multicast distribution tree, the MR-BS creates the binding between the determined path and the MCID. The MR-BS distributes the path and MCID binding information to all the RSs along the path. The MR-BS adds this path to the multicast distribution tree and record the number and identification information of the MSs using the path for the multicast communications. If the path is already in the multicast distribution tree (due to the prior establishment of MR-BS or the request of another MS using the same path), the MR-BS simply updates the number and identification information of the MSs using the path for the MBS in the multicast tree.

A path may be removed from a multicast distribution tree by the MR-BS. When a MS needs to leave the multicast service, the MS sends a DSD-REQ to the MR-BS to request removing it from the multicast service flow. The MR-BS first updates the number and identification information of the MSs that are receiving the

MBS along the path to this requesting MS. The MR-BS determines whether the path can be removed from the tree MCID. If no more MSs uses this path for the MBS, the path may be removed from the multicast distribution tree. Otherwise, the path shall not be removed from the multicast distribution tree. If the path is removed from the tree-MCID then the MR-BS removes the binding between the path and the MCID by sending a DSD-REQ along path as specified in Section 6.3.25.2.

When the parameters for a multicast service flow change, a MR-BS or MS may also sends a DSC-REQ message to update these changes. All the RSs in the multicast distribution tree of the MBS are informed of these changes. This is achieved by MR-BS sending a DSC-REQ message to all of the RSs along all the paths in the multicast distribution tree as specified in Section 6.3.25.2.

Insert new subclause 6.3.26:

6.3.26 Relay station neighborhood discovery

During the RS neighborhood discovery procedure, the potential RS can obtain its neighbor information during PHY synchronization before initial ranging. Therefore, it can send the report to MR-BS after RNG-REQ, SBC-REQ or REG-REQ. Then, the RS sends a RS_NBR-MEAS-REP message (6.3.2.3.68) back to the MR-BS to response the measurement report.

When a RS newly deployed into a MR network, it can act as a SS/MS and scan the preamble transmitted by the existing stations before network entry. The RS can report its initial neighborhood discovery and measurement results to MR-BS by RS_NBR-MEAS-REP (6.3.2.3.68). The neighboring station list may be instructed by MR_NBR-INFO (6.3.2.3.63). Because not every RS will transmit its own preamble and the existing RSs in MR network need to perform measurement over the new RS, MR-BS can instruct the RSs to perform complete neighborhood discovery:

There are two methods to carry out neighborhood measurements. One method uses the repeatable R-amble transmission and monitoring method described in Section 8.4.6.1.1.4. After that the measurements can be sent to the MR-BS using the message RS_NBR-MEAS-REP (6.3.2.3.66) or using any other appropriate measurement report messages. The other method for measurement uses a pre-planned scheme which is described below.

First, the MR-BS sends the RS_Config-REQ message to the RSs which will be involved in the neighborhood discovery mechanism, and the message is either sent by the broadcast, multicast or unicast CID for these RSs. The 8 LSB bits of frame number shall be set to instruct the starting time to the RSs. If the RSs involved in this mechanism are in different MR-cell, each of the Start Frame Number sent by different MR-BSs shall synchronize to the same frame time. The Prefix shall be set "00" and attach the transmit/receive pattern for each iteration.

Second, the stations follow the instruction to transmit/receive the R-amble at the designated frames in each iteration.

Third, the RSs report the RSSI or CINR with corresponding amble index by RS_NBR-MEAS-REP to MR-BS.

Note that this mechanism can also be applied to the RSs during normal operation. So that the R-amble can be transmitted in relay zone when necessary.

Insert new subclause 6.3.27:

6.3.27 Interference measurement for MR

This subclause describes a measurement and reporting procedure with supported messaging mechanism to estimate the interference level in MR network.

Insert new subcluase 6.3.27.1:

6.3.27.1 Interference prediction by RS neighborhood measurement

In order to predict the interference or SINR of the radio links for different MR network topology and radio resource reuse pattern, the following prediction method may be considered based on the RSSI reported by RS_NBR-MEAS-REP message (see 6.3.2.3.68).

1. Prediction of the interference plus noise power received by node #i: The interference plus noise may be the summation of (1) the thermal noise plus background interference power received by node #i and (2) the signal power not intended to be received by node #i but transmitted by the same radio resource.

2. Prediction of the received SINR of node #i: The SINR may be the ratio of "the total signal power destined to node # i" to "the interference plus noise power obtained in Step 1".

Insert new subcluase 6.3.27.2:

6.3.27.2 Optional interference detection and measurement by RS sounding

As an option, the path loss and interference between multiple RSs and the MR-BS can be estimated using the UL sounding mechanism (8.4.6.2.7). In order to predict the interferences between different RS cells, the MRBS needs to collect the interference measurements from the related RSs and possibly from their associated MSs. The interference can be estimated by having one or multiple RSs or MSs transmit UL sounding signals at specific sounding zones and having the other related RSs and BSs measure the related CINR or RSSI of the received sounding signals. An MR-BS may construct a multicast group within its MR-cell which uses a multicast CID to represent the group of the RSs that participate in the interference measurement. Alternatively multiple unicast messages can be sent. This group is called RS_interference_measurement group and shall be setup before any measurement of UL sounding signals by the group. The interference measurement procedure is controlled by the MR-BS for intra-MR-cell interference measurement. For interference measurement performed across clusters of MR-cells, a network control entity is required to coordinate the measurement activities across the MR-cells.

The interference measurement operation within an MR cell is as follows: the MR-BS sends an REP-REQ message to its RS_interference_measurement group. The REP-REQ carries the reporting period, start frame number and the type of measurement reports (either CINR or RSSI). MR-BS sends UL_Sounding_Command_IE to RS_interference_measurement_group as a multicast burst. The MR-BS shall also transmit PAPR_Safety_and_Sounding_Zone_Allocation_IE. When an RS receives such an REP-REQ, it expects to hear the Sounding zone allocation IE (8.4.5.4.2) starting from the start frame number until the time indicated in the TLV of report period in the REP-REQ message. If an RS specified by the multicast CID in PAPR_Safety_and_Sounding_Zone_Allocation_IE, and indicated by CID in the UL_Sounding_Command_IE, the RS shall transmit the sounding signal at the specified symbol and subcarriers as instructed by the MR-BS. Otherwise, the RSs belonging to the RS_interference_measurement_group shall measure the sounding signals if they are not scheduled to transmit sounding signals in the same symbol. The scheduling of RS Sounding zone allocation IEs by MR-BS is implementation specific.

The sounding signal sent from different RSs and different MSs can be multiplexed in the same sounding zone. This can be done when the MR-BS or RS serving the MS sends to the MS a separate UL_Sounding_Command_IE with instruction of the sounding signal that may be sent by the MS. The measurement and reporting procedure of the MS UL sounding signal by the RSs in the

RS_interference_measurement_group remains the same as the RS sounding procedure. The average measurement results are reported. After an MR-BS receives the REP-RSP from all the RSs in its RS_interference_measurement_group, it shall forward it to the network control entity.

When interference across different MR-cells needs to be estimated, the above UL sounding procedure shall be conducted with the coordination of a network control entity which controls multiple BSs. In this case the network control entity shall coordinate the multiple BSs to send PAPR_Safety_and_Sounding_Zone_Allocation_IE and UL_Sounding_Command_IE to their respective RS_interference_measurement_groups and MSs for conducting UL sounding measurement across MR-cells. When the RS sounding signal is to be sent by an RS in one of the MR-cells, the same PAPR_Safety_and_Sounding_Zone_Allocation_IE and UL_Sounding_Command_IE shall be duplicated and sent in the other MR cells, so the RSs in these other cells will conduct measurement on the UL sounding signal.

Insert new subclause 6.3.28:

6.3.28 Messages and data relaying

Insert new subclause 6.3.28.1:

6.3.28.1 RS broadcast message relaying

A non-transparent RS shall broadcast DCD, UCD, DL-MAP and UL-MAP messages in the DL access zone, which may be generated by the MR-BS and be sent in the relay zone. The MR-BS should send DCD and UCD messages with RS primary CID, and DL-MAP and UL-MAP messages with RS basic CID to the RS.

Upon receiving the DCD/UCD message with RS primary CID, the RS shall broadcast the DCD/UCD message with fragmentable broadcast CID.

Upon receiving the DL-MAP/UL-MAP message with RS basic CID, the RS shall broadcast the DL-MAP/UL-MAP message with broadcast CID.

Insert new subclause 6.3.28.1.1:

6.3.28.1.1 Fragmentable broadcast message relaying

In MR networks, each RS would be assigned the different DCD/UCD message with the same configuration change count. In this case, each DCD/UCD message may be separated into the common part and the specific part before fragmentation. The common part shall be packed with multicast management CID, and the receiving RS shall buffer the common part until receiving the specific part which shall be packed as a new DCD/UCD message with the RS primary management CID. In the specific part, the message type field, reserved field and configuration change count field shall be the same as the associated common part. The receiving RS shall restructure the common part and the associated specific part to a complete DCD/UCD message, and then broadcast the message with Fragmentable Broadcast CID.

Insert new subclause 6.3.29:

6.3.29 RS service end

In MR networks, an RS may end its service and be removed from the networks. During RS service-end process, all subordinate MSs of the RS should be transferred to another RS or MR-BS prior to RS deregistration. An RS shall transmit DREG-REQ to an MR-BS so that it initiates service-end procedure and requests handover of all its subordinate MS's. Upon receiving DREG-REQ, the MR-BS decides whether it allows the RS service-end. If the request is accepted, the MR-BS may transmit DREG-CMD to inform the acceptance and start BS-initiated handover process for the requested MSs. After handover procedures between the MR-BS and its subordinate MSs are completed, the MR-BS informs the RS that handover is completed by transmitting DREG-CMD. Upon receiving DREG-CMD, the RS starts deregistration process.

If the MR-BS rejects the request (Action Code = 0x06), the MR-BS informs the RS rejection of the request by transmitting DREG-CMD. Upon receiving DREG-CMD with rejection information, the RS continues normal operation. After REQ-duration expires, the RS retransmits DREG-REQ to the MR-BS.

7. Security sublayer

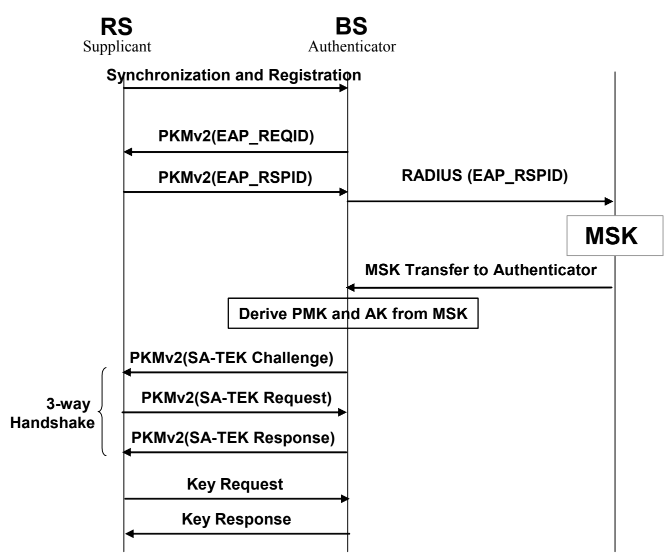
7.1 Architecture

Insert the following at the end of 7.1:

In multihop relay system, RS uses the same security architecture and procedures as an SS to provide privacy, authentication and confidentiality between itself and the MR-BS.

In IEEE 802.16e PKMv2 specification, MS uses the PKM protocol to obtain authentication and traffic keying material from BS, and to support re-authentication and key refresh. Either mechanism is applicable to the RS authentication within the MR relay network as depicted in the following diagram.

Table 220b—[INSERT TITLE]

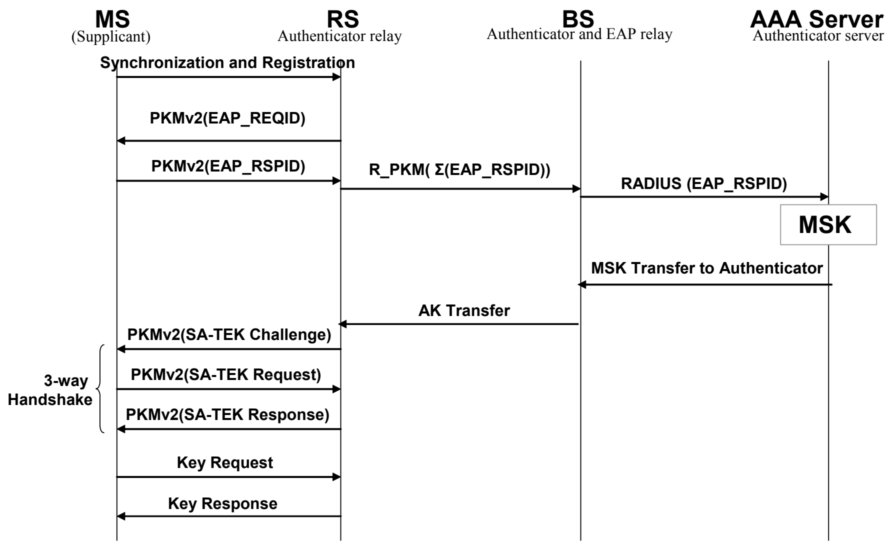


During the registration process, RS could be registered as Authenticator Relay(AR) RS based on its capability and willingness to become the AR RS.

When a downstream RS or a MS imitates its authentication request to the AR RS, each RS/MS presents its credentials which will be an unique X.509 certificates issued by manufacturer or by external authority(if RSA PCKS#1 is chosen) or an operator specific credentials(in the case of EAP based authentication) The AR RS will intercept the downstream MS/RS's authentication request and envelop the PKM request to Aggregated PKM messages and send towards the authenticator BS.. It's optional for the AR RS to aggregate the PKM Req/Rsp from multiple downstream RSs or MSs for more efficient transmission. The PKM messages transmitted between RS and the BS will be protected by the HMAC / CMAC tuple calculated from AR RS's HMAC_KEY_U/D or CMAC_KEY_U/D.

When the MSK for the downstream RS/MS is granted and sent to the authenticator BS, where the PMK and AK will be derived from MSK. Thereafter the AK will be sent over the relay link to RS, the AK will be encrypted by the secret between AR RS and BS.

Table 220c—[INSERT TITLE]



Insert new subclause 7.1.6:

7.1.6 Centralized Security Control in Multihop Relay System

With centralized security control residing in the MR-BS in the multihop relay system, the security association is established between MS and MR-BS without the involvement from the intermediate RS. RS does not try to decrypt the user data or authenticate the MAC management message it receives from the MS, but simply relays it.

Similar to other MAC management messages, all the PKM messages are exchanged between MS and MR-BS. For the PKM messages that are not protected by the message authentication code from the MS (termed as non-MS-authenticated PKM messages, e.g., Authorization Request, Authorization Reply, PKMv2 RSA-Request, PKMv2 RSA-Reply), the following procedure may be applied. For all the other cases, the access RS and the intermediate RSs just simply relay the PKM messages.

- - Upon receiving a non-MS-authenticated PKM message, the access RS may add the HMAC/CMAC tuple based on the SA established between itself and the MR-BS into the message.
- - Upon receiving a non-MS-authenticated PKM message with the presence of HMAC/CMAC tuple, the MR-BS authenticates the message based on the shared SA between itself and the access RS.
- - When the MR-BS generates a non-MS-authenticated PKM message to the MS, it may add the HMAC/CMAC tuple based on the SA established between itself and the access RS.
- - Upon receiving a non-MS-authenticated PKM message with the presence of HMAC/CMAC tuple, the access RS authenticates the message based on the SA between itself and MR-BS. If the message is valid, it then removes the HMAC/CMAC tuple, and then sends the PKM message to the MS.

All the keys are stored and maintained at the MS and MR-BS, and RS doesn't have any key information associated with the MS.

7.2 PKM protocol

7.2.2 PKM Version 2

7.2.2.2 Key derivation

7.2.2.2.9 Message authentication keys (HMAC/CMAC) and KEK derivation

Change subclause 7.2.2.2.9 as indicated:

MAC (message authentication code) keys are used to sign management messages in order to validate the authenticity of these messages. The MAC to be used is negotiated at SS Basic Capabilities negotiation.

There is a different key for UL and DL messages. Also, a different message authentication key is generated for a multicast message (this is DL direction only) and for a unicast message.

In general, the message authentication keys used to generate the CMAC value and the HMAC-Digest are derived from the AK.

The keys used for CMAC key and for KEK are as follows:

CMAC_KEY_U | CMAC_KEY_D | KEK <= Dot16KDF(AK, SS MAC Address | BSID | "CMAC_KEYS+KEK", 384)

CMAC_KEY_GD <= Dot16KDF(GKEK, "GROUP CMAC KEY",128) (Used for multicast MAC message such as a PKMv2 Group-Key-Update-Command message and downlink unicast MAC message sent between RSs within the same security zone)

CMAC_KEY_GU <= Dot16KDF(GKEK, "GROUP CMAC KEY", 128) (Used for uplink unicast MAC message sent between RSs within the same security zone).

The keys used for HMAC key and for KEK are as follows:

HMAC_KEY_U | HMAC_KEY_D | KEK <= Dot16KDF(AK, SS MAC Address | BSID | "HMAC_KEYS+KEK", 448)

HMAC_KEY_GD <= Dot16KDF(GKEK, "GROUP HMAC KEY", 160) (Used for multicast MAC message such as a PKMv2 Group-Key-Update-Command message and downlink unicast MAC message sent between RSs within the same security zone)

HMAC_KEY_GU <= Dot16KDF(GKEK, "GROUP HMAC KEY", 128) (Used for uplink unicast MAC message sent between RSs within the same security zone).

Exceptionally, the message authentication keys for the HMAC/CMAC Digest included in a PKMv2 Authenticated-EAP-Transfer message are derived from the EIK instead of the AK

The keys used for CMAC key and for KEK are as follows:

CMAC_KEY_U | CMAC_KEY_D <= Dot16KDF(EIK, SS MAC Address | BSID | “CMAC_KEYS”, 256)

The keys used for HMAC key and for KEK are as follows:

HMAC_KEY_U | HMAC_KEY_D <= Dot16KDF(EIK, SS MAC Address | BSID | “HMAC_KEYS”, 320)

Insert new subclause 7.2.2.6:

7.2.2.6 Aggregation of Authentication Relay Protocol

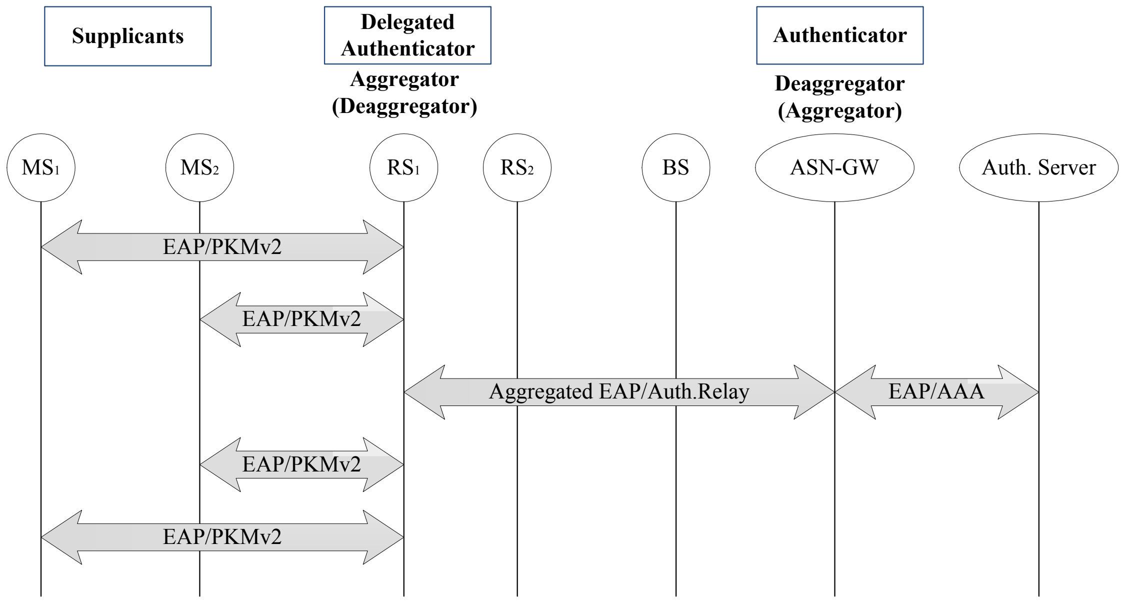
The end-to-end authentication structure is depicted as that the authentication protocols between Supplicant (i.e., MS) and Auth. Relay (AR, i.e., BS) is Extended Authentication Protocol/Privacy Key Management version 2 (EAP/PKMv2) protocol, between BS and ASN-GW is the EAP/Auth.Relay protocol, and between ASN-GW and Authentication Server (AS) is EAP/AAA protocol. By inheriting from legacy end-to-end authentication structure, access RS shall be acted like an AR. In other words, access RS shall perform the transformation between EAP/PKMv2 and EAP/Auth.Relay protocols, whereas the BS need not do the transformation again.

Transmitting authentication message flow for each RS or MS will consume bandwidth resource and even block the MR network due to precious radio resource for relaying. Therefore, in this contribution, we propose to aggregate authentication messages for several MSs or RSs. As shown in Fig. 7, the access RS (RS1) acts as an aggregator, whereas the ASN-GW acts like a deaggregator and vice versa. The access RS can collect some PKMv2 messages from several different MSs or RSs within a given period T and aggregate them for forwarding to ASN-GW. Here the period T shall be less than the re-authentication interval defined for each MS or RS. The aggregations are done as following ways.

Table 226a—[INSERT TITLE]

EAP/PKMv2 (MS <-> AR)	Aggregation	Aggregated EAP/Auth. Relay (AR <-> ASN-GW)
PKMv2 EAP Start	------------>	Aggregated Authentication Relay EAP Start
PKMv2 EAP Transfer	------------>	Aggregated Authentication Relay EAP Transfer
PKMv2 Authenticated EAP Start	------------>	Aggregated Authentication Relay Authenticated EAP Start
PKMv2 Authenticated EAP Transfer	------------>	Aggregated Authentication Relay Authenticated EAP Transfer

Table 226b—[INSERT TITLE]



7.3 Dynamic SA creation and mapping

7.4 Key usage

Insert new subclause 7.4.3:

7.4.3 Security zone key (SZK) for multihop relay

The SZK is a group key shared by the MR-BS and a group of RS within the same security zone. The membership of the security zone (i.e., which security zone(s) a RS should be belong to) is determined by the MR-BS. The SZK is used to authenticate the MAC management messages transmitted over the relay links. The SZK is randomly generated by the MR-BS and used as the GKEK to compute the HMAC/CMAC as defined in section 7.2.2.2.9. SZK is distributed by the MR-BS to a RS after the RS gets authenticated during initial network entry, using the same key distribution procedure defined for the GKEK distribution.

Insert new subclause 7.4.3.1:

7.4.3.1 SZK exchange

The TEK exchange 3-way handshake procedure specified in the PKMv2 is used for MR-BS to distribute the SZK to the RSs within one security zone.

7.5 Cryptographic methods

7.5.4 Derivation of TEKs, KEKs, and message authentication keys

7.5.4.4 Cipher-based MAC

7.5.4.4.1 Calculation of CMAC value

Insert the following after the second paragraph of 7.5.4.4.1:

For an authentication unicast message transmitted between RSs within the same security zone, a CMAC_KEY_GU and CMAC_KEY_GD shall be used. The group authentication key is derived from GKEK, which is the same as SZK.

7.6 Certification profile

7.7 Pre-Authentication

7.8 PKMv2

8. PHY

8.4 WirelessMAN-OFDMA PHY layer

8.4.1 Introduction

8.4.4 Frame structure

8.4.4.2 PMP frame structure

Insert the following text at the end of 8.4.4.2:

In TDD and H-FDD systems, relay station allowances shall be made by an RSRTG and by an RSTTG. The relay station shall not transmit downlink information to a subordinate station later than RSTTG-RTD/2 before the beginning of a received mode DL relay zone . The relay station shall not receive uplink information from a subordinate station later than RSRTG+RTD/2 before the beginning of a transmit mode UL relay zone. The parameters of RSRTG and RSTTG are capabilities provided by the RS to MR-BS upon request during RS network entry (see 11.8.3.1).

8.4.4.5 Uplink transmission allocations

Change subclause 8.4.4.5 as indicated:

The BS and RS shall not allocate more than three ranging allocation IEs (UIUC 12) per frame in the access zone, one for initial ranging/handover ranging (Dedicated ranging indicator bit in UL-MAP IE is set to 0 and Ranging Method is set to 0b00 or 0b01), one for bandwidth request/periodic ranging (Dedicated ranging indicator bit in UL-MAP IE is set to 0 and Ranging Method is set to 0b10 or 0b11), and one for initial ranging for the paged MS and/or coordinated association (Dedicated ranging indicator bit in UL-MAP IE is set to 1).

Insert new subclause 8.4.4.7:

8.4.4.7 Frame structure of MR-BS and RS

This section describes the minimal requirements for an in-band frame structure for a MR-BS and its subordinate RS.

Insert new subclause 8.4.4.7.1:

8.4.4.7.1 Frame structure for transparent mode

Insert new subclause 8.4.4.7.1.1:

8.4.4.7.1.1 MR-BS frame structure

For the TDD mode, an example of the MR-BS frame structure is shown in Figure xxx.

Each frame in the downlink transmission begins with a preamble followed by an FCH, DL-MAP, and possibly UL-MAP. R-MAP is located following MAP or defined as an extension of MAP. The frame structure consists of DL sub-frame period and UL sub-frame period. In each frame, the TTG shall be inserted between the DL sub-frame and the UL sub-frame. The RTG shall be inserted at the end of each frame.

The common ranging subchannel is shared by all RSs and MSs within one MR-cell.

The DL sub-frame shall include at least one access zone and may include one transparent zone for RS to subordinate station transmissions. The MR-BS may also transmit in the transparent zone as well. The transparent zone shall be indicated by an STC_DL_ZONE_IE(), as defined in Table 279. The UL sub-frame may include an access zone and may include a relay zone for RS to superordinate station transmissions.

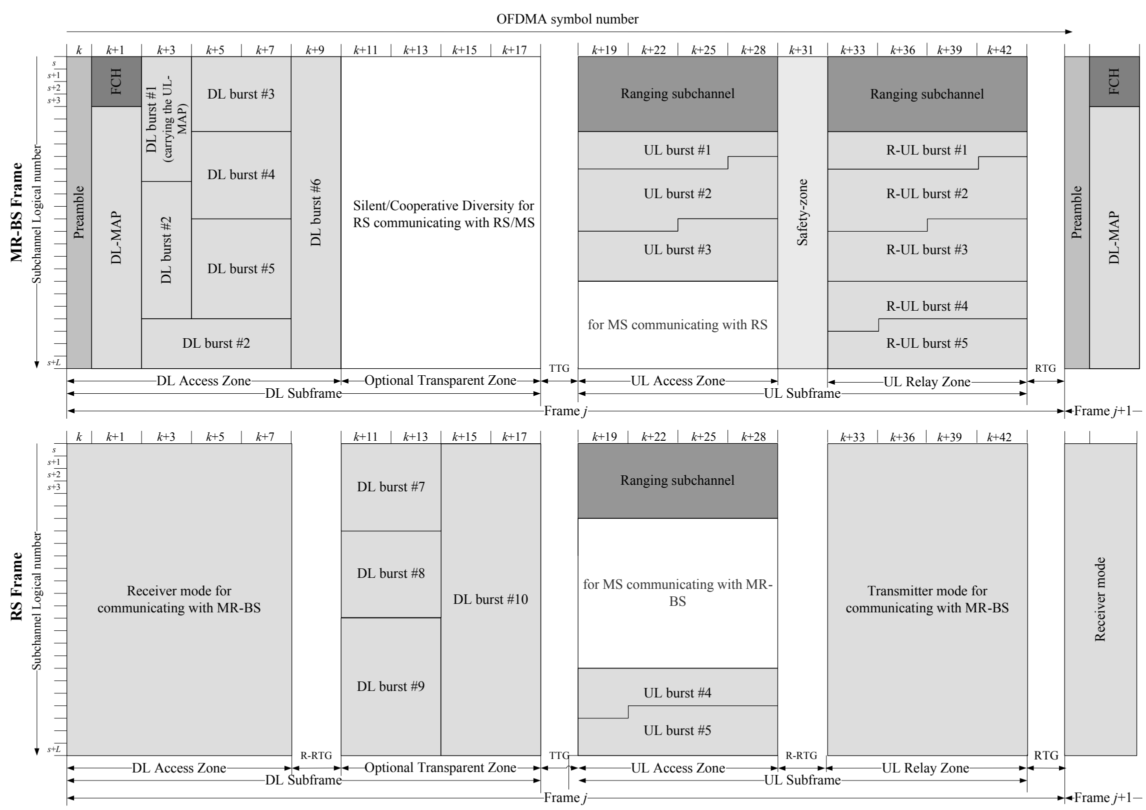


Figure 270a—Example of configuration for an in-band transparent relay frame structure

Insert new subclause 8.4.4.7.1.2:

8.4.4.7.1.2 Relay frame structure

For the TDD mode, an example of an RS frame structure is shown in Figure xxx.

A transparent RS does not transmit the preamble, FCH and MAP at the beginning of the frame. Instead it receives the preamble, FCH and MAP and optional R-MAP transmission from MR-BS. The detailed allocation for RS can be indicated by MAP or R-MAP. The signaling method shall be negotiated during the RS network entry procedure. In each frame, a TTG shall be inserted between the DL sub-frame and the UL sub-frame. An RTG shall be inserted at the end of each frame.

The DL sub-frame shall include one access zone for MR-BS to RS and MS transmissions and may include one transparent zone for RS to subordinate station transmissions. The UL sub-frame may include one access zone and may include one relay zone for RS to superordinate station transmissions. The ranging channel is shared by RS and MS. Optionally, an RS amble may be transmitted.

If the RS switches from transmission to reception mode, an R-TTG shall be inserted. If the RS switches from reception to transmission mode, an R-RTG shall be inserted.

Insert new subclause 8.4.4.7.2:

8.4.4.7.2 Frame structure for non-transparent mode

For the case where MR-BS supports two-hop relay, the DL and UL subframes shall include at least one access zone and may include one or more relay zones to enable RS operating in either transmit or receive mode.

Two approaches for supporting more than two hop relaying are specified. An RS shall be capable of being configured to support either one of the operations, but shall not be required to support both operations simultaneously.

The first approach allows one or more RS or MR-BS frames to be grouped into a multi-frame with a repeating pattern of allocated relay zones. The MR-BS and RSs are assigned to transmit, receive or be idle in each of the relay zones within the multi-frame. As an example, a two-frame multi-frame can be used to assign odd hop RSs to transmit in the DL relay zone of odd number frames and the MR-BS and even hop RSs to transmit in the DL relay zone of even number frames.

The second approach enables a single-frame frame structure consisting of more than one Relay zones. The MR-BS and RSs are assigned to transmit, receive, or be idle in each relay zone within the frame. As an example, the odd hop RSs can be assigned to transmit in one DL relay zone, while the MR-BS and even hop RSs can be assigned to transmit in another DL relay zone.

Insert new subclause 8.4.4.7.2.1:

8.4.4.7.2.1 MR-BS frame structure

For the TDD mode, an example of the MR-BS frame structure is shown in Figure 270b.

Each MR-BS frame begins with a preamble followed by an FCH and the DL MAP and possibly UL MAP. The DL sub-frame shall include at least one DL access zone and may include one or more DL relay zones. The UL sub-frame may include one or more UL access zones and it may include one or more UL relay zones. A relay zone may be utilized for either transmission or reception but the MR-BS shall not be required to support both modes of operation within the same zone. In each frame, the TTG shall be inserted between the DL sub-frame and the UL sub-frame. The RTG shall be inserted at the end of each frame. In the DL access zone, the subchannel allocation, the FCH transmission, and the FCH shall be defined as in Section 8.4.4.2.

The first transmitted relay zone in the downlink shall include an R-FCH and an R-MAP. In the DL relay zone, the subchannel allocation may be the same as that in the DL access zone.

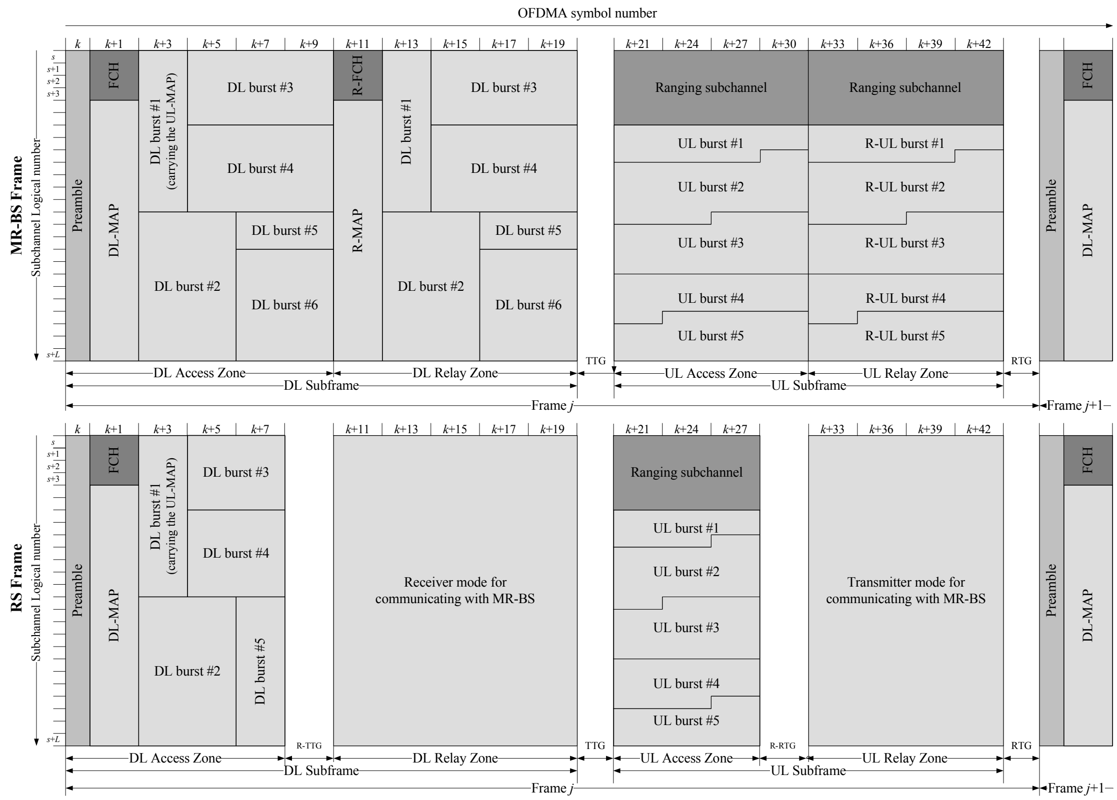


Figure 270b—Example of minimum configuration for an in-band non-transparent relay frame structure

Insert new subclause 8.4.4.7.2.2:

8.4.4.7.2.2 Relay frame structure

For the TDD mode, an example of an RS frame structure is shown in Figure 270b .

The RS transmits its frame start preamble time aligned with its serving MR-BS frame start preamble.

The UL sub-frame of the RS is aligned to the UL sub-frame of the MR-BS.

The DL sub-frame shall include at least one DL access zone and may include one or more relay zones. An R-TTG may be placed between a DL access zone and a DL relay zone and an R-TTG or R-RTG may be place between two adjacent DL relay zones.

The UL sub-frame may include one or more UL access zones and one or more relay zones. An R-RTG may be placed between a UL access zone and a UL relay zone and an R-TTG or R-RTG may be inserted between two adjacent UL relay zones.

A relay zone may be utilized for either transmission or reception but the RS shall not be required to support both modes of operation within the same zone.

If the relay station switches from transmission to reception mode, an R-TTG may be required. If the relay station switches from reception to transmission mode, an R-RTG may be required. There may be more than one R-TTG and more than one R-RTG inserted in the RS frame. In each frame, the TTG shall be inserted between the DL sub-frame and the UL sub-frame. The RTG shall be inserted at the end of each frame.

The contents of the FCH, DL-MAP and UL-MAP in the Relay Frame may be different from those in the MR-BS frame.

Each RS frame begins with a preamble followed by an FCH and the DL-MAP and possibly a UL-MAP. In the DL access zone, the subchannel allocation, the FCH transmission, and the FCH shall be as defined in Section 8.4.4.2.

The R-FCH and the R-DL-MAP shall be transmitted in the first DL Relay zone that is in Tx mode.

The MR-BS or RS shall transmit the Relay_Frame_configuration_message in the DL relay zone for the subordinate RSs to configure the multihop relay frame structure.

For synchronization purpose, the relay amble, when present, shall be located either at the end of the last DL relay zone in which MR-BS/RS is in transmit mode or at the end of the DL subframe. For monitoring purpose, the relay link amble, when present, shall be located at the end of the DL subframe. An R-TTG or R-RTG may be inserted before relay amble.

Insert new subclause 8.4.4.7.2.3:

8.4.4.7.2.3 Optional AAS relay zone frame structure

For reference, the MR-BS to RS frame construction for non-transparent relay is illustrated in Figure xxx of Section 8.4.4.7.2.1 showing the relay zone for the downlink and the relay zone for the uplink. The AAS relay zone is a zone within the relay zone of the referenced figure.

Figure 5 shows an expanded view of these same zones using the AAS relay zone frame structure with zone “A” part of DL relay zone and zone “B” part of the UL relay zone. Figure 5 is shown with the AAS relay zone Type field set to the Direct Signaling Method. In this case, the AAS zone uses the AMC subchannel permutation and either the 2 bin x 3 symbol or 1 bin x 6 symbol construction. Figure 6 the 2 x3 or 1 x 6 slot construction complete with the preamble allocation . The permutation and slot construction is signaled in the AAS_Relay Uplink_IE and AAS_Relay_Downlink_IE. The AAS relay zone Access Channel is defined to be 1 or more subchannels starting at subchannel 0 for both the uplink and downlink. Subchannel 0 is paired with subchannel n-1-k where n is the total number of subchannels and k is the number of subchannels designated in the IE. Two repetitions of the AAS preamble and data are used in the subchannel pair to aid robust reception via signal processing methods (i.e. diversity combining).

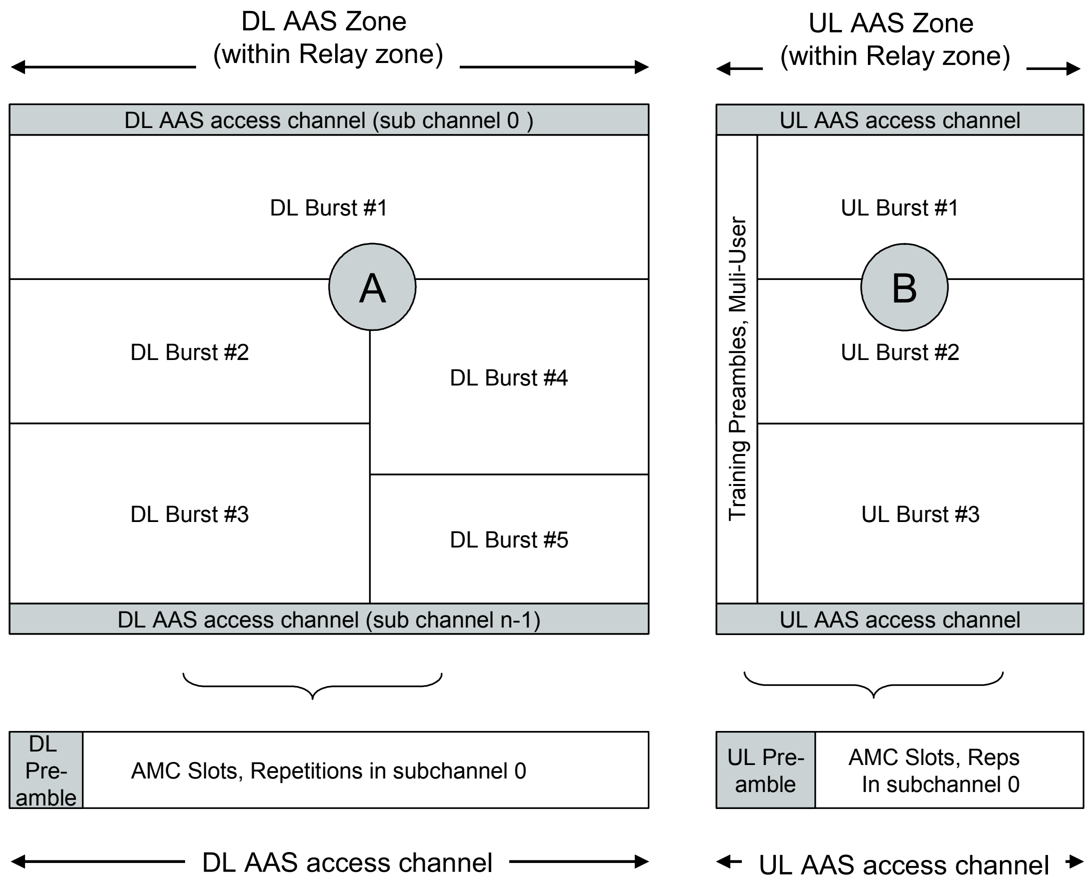


Figure 270c—AAS relay zone construction

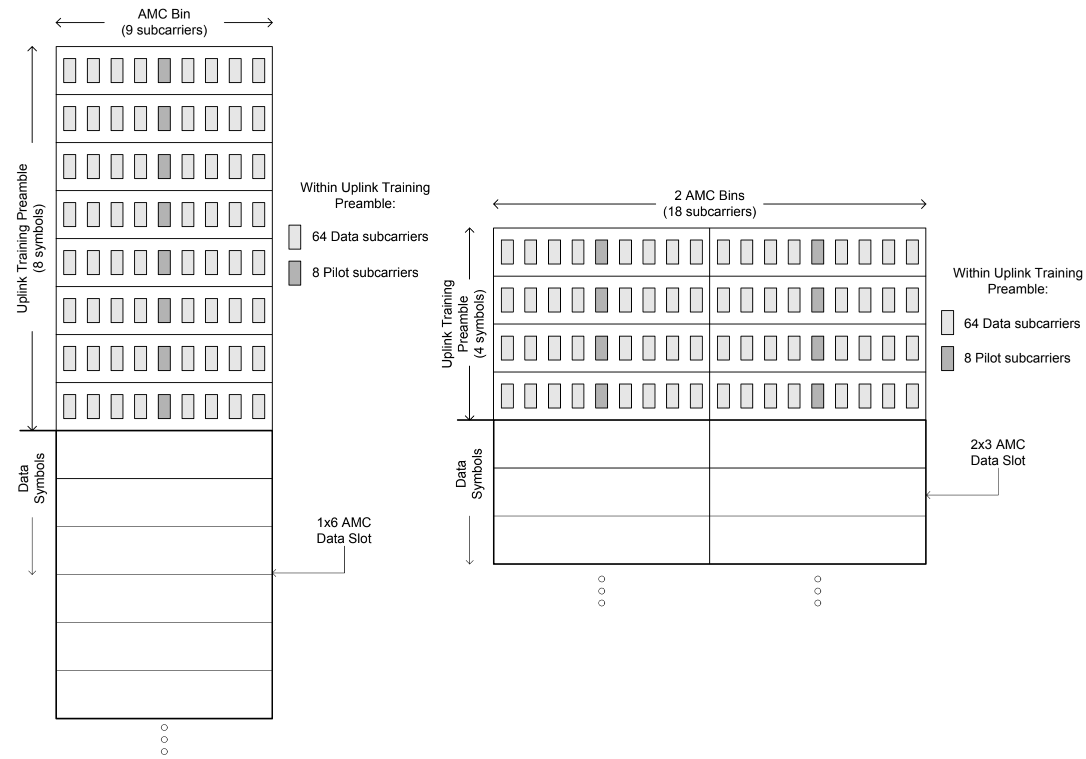


Figure 270d—AAS preamble construction using 1 x 6 and 2 x 3 AMC bins

Figure 5 shows that the AAS relay zone Access Channel begins with the AAS DL preamble. Edge-of-cell RS nodes that cannot decode the R-MAP can find the access channel by searching for this preamble.

The AAS network entry utilizing the AAS relay zone Access Channel involves the following procedure:

- The AAS-RS synchronizes frame timing and frequency to the MR-BS.
- Most AAS-RS receive and decode the broadcast R-MAP messages. These broadcast messages define the AAS relay zone (within the relay zone) via informational elements within the R-MAP. These IE are the AAS_Relay_Downlink_IE and the AAS Relay_Uplink_IE.
- An AAS-RS at the cell edge that cannot decode the standard R-MAP messages will search for the AAS preamble in the AAS relay zone Access Channel. Since the location of the access subchannels are well known in the subchannel domain, only a 1-D searchacross the symbol time dimension is required. The edge-of-cell AAS-RS then receives the R-MAP containing the AAS_Relay Downlink_IE and AAS_Relay_Uplink_IE. The AAS relay zone Access Channel provides the benefit of scatter-cast beam-forming and selection diversity enabled by the frequency repetitions. The R-MAP starts immediately after the AAS zone start preamble. The R-MAPs are transmitted using the well-known rate 1/2 QPSK modulation with 2 repetitions. The R-MAP received in the AAS relay zone Access Channel must use the AMC permutation.
- Most AAS-RS receive broadcast messages such as the DCD and UCD in the access zone using standard allocations pointed to by standard MAP IEs while edge-of-cell RS nodes receive DCD and UCD messages in the AAS relay zone Access Channel via allocations pointed to by IEs contained in the R-MAP received in the access channel.
- Once the AAS-RS decodes the DCD and UCD, it performs initial ranging using the initial ranging preambles (drawn from the codeword set) defined below. The preamble length is specified in the AAS_Relay_Uplink_IE.

- When initial ranging code is successfully detected, the base station is able to compute UL and DL beamforming solutions and thus, is able to send and receive unicast messaging with beamforming gain.
- The AAS-RS receives a unicast ranging response message through a private allocation in the AAS Access Zone with the broadcast CID. In addition, it receives a periodic ranging codeword. Subsequent ranging uses the periodic ranging codeword. The ranging protocol proceeds normally as described in Section 6.3.10.3 CDMA-Based Ranging.
- Subsequent allocations can be managed with private allocations sent to the RS nodes using multi-user beamforming.

Insert new subclause 8.4.4.7.2.3.1:

8.4.4.7.2.3.1 Definition of uplink preambles (Codewords)

The uplink training preambles are based upon 64 QPSK subcarriers constructed from Hadamard sequences. The properties of these preambles are as follows:

- Provides a spatial training sequence for up to 16 antennas with the adequate time bandwidth product
- Provides unique RS identification at the base station. The preambles can be detected in co-channel interference with beamforming gain
- Provides an initial and periodic ranging capability for edge-of-cell RS
- Provides multi-user AAS bandwidth request capability with appropriate messaging.
- 8064 codewords are available
- High probability of detection, low false alarm rate consistent with modest crosscorrelation properties between assigned codewords at various code delays
- The same codewords may be re-used multiple times at the base station if sectors or subbands are used
- Robust codeword reuse factor of 4 between base stations.
- The base station can separate multiple RS in the AAS relay zone using different codewords

Codeword construction

Each RS registered to a base is assigned a basic CID and a unique Hadamard access codeword (ACW) for bandwidth requests and for training. The base station pairs the access code with the basic CID. The access code set is assigned to the base station during cell planning as follows. Within a given sub-band or sector, each RS has its own unique access and traffic code. There are a maximum of 8064 access codewords. The access codewords, $a = 2016t + c$, are divided into four equal sets; $0 \le t \le 3$, where t is the MR-BS reuse “color”. Each set of 2016 codewords are divided into two types with each type allocated a certain number of access codes: up to 2000 are assigned to the RS nodes for bandwidth request, periodic ranging and traffic: $0 \le c \le 1999$, and there are 16 access codewords, c, for RS initial ranging: $2000 \le c \le 2015$.

ACW codewords are based on Hadamard basis functions. ACW are described by an access code, a, $0 \le a \le 8064$. A ACW codeword, $\mathbf{p}_a$ modulating the 64 QPSK subcarriers has in-phase and quadrature components taken from the columns $\mathbf{h}$ of a 64 by 64 Hadamard matrix,

$$b = mod(a, 4032)$$

$$i_1 = mod(b, 64)$$

$$i_0 = mod(\lfloor b/64 \rfloor + i_1 + 1, 64)$$

$$\boldsymbol{p}_a = \boldsymbol{F}_1\boldsymbol{h}_{i_1} + j\boldsymbol{F}_1\boldsymbol{h}_{i_0}, \quad \text{if } 0 \le a \le 4031$$

$$\boldsymbol{p}_a = \boldsymbol{F}_2\boldsymbol{h}_{i_1} + j\boldsymbol{F}_2\boldsymbol{h}_{i_0}, \quad \text{if } 4032 \le a \le 8063$$

$\mathbf{F}_1$ is a 64 x 64 toggle matrix derived from the identity matrix with the following diagonal values (zero-based indices) toggled to -1: 4, 8, 9, 14, 15, 20, 24, 25, 29, 30, 35, 41, 46, 47, 50, 52, 56, 62.

$\mathbf{F}_2$ is a 64 x 64 toggle matrix derived from the identity matrix with the following diagonal values (zero-based indices) toggled to -1: 1, 2, 5, 6, 18, 21, 23, 26, 28, 32, 34, 38, 43, 48, 49, 54, 60.

The toggle matrices increase the number of ACW codewords by a factor of two and lowers the cross-correlation of codewords between adjacent MR-BS. A base station removes the effect of the toggle matrix before further processing.

The first 2-bit symbol of the Hadamard sequence modulates the first subcarrier in the first bin of the subchannel definition. Mapping proceeds in ascending order with all pilot subcarriers in the AMC subchannel skipped.

Insert new subclause 8.4.4.7.2.3.2:

8.4.4.7.2.3.2 AAS relay zone access channel downlink preamble

The AAS downlink preamble marks the beginning of the DL AAS relay zone Access Channel. It length is specified in the AAS_Relay_DL_IE. Construction of the preamble follows 8.4.4.6.4.1

Insert new subclause 8.4.4.7.3:

8.4.4.7.3 R-FCH channel

If a DL relay zone contains an R-FCH channel, the R-FCH channel shall be transmitted as FCH described in 8.4.4.2. The R-FCH contains the R-Zone_Prefix as described in 8.4.4.7.4.

Insert new subclause 8.4.4.7.4:

8.4.4.7.4 R-Zone prefix

The R-Zone_Prefix is a data structure transmitted on R-FCH of a DL relay zone. The R-Zone_Prefix includes information regarding the location of the first relay zone in the next frame and the information required for decoding R-MAP. Table XXX defines the format of the R-Zone_Prefix.

Table 377a—R-Zone_Prefix format

Syntax	Size(bits)	Notes
R-Zone_Prefix_format() {	-	-
R-Zone_Location	7	The field indicates the OFDM symbol index referenced to the beginning of next frame in unit of 1 OFDM symbol
Used_subchannel_bitmap	6	Bit #0: Subchannel group 0 Bit #1: Subchannel group 1 Bit #2: Subchannel group 2 Bit #3: Subchannel group 3 Bit #4: Subchannel group 4 Bit #5: Subchannel group 5
R-MAP_Length	5	Length in unit of slot
FEC Code type and modulation type	5	0b0000 = QPSK (CTC) 1/2 0b0001 = QPSK (CTC) 3/4 0b0010 = 16-QAM (CTC) 1/2 0b0011 = 16-QAM (CTC) 3/4 0b0100 = 64-QAM (CTC) 1/2 0b0101 = 64-QAM (CTC) 2/3 0b0111 = 64-QAM (CTC) 3/4 0b1000 = 64-QAM (CTC) 5/6 0b1001-0b1111 reserved
Repetition_Coding_Indication	1	0: No repetition coding on R-MAP 1: Repetition coding of 2 used on R-MAP
}		

R-Zone_Location

An indicator regarding the location of the first relay zone in the next frame. The first OFDM symbol in each frame is indexed as 0. The R-Zone location indicates the OFDM symbol index relative to the first OFDM symbol in next frame. The unit is 1 OFDM symbol.

R-MAP_Length

The length in slots of the R-MAP message that immediately follows the R-Zone_Prefix.

FEC Code type and modulation type

An indicator indicating the modulation and code rate used for R-MAP message.

8.4.5 Map message fields and IEs

8.4.5.3 DL-MAP IE format

Insert the following at the end of 8.4.5.3:

MR-BS or RS may transmit DIUC=13 in the DL-MAP in the access zone to indicate the location of a DL relay zone in the same frame. The boosting field in DIUC=13 is used to indicate to the receiving RSs that the IE defines a relay zone.

Change Table 275(.16e)/Table 380(Rev2) as indicated:

Table 380—OFDMA DL-MAP_IE format

Syntax	Size	Notes
DL-MAP_IE() {		
DIUC	4 bits	
if (DIUC == 14 {		
Extended-2 DIUC dependent IE	*variable*	
if (DIUC == 15) {		
Extended DIUC dependent IE	*variable*	See subclauses following 8.4.5.3.1
} else {		
if (INC_CID == 1) {		The DL-MAP starts with INC_CID =0. INC_CIDis toggled between 0 and 1 by the CID-SWITCH_IE() (8.4.5.3.7)
N_CID	8 bits	Number of CIDs assigned for this IE
for (n=0; n< N_CID; n++) {		
If (included in SUB-DL-UL-MAP) {	—	—
RCID_IE()	—	For SUB-DL-UL-MAP, reduced CID format is used
} else {	—	—
CID	16 bits	Represents the assignment of the IE to a broadcast, multicast, or unicast address.
}		
}		
}		
OFDMA Symbol offset	8 bits	
if (Permutation = 0b11 and (AMC type is 2x3 or 1x6)) {		0b11 = Adjacent subcarrier permutation
Subchannel offset	8 bits	
If(DIUC == 13) {		
Relay zone indicator	1 bits	0b0: Normal Gap/PAPR/safety zone 0b1: Relay zone indicator
reserved	2 bits	Shall be zero
} else {		
Boosting	3 bits	000: normal (not boosted); 001: +6dB; 010: -6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB;

Table 380—OFDMA DL-MAP_IE format

}		
No. OFDMA triple symbol	5 bits	Number of OFDMA symbols is given in multiples of 3 symbols
No. Subchannels	6 bits	
} else {		
Subchannel offset	6 bits	
If(DIUC == 13) {		
Relay zone indicator	1 bits	0b0: Normal Gap/PAPR/safety zone 0b1: Relay zone indicator
reserved	2 bits	Shall be zero
} else {		
Boosting	3 bits	000: normal (not boosted); 001: +6dB; 010: -6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB;
}		
No. OFDMA Symbols	7 bits	
No. Subchannels	6 bits	
}		
Repetition Coding Indication	2 bits	0b00 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11 – Repetition coding of 6 used
}		
}		

8.4.5.3.2.1 DL-MAP extended IE format

Change Table 277a(.16e)/Table 383(Rev2) as indicated:

Table 383—Extended DIUC code assignment for DIUC=15

Extended DIUC	(hexadecimal) Usage
00	Channel_Measurement_IE
01	STC_Zone_IE
02	AAS_DL_IE
03	Data_location_in_another_BS_IE
04	CID_Switch_IE
05	MIMO_DL_Basic_IE
06	MIMO_DL_Enhanced_IE
07	HARQ_Map_Pointer_IE
08	PHYMOD_DL_IE
09-0A	Reserved
0B	DL PUSC Burst Allocation in Other Segment
0C	DL_Burst_Transmit_IE
0~~C~~D-0E	*Reserved*
0F	UL_interference_and_noise_level_IE

8.4.5.3.2.2 DL-MAP extended-2 IE format

Change Table 277c(.16e)/Table 385(Rev2) as indicated:

Table 385—Extended-2 DIUC code assignment for DIUC=14

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

8.4.5.3.21 HARQ DL MAP IE

Change 8.4.5.3.21 as indicated:

Each HARQ Map IE and sub-burst IE shall be nibble-aligned. When there is an if-else clause, regardless of whether the “if” clause or the “else” clause is executed, the resulting Map IE shall be nibble-aligned. When there is a loop, nibble-alignment shall be required before the loop starts and inside the loop.

If MAC tunneling is used, tunnel CID should be used as RCID in the related DL HARQ sub-burst IE for the corresponding sub-burst.

Insert new subclause 8.4.5.3.28:

8.4.5.3.28 DL Burst Transmit IE format

Table 421a—DL Burst Transmit IE format

Syntax	Size	Notes
DL_Burst_Transmit_IE(){	-	-
Extended UIUC	4 bits	DL_Burst_Transmit_IE=0C
Length	4 bits	Length = 2+2Nr
RCID	8 bits	Reduced RS basic CID
Nr	8 bits	Number of bursts forwarding by RS
for(n=0;n<Nr;n++){	-	-
Relay burst length	16 bits	Relay burst length (in unit of byte)
}		
}		

8.4.5.4 UL-MAP IE format

8.4.5.4.2 PAPR reduction/Safety zone/Sounding zone allocation IE

Insert the following at the end of 8.4.5.4.2:

MR-BS or RS may transmit a PAPR reduction/safety zone/sounding zone allocation IE (UIUC=13) in the UL-MAP in the access zone to indicate the location of a UL relay zone.

8.4.5.4.4 UL-MAP extended IE format

8.4.5.4.4.1 UL-MAP extended IE format

Change Table 290a(.16e)/Table 427(Rev2) as indicated:

Table 427—Extended UIUC code assignment for UIUC=15

Extended UIUC (hexadecimal)	Usage
00	Power_control_IE
01	Mini-subchannel_allocation_IE
02	AAS_UL_IE
03	CQICH_Alloc_IE
04	UL Zone IE
05	PHYMOD_UL_IE
06	MIMO_UL_Basic_IE
07	UL-MAP_Fast_Tracking_IE
08	UL_PUSC_Burst_Allocation_in_Other_Segment_IE
09	Fast_Ranging_IE
0A	UL Allocation Start IE
0B	RS-RNG_RSP_Allocation_ IE
0C	UL_Burst_Receive_IE
0~~B~~D...0F	*Reserved*

8.4.5.4.6 AAS uplink IE format

Insert new Table 293a (.16e)/Table 431a (Rev2) in 8.4.5.4.6:

Table 431a—OFDMA AAS relay uplink IE

Syntax	Size	Notes
AAS_UL_IE() {		
Extended UIUC	4 bits	AAS = 0x02
Length	4 bits	Length = 0x04
Permutation	2 bits	0b00 = PUSC permutation 0b01 = Optional PUSC permutation 0b10 = adjacent-subcarrier permutation, 2 bins x 3 symbols 0b11 = adjacent-subcarrier permutation, 1 bins x 6 symbols
UL_PermBase	7 bits	
OFDMA symbol offset	8 bits	
AAS zone length	8 bits	Number of OFDMA symbols in AAS zone
Uplink_preamble_config	2 bits	0b00 - 0 symbols 0b01 - 1 symbols 0b10 - 2 symbols, 4 symbols if AAS Relay Zone Type=1 0b11 - 3 symbols, 8 symbols if AAS Relay Zone Type=1
Preamble type	1 bit	0 =Frequency shifted preamble is used in this UL AAS zone 1 =Time shifted preamble is used in this UL AAS zone 0 = Hadamard preamble, if AAS Relay Zone Type =1) 1 = Reserved
Number of AAS Relay Zone Access Channel subchannels	1 bit	0 = 1 subchannel pair 1 = 2 subchannel pairs
AAS Relay Zone Type	1 bit	0 = Diversity MAP Relay Zone 1 = Direct Signaling Relay Zone
Reserved	2 bits	Shall be set to zero
}		

8.4.5.4.13 UL ACK channel

Insert the following text at the end of 8.4.5.4.13:

When MR-BS receives the ACK/NACK signal from MS through RS in the RS-assisted relay case, the new sequences based on Table 301a is used. RS notifies the status of HARQ sub-burst at both RS and MS with the encoded ACK/NACK signal defined in the table xxx. When RS receive ACK signal from MS then irrespective of whether RS receives the HARQ sub-burst correctly or not, the RS replies ACK to the MR-BS.

Insert new subclause 8.4.5.4.13.1

8.4.5.4.13.1 ACK / NAK Encoding for multihop relay

MR-BS needs to identify the failed link over the multihop chain in case of HARQ. Therefore new sequences based on Table 301a in section 8.4.5.4.13 are defined in order to uniquely identify the failed link. Further, it should be noted that BS only needs to identify the failed link, i.e. if the HARQ attempt is failed between RSj and its upstream RS RSj+1, then BS should identify RSj. For two hop case, only C0 to C1 are needed.

Table 463a—ACK/NAK Encoding for multihop relay for UL HARQ

Link Distance/Depth	ACK/NAK 1-bit symbol	Vector Indices per Tile Tile(0), Tile(1), Tile(2)	Code#
Any Distance	0(ACK)	0,0,0	C_0
1	1(NAK)	1,1,1	C_1
2	1(NAK)	2,2,2	C2
3	1(NAK)	3,3,3	C_3
4	1(NAK)	4,4,4	C_4
5	1(NAK)	5,5,5	C_5
6	1(NAK)	6,6,6	C_6
7	1(NAK)	7,7,7	C7

8.4.5.4.24 HARQ UL MAP IE

Change 8.4.5.4.24 as indicated:

The HARQ UL MAP IE defines one or more bursts. Each burst is separately encoded.

If MAC tunneling is used, tunnel CID should be used as RCID in the related UL HARQ sub-burst IE for the corresponding sub-burst.

8.4.5.4.25 HARQ ACK region allocation IE

Insert the following text at the end of 8.4.5.4.25:

This IE may be used by MR-BS to define an ACK channel region on the R-UL to include one or more ACK channel(s) for RS.

RS receives HARQ UL sub burst from MS for relaying to MR-BS at frame i shall transmit the ACK/NAK signal through the ACK Channel in the ACKCH region for UL MS data at frame (i+k). The frame offset k is defined by the "HARQ ACK Delay for UL Burst for MR" field in the UCD message.

In case of non-transparent RS, RS receives HARQ UL sub burst, from MS or sub-ordinate RS for relaying to MR-BS at frame i. It shall transmit the ACK/NAK signal through the ACK Channel in the ACKCH region along with the UL MS HARQ sub-burst at frame (i+k). RS shall transmit the ACK/NAK signal according to the order of UL HARQ sub-burst in the UL-MAP. The frame offset k is defined by the "HARQ ACK Delay for UL Burst for MR" field in the UCD message.

Insert the following after Table 302t(.16e)/Table 484(Rev2)

Table 484a—HARQ_ACKCH region allocation for UL Data IE

Syntax	Size	Notes
HARQ_ACKCH_Region_for UL Data IE() {		
Extended-2 UIUC	4 bits	0xYY
Length	8 bits	Length in bytes
OFDMA Symbol	8 bits	
Subchannel offset	7 bits	
No. OFDMA symbols	5 bits	
No. subchannels	4 bits	
}		

When RS receives HARQ DL sub-burst for relaying to MS at frame i, it shall transmit the encoded ACK/NAK signal through ACK Channel in the ACKCH region at frame (i + n) where n is calculated at each RS according to the following equation.

n = H*p + (H+1)*j

H is defined by "number of hops RS is away from the MS".

p is defined by the "static delay at the RS in number of frames"

j is defined by the "HARQ_ACK_Delay for DL Burst" field in the DCD messages.

In 2-hop case, there is only one RS and n=p + 2*j.

If the frame structure allows relaying either HARQ DL sub-burst or encoded ACK/NAK in the same frame, then the above equation will change. If encoded ACK/NAK is relayed in the same frame, then n=H*p+j. Similarly, if RS can relay the HARQ DL Sub-burst signal in the same frame, then n=p+ (H+1)*j.

Insert new subcluase 8.4.5.4.29:

8.4.5.4.29 RS-RNG_RSP_ALLOC IE

This IE is transmitted to a non-transparent RS from MR-BS. This IE provides the allocation to RS for transmission of RNG_RSP to SS.

Table 486a—RS-RNG_RSP_ALLOC_IE format

Syntax	Size	Notes
RS-RNG_RSP_ALLOC_IE {	-	-
Extended 2 DIUC	4 bits	0x0B
CID	16 bits	RS Connection Identifier
TID	4 bits	Transaction ID
DIUC	4 bits	
OFDMA Symbol Offset	8 bits	
Subchannel offset	6 bits	
Boosting	3 bits	000: normal (not boosted); 001: +6dB; 010: -6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB.
No. OFDMA Symbols	7 bits	
No. Subchannels	6 bits	
Repetition Coding Indication	2 bits	0b00 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11 – Repetition coding of 6 used
}		

Insert new subclause 8.4.5.4.30:

8.4.5.4.30 UL_Burst _Receive_IE format

Table 486b—UL_Burst_Receive_IE format

Syntax	Size	Notes
UL_Burst_Receive_IE() {	16 bits	
Extended UIUC	4 bits	UL_Burst_Receive_IE=0x0C
Length	4 bits	Length=1
Nr	8 bits	Number of UL-MAP_IE following current IE for RS to receive from subordinate station(s)
}		

Insert new subclause 8.4.5.9:

8.4.5.9 R-MAP message

This message may be used to signal the resource assignments and other control information contained in the relay zones transmitted by an MR-BS or RS. This message shall be sent in the first transmitted DL relay zone. This message shall immediately follow the R-FCH and shall not be preceded by a MAC header and message type field. The modulation and coding rate for the R-MAP message is indicated in the R-FCH. The message format is shown in Table xxx.

Table 496a—R-MAP message format

Syntax	Size	Notes
R-MAP format {		
Length	11 bits	Length of R-MAP
for(i=0;i<Number of IEs; i++){		
IE type	2 bits	0b00: DL MAP IE 0b01: UL MAP IE 0b10: R-link specific IE 0b11: reserved
if(IE type = 0){		
DL_MAP_IE}	Variable	
elseif(IE type = 01){		
UL-MAP_IE}	Variable	
elseif(IE type = 10){		
R-link specific IE}	Variable	
}		
}		

The CRC-32 value shall be appended to the end of an R-MAP message. The CRC is computed across all bytes of the R-MAP. The CRC calculation is the same as that used for the MAP messages.

Insert new subclause 8.4.5.9.1:

8.4.5.9.1 R-link specific IE

The R-link specific IE format is shown in Table XXX.

Table 496b—R-link specific IE format

Syntax	Size	Notes
R-link specific IE(){		
Type	5 bits	
Length	4 bits	
IE specific data	Variable	
}		

The R-link specific IE types are listed in Table yyy.

Table 496c—R-link specific IE types

Type (hexadecimal)	Usage
00	RS_UL_DCH assignment IE
0x01-1F	*Reserved*

Insert new subclause 8.4.5.9.2:

8.4.5.9.2 RS UL DCH assignment IE

This IE is used for the initial allocation and subsequent updates of the uplink dedicated channel on the R-link.

Table 496d—RS_UL_DCH assignment IE format

Syntax	Size	Notes
RS_UL_DCH assignment IE {		
Type	5 bits	
Length	4 bits	
RSCID	8 bits	Reduced basic CID of the RS
Update type	2 bits	00 = Normal 01 = Service flow based 10-11 = *Reserved*
If (Update type == 01) {		If service flow based update
Throughput size	24 bits	Amount of throughput update in byte/s
Access RSCID	8 bits	Reduced basic CID of the access RS of the MS that completed the service flow event
}		
Assignment type	2 bits	00 = Incremental 01 = Aggregate 10 = Remove 11 = Remove all
OFDMA symbol offset	8 bits	
Subchannel offset	8 bits	
Duration	10 bits	Resources allocated to DCH (in OFDMA slots)
Frequency (N)	4 bits	Allocation repeats once every N frames
}		

Insert new subclause 8.4.6.1.1.3:

8.4.6.1.1.3 Relay amble

The relay amble, if present, is a repetitive structure with a maximum repetition period given by Equation xxx.

$$\text{Max RelayAmbleRepetitionPeriod} = 40 \text{ ms} \tag{121a}$$

For FFT size of 2048 and 1024, the relay amble series PN_i^R, $i = 0, 1, ..., 113$, $j = 0, 1, ..., J$ shall be obtained by reversing the corresponding preamble series in 8.4.6.1.1, i.e.

$$PN_i^R(j) = PN_i(J - j), \quad i = 0, 1, ..., 113,\ j = 0, 1, ..., J \tag{121b}$$

where PN_i is the related PN sequence length with index of i, and J is 567 and 283 for FFT size of 2048 and 1024, respectively.

For FFT size of 512 and 128, the relay amble series PN_i^R, $i = 0, 1, ..., 113$, $j = 0, 1, ..., J$ shall be obtained by circle-shifting the corresponding preamble series in 8.4.6.1.1, i.e.

$$PN_i^R(j) = \begin{cases} PN_i(J - s + j + 1) & \text{if } j=0, 1, \ldots, s-1 \\ PN_i(j) & \text{if } j=s, s+1, \ldots, J \end{cases} \tag{121c}$$

where J is 142 and 35 for FFT size of 512 and 128, respectively, and s is 2 and 1 for FFT size of 512 and 128, respectively.

The index, i, of the relay amble used in each sector/cell shall be the same as that of the preamble used in the access zone.

The relay amble series shall be modulated using boosted BPSK modulation, as specified in 8.4.9.4.3.3.

Insert new subclause 8.4.6.1.1.4:

8.4.6.1.1.4 R-amble Repetition Scheme

The R-amble shall be used for two purposes:

1. To acquire/keep in time and frequency synchronization for subordinate RSs. Once synchronization is acquired during the initial entry/reentry using the 16e preamble, an RS shall keep in sync by monitoring an R-amble transmitted by its parent station (RS or MR-BS) at regular intervals. RSs which do not support synchronization of its subordinate RSs may not transmit this amble. Since RS is an infrastructure station, the operation of which will affect all the users connected through that RS, the synchronization of an RS shall be maintained at all times. For this every RS shall be monitoring a synchronization signal at least within 40 msec.

2. To enable the RS to monitor its neighborhood. This requires monitoring the R-amble transmissions of the neighbors. This monitoring function may be accomplished with less regularity than that required for synchronization.

These two objectives shall be accomplished with a combination of two R-amble transmission /monitoring schemes indicated below.

The parameters defined below shall be communicated by a MR-BS to its subordinate RSs using the message described in Section 6.3.2.3.Y. If the MR-BS uses optional common sync, then RS shall not transmit R-amble in that frame. In that case, the selection of the configuration parameters should be done not to have such overlapping.

Insert new subclause 8.4.6.1.1.4.1:

8.4.6.1.1.4.1 R-amble repetition for synchronization

For synchronization, the R-amble repetition pattern is defined using two parameters, offset, Ks and a Synchronization Cycle consists of N consecutive frames.

There are defined two sequences for transmitting the R-amble. Sequence A transmits the R-amble when the following relation is satisfied 1 = (Frame_Number modulo N) + 1, while the sequence B transmits the R-amble when Ks = (Frame_Number modulo N) + 1 relation is satisfied.

Each RS supporting a subordinate RS for synchronization shall transmit the R-amble in either A or B frames, but not on both. MR-BS may transmit the R-Amble in both frames. An RS during initial entry, searches A or B frames for the parent station's R-amble. After determining the R-amble sequence of its parent RS/MR-BS, the RS performs the synchronization using the detected sequence, while shall transmit on the complementary sequence. For example, if the RS detects that its parent station transmits using the sequence B, than shall use the sequence A for transmitting its R-amble. It may not be necessary to transmit the R-amble if an RS does not support a subordinate RS to obtain the synchronization, and this capability is provided in the configuration message.

Using the frame number as the reference, ensures that the Synchronization Cycle is synchronized across the network.

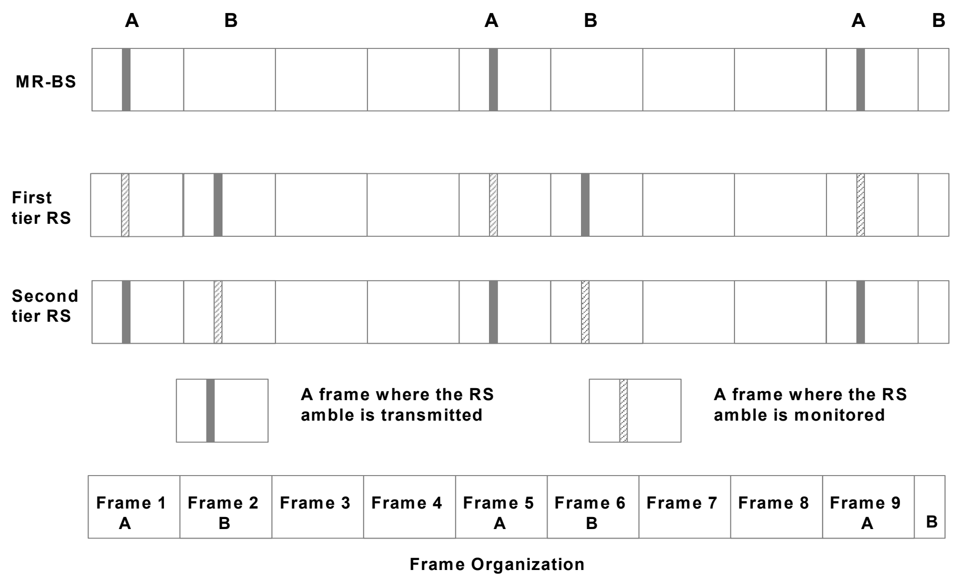


Figure 289a—An example implementation of the alternate R-amble transmission monitoring scheme for synchronization, N = 4 and Ks = 2.

An example of pattern generation for transmitting the R-amble is provided in Figure XXX. Note that MR-BS and the Second Tier of relays use the sequences A for transmitting their R-ambles, while in the positions given by sequence B they are performing the synchronization task. On the other hand, the First Tier of RSs are transmitting their R-ambles using B sequences, while they are using the A sequences for synchronization purpose.

Insert new subclause 8.4.6.1.1.4.2:

8.4.6.1.1.4.2 R-amble repetition for neighborhood monitoring

An R-amble should be transmitted in every Lth frame with an offset of Km whenever the neighborhood monitoring scheme is specified. Sequence C transmits the R-amble when the following relation is satisfied Km = (Frame_Number modulo L) + 1.

M such monitoring frames forms a Neighborhood Monitoring Cycle, i.e. L*M frames. Out of M possible R-ambles positions for transmission within a Neighborhood Monitoring Cycle, each RS randomly selects one of these positions for monitoring the neighbor RSs. The MR-BS may also follow the same transmission / monitoring scheme.

This monitoring scheme may also be also used for synchronization, if the RS can listen to its parent RS within the required sync time.

Insert new subclause 8.4.6.1.1.4.3:

8.4.6.1.1.4.3 Parallel Operation of the neighborhood monitoring and synchronization

In order to have use synchronization and neighborhood monitoring, the above two schemes may operate together. The choice of these parameters is implementation dependent and some example cases are explained below.

Figure XXY shows the case where, N = 4, L =8, Ks = 2, Km = 3. The C frames are the frames in which the R-ambles are transmitted for neighborhood monitoring.

Frame1 A	Frame2 B	Frame3 C	Frame4	Frame5 A	Frame6 B	Frame7	Frame8	Frame9 A	Frame10 B	Frame11 C	

Figure XXY. An example implementation of the combined scheme for neighborhood monitoring and synchronization, N = 4, L =8, Ks = 2, Km = 3.

For the cases where Km = 1 or Km = Ks, i.e. monitoring frame is the same as the synchronization frames, the monitoring may be done using the synchronization R-ambles. Thus, if an RS uses A frames for transmitting the R-amble and B frames for monitoring, that RS would additionally randomly monitor in one of the A frames out of M such frames. This however means that occasionally R-amble is not transmitted to its subordinate RS and hence the minimum synchronization time increases to 2*N frames for that particular instance.

The synchronization R-ambles may also be used for neighborhood monitoring. An RS monitoring in frame A may monitor not only its parent RS/MR-BS, but also all the other RSs which transmit an R-amble in frame A. However, the group of RSs listening in the same frame, cannot monitor each other. For full monitoring of the neighborhood, the monitoring scheme included in Section 8.4.6.1.1.4.2 shall be used.

8.4.7 OFDMA ranging

8.4.7.3 Ranging codes

Change the fourth paragraph of 8.4.7.3 as indicated:

The number of available codes is 256, numbered 0..255. Each BS uses a subgroup of these codes, where the subgroup is defined by a number S, 0 <= S <= 255. The group of codes will be between S and ((S+O+N+M+L+P) mod 256).

— The first N codes produced are for initial-ranging. Clock the PRBS generator $144 \times (S \bmod 256)$ times to $144 \times ((S + N) \bmod 256) - 1$ times.

— The next M codes produced are for periodic-ranging. Clock the PRBS generator $144 \times ((N + S) \bmod 256)$ times to $144 \times ((N + M + S) \bmod 256) - 1$ times.

— The next L codes produced are for bandwidth-requests. Clock the PRBS generator $144 \times ((N + M + S) \bmod 256)$ times to $144 \times ((N + M + L + S) \bmod 256) - 1$ times.

— The next O codes produced are for handover-ranging. Clock the PRBS generator $144 \times ((N + M + L + S) \bmod 256)$ times to $144 \times ((N + M + L + O + S) \bmod 256) - 1$ times.

— The next P codes produced are for RS initial-ranging. Clock the PRBS generator $144 \times ((N + M + L + O + S) \bmod 256)$ times to $144 \times ((P + N + M + L + O + S) \bmod 256) - 1$ times

Insert the following text at the end of 8.4.7.3:

The ranging codes used in the relay zone are the same as already defined for the access zone.

8.4.8 Space-Time Coding (optional)

Insert new subclause 8.4.8.10:

8.4.8.10 Cooperative Relaying

Cooperative relaying can be achieved within an MR-BS cell with BS and RS transmit cooperation. For non-transparent relays, the macro diversity procedure can be used. It is possible to achieve diversity by sending correlated signals across different BS and RS transmit antennas during the transmission of a burst to subordinate stations. The three modes of operation for cooperative relaying are cooperative source diversity, cooperative transmit diversity, and cooperative hybrid diversity.

There are three modes for cooperative relaying. For cooperative source diversity, the transmitting antennas simultaneously transmit the same signal using the same time-frequency resource. In cooperative transmit diversity mode, STC-encoded signals are transmitted across the transmitting antennas using the same time-frequency resource (refer to Section 8.4.8 for a list of valid STCs). Cooperative hybrid diversity is a combination of source and transmit diversity.

In a STC DL Zone with STC not set to “0b00”, the RS shall perform STC encoding locally by using the STC Matrix as defined by STC_DL_Zone_IE (or MIMO DL Basic IE or MIMO DL Enhanced IE) for its assigned antenna number(s) as indicated in RSCDC, and shall not forward an incorrectly decoded burst to its subordinate stations. Figure ZZZ is an example of local STC encoding at the RS.

In cooperative relaying, the frames sent by MR-BS and RS at a given frame time must arrive at the MS within the prefix interval, similar to MDHO.

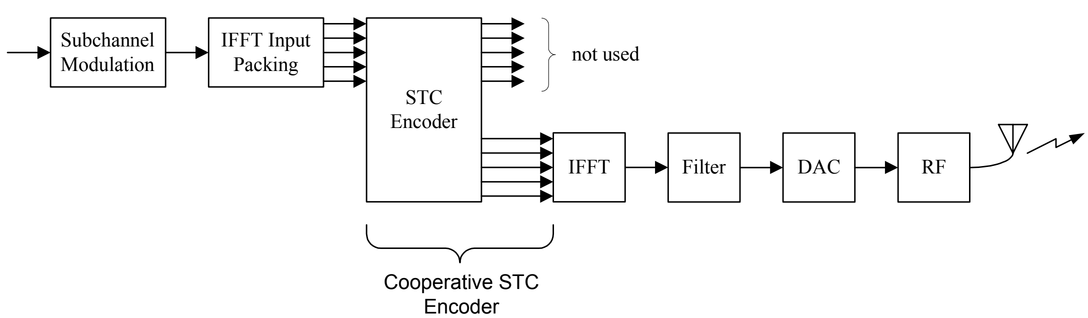


Figure 323a—A logical block example of local STC Encoding at RS. The STC Encoder is identical to the encoder in Figure 244*[Figure 301 in Rev2]* of Section 8.4.8.1.

8.4.9 Channel coding

Insert new subclause 8.4.9.4.3.1.1:

8.4.9.4.3.1.1 Relay amble pilot modulation

The pilots in the relay amble for 512FFT, 1k FFT and 2k FFT shall follow the instructions in 8.4.6.1.1.3 and shall be modulated according to Equation (184a)

$$Re\{AmblePilotsModulated\} = 4\sqrt{2}\left(\frac{1}{2} - w_k\right)$$
$$Im\{AmblePilotsModulated\} = 0 \quad (184a)$$

The pilots in the relay amble for 128 FFT shall follow the instructions in 8.4.6.1.1.3 and shall be modulated according to Equation (184b)

$$Re\{AmblePilotsModulated\} = 3.55\sqrt{2}\left(\frac{1}{2} - w_k\right)$$
$$Im\{AmblePilotsModulated\} = 0 \quad (184b)$$

8.4.10 Control mechanisms

Insert new subclause 8.4.10.4:

8.4.10.4 Power control in MR networks

A power control algorithm shall be supported in MR networks for the uplink channels from RSs and SSs with both an initial calibration and periodic adjustment procedure without loss of data. Power control of the RS downlink channels shall also be supported.

In the case of centralized MR, the UL power control algorithm shall be located in the MR-BS and the MR-BS shall control the transmit power on all uplink channels served by the MR-BS and its subordinate RSs. In the case of distributed MR, an UL power control algorithm shall be located in both the MR-BS and RSs to control the uplink channels it serves.

The response of the SS to power control messages received from the MR-BS or RS is described in subclause 8.4.10.3. This subclause defines how the RS responds to power control messages from the MR-BS and how the MR-BS and RS control the transmit power in MR networks.

The following subclauses describe the power control mechanism for both centralized and distributed cases.

Insert new subclause 8.4.10.4.1:

8.4.10.4.1 Power control of RS

The RS shall respond to UL power control messages from the MR-BS or RS in the same way an SS responds to power control messages, as specified in subclause 8.4.10.3. The RS shall also be capable of receiving DL power control messages from the MR-BS or RS. DL power control messages define the DL transmit power that the RS shall use.

Insert new subclause 8.4.10.4.2:

8.4.10.4.2 Power control of SS in centralized MR

In the centralized MR network the MR-BS shall generate the power control messages for the SS and transmit them to the SS via the RS. RSs shall have the capability to report the channel quality measurement information of their access-uplink channels to an MR-BS or superordinate RS. The SS shall respond to power control messages in the manner described in 8.4.10.3. The MR-BS shall also be responsible for controlling the DL transmit power used at all subordinate RSs.

Insert new subclause 8.4.10.4.3:

8.4.10.4.3 Power control of SS in distributed MR

In the distributed MR network, the RS shall generate the power control messages for the SSs that it serves. The SS shall respond to power control messages in the manner described in 8.4.10.3.

8.4.11 Channel quality measurements

8.4.12 Transmitter requirements

8.4.13 Receiver requirements

8.4.14 Frequency control requirements

8.4.15 Optional HARQ support

9. Configuration

Insert new subclause 9.3:

9.3 MR-BS configuration

Insert new subclause 9.4:

9.4 RS configuration

After the measurement report from RS neighborhood discovery process, MR-BS may send a RS preamble configuration request (RS_Config-REQ) message (6.3.2.3.xx) to the RS for configuring the preamble segment and IDcell values. The RS sends a RS_CONF-RSP message to the MR-BS for responding the preamble assignment result.

10. Parameters and constants

10.1 Global values

Change Table 342(.16e)/Table 583(Rev2) as indicated:

Table 583—Parameters and constants

System	Name	Time Reference	Minimum value	Default value	Maximum value
MR-BS	T48	Wait for RNG-REQ from the subordinate RS	tbd	tbd	
MR-BS	T49	Time the MR-BS waits for SLP_INF-ACK from RS	-	-	-
MR-BS	T50	Time the MR-BS waits for DSA*-RSP from RS	TBD	TBD	TBD
MR-BS	MR_SLP_INFO_retry_count	Number of retries on MR_SLP-INFO transmission			
RS	Txx	Wait for DSA-REQ after receiving RNG-RSP with Path-Addition TLV or Path-CID-Binding-Update TLV	TBD	TBD	TBD

10.2 PKM parameter values

10.3 PHY-specific values

Insert new subclause 10.3.5:

10.3.5 Relay mode PHY parameters and definitions

10.4 Well-known addresses and identifiers

Change Table 345(.16e)/Table 586(Rev2) as indicated:

Table 586—CIDs

CID	Value	Description
Initial Ranging	0x0000	Used by SS and BS during initial ranging process.
Basic CID	0x0001 - *m*	The same value is assigned to both the DL and UL connection.
Primary management	*m*+1 - 2*m*	The same value is assigned to both the DL and UL connection.

Table 586—CIDs

CID	Value	Description
Tunnel CID	2m+1 - n	Used by MR-BS or RS for tunneling transport connection packet.
Management Tunnel CID	n+1 - p	Used by MR-BS or RS for tunneling management connection packets.
Transport CIDs, Secondary Mgt CIDs	p2m+1 - FE9F	For the secondary management connection, the same value is assigned to both the DL and UL connection.
Multicast management CID	0xFEA0-0xFEBF	For the downlink multicast management services
Multicast CIDs	0xFECA0 - 0xFEFE	For the downlink multicast service, the same value is assigned to all MSs on the same channel that participate in this connection.
AAS initial ranging CID	0xFEFF	A BS supporting AAS shall use this CID when allocating a an ASS AAS Initial Ranging period (using AAS Ranging Allocation IE)
Multicast polling CIDs	0xFF00 - 0xFFF9	A BS may be included in one or more multicast polling groups for the purposes of obtaining bandwidth via polling. These connections have no associated service flow.
Normal mode multicast CID	0xFFFA	Used in DL-MAP to denote bursts for transmission of DL broadcast information to normal mode MS.
Sleep mode multicast CID	0xFFFB	Used in DL-MAP to denote bursts for transmission of DL broadcast information to Sleep mode MS. May also be used in MOB_TRF-IND messages.
Idle mode multicast CID	0xFFFC	Used in DL-MAP to denote bursts for transmission of DL broadcast information to Idle mode MS. May also be used in MOB_PAG-ADV messages.
Fragmentable Broadcast CID	0xFFFD	Used by the BS for transmission of management broadcast information with fragmentation. The fragment sub header shall use 11-bit long FSN on this connection.
Padding CID	0xFFFE	Used for transmission of padding information by SS and BS.
Broadcast CID	0xFFFF	Used for broadcast information that is transmitted on a downlink to all SS.

11. TLV Encodings

11.1 Common encodings

11.1.2 Authentication tuples

11.1.2.2 CMAC tuple

Change Table 348a(.16e)/Table 590(Rev2) as indicated:

Table 590—CMAC Tuple definition

Type	Length	Value	Scope
150	13 or 19	See Table 348b	DSx-REQ, DSx-RSP, DSx-ACK, REG-REQ, REG-RSP, RES-CMD, DREG-CMD, TFTP-CPLT, PKM-REQ, PKM-RSP, MOB_SLP-REQ, MOB_SLP-RSP, MOB_SCN-REQ, MOB_SCN-RSP, MOB_BSHO-REQ, MOB_MSHO-REQ, MOB_BSHO-RSP, MOB_HO-IND, DREG-REQ MR_LOC-REQ, MR_LOC-RSP

11.1.2.3 Short-HMAC Tuple

Change Table 348c(.16e)/Table 592(Rev2) as indicated:

Table 592—Short-HMAC Tuple definition

Type	Length	Value	Scope
151	*variable*	See Table 348d	MOB_SLP-REQ, MOB_SLP-RSP, MOB_SCN-REQ, MOB_SCN-RSP, MOB_MSHO-REQ, MOB_BSHO-RSP, MOB_HO-IND, RNG-REQ, RNG-RSP, PKM-REQ, PKM-RSP MR_LOC-REQ, MR_LOC-RSP

11.1.3 MAC version encoding

Change the table in 11.1.3 as indicated:

Type	Length	Value	Scope
148	1	Version number of IEEE 802.16 supported on this channel. 1: Indicates conformance with IEEE Std 802.16-2001 2: Indicates conformance with IEEE Std 802.16c-2002 and its predecessors 3: Indicates conformance with IEEE Std 802.16a-2003 and its predecessors 4: Indicates conformance with IEEE Std 802.16-2004 5: Indicates conformance with IEEE Std 802.16-2004 and IEEE Std 802.16e-2005 6: Indicates conformance with IEEE Std 802.16-2004, IEEE Std 802.16e-2005 and IEEE Std 802.16j-xxxx ~~6~~7-255: *Reserved*	PMP: DCD, RNG-REQ MESH: REG-REQ, REG-RSP

11.3 UCD management message endcodings

Insert the following row into Table 353(.16e)/Table 601(Rev2):

Name	Type (1 byte)	Length	Value (Variable-length)
RS Initial Ranging Code	TBA	1	Number of handover ranging CDMA codes. Possible values are 0-255.

11.4 DCD management message encodings

Insert the following row into Table 358(.16e)/Table 606(Rev2):

Name	Type (1 byte)	Length	Value
ETE Metric	62	1	Bit #0-2: hop count Bits #3-7: reserved

11.5 RNG-REQ message encodings

Change Table 364(.16e)/Table 613(Rev2) as indicated:

Table 613—RNG-REQ message encodings

Name	Type (1 byte)	Length	Value (variable length)	PHY Scope
Ranging Purpose Indication	6	1	Bit #0: HO indication (when this bit is set to 1 in combination with other included information elements indicates the MS is currently attempting to HO or Network Re-entry from Idle Mode to the BS) Bit #1: Location Update Request (when this bit is set to 1, it indicates MS action of Idle Mode Location Update Process) Bit #2: MRS Location Update Request Bits ~~2~~3-7: *Reserved*	
RS Type	-	1	0: Fixed RS 1: Mobile RS 2-555: *Reserved*	
New MS Indication ID	TBA	1	Unique identifier assigned by RS for each MS under ranging process	
Received Ranging Codes	TBA	Variable	Received Ranging codes is a compound TLV value that indicates received code information	OFDMA
Timing Adjust	TBA.1	4	Tx timing offset adjustment (signed 32-bit). The amount of time required to adjust SS transmission so the bursts will arrive at the expected time instance at the BS. Units are PHY specific (see 10.3).	OFDMA
Power Level Adjust	TBA.2	1	Tx Power offset adjustment (signed 8-bit, 0.25 dB units) Specifies the relative change in transmission power level that the SS is to make in order that transmissions arrive at the BS at the desired power. When subchannelization is employed, the subscriber shall interpret the power offset adjustment as a required change to the transmitted power density.	OFDMA

Table 613—RNG-REQ message encodings

Offset Frequency Adjust	TBA.3	4	Tx frequency offset adjustment (signed 32-bit, Hz units) . Specifies the relative change in transmission frequency that the SS is to make in order to better match the BS. (This is fine-frequency adjustment within a channel, not reassignment to a different channel.)	OFDMA
Ranging Status	TBA.4	1	Used to indicate whether uplink messages are received within acceptable limits by BS. 1 = continue, 2 = abort, 3 = success	OFDMA
Ranging code attributes	TBA.5	4	Bits 31:22 - Used to indicate the OFDM time symbol reference that was used to transmit the ranging code. Bits 21:16 - Used to indicate the OFDMA subchannel reference that was used to transmit the ranging code. Bits 15:8 - Used to indicate the ranging code index that was sent by the SS. Bits 7:0 - The 8 least significant bits of the frame number of the OFDMA frame where the SS sent the ranging code.	OFDMA
Channel Measurement Information	TBA.6	TBA	TBD	
MS Basic CID	TBA.7	2	MS Basic CID	OFDMA

11.6 RNG-RSP message encodings

Change Table 367(.16e)/Table 616(Rev2) as indicated:

Table 616—RNG-RSP message encodings

Name	Type (1 byte)	Length	Value (variable-length)
New MS Indication ID	TBA	1	New MS Indication ID from corresponding RNG-REQ from RS
RS network entry optimization	TBA	1	Bit #0: Omit neighbor station measurement report if set to '1'. Bit #1: Omit path selection phase if set to '1' Bit #2: Omit relay station operational parameter configuration if set to '1' Bit #3-7: *reserved*
RS HO Optimization	TBA	1	Bit #0: set to 1 to indicate path selection is omitted Bit #1: set to 1 to indicate RS operational parameter configuration is omitted Bit# 2: set to 1 to indicate RS connection/tunnel reestablishment is omitted Bit #3: set to 1 to indicate MS service flow re-establishment sub-stage is omitted Bit #4-7: *reserved*
Preamble Indexs	TBA	Number of candidate neighbor access stations	8 bit index of preamble indexes of candidate neighbor access stations

Insert new subclause 11.6.3:

11.6.3 CID ~~L~~list

The CID List carries a list of the CIDs of the MSs attached to an MRS. It provides a mapping between old CID (assigned by the old MR-BS) and new CID (assigned by the new MR-BS).

Type (1 byte)	Length	Value (variable-length)
TBA	Variable	See the following table

Field	Length	Note
Number of CIDS	2 bytes	The next two fields will be repeated number of MS times
Old CID	2 bytes	
New CID	2 bytes	

Insert new subclause 11.6.4:

11.6.4 Tunnel CID list

The Tunnel CID List carries a list of the CIDs of the tunnels between an MRS and the MR-BS. It provides a mapping between old tunnel CID (assigned by the old MR-BS) and new tunnel CID (assigned by the new MR-BS) in tunneling case.

Type (1 byte)	Length	Value (variable-length)
TBA	Variable	See the following table

Field	Length	Note
Number of CIDS	2 bytes	The next two fields will be repeated once for each tunnel associated with the MRS
Old CID	2 bytes	
New CID	2 bytes	

Insert new subclause 11.7.8.14:

11.7.8.14 Location support

Name	Type	Length	Value	Scope
Location Support	19	1	0: no location support 1: location support	REG-REQ REG-RSP

11.7.25 MAC header and extended subheader support

Change the table in 11.7.25 as indicated:

Type	Length	Value	Scope
43	3	Bit #0: Bandwidth request and UL Tx Power Report header support Bit #1: Bandwidth request and CINR report header support Bit #2: CQICH Allocation Request header support Bit #3: PHY channel report header support Bit #4: Bandwidth request and uplink sleep control header support Bit #5: SN report header support Bit #6: Feedback header support Bit #7-10: SDU_SN extended subheader support and parameter Bit #7: SDU_SN extended subheader support Bit #8-10 (=p): period of SDU_SN transmission for connection with ARQ disabled = once every 2p MAC PDUs Bit #11: DL sleep control extended subheader Bit #12: Feedback request extended subheader Bit #13: MIMO mode feedback extended subheader Bit #14: UL Tx Power Report extended subheader Bit #15: Mini-feedback extended subheader Bit #16: SN request extended subheader Bit #17: PDU SN(short) extended subheader Bit #18: PDU SN(long) extended subheader Bit #19: ACK header Bit #~~19~~20–23: *Reserved*	REG-REQ, REG-RSP

Insert new subclause 11.7.27:

11.7.27 RS frame offset

RS frame offset indicates the offset value between frame number used by MR-BS and frame number used by the RS transmitting (receiving) REG-REQ(REG-RSP) with RS frame offset.

When the RS broadcast frame number in its frame, RS shall keep the offset to the frame number used by BS as indicated by this TLV.

Name	Length	Value	Scope
RS frame offset	1 byte	Unsigned integer for frame offset of LSB 8 bit between Relay Station and Base Station.	REG-REQ, REG-RSP

Insert a new subclause 11.7.28:

11.7.28 MR MAC feature support

This TLV indicates the MR features supported by the RS and the MR-BS.

Type	Length	Value	Scope
TBA	1	Bit #0: RS scheduling support Bit #1: NBR-ADV generating Bit #2: Tunneling packet mode support Bit #3: Tunneling burst mode support Bit #4: RS mobility support Bit #5: Subordinate RS network entry support Bit #6-7 : Reserved	REG-REQ REG-RSP

Insert new subclause 11.7.29:

11.7.29 Multicast management support

Name	Length	Value	Scope
Multicast management support	1 byte	Bit #0: If this bit is set to 1, RS can support the broadcast messages relaying via common/ specific mechanism (see 6.3.28.1.1) #1-7: Reserved	REG-REQ, REG-RSP

11.8 SBC-REQ/RSP management message encodings

11.8.3 Physical parameters supported

11.8.3.7 WirelessMAN-OFDMA specific parameters

Insert new subclause 11.8.3.7.20:

11.8.3.7.20 RS maximum downlink transmit power

The maximum EIRP for the access DL preamble transmission at the RS. The RS will inform the MR-BS of the maximum EIRP that can be supported during network entry. The MR-BS will indicate to the RS the maximum EIRP the RS can utilize on the access DL preamble and advertise in any DCD message transmitted by the RS on the access link. The MR-BS may also send unsolicited SBC-RSP at any time to adjust the maximum EIRP that the RS may use, up to the maximum EIRP that the RS indicated during network entry. The maximum EIRP parameters are reported in dBm and quantized in 1dB steps ranging from [TBD]dBm (encoded 0x00) to [TBD]dBm (encoded 0xFF). Values outside this range shall be assigned the closest extreme.

Type	Length	Value	Scope
TBA	1	RS EIRP	SBC-REQ SBC-RSP

Insert new subclause 11.8.3.7.21:

11.8.3.7.21 RS Downlink Processing Delay

Type	Length	Value	Scope
TBA	1	RS Downlink Processing Delay (unit: frame)	SBC-REQ

Insert new subclause 11.8.3.7.22:

11.8.3.7.22 RS waiting time for MBS

Type	Length	Value	Scope
TBA	1	RS waiting time for MBS (unit: frame)	SBC-RSP

Insert new subclause 11.8.3.7.23:

11.8.3.7.23 RS waiting time for Paging

Type	Length	Value	Scope
TBA	1	RS waiting time for Paging (unit: frame)	SBC-RSP

Insert a new subclause 11.8.3.7.24:

11.8.3.7.24 MR PHY feature support

This TLV indicates the MR PHY features supported by the RS and the MR-BS.

Type	Length	Value	Scope
TBA	1	Bit #0: Access zone preamble transmission support Bits #1-7: *Reserved*	SBC-REQ SBC-RSP

11.8.4 Security Negotiation Parameters

11.8.4.2 Authorization policy support

Change the TLV table as indicated:

Type	Length	Value
25.2	1	Bit #0: RSA-based authorization at the initial network entry Bit #1: EAP-based authorization at the initial network entry Bit #2: Authenticated EAP-based authorization at the initial network entry Bit #3: ~~Reserved. Set to 0~~Authentication relay indicator Bit #4: RSA-based authorization at re-entry Bit #5: EAP-based authorization at re-entry Bit #6: Authenticated EAP-based authorization at re-entry Bit #7: ~~Reserved. Set to 0~~Authentication relay indicator at re-entry

Insert the following text at the end of 11.8.4.2:

During the registration process, RS could be registered as Authenticator Relay(AR) RS based on its capability and willingness to become the AR RS as indicated in the bit 3 and 7 of the authorization policy support field. Bit 3 & 7 default value is set to 0, meaning not capable of or not configured to be the Authentication Relay (AR), 1 means the RS is capable of and willing to be the Authenticator Relay(AR).

Insert new subclause 11.8.9:

11.8.9 Mobile RS mode support

This field indicates the mobile RS operation mode. A mobile RS uses this field in SBC-REQ to indicate its operation mode. The MR-BS uses this field in SBC-RSP to confirm the mobile RS mode. MR-BS shall not set both bits of the Mobile RS mode support TLV in the SBC-RSP.

Type	Length	Value	Scope
168	1 byte	Bit #0: moving RS mode Bit #1: moving BS mode Bits #2-7: *Reserved*	SBC-REQ/ RSP

Insert the following text at the end of 11.8.4.2:

During the registration process, RS could be registered as Authenticator Relay (AR) RS based on its capability and willingness to become the AR RS as indicated in the bit 3 and 7 of the authorization policy support field. Bit 3 & 7 default value is set to 0, meaning not capable of or not configured to be the AR, 1 means the RS is capable of and willing to be the AR.

Insert new subclause 11.9.38:

11.9.38 The Aggregation Message Formats

According to the messages defined in EAP/Auth.Relay protocol, we extend the TLV from single TLV to multiple TLVs and add "# of TLVs" filed to indicate the number of TLVs follows. Below messages are the formats for aggregations.

Table 632a—Aggregated authentication relay EAP start

Function Type	Message Type	# of TLVs	TLVs				
TBD	TBD	1..N	1st TLV name	2nd TLV name	...	Nth TLV name	M/O
			MS_1 info	MS_2 info	...	MS_n info	M

Table 632b—Aggregated authentication relay EAP transfer

Function Type	Message Type	# of TLVs	TLVs				
TBD	TBD	1..N	1st TLV Name	2nd TLV Name	...	Nth TLV Name	M/O
			MS_1 info	MS_2 info	...	MS_n info	M
			EAP payload	EAP payload		EAP payload	M

Table 632c—Aggregated authentication relay authenticated EAP start

Function Type	Message Type	# of TLVs	TLVs				
TBD	TBD	1..N	1st TLV name	2nd TLV name	...	Nth TLV name	M/O
			MS_1 info	MS_2 info	...	MS_n info	M

Table 632d—Aggregated authentication relay authenticated EAP transfer

Function Type	Message Type	# of TLVs	TLVs				
TBD	TBD	1..N	1st TLV Name	2nd TLV Name	...	Nth TLV Name	M/O
			MS_1 info	MS_2 info	...	MS_n info	M
			EAP payload	EAP payload		EAP payload	M

11.11 REP-REQ management message encodings

Insert the following table and text at the end of 11.11:

Name	Type	Length	Value
RS sounding Report period	1.9	1	RS sends REP-RSP after the number of frames since receiving the REP-REQ
Start Frame Number	1.10	1	8 LSB bits of the frame number to synchronize the sounding opportunity
RS Sounding Zone-specific CINR request	1.11	1	Bits #0-3: averaging parameter in multiples of 1/16 (range is [1/16,16/16]). Bits #4-7: Reserved, shall be set to zero
RS Sounding Zone-specific RSSI request	1.12	1	Bit #0: Type of zone on which RSSI is to be reported 0: RS reports RSSI on all subcarriers 1: RS reports RSSI on the sub-carriers allocated in the Sound zone allocation IE

TLV of report period indicates the period of measurement in the unit of frame number. After this period, the RSs in the RS_interference_measurement group shall report to the MR-BS the related measurement results (implementation specific). TLV of RS Sounding Zone-specific CINR requested is needed only when RSs are requested to report CINR measurements (implementation specific); TLV of RS Sounding Zone-specific RSSI requested is needed only when RSs are requested to report RSSI measurements (implementation specific).

11.12 REP-RSP management message encodings

Insert the following rows into the third table in subclause 11.12 as indicated:

REP-REQ Channel Type request (binary)	Name	Type	Length	Value
11	Vector of neighbor stations	2.6	2N	Basic CIDs of the N reported stations
11	UL Sounding CINR Report	2.7	N	CINR for each of the N RS or MS UL sounding signal in the sounding zone
11	UL Sounding RSSI Report	2.8	N	RSSI for each of the N RS or MS UL sounding signal in the sounding zone

Insert the following text after the third table in subclause 11.12:

When an RS received an REP-REQ with the TLV of Channel type request equal to 0b11, it shall respond to the MR-BS with an REP-RSP with TLVs of Sound reports (type 2.6 or 2.7) after measuring RS or MS sounding signals. The reporting time is indicated in REP-REQ. A vector of N measurement results of all participating RSs is reported by each RS. Moreover, an RS reports CINR or RSSI or both information dependent on whether the corresponding TLV (type 1.11 or 1.12) appears in REP-REQ. The CINR or RSSI report shall be measured on the UL sounding.

Insert the following text at the end of subclause 11.12:

An R-Link TLV may optionally be included in the REP-RSP message to report CQI information for relay links.

The proposed R-Link TLV format is as follows. In 802.16-2005, preamble is defined an 8-bit integer. Similar convention is used to index Relay-amble. Direction is specified as two bits.

Name	**Type**	**Length**	**Value**
R-Link	7	2 bytes	16-bit Integer

Syntax	**Size**	**Notes**
R-Link{		
Direction	2 bits	0b00 = Reserved 0b01 = Uplink 0b10 = Downlink 0b11 = Neighbor measurement
Reserved	6 bits	
Source	8 bits	Relay amble index
}		

An Access-Link may optionally be included in the REP-RSP message to report DL CQI information for access links. The Access-Link TLV format is as follows. MS CID specifies the identity of the MS for which the measurements are reported. Relay amble index is used to index the DL MS channel measurements.

Syntax	Type	Length	Notes
Access-Link{			
CID	8.1	2	CID of MS being reported
Source	8.2	N	Relay amble indices for which measurements are reported
DL CINR Report	8.3	N	CINR report for each relay index
DL SINR Report	8.4	N	SINR report for each relay index
}			

11.13 Service flow management encodings

11.13.36 PDU SN extended subheader for HARQ reordering

Change the first paragraph of 11.13.36 as indicated:

This TLV is valid only in HARQ enabled connection. It specifies whether PDU SN extended subheader should be applied by the transmitter on every PDU on this connection. The PDU can be a tunnel PDU constructed in tunnel packet mode. This SN may be used by the receiver to ensure PDU ordering.

11.15 HO management encodings

Insert new subclause 11.15.2:

11.15.2 Preamble Index

This TLV is used for re-assignment of the preamble during the MRS handover.

Name	Type	Length	Value
Preamble Index	xx	1	A preamble index assigned to the MRS at the target MR-BS

11.17 MOB_PAG-ADV management message encodings

Insert new subclause 11.17.4:

11.17.4 RS tx frame number

RS tx frame number indicates the frame number at which RS shall transmit the message including this TLV to MS's. When RS receive PAG-ADV including this TLV, RS shall restructure and transmit PAG-ADV by extracting this TLV and updating the length field at the frame number as specified by this TLV.

Name	Length	Value	Scope
RS tx frame number	1 byte	Unsigned integer for LSB 8 bit of frame number at which RS shall transmit.	PAG-ADV

11.19 MOB_SCN-REP message encodings

Insert new subclause 11.19.1:

11.19.1 CDMA Codes TLV

Name	Type (1 byte)	Length	Value
RS CDMA Code	-	4	The TLV carries 4 byte ranging code in the following order - Ranging Request for SS (Continue) - Forward a Bandwidth Request Message from RS - Ranging Request for RS (Continue) - Forward a Bandwidth Request Header from RS - Resource Request for HARQ Error Report(UL)
Transparent MR system CDMA Code	TBD	1	The TLV carries 1 byte ranging code in the following order: - Dedicated periodic ranging code

Insert new subclause 11.20:

11.20 Preamble index with least signal strength

Type	Length	Value	Scope
TBD	Variable	b0 – b7: num_preambles for (i = 0; i<num_preamble;i++) { preamble index (8 bits) }	RS_NBR_MEAS_REP

Insert new subclause 11.21:

11.21 Tunnel CID and Management Tunnel CID

For RS supporting tunnels, the T-CID and MT-CID are assigned in REG-RSP messages by the Serving BS.

Type	Length (byte)	Value	Scope
Xx	2	T-CID allocated to the RS	REG-RSP
Xx	2	MT-CID allocated to the RS	REG-RSP

Insert new subclause 11.22:

11.22 Path management message encodings

The TLV encodings defined in this section are specific to the path management related MAC Management messages including DSA-REQ/RSP, DSC-REQ/RSP and DSD-REQ/RSP.

Insert new subclause 11.22.1:

11.22.1 Path-Addition TLV

This field contains a compound attribute whose subattributes identifies Path ID, the direction of the path, the number of RSs on the path and an ordered list of RSs on the path as listed in Table S1.

Type	Length	Value	Scope
TBD	variable	Compound	DSA-REQ, RNG-RSP

Table 638a—Path-Addition sub-attributes

Attribute	Content
Path ID	The ID of the path
Path Direction	The direction of the path
Existing Path ID	The ID of an existing path that is used to derive the information of the new path
Number of RS	The number of RSs in the ordered list of RSs
Ordered list of RSs	An ordered list of the basic CID of RSs that identifies the path in the case of non-presence of the Existing Path ID; or a ordered list of RSs that identifies the difference between the new path and the existing path in the case of presence of the Existing Path ID

Insert new subclause 11.22.2:

11.22.2 Path-CID-Binding-Update TLV

This field contains a compound attribute whose subattributes identifies Path ID, the CIDs bound to the specified path, the service flow parameter associated with the CIDs as listed in Table S2.

Type	Length	Value	Scope
TBD	variable	Compound	DSA-REQ, RNG-RSP

Table 638b—Path-CID-Binding-Addition sub-attributes

Attribute	Content
Path ID	The ID of the path
Number of CIDs	The number of CIDs bound to the path
List of CIDs	An list of CIDs that are bound to the path
List of service flow parameters	An list of service flow parameters associated with the CIDs bound to the path

Insert new subclause 11.22.3:

11.22.3 Path-CID-Binding-Removal TLV

This field contains a compound attribute whose subattributes identifies Path ID, the CIDs bound to the specified path to be removed as listed in Table S3.

Type	Length	Value	Scope
TBD	variable	Compound	DSD-REQ

Table 638c—Path-CID-Binding-Removal sub-attributes

Attribute	Content
Path ID	The ID of the path
Number of CIDs	The number of CIDs bound to the path
List of CIDs	An list of CIDs that are bound to the path

Insert new subclause 11.22.4:

11.22.4 Path-ID TLV

This field contains the ID of a path between MR-BS and a RS.

Type	Length	Value	Scope
TBD	TBD	ID of path	DSx-REQ, DSx-RSP, DSx-ACK

Insert new subclause 11.22.5:

11.22.5 Path-Direction TLV

This field specifies the direction of the path, which could be uplink only, downlink only or both uplink and downlink.

Type	Length	Value	Scope
TBD	1	0: uplink 1: downlink 2: both uplink and downlink	DSA-REQ

Insert new subclause 11.22.6:

11.22.6 Number-of-RS TLV

This field specifies the number of intermediate RSs on the path.

Type	Length	Value	Scope
TBD	1	Number of RS on the path	DSA-REQ

Insert new subclause 11.22.7:

11.22.7 Ordered-List-of-RS TLV

This field contains an ordered list of intermediate RSs on the path in the case of non-presence of the Existing Path ID; or a ordered list of RSs that identifies the difference between the new path and the existing path in the case of presence of the Existing Path ID. Note that if the Path Direction indicates for both uplink and downlink, then the ordered list of RS is for the downlink direction. The ordered list of RS for the uplink can be obtained by reverse the ordered list.

Type	Length	Value	Scope
TBD	Number of RS x 2 bytes	An ordered list of basic CID of RSs on a path; if Path Direction == 2, then the ordered list of RS on the path is for the downlink direction	DSA-REQ

Insert new subclause 11.22.8:

11.22.8 PM-Confirmation-Code TLV

TBD.

Insert new subclause 11.22.9:

11.22.9 Existing-Path-ID TLV

This field contains the ID of a path between MR-BS and a RS.

Type	Length	Value	Scope
TBD	TBD	ID of an existing path	DSA-REQ

Insert new subclause 11.23:

11.23 MR Code Report management message encodings

Name	Type (1 byte)	Length	Value
Code attributes	TBA	4	Bits 31:22 - Used to indicate the OFDM time symbol reference that was used to transmit the ranging code. Bits 21:16 - Used to indicate the OFDMA subchannel reference that was used to transmit the ranging code. Bits 15:8 - Used to indicate the ranging code index that was sent by the SS or RS. Bits 7:0 - The 8 lease significant bits of the frame number of the OFDMA frame where the SS sent the ranging code

Insert new subclause 11.24:

11.24 MR_NBR-INFO Management Message Encoding

Name	Type (1 byte)	Length (bits)
DCD Configuration Change count	1	4
UCD Configuration Change count	2	4
DCD settings	3	variable
UCD settings	4	variable
Neighbor BS trigger	5	variable
PHY Mode ID	6	8

Insert new subclause 11.25:

11.25 RS_CD message TLV encoding

Insert new subclause 11.25.1:

11.25.1 Preamble indexes reserved for moving relay station

This field may be used by a MR-BS to broadcast to relay stations the preamble indexes reserved for moving relay station

Type	Length	Value	Scope
1	Variable	Bits#0-#3 : number of preamble indexes(N) Bit#4-#(7N+3): List of N preamble indexes (7 bits each)	RS_CD

Insert new subclause 11.26:

11.26 Preamble reselection thresholds

This field may be used by a MR-BS to broadcast the preamble reselection thresholds for moving relay station.

Type	Length	Value	Scope
2	2	Bits #0 -#7: Interference signal strength threshold Bits#8-#11: Interference duration threshold in number of Frames Bits #12-#15: Window for reselecting the preamble (segment) in unit of 10 frames	RS_CD

12. System profiles

12.4 WirelessMAN-OFDMA and WirelessHUMAN(-OFDMA) system profiles

12.4.3 WirelessMAN-OFDMA and WirelessHUMAN(-OFDMA) System PHY

12.4.3.1 Common features of PHY profiles

12.4.3.1.5 Minimum performance requirements

Change Table 413(.16e)/Table 666(Rev2) as indicated:

Table 666—Minimum performance requirements for all profiles

Capability	Minimum performance
RSTTG and RSRTG: TDD	≤50μs