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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

~~Sponsor~~

~~**LAN MAN Standards Committee**~~

~~**of the**~~

~~**IEEE Computer Society**~~

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.~~

IEEE 802.16 Working Group Officers

[Editor's Note: Insert list of WG Officers]

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

TG Officers

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Contents

List of Tables

List of Figures

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 underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

1. 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

1.4 Reference model

Insert new subclause 1.4.2:

1.4.2 Relaying reference model

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 transmision/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 transmission

3.91 UL Access_Zone: A portion of the UL sub-frame in the MR-BS/RS frame used for MS(s) 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 T-CID(Tunnel CID): A unique identifier taken from the connection identifier (CID) address space that uniquely identifies transport tunnel connections between the MR-BS and RSs.

3.95 MT-CID(Management Tunnel CID): A unique identifier taken from the connection identifier (CID) address space that uniquely identifies management tunnel connections between the MR-BS and RSs.

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 uplink access zone and uplink relay zone in RS frame. It shall be an integer number of symbols. Not applicable for frequency division duplex (FDD) systems. The R-RTG may be calculated by following equation:

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

3.101 R-TTG: RS transmit/receive transition gap between uplink access zone and uplink relay zone in RS frame between DL access zone and DL relay zone in RS frame. It shall be an integer number of symbols. Not applicable for frequency division duplex (FDD) systems. The R-TTG may be calculated by following equation:

$$R\text{-}TTG = \begin{cases} 0 & if\ , RTD/2 \geq RSTTG \\ OFDMSymbol\ Unit\left(RSTTG - RTD/2\right) & if\ , RTD/2 < RSTTG \end{cases}$$

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

4. Abbreviations and acronyms

Insert the following at the end of section 4:

R-TTG	Relay-TTG
R-RTG	Relay-RTG
R-FCH	Relay-FCH
R-MAP	Relay MAP

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. Please refer to section 6.3.1.1 for the specification. This section specifies the additional addressing and connection definitions that apply to relay functions. Each air interface in the 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.

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

6.3.2.1 MAC header formats

Insert the following at the end of 6.3.2.1:

The MAC header of the PDU from the MS to the MR-BS via the RS is encapsulated by the access RS, and the MAC header of the PDU from the MR-BS to the MS via the RS is decapsulated by the access RS.

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 as indicated:

Table 7g—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.

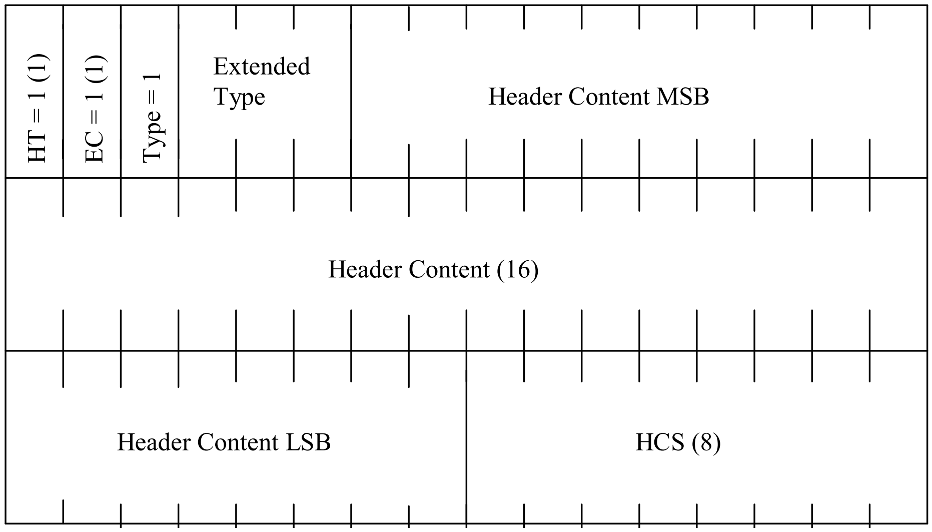


Figure uuu—Extended MAC Signaling Header Type II Format

Table <X1>—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		
2-7	*Reserved*		

Insert new subclause 6.3.2.1.2.2.2.1:

6.3.2.1.2.2.2.1 RS BW Header

RS BW request header is sent by the RS to request bandwidth for its access link from the MR-BS to send RNG_RSP. The RS Bandwidth request header is illustrated in Figure xxx.

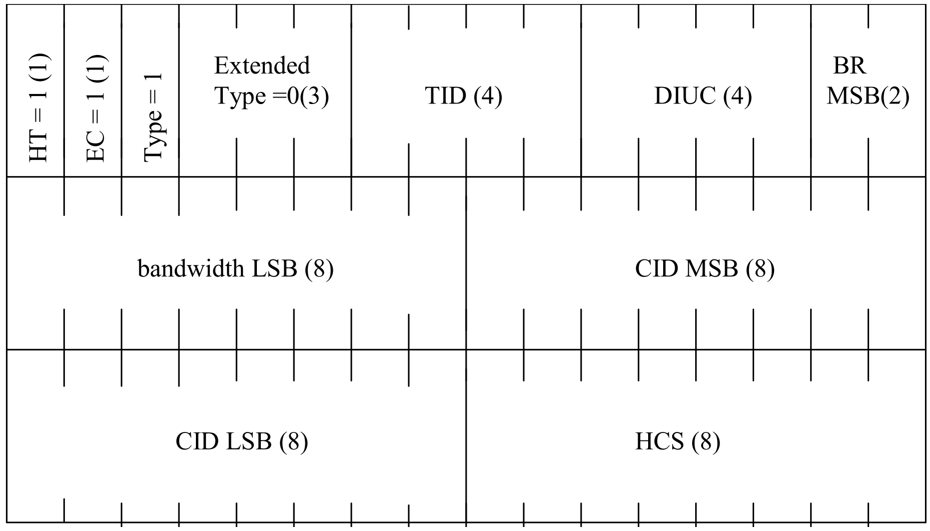


Figure uuu—RS BR Header Format

Table <XX>—Description of fields in RS BR header

Name	Length	Description
TID	4	Transaction Identifier. MR-BS when allocating resources using RNG_RSP_ALLOC_IE will send the same TID. The TID is used at RS for mapping to generate RNG_RSP
DIUC	4	Indicates the DIUC used by RS to transmit RNG_RSP. MR-BS allocates sufficient resources to send RNG_RSP from RS using RNG_RSP_ALLOC_IE.
Bandwidth request	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

The RS requests a dedicated uplink resource through the RS UL_DCH request header. This header is as follows:

<table>
<tr><td>HT = 1
(1)</td><td>EC = 1
(1)</td><td>Type =
1 (1)</td><td>Extended Type (3)</td><td>Type (MSB)
(2)</td></tr>
<tr><td colspan="2">Type (LSB)
(2)</td><td colspan="2">DCH Type
(2)</td><td>Header content
(4)</td></tr>
<tr><td colspan="5">Header content
(8)</td></tr>
<tr><td colspan="5">Header content
(8)</td></tr>
<tr><td colspan="5">Header content
(8)</td></tr>
<tr><td colspan="5">HCS (8)</td></tr>
</table>

Figure uuu—RS UL_DCH request header

Table <XXX>—RS UL-DCH header

Syntax	Size	Notes
MAC Header() {		
RMI	3 bits	Relay mode indication: "111" this MPDU uses 802.16j relay format, others = this MPDU uses legacy 802.16e format
if (RMI == 111) {		relay MAC PDU format will be used
Extended TYPE	3 bits	
if (Extended TYPE == 001({		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
} else(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

Table <XXX>—RS UL-DCH header

Syntax	Size	Notes
} else(DCH TYPE == 10){		DCH Request Rate Based
Progressive rate	12 bits	Average data rate with the progressive resolution unit
Reserved	8 bits	Reserved
}		
RS CID	8 bits	Reduced Basic CID of RS
}		
}		
HCS	8 bits	Header check sequence
}		
}		

6.3.2.2 MAC subheaders and special payloads

6.3.2.3 MAC management messages

Change Table 14 as indicated:

Table 14—MAC Management messages

67	RS-CDC	Cooperative diversity configuration for RS message	Basic
Xx	CID_ALLOC-IND	CID allocation message	Basic
~~67~~68-255		*Reserved*	

6.3.2.3.5 Ranging Request(RNG-REQ) message

Change 'Reserved' field in Table 19 as indicated:

~~*Reserved*~~ MS ranging Indicator	8 bits	~~Shall be set to zero~~ 0 : *Reserved* 1 : Indicates this message used for MS ranging 2-255: *Reserved*

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 as indicated:

~~*Reserved*~~ MS ranging Indicator	8 bits	~~Shall be set to zero~~ 0 : *Reserved* 1 : Indicates this message used for MS ranging 2-255: *Reserved*

Insert the following text at the end subclause 6.3.2.3.6:

When a MMR-BS sends RNG-RSP message in response to a RNG-REQ message containing MRS Paging Group ID, the MMR-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)

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)

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)

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 at the end of 6.3.2.3.10:

In multi-hop 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.

The DSA-REQ 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 DSA message's attribute list.

6.3.2.3.11 DSP-RSP message

Insert the following text at the end of 6.3.2.3.11:

In multi-hop 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 39a—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.

The DSA-RSP 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 DSA message's attribute list.

6.3.2.3.13 DSC Request (DSC-REQ) message

Insert the following text at the end of 6.3.2.3.13:

In multi-hop 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 38 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.

The DSC-REQ 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 DSC message's attribute list.

6.3.2.3.14 DSC Response (DSC-RSP) message

Insert the following text at the end of 6.3.2.3.14:

In multi-hop 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 42a—DSC-RSP message format

Syntax	Size	Notes
DSC-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.

The DSC-RSP 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 DSA message's attribute list.

6.3.2.3.15 DSC Acknowledge (DSC-ACK) message

Insert the following text at the end of the subclause:

In multi-hop 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.

The DSD-REQ 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 DSD message's attribute list.

6.3.2.3.17 DSD-RSP message

Insert the following text at the end of 6.3.2.3.17:

In multi-hop 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 44a—DSD-RSP message

Syntax	Size	Notes
DSD-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 DSD-REQ.

The DSD-RSP 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 DSD message's attribute list.

6.3.2.3.23 SS basic capability request (SBC-REQ) message

Insert the following at the end of 6.3.2.3.23:

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 basic capability response (SBC-RSP) message

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 as indicated:

Table 55—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.

6.3.2.3.52 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 MMR-BS sends MOB_BSHO-RSP message in response to a MOB_MSHO-REQ message containing MRS_PGID the MMR-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)

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 109z—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
RS Encoding Method	1 bit	0b0 = No encoding 0b1 = Encoding
Reserved	3 bits	Reserved
}		

An MR-BS shall generate RS-CDC message in the form shown in Table 109z, including the following parameters:

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, each antenna of the RS shall be playing the role of Antenna #0 and #1, respectively. Each antenna will transmit pilots according to Figure 245, 247, 251, 251a, based on the chosen STC in the corresponding STC_DL_Zone_IE. If no transmit diversity is used (STC='0b00' in STC_DL_Zone_IE), all active antennas use non-STC pilot patterns.

RS Encoding method

No Encoding indicates that the relay station retransmits the data symbols, in order, without modification. Note that the pilot transmission must still be obeyed, according to the antenna assignment and STC. Encoding indicates that the symbols [S1, S2], or [S1, S2, S3, S4], or [S1, S2, S3, S4, S5, S6, S7, S8] are transmitted by the BS and received by the RS, in that order, and re-encoded by the RS according to the chosen STC defined in 8.4.8.1.4 and 8.4.8.2.3. The STC is based on the parameters in the corresponding STC_DL_Zone IE. For 2 transmit antennas using Matrix A, Encoding follows the coding scheme for code A in 8.4.8.1.4. That is, it represents the operation [S1 S2] .. [S1 –S2*] for Antenna #0, [S2 S1*] for Antenna #1. For 4 transmit antennas using Matrix A, Encoding follows the coding scheme for code A in 8.4.8.2.3. That is, it represents the operation [S1 S2 S3 S4] .. [S1 –S2* 0 0] for Antenna #0, [S2 S1* 0 0] for Antenna #1, [0 0 S3 –S4*] for Antenna #2, [0 0 S4 S3*] for Antenna #3. For 2 transmit antennas using Matrix B, Encoding follows the coding scheme for code B in 8.4.8.1.4. This is a mapping from two symbols to one symbol, i.e. [S1 S2] .. [S1], [S2] for Antenna #0, #1 respectively. For 4 transmit antennas using Matrix B, Encoding follows the coding scheme for code B in 8.4.8.2.3. This is a mapping from eight symbols to four symbols. For 4 transmit antennas using Matrix C, Encoding follows the coding scheme for code C in 8.4.8.2.3. This is a mapping from four symbols to one symbol.

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.

Syntax	Size	Notes
MR_NBR-INFO Message format(){	-	-
Management Message Type = TBD	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.

}		
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){	-	-

Scheduling Service Supported	8 bits	Bitmap to indicate if Station supports a particular schedul-ing 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.
PHY Profile ID	8 bits	Aggregated IDs of Co-located FA Indicator, FA Configura-tion 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){	-	-
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.
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.

When Mobility Feature Supported bit indicate support for idle mode, 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 xx—MR Code Report(MR_CODE-REP) message Format

Syntax	Size	Note
MR_Code_Report_format() {		
Management Message Type = xx	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 shall 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 shall 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 <xx>—CID_ALLOC-IND message format

Syntax	Size	Note
CID_ALLOC-IND_Message_Format() {		
Management Message Type (TBD)	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
}		
}		

Insert new subclause 6.3.2.3.66:

6.3.2.3.66 RS configuration request message

[Editor's note: Two contributions provided conflicting text for input into this section at session #48. The following is from accepted comment #007]

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.

Table <XXX>—RS_Config-REQ message format

Syntax	Size	Note
RS_Config-REQ format {		
Management message type = 67	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.

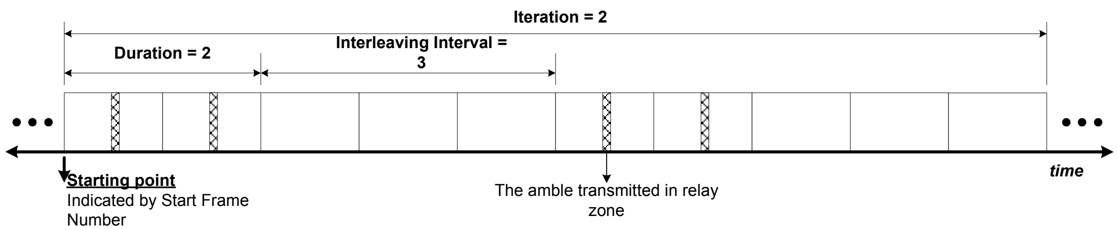
Preamble_index

This field is used to indicate the preamble index.

[Editor's Note: The following is merged text from accepted comments #054 and #126]

The MR-BS can send a RS_Config-REQ message to instruct the RSs to transmit or receive the R-amble in relay zone. This message can be sent by either unicast, multicast or broadcast CID of the RSs. An 8 LSB bits of the frame number index will indicate the starting point of the subsequent R-amble transmission/reception opportunities. In order to instruct the stations in different MR-cell to transmit/receive the R-ambles at the same time, a coordinator in backhaul network is needed to ensure the Start Frame Number in the message sent by different MR-BSs will align to the same time.

When the Prefix is set as "00", the RS shall follow the pattern instructed by MR-BS to transmit/receive the R-amble in relay zone. 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. The transmission opportunities are identified by Duration and Interleaving Interval for each iteration. An example is given in Figure x, 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 in relay zone without periodic instruction from MR-BS. The detail design of the associated parameters is stated in 6.3.x.x. The RS is instructed to report its measurement results if the Prefix is set as "10". When the RS is instructed to transmit/receive the R-amble transmission autonomously, MR-BS can instruct the RS to report its measurement results by this message with the prefix set as "10".

This message is transmitted (unicast or broadcast) by a MMR-BS for the purpose of RS configuration. A MMR-BS can use this message to set operation parameters for a RS. This also can be used to choose the R-amble repetition pattern and to activate or deactivate these monitoring/synchronization processes for a specified period.

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.

Syntax	Size	Notes
RS_Config-REQ_Message_format(){		
Management Message Type =TBD	8 bits	
Start Frame Number	8 bits	8 LSB bits of the frame number
Duration	8 bits	Units are frames
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 = 0){		
Interleaving Interval	8 bits	Units are frames
Iteration Number	8 bits	Units are frames
N_stations	8 bits	Number of stations received this message
For(j = 0; j<Iteration; j++){		
N_Transmitter	8 bits	Number of stations to transmit the R-amble
For(i=0;i<N_Transmitter;i++){		
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
}		
}		
}		
If(Prefix=01){		
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	Kn, Units are frame (see subsection 8.4.6.1.1.3.1)
Neighbor monitoring 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
}		

Start Frame Number

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

Duration

Duration (in units of frames) of the measurement/monitoring/transmission process. If the 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, Kn
The offset of the R-amble in the neighbor monitoring cycle

Neighbor Monitoring Cycle Length, M
This defines the number of neighbor monitoring amble frames in an R-amble monitoring cycle

Insert new subclause 6.3.2.3.67:

6.3.2.3.67 MR-BS configuration response 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 RS_Config-REQ or as an unsolicited message.

Table <XXX>—RS_Config-RSP message format

Syntax	Size	Note
RS_Config-RSP format {		
Management message type = 68	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 - b7: reserved

If (b0 of Configured_para_type == 1) {		
reserved	1 bits	Shall be zero
Preamble_index	7 bits	Preamble index
}		
If (b2 of Configured_para_type == 1) {		
Unicast RSID	8 bits	Unicast RSID
}		
If (b3 of Configured_para_type == 1) {		
Multicast RSID	8 bits	Multicast RSID as the RS Group ID
}		
}		

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 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.

Insert new subclause 6.3.2.3.68:

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

Syntax	Size	Notes
RS_NBR-MEAS-REP_Message_Format(){		
Management Message Type =TBD		
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 RS preamble configuration request (RS_Config-REQ) message

Syntax	Size	Notes
N_Preamble	2 bits	N_Preamble=0 specifies NULL preamble (e.g., Transparent RS) N_Preamble=1 assigns one preamble to the RS N_Preamble=2 assigns two preambles on different segments to the RS N_Preamble=3 assigns three preambles on different segments to the RS
Reserved	6 bits	Reserved
for (i=0, i<N_Preamble; i++){		
Preamble index	8 bits	Assign a preamble index value to the potential RS
}		
TLV Encoded Information	Variable	TLV specific

N-Preamble

N_Preamble is the number of preamble index assigned to the potential RS. For example, N-Preamble=0 means the potential RS does not transmit preamble acting as a Transparent RS. If N-Preamble=1 means the potential RS transmit one preamble index (i.e., the RS transmit one segment value and one IDCell) acting as a Non-Transparent RS. If N-Preamble=2 means the potential RS transmit two preamble index (i.e., the RS transmit two different segment values and IDCells) acting as a Non-Transparent RS.

The RS_Config-REQ shall contain the following TLVs:

HMAC/CMAC Tuple (see 11.1.2)

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

Insert new subclause 6.3.2.3.70:

6.3.2.3.70 RS preamble configuration response (RS_Config-RSP) message

Syntax	Size	Notes
RS_Config-RSP_Message_Format() {		
Management Message Type = TBD	8 bits	
Result	1 bit	0 = Fail 1 = Success
Reserved	7 bits	
TLV Encoded Information	Variable	TLV specific
}		

Result

Result indicates the RS preamble configuration request message; a bit of 0 indicates the message fail and a bit of 1 indicates the message success.

The RS_Config-RSP shall contain the following TLVs:

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

Insert new subclause 6.3.2.3.71:

6.3.2.3.71 Location information requesting 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 6.3.2.3.71.1:

6.3.2.3.71.1 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 <X1>—MR_LOC-REQ message format

Syntax	Size	Notes
MR_LOC-REQ_ Message_Format() {	-	-
Type = xx	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.

Table <X1>—MR_LOC-REQ message format

Syntax	Size	Notes
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.
}	-	-

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.

Insert new subclause 6.3.2.3.71.2:

6.3.2.3.71.2 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 <X2>—MR_LOC-RSP message format

Syntax	Size	Notes
MR_LOC-RSP_ Message_Format() {	-	-
Type = xx	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 deviation format defined in section 6.3.2.3.62.3.
}	-	-
}	-	-
padding	variable	Padding bits to ensure byte aligned.
}	-	-

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.

Insert new subclause 6.3.2.3.71.3:

6.3.2.3.71.3 LLA IE() format and sequence charts

Table <X3>— LLA_IE()

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°.
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°.
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 uuu—Relay location report (part 1)

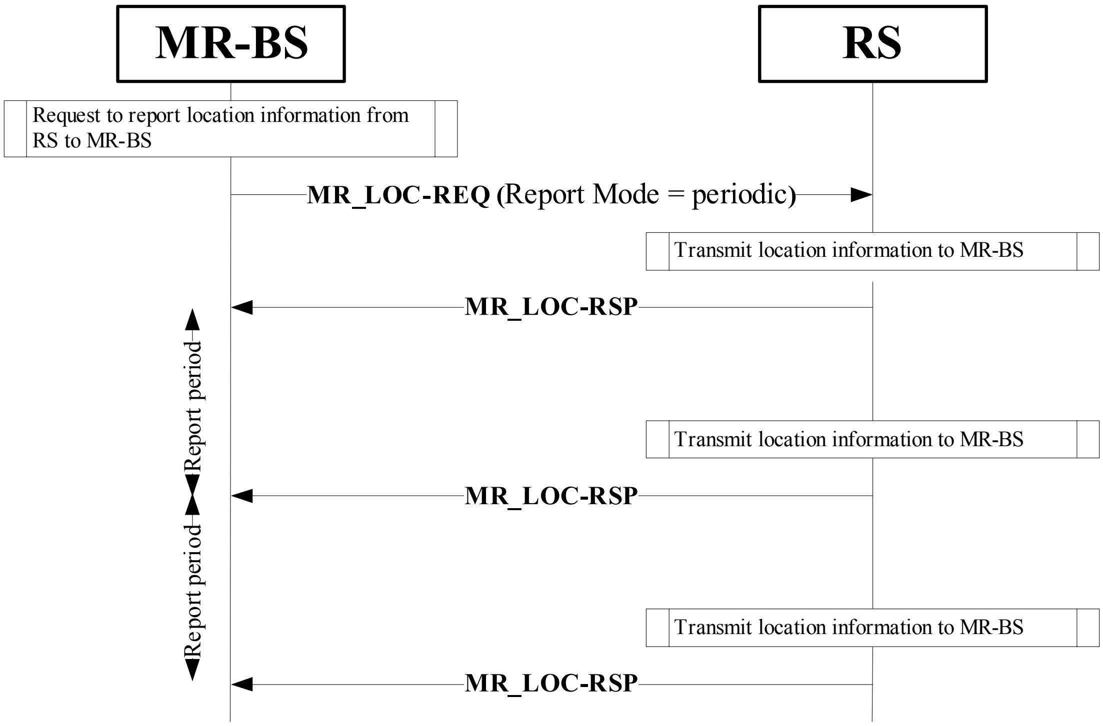


Figure uuu—Relay location report (part 2)

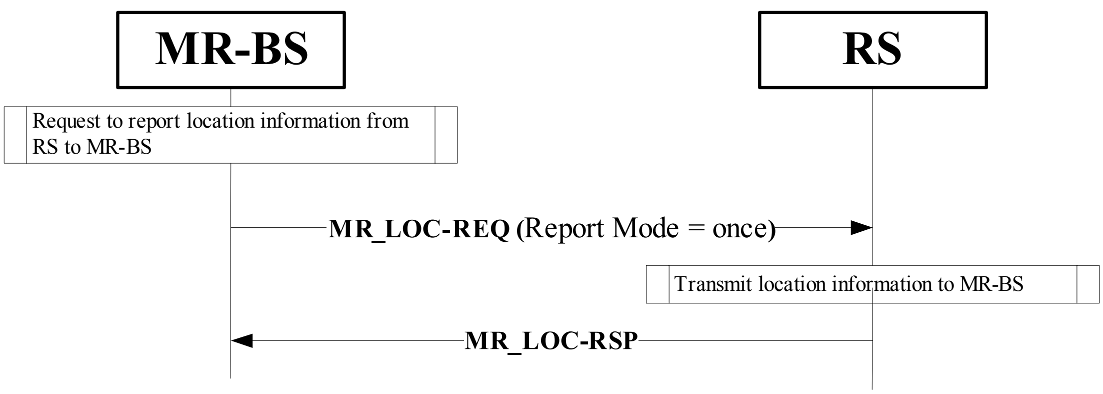


Figure uuu—Relay location report (part 3)

Insert new subclause 6.3.2.3.72:

6.3.2.3.72 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 <x>—MS_SCN-INF message format

Syntax	Size	Notes
MS_SCN-INF_Message_format(){		
Management Message Type =TBD		
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 6.3.2.3.73:

6.3.2.3.73 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 <y>—MS_SCN-ACK message format

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

Insert new subclause 6.3.2.3.74:

6.3.2.3.74 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 <vvv>—MS_SCN-CLT message format

Syntax	Size	Notes
MS_SCN-CLT_Message_format(){		
Management Message Type =TBD	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 6.3.2.3.75:

6.3.2.3.75 MS Context Information Delete (MS_INFO-DEL) message

An MR-BS transmits a 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 <x>—MS_INFO-DEL message format

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

Insert new subclause 6.3.2.3.76:

6.3.2.3.76 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 <y>—MS_DEL-ACK message format

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

Insert new subclause 6.3.2.3.77:

6.3.2.3.77 Relay Frame configuration Message

The MR-BS or RS shall transmit the Relay_Frame_configuration message for subordinate RSs to configure the multi-hop relay frame structure. The message shall be transmitted on the basic CID or broadcast CID.

Syntax	Size	Notes
Relay_Frame_configuration_Message_format(){		
Management Message Type =TBD	8 bits	
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	
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	

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	
Duration	6 bits	
}		
}		
}		
Padding		
}		

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 includes DL subframe configuration.

UL indicator:

1 indicates that the message includes 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.

Duration:

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

Number of frame :

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

Insert new subclause 6.3.2.3.78:

6.3.2.3.78 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 <xxx>—CLK-SYNC message format

Syntax	Size	Notes
CLK-SYNC_message_format(){		
Management Message Type =TBD	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 $fractionGPStime \equiv GPStime - frameduration \times \left\lfloor \frac{GPStime}{frameduration} \right\rfloor$
}		

Insert new subclause 6.3.2.3.79:

6.3.2.3.79 ASC-REQ

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

Table <xxx>—ASC-REQ message format

Syntax	Size	Notes
ASC_REQ_message_format(){		
Management Message Type =TBD	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 6.3.2.3.80:

6.3.2.3.80 ASC-RSP

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

Table <xxx>—ASC-RSP message format

Syntax	Size	Notes
ASC_RSP_message_format(){		
Management Message Type =TBD	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 6.3.2.3.81:

6.3.2.3.81 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 A—MOB_RSSCN-REP message format

Syntax	Size	Notes
MOB_RSSCN-REP_message_format(){		
Management Message Type =TBD	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 6.3.2.3.82:

6.3.2.3.82 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 B—MOB_RSSCN-REP message format

Syntax	Size	Notes
MOB_RSSCN-REP_message_format(){		
Management Message Type =TBD	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(RSID_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
}		
}		
}		

6.3.3 Construction and transmission of MAC PDUs

6.3.3.2 Concatenation

Insert the following after the first paragraph:

In MR networks, multiple MAC PDUs may be concatenated into a single transmission in either the uplink or downlink directions. Downlink MAC PDUs on relay links and downlink MAC PDUs on access links shall not be concatenated into the same burst.

Insert new subclause 6.3.3.8:

6.3.3.8 MMR 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.

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 for 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 T-CID or MT-CID may appear in the map IE that describes the allocation in which the burst is transmitted. Alternately, the T-CID or MT-CID can be omitted from map IEs and 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 map IE to identify the tunnel on which the PHY burst is transmitted. 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.

Insert new subclause 6.3.3.8.2:

6.3.3.8.2 Transmission using station CID

The construction of MPDUs is the same as without relay. The forwarding of MPDUs by each RS is performed based on the CID. An RS is informed apriori about the next hop station during SF setup for a station CID. The inclusion of CID in DLMAP is optional as it is without relay.

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

6.3.6 Bandwidth allocation and request mechanisms

Insert the following text after the second paragraph of 6.3.6:

<u>An RS may request a dedicated uplink resource with the bandwidth request R-MAC header RS UL DCH Request.</u>

Insert new subclause 6.3.6.7:

6.3.6.7 Relay bandwidth request and allocation mechanisms

In all bandwidth request and allocation mechanisms, the SS shall use the same CDMA bandwidth request procedure as specified in 6.3.6.5.

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 it own MAPs reflecting these decisions.

Bandwidth request and allocation procedures on the access link (i.e. between the SS and its access RS or MR-BS) are the same as those outlined in 6.3.6.1-6.3.6.3 and 6.3.6.5.

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.>

[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 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.>

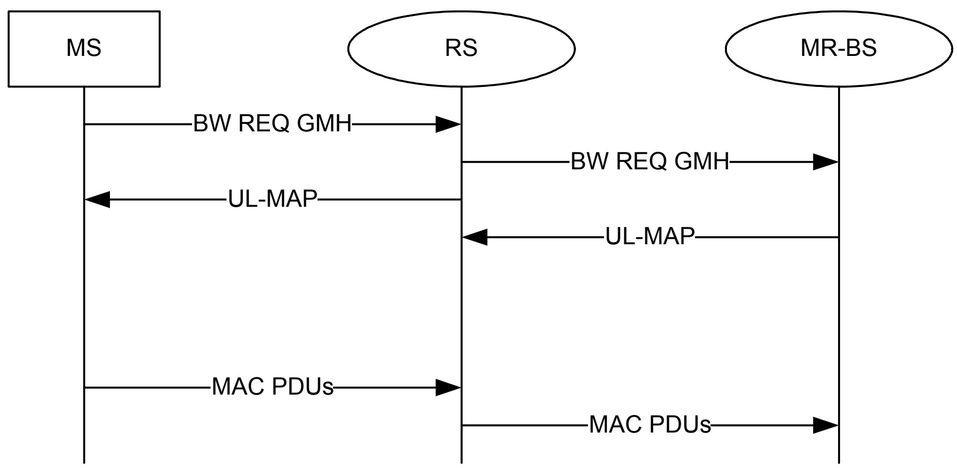


Figure <XXX>03—Reducing latency in relaying traffic by transmitting BW req. header on R-UL before packets arrive

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.

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).

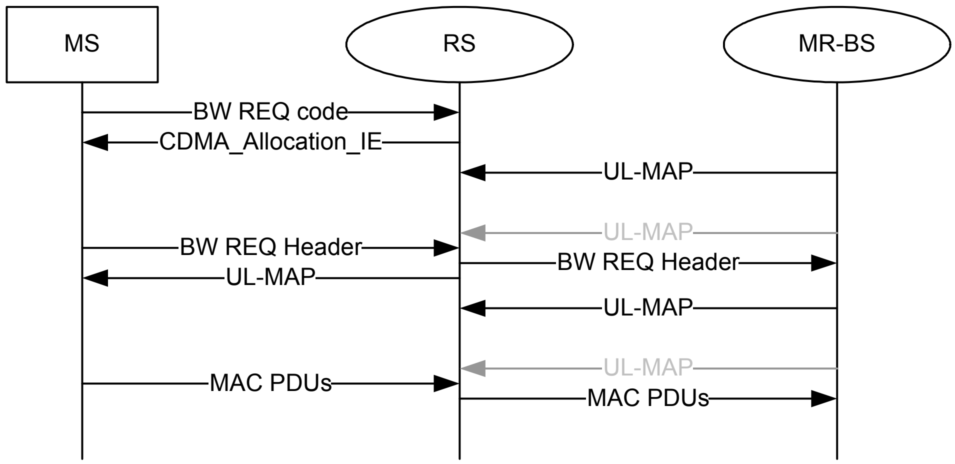


Figure <XXX>03—Reducing latency in relaying traffic via RS polling

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).

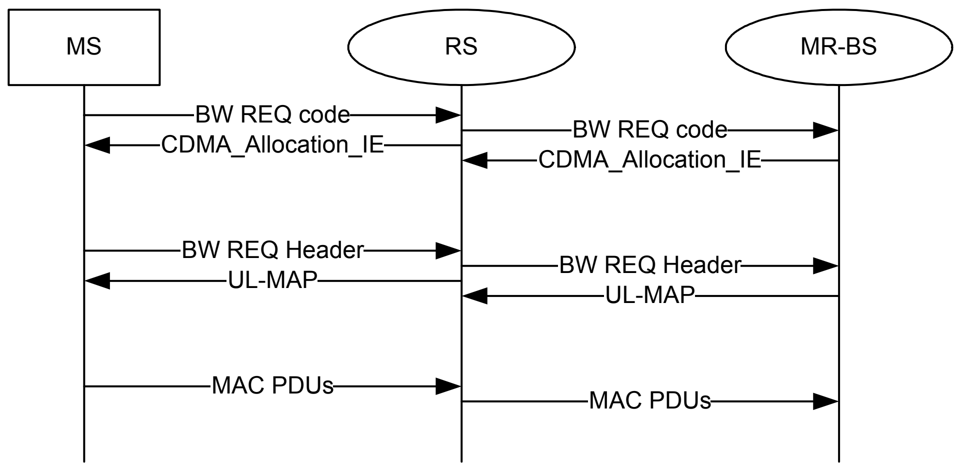


Figure <XXX>03—Reducing latency in relaying traffic by early transmission of BW request ranging code on the R-UL

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.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 creating the appropriate downlink and uplink allocations.

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 multi-hop 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.

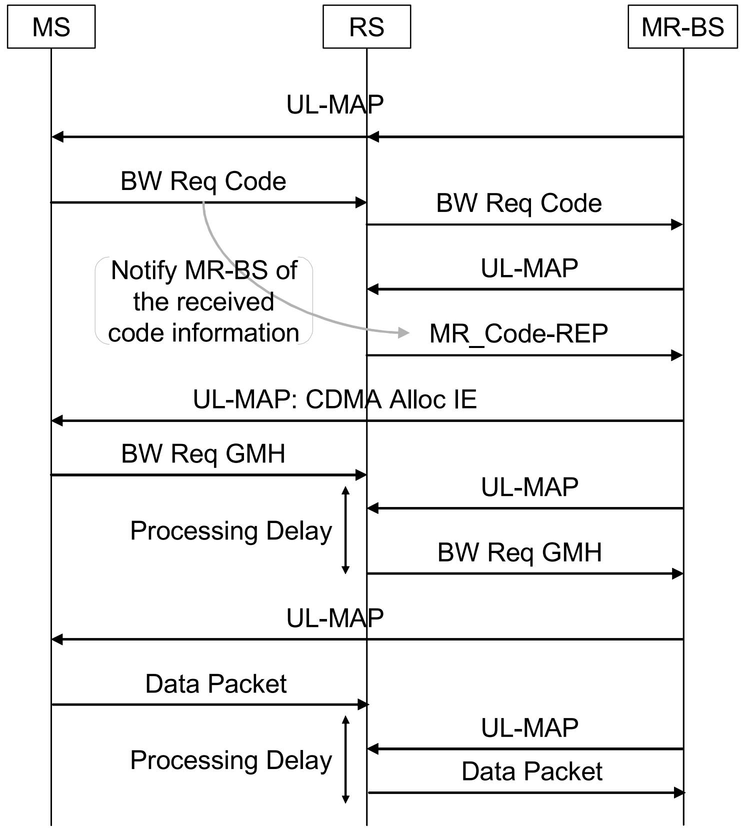
The dedicated channel allocation is assigned through MAP IE within the RS-Zone, i.e. R-MAP. The allocation is available starting in the same frame when the R-MAP IE is received by the RS.

Insert new subclause 6.3.6.8:

6.3.6.8 Bandwidth request and allocation mechanisms for MR

Upon receiving an RS CMDA ranging code, the MR-BS shall respond by allocating uplink bandwidth to each RS along the relay path from the RS specified by the code for the purpose of forwarding an MR_Code-REP message containing information about the CDMA ranging code received from the SS. The MR-BS shall use the CMDA ranging code and transmit region information in the MR_Code-REP to create a CDMA_allocation_IE that allocates bandwidth on which the SS can forward a BW request header to the MR-BS. Please see the figure <XXX>.

Figure <XXX>—BW request/allocation signaling in centralized scheduling



Insert new subclause 6.3.6.8.1:

6.3.6.8.1 Dedicated channel between MR BS and RS

An RS or MR-BS may allocate a dedicated channel using RS_UL_DCH (see 6.3.2.xxxx). 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 (see 6.3.2.xxxx).

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.

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

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 shall store preamble index and signal strength that are above a certain threshold value 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 MMR-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.

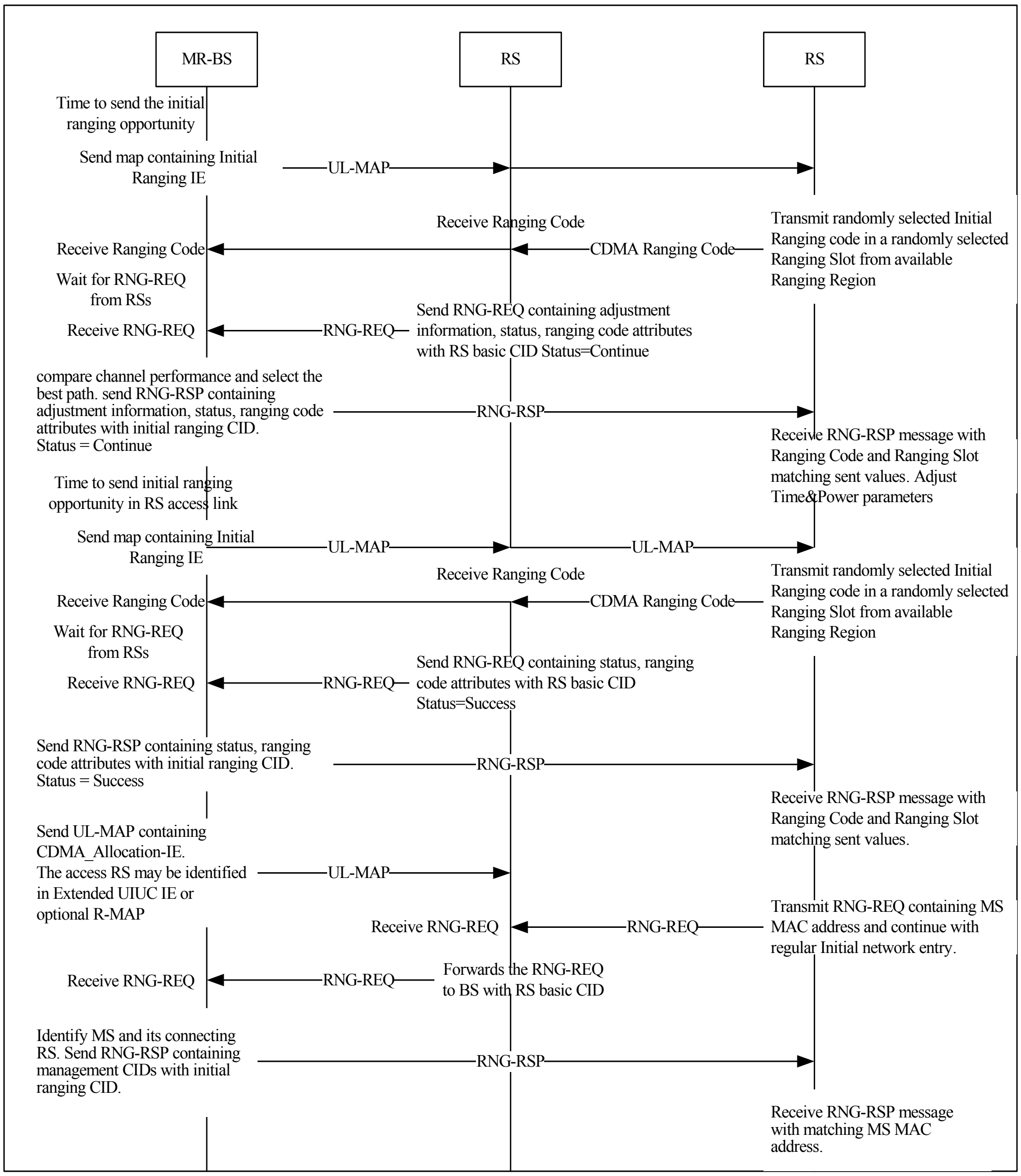


Figure <XXX>03—Ranging and automatic adjustments procedure in MR mode

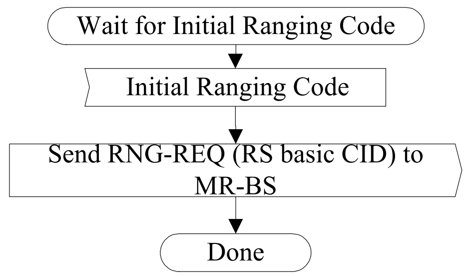


Figure <XXX>03—MS CDMA Initial Ranging -- Access Transparent RS

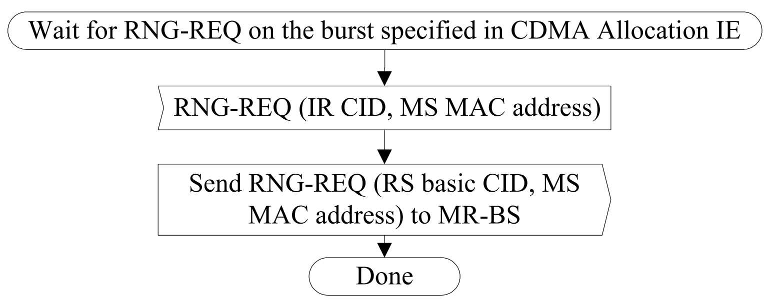


Figure <XXX>03—MS Initial Ranging -- Access Transparent RS

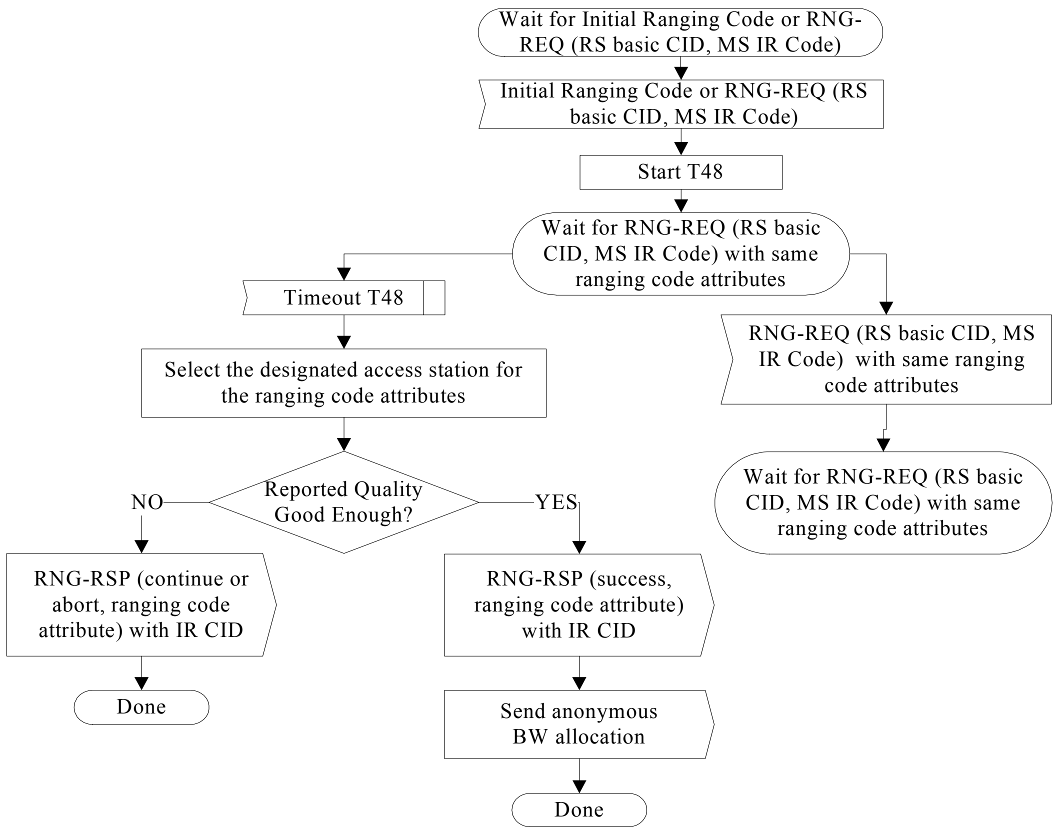


Figure <XXX>03—MS CDMA Initial Ranging with Transparent RS -- MR-BS

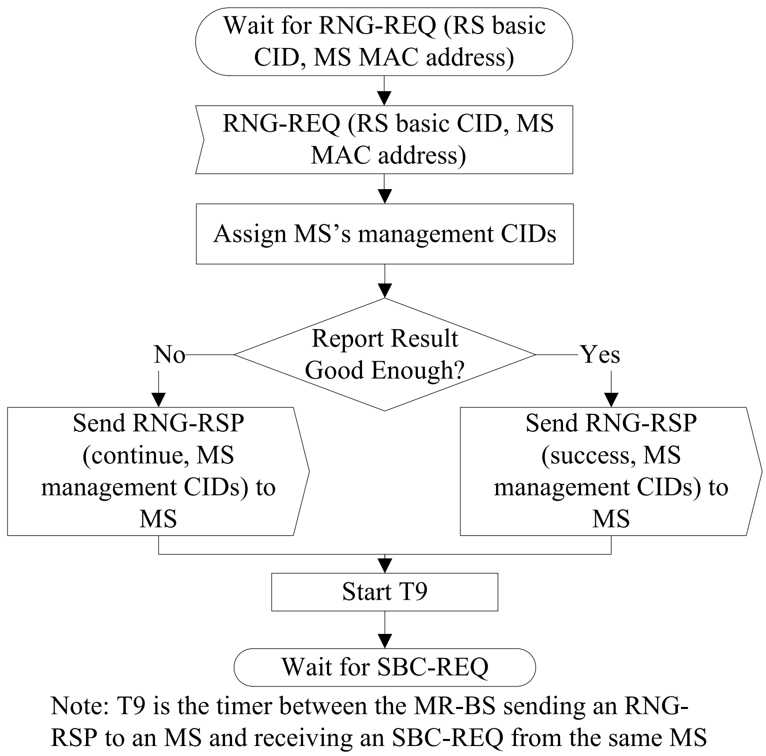


Figure <XXX>03—MS Initial Ranging with Transparent RS-- MR-BS

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 RS receives the 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. This procedure shall also be used in case of periodic ranging and handover ranging. Furthermore, the above procedure shall also be used in case of periodic ranging where 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 contains information of number of 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.

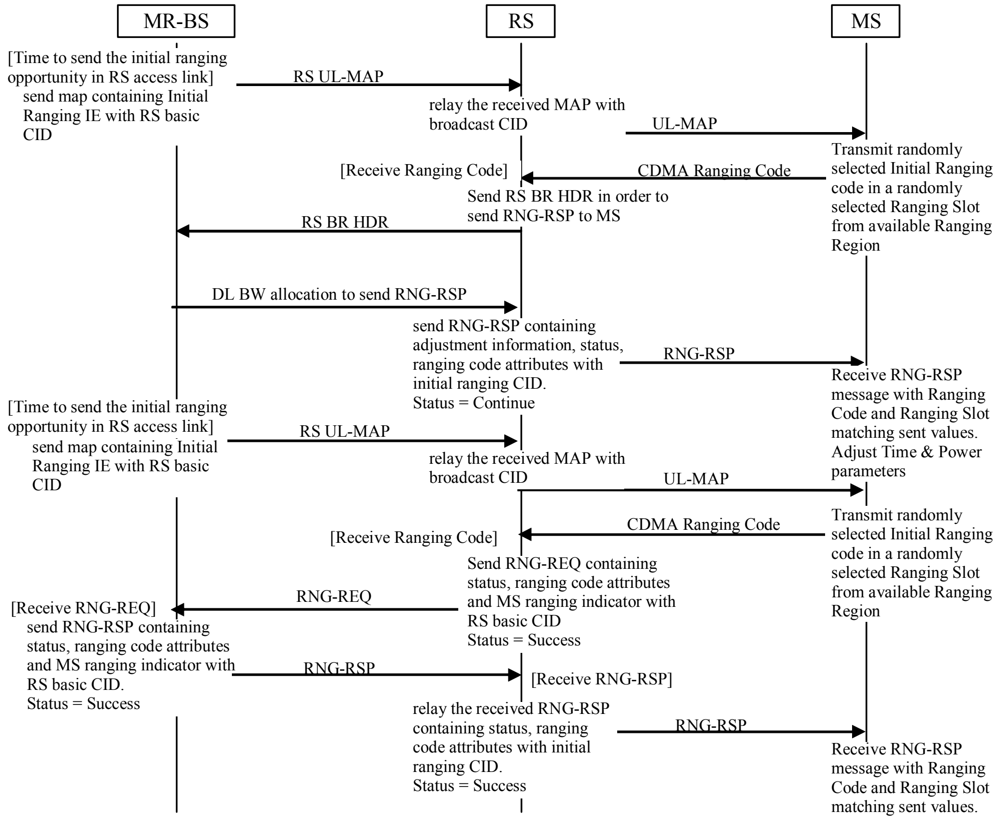
Once the MR-BS receives the RNG-REQ containing MS MAC Address with the RS basic CID, the MR-BS shall assign Basic and Primary management CIDs to the MS, and transmit a RNG-RSP containing those management CIDs and MS MAC Address with the RS basic CID.

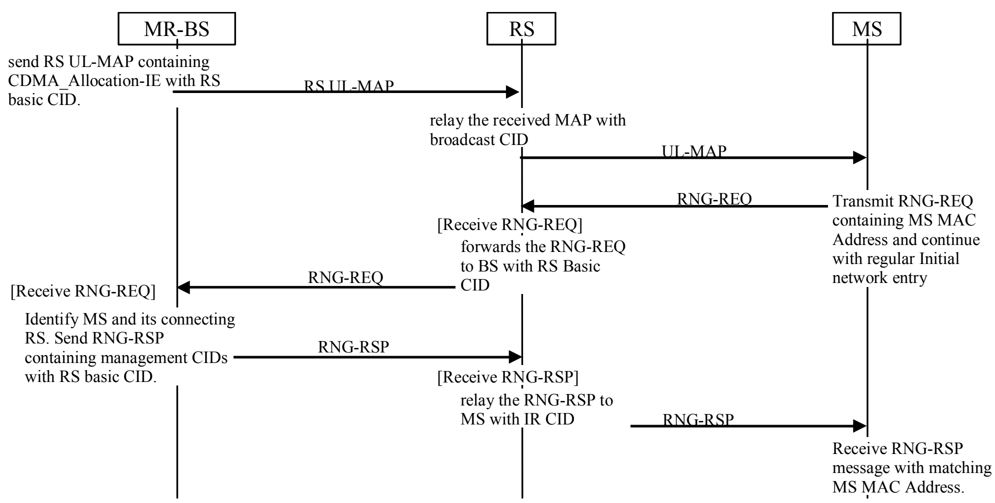
The RS receiving the RNG-RSP containing the management CIDs and MS MAC Address relays it to the MS with the initial ranging CID.

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°Øs 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.

Figure uuu—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 chart (Figure <XXX>03 and Figure <XXX>03) 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.

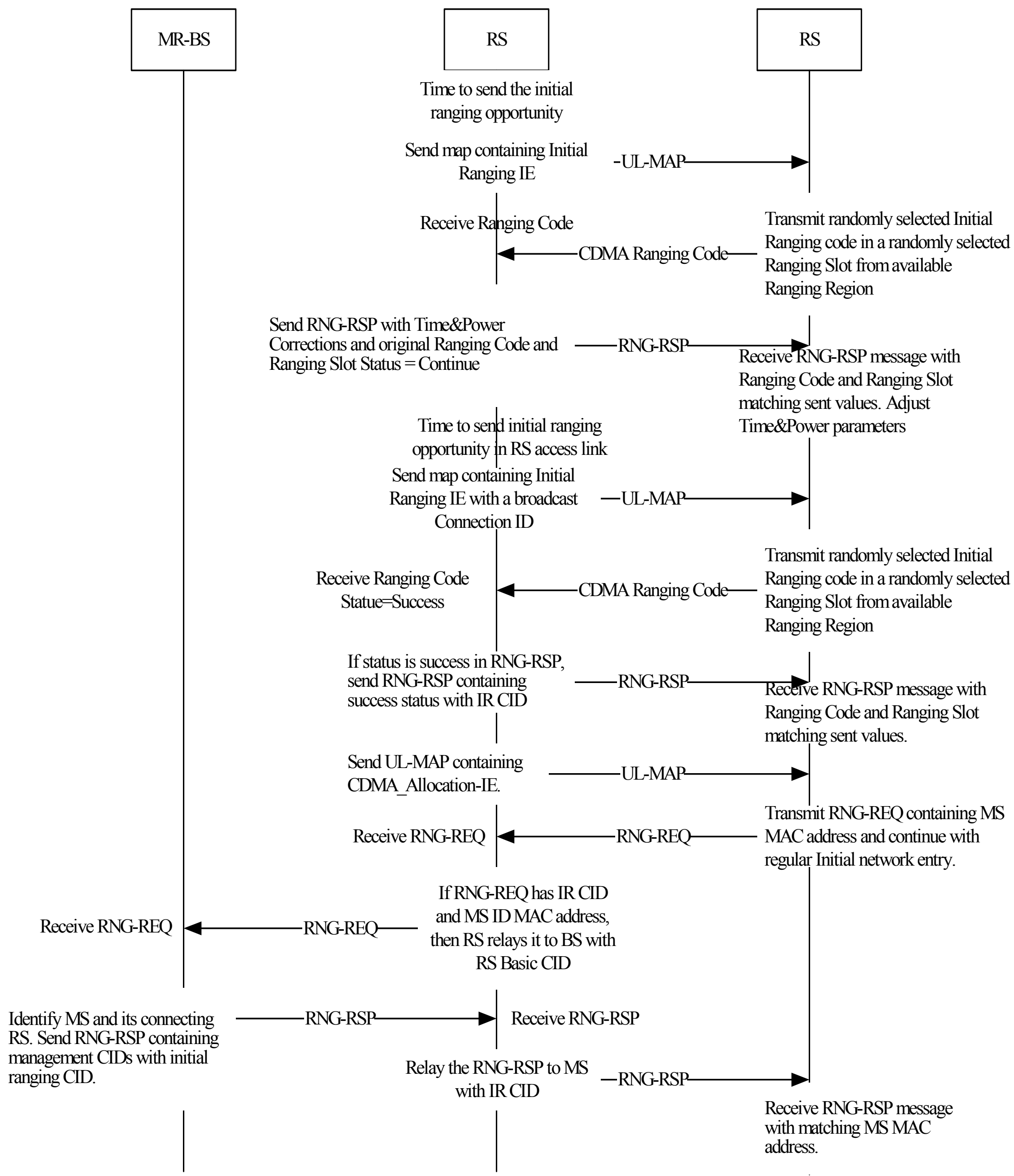


Figure <XXX>03—Ranging and automatic adjustments procedure in MR mode

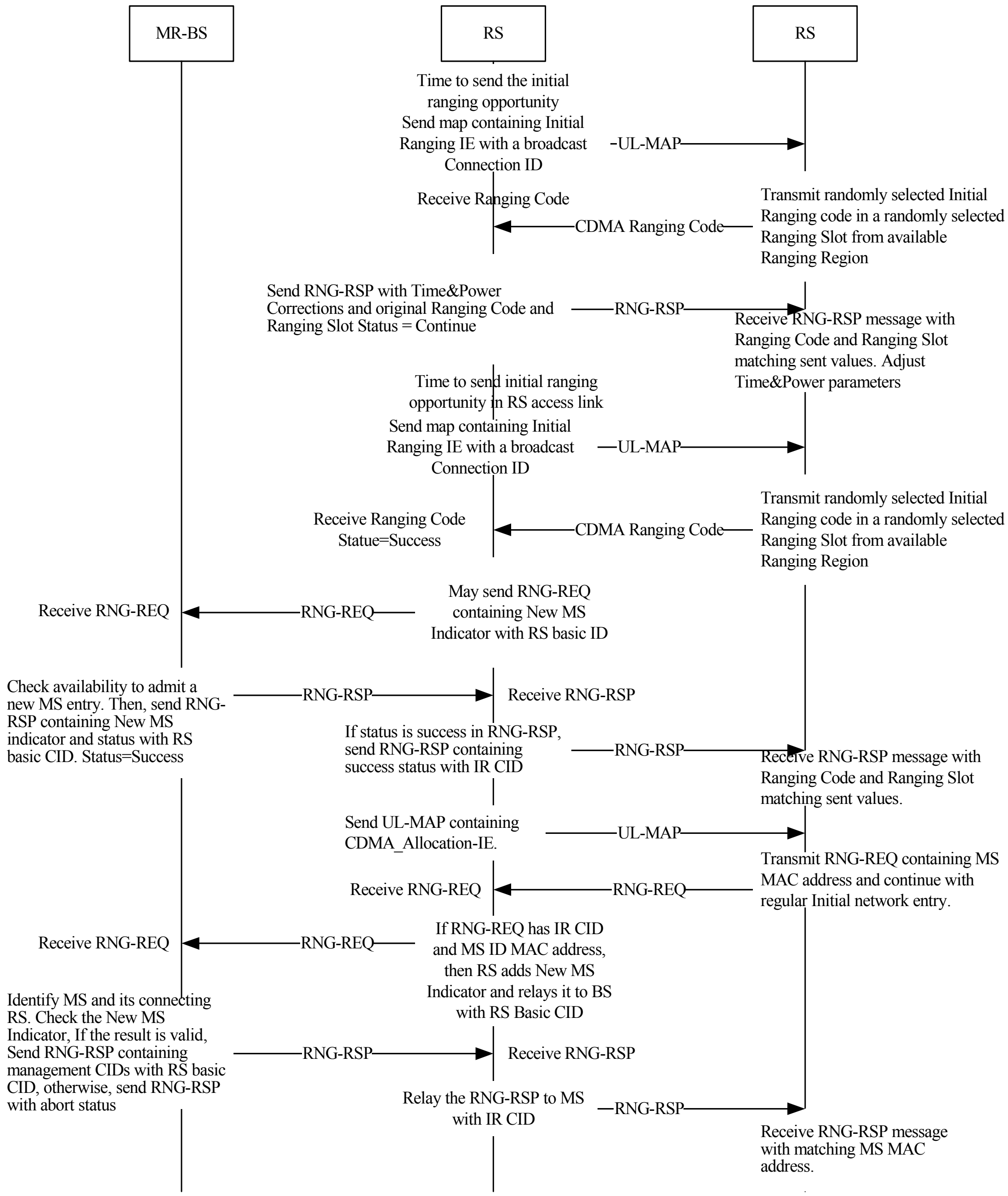


Figure <XXX>03—Ranging and automatic adjustments procedure with optional availability check at MR-BS in MR mode

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 Ranging procedure, 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 include an MR-BS, all the RSs in the virtual group shall either transmit the same preamble as the MR-BS, FCH and MAP or they all do not transmit any preamble. 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).
- Different groups transmit different preambles.
- 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 seg-

ment). 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.

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.xx), containing the signal strength measurement from other stations, to the MR-BS.

6.3.10 Ranging

6.3.10.3 OFDMA based 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.

Figure uuu—Ranging and automatic adjustment procedure in transparent RS system

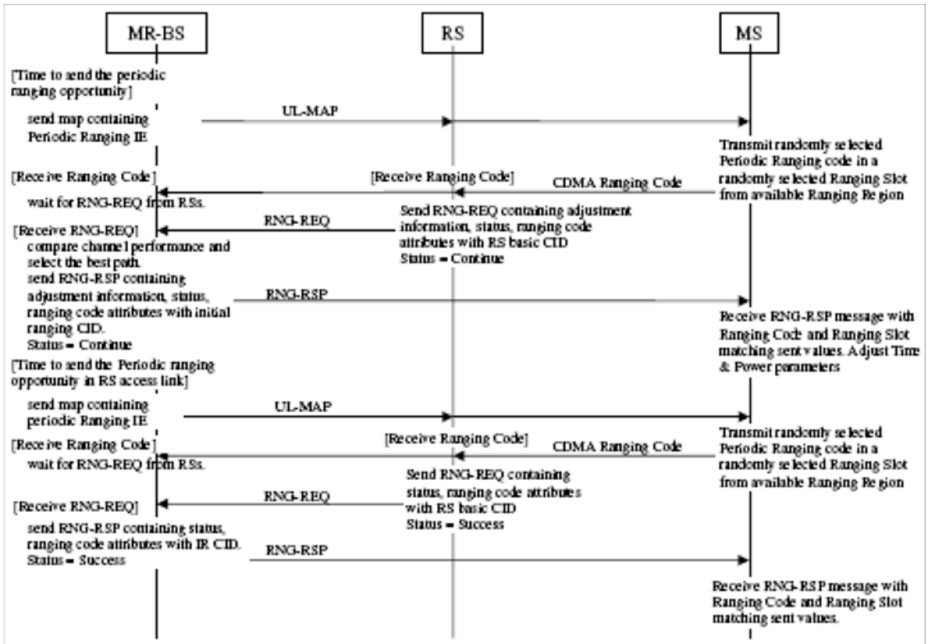


Figure uuu—MS CDMA-based periodic ranging in transparent RS systems - Access Transparent RS

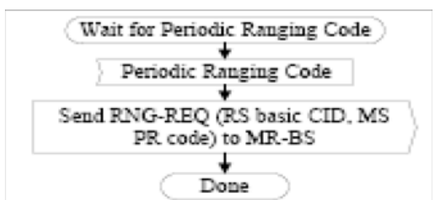
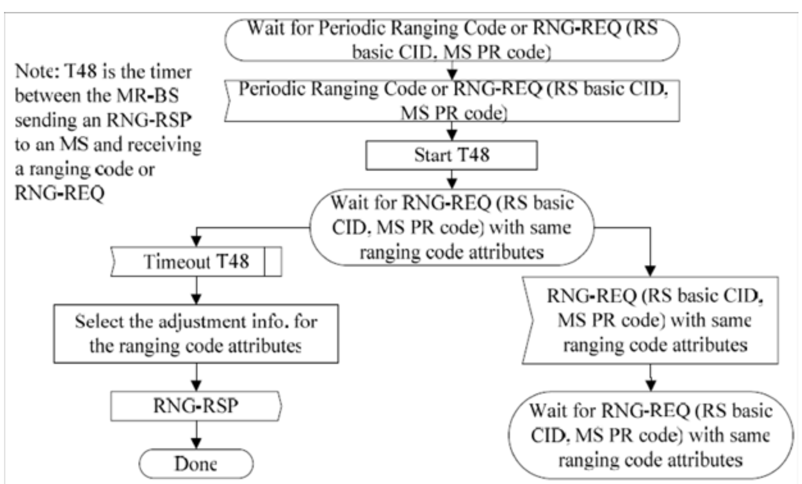


Figure uuu—MS CDMA-based periodic ranging in transparent RS systems- MR-BS



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 contains information of number of 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.

Figure uuu—Ranging and automatic adjustment procedure in non-transparent RS systems(centralized)

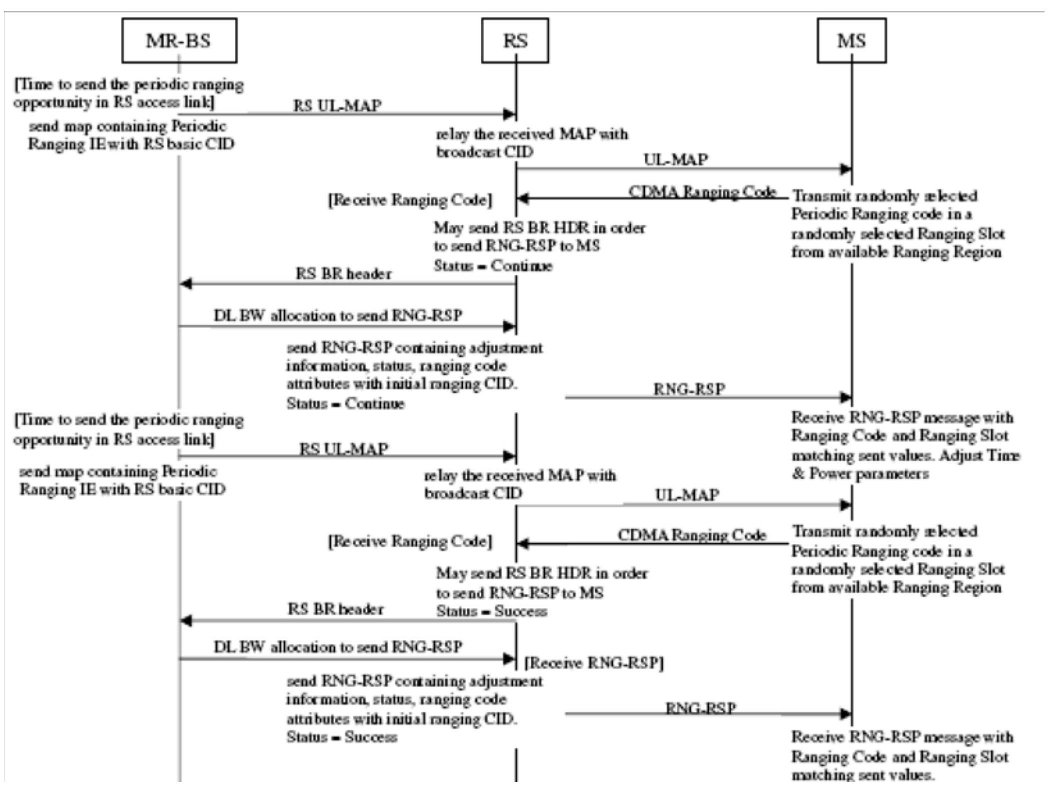


Figure uuu—MS CDMA-based periodic ranging in non-transparent RS systems - Access

Non-transparent RS

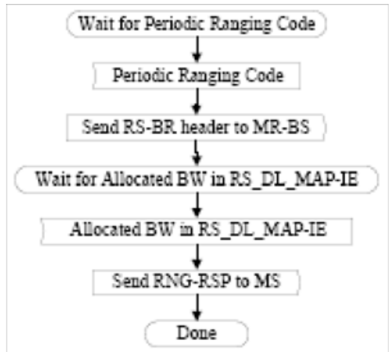


Figure uuu—MS CDMA-based periodic ranging in non-transparent RS systems - MR-BS

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 yyy—Ranging and automatic adjustment procedure in non-transparent RS systems under distributed scheduling

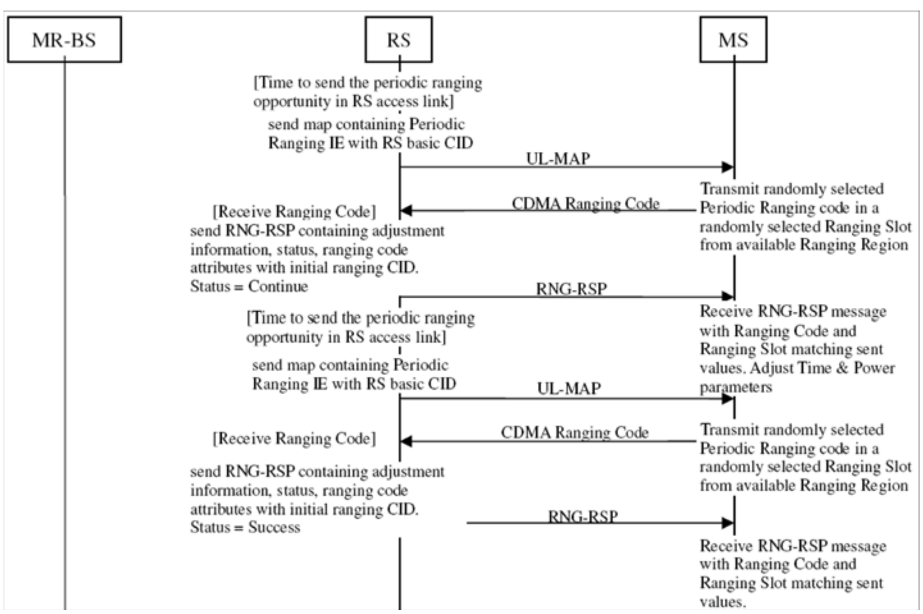
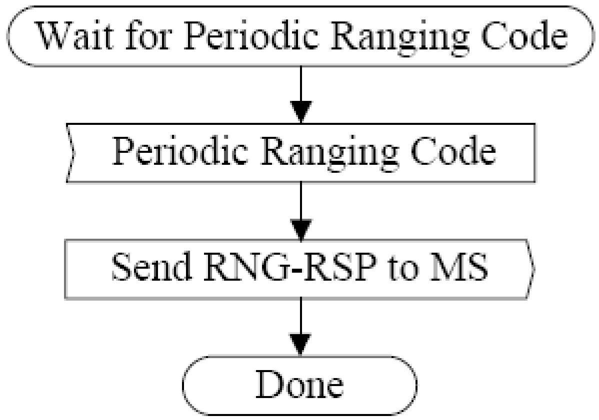


Figure zzz—MS CDMA-based periodic ranging in non-transparent RS systems - Access

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 received a bandwidth request CDMA ranging code resulting in continue status, 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 resulting in continue status, 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 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.

Figure uuu—Unsolicited RNG-RSP triggered by upstream traffic in non-transparent RS sys-

tem

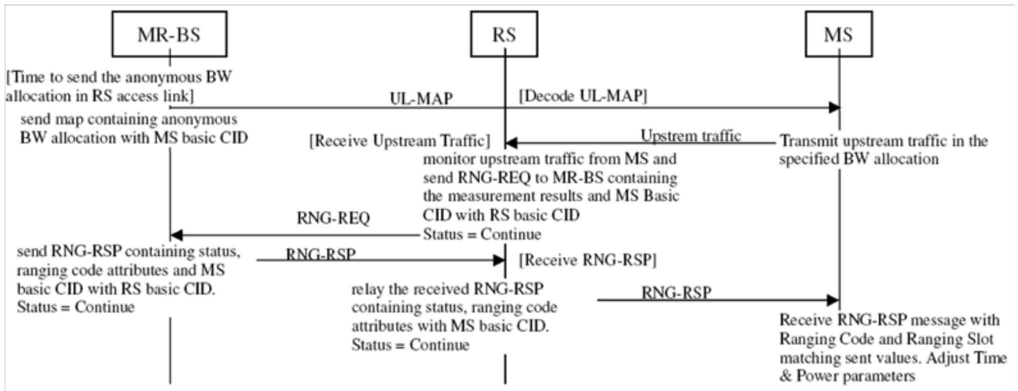


Figure uuu—Unsolicited RNG-RSP procedure triggered by CDMA BR ranging code in transparent RS system

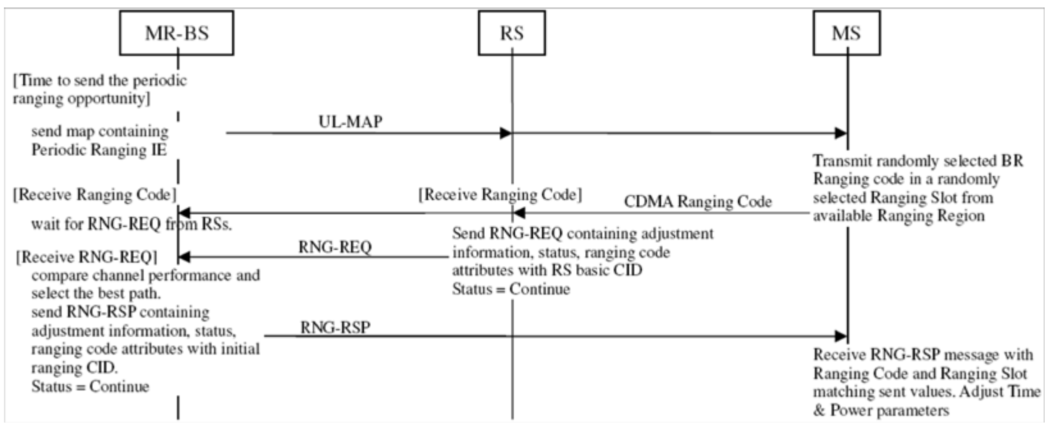


Figure uuu—Unsolicited RNG-RSP in transparent RS system- Transparent Access RS

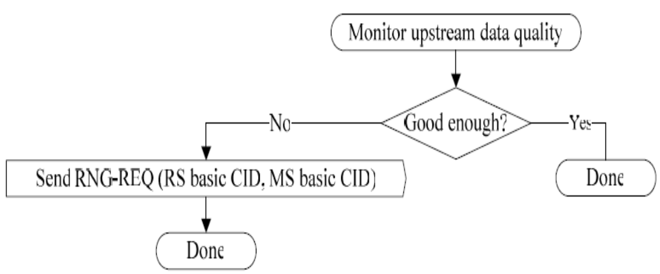


Figure uuu—Unsolicited RNG-RSP in Transparent RS system-MR-BS

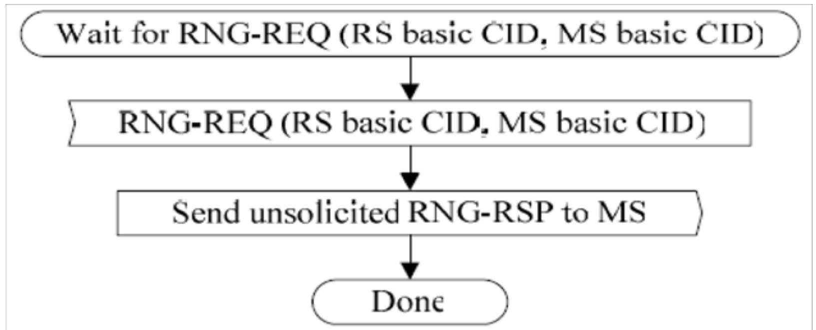


Figure uuu—Unsolicited RNG-RSP triggered by CDMA BR ranging code in Transparent RS system - Transparent Access RS

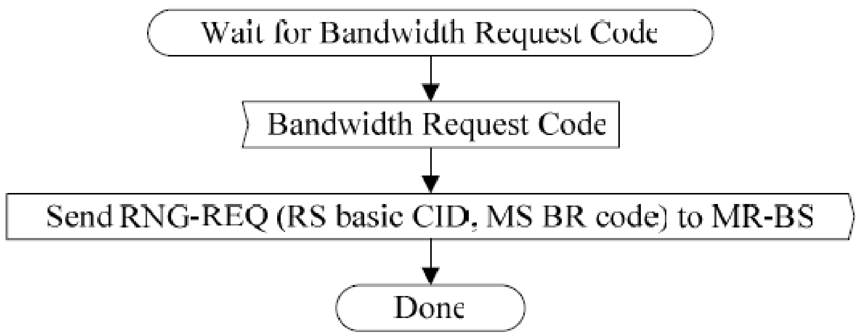
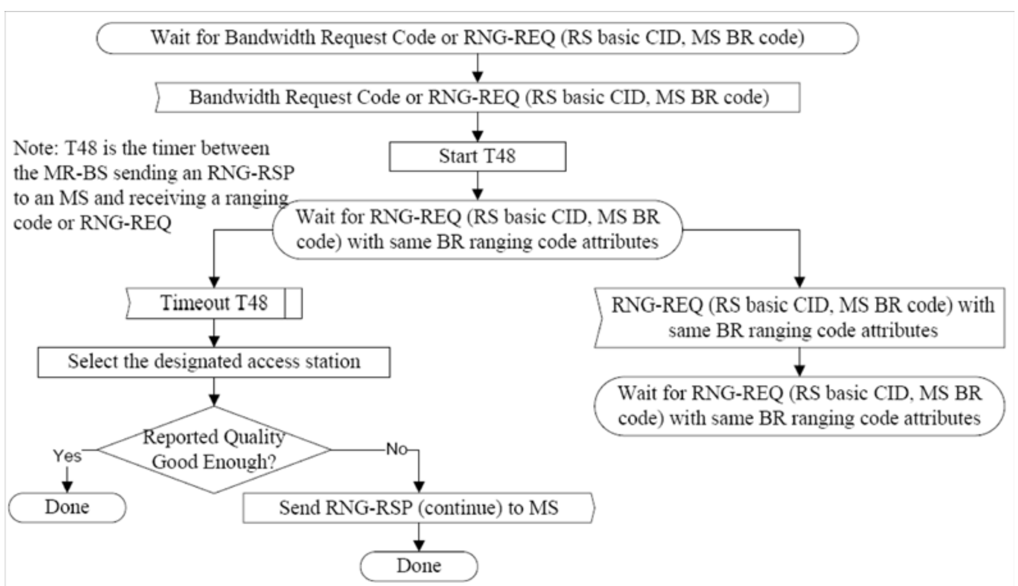


Figure uuu—Unsolicited RNG-RSP triggered by CDMA BR ranging code in Transparent RS system - MR-BS



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 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. The RNG-REQ message sent by the RS to serving MR-BS may contain information of multiple measured reports.

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 through the RS.

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 contains information of number of 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 uuu—Unsolicited RNG-RSP triggered by upstream traffic in non-transparent RS system

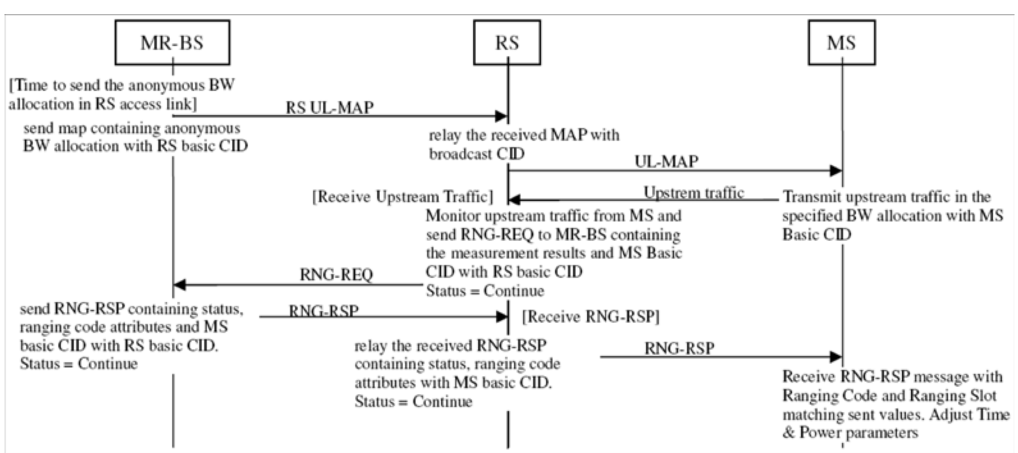


Table xxx—Unsolicited RNG-RSP triggered by BR ranging code in non-transparent RS sys-

tem

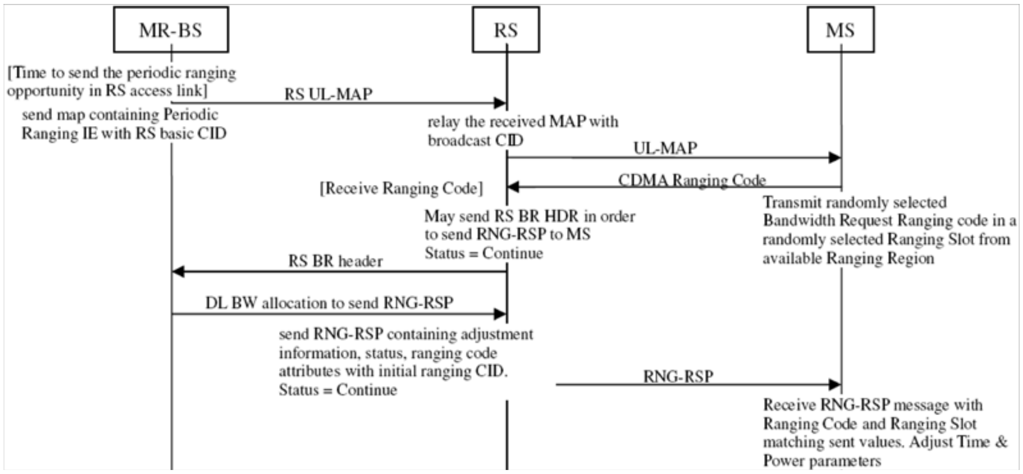


Figure uuu—Unsolicited RNG-RSP triggered by upstream traffic in non-transparent RS system - Access non-transparent RS

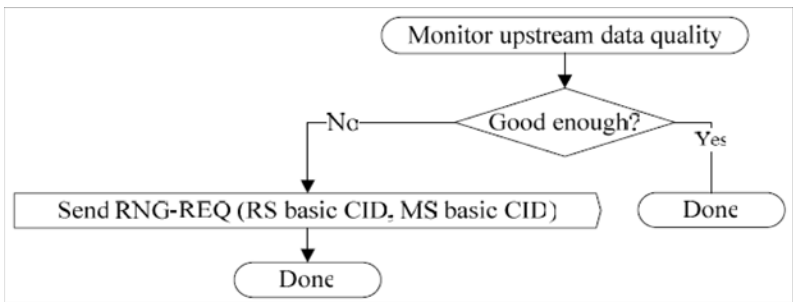


Figure vvv—Unsolicited RNG-RSP triggered by BR ranging code in non-transparent RS system - MR-BS

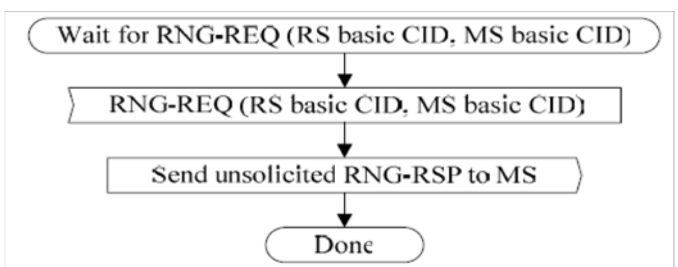


Figure xxx—Unsolicited RNG-RSP triggered by BR ranging code in non-transparent RS

system - Access non-transparent RS

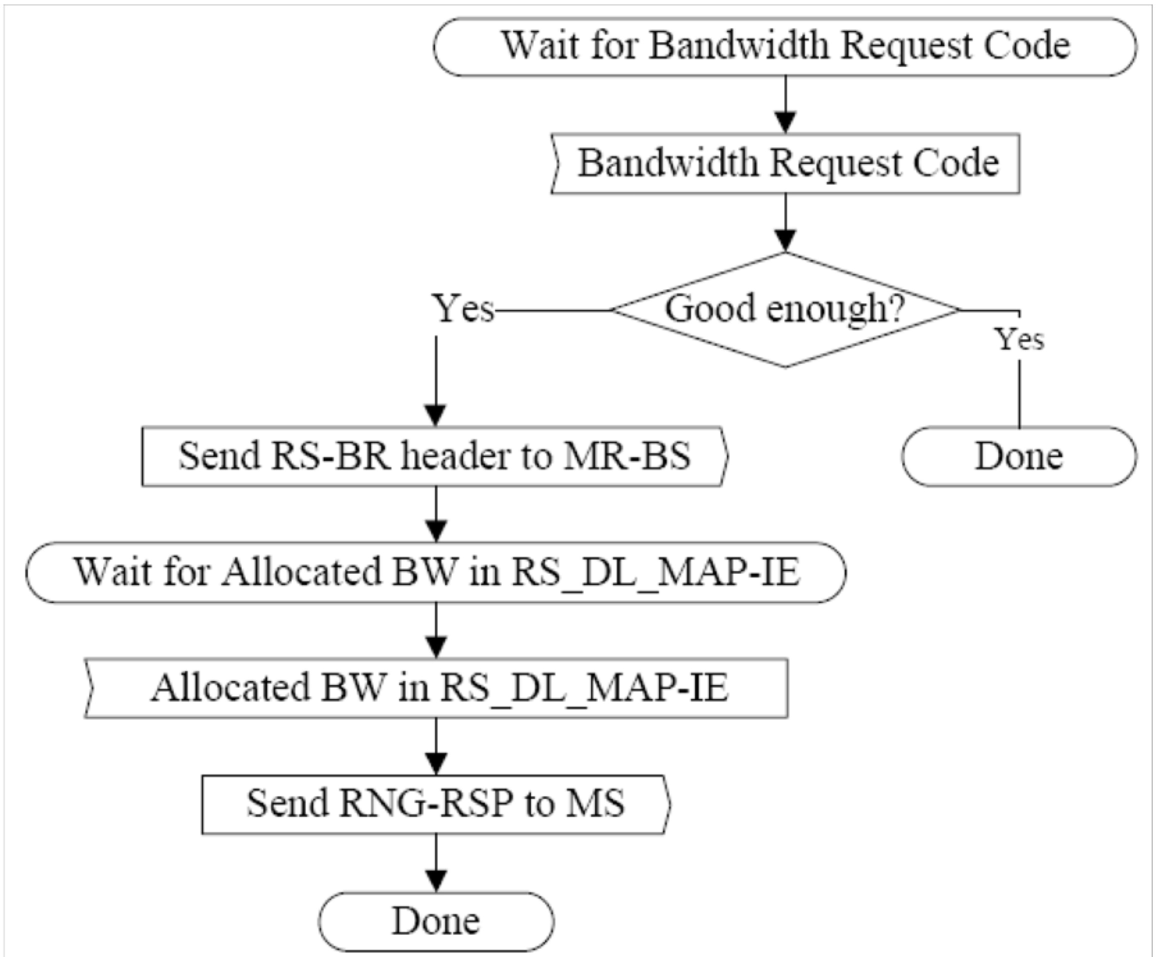
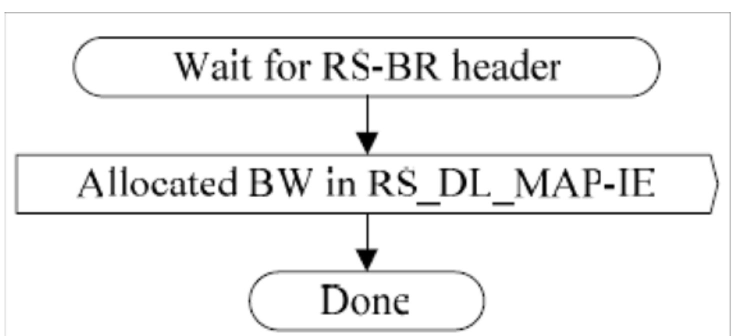


Figure yyy—Unsolicited RNG-RSP tirggered by BR ranging code in non-transparent RS system - MR-BS



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

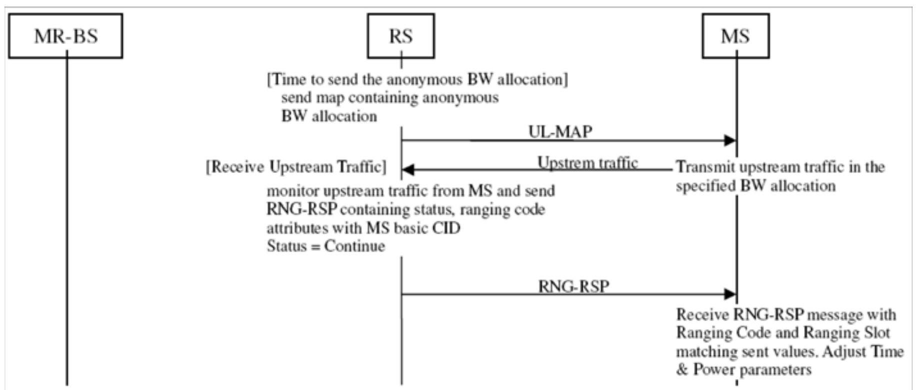


Table yyy—Unsolicited RNG-RSP triggered by BR ranging code in non-transparent RS system under distributed scheduling

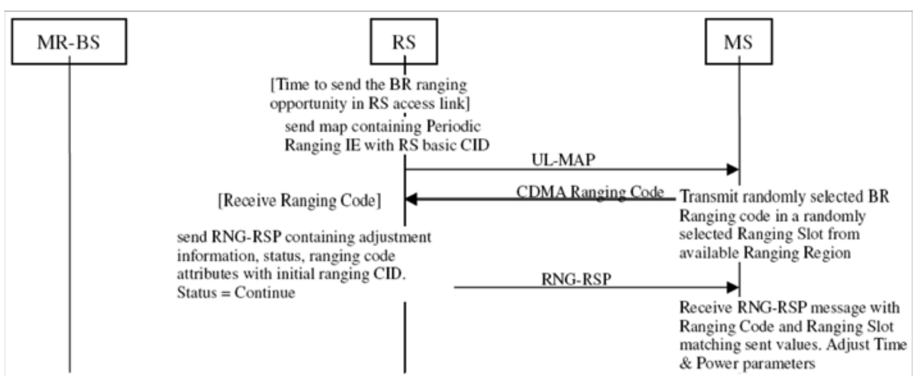


Figure www—Unsolicited RNG-RSP triggered by upstream traffic in non-transparent RS

system - Access non-transparent RS

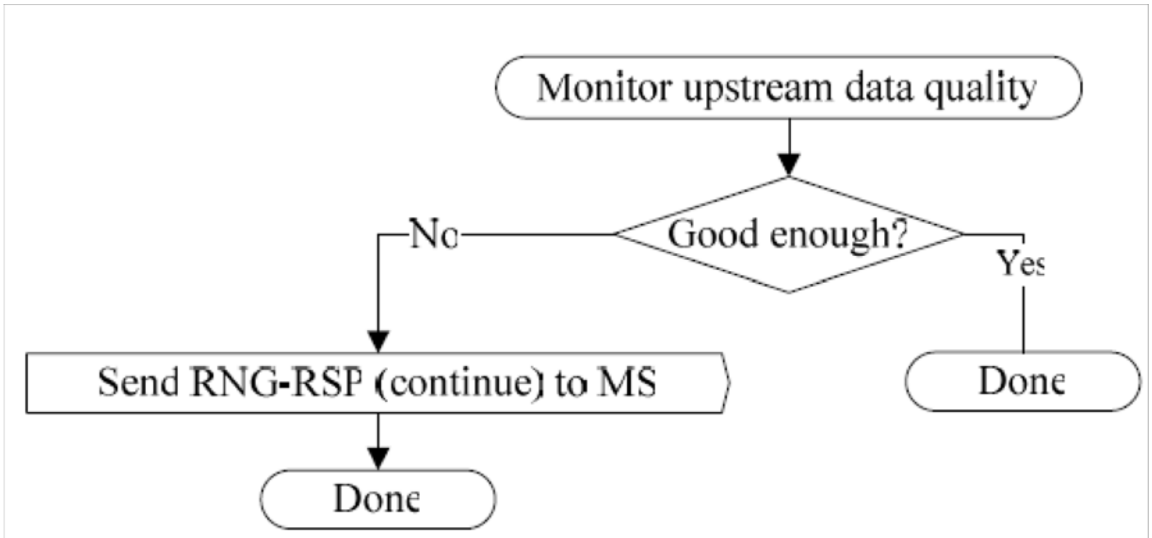
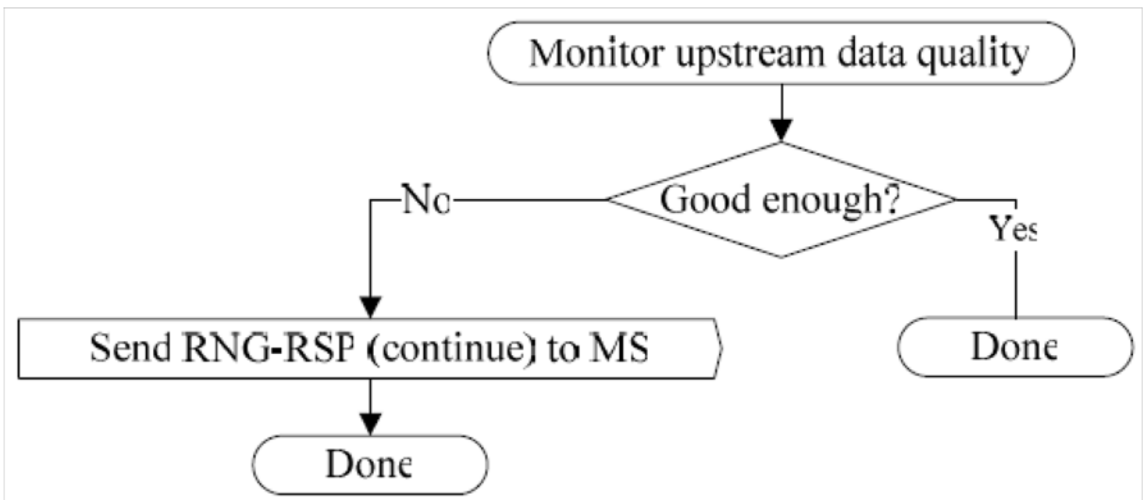


Figure zzz—Unsolicited RNG-RSP triggered by BR ranging code in non-transparent RS system - Accessnon-transparent RS



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 6.3.10.3.5:

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 section 6.3.14.2:

<u>In MR networks, a service flow may traverse one or more RSs.</u>

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, the MR-BS or access RS 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 (DS* 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, while intermediate RSs traversed by the tunnel, may ignore the QoS parameters of the individual service flows.

6.3.17 MAC support for HARQ

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-DL 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 TRF-IND to an RS to forward to MSs under the RS. The MR-BS shall schedule and transmit TRF-IND in consideration of RS's processing delay, D_R, and RS frame offset so that the RS has enough time to decode and transmit TRF-IND and the delay is minimized until RS forward.

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.

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 subclause 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 RS can broadcast a different MOB_NBR-ADV message that is suitable for its service area.

To facilitate each 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.

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 can broadcast the MOB_NBR-ADV message without modifying the neighbor list of the MR_NBRINFO message, received from the MR-BS.

(b) An RS can 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.

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 transmits MS_SCN-ACK message as an acknowledgement of MS_SCN-INF. 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

In a centralized MR system with distributed scheduling

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

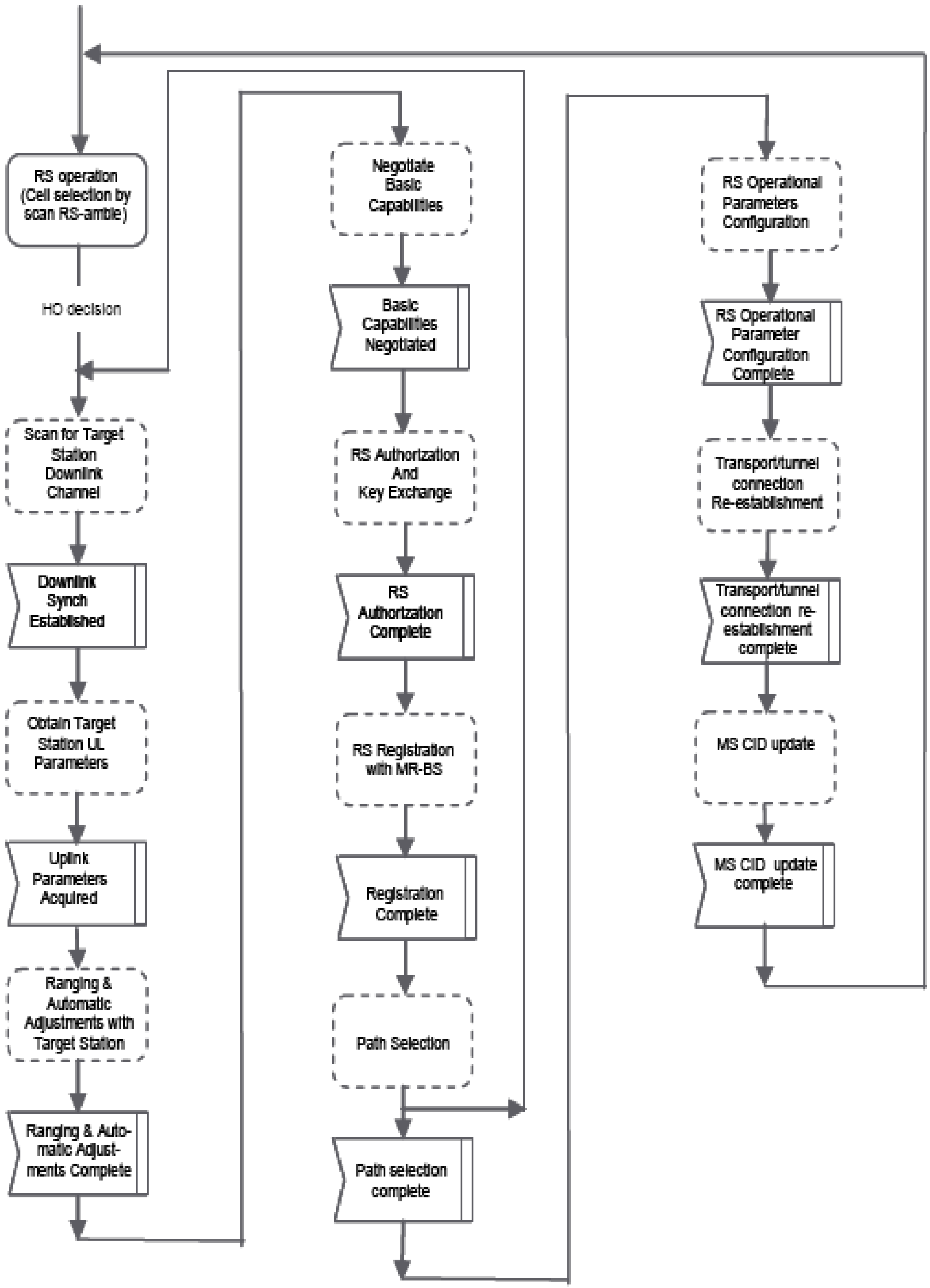
During the scanning with association level 2, the MS is required to transmit the CDMA ranging code to the scanned neighbor RS. The MS does not have to wait for RNG-RSP from the scanned neighbor RS. Instead, the neighbor RS shall send the RNG-RSP to its serving MR-BS (the MS's neighbor MR-BS). The neighbor 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.

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 uuu—RS HO process



The RS HO process consists of stages of MS HO process and the following additional stages:

- Path selection. This stage enable the target MR-BS to indicate a path re-reselection. The target MRBS may decide to skip this step if the bit #0 in RS HO optimization TLV of MOB_BS-REQ/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 MOB_BS-REQ/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 MOB_BS-REQ/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.

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 MRS informs the MR-BS that it is a MRS. The serving MR-BS may exchanges the backbone messages with the target MR-BS to retrieve 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.

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.

Insert new subsection 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, the Preamble Index TLV is sent in the MOB_BSHO-REQ/RSP messages.

The MR-BS may set "Action Time" for fast handover ranging of the MRS using MOB_BSHO-REQ/RSP-messages, 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. 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 6.3.22.5:

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.

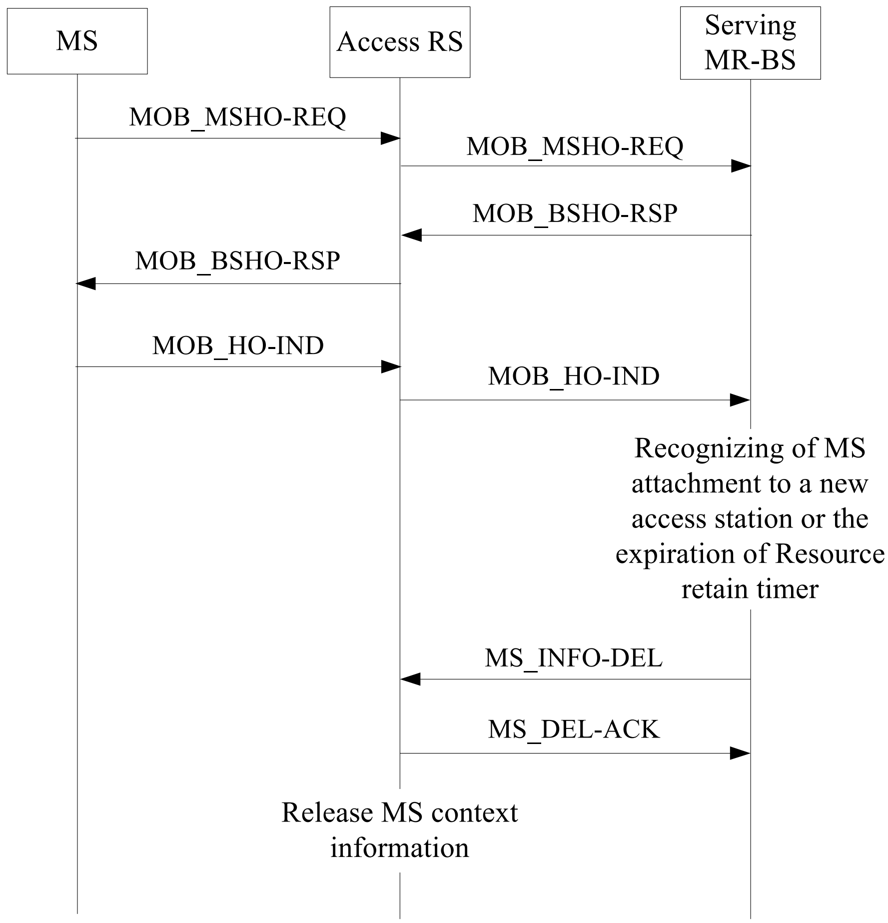
Insert new subclause 6.3.22.5.1:

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 as a reply and remove the MS context information

Figure uuu—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.

Insert new subclause 6.3.22.6:

6.3.22.6 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.

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), DR, 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 DR 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, DR, to the MR-BS as a capability parameter in the SBC-REQ message. The MR-BS shall determine the maximum cumulative delay, DM, 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, Wi, for each RS based on the value of DM 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 DM 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 DM frames and each RS has waited its specified waiting time, Wi, 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:

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

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 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.

6.3.24.8.2 Location Update Process

Insert the following text after the first paragraph:

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

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 MMR-BS when the MRS detects achange 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 MMR-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 MMR-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 6.3.24.10.2:

6.3.24.10.2 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 6.3.24.11:

6.3.24.11 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 6.3.24.12:

6.3.24.12 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, 10 load condition of a RS, etc. The path calculation algorithm is out of scope of this specification.

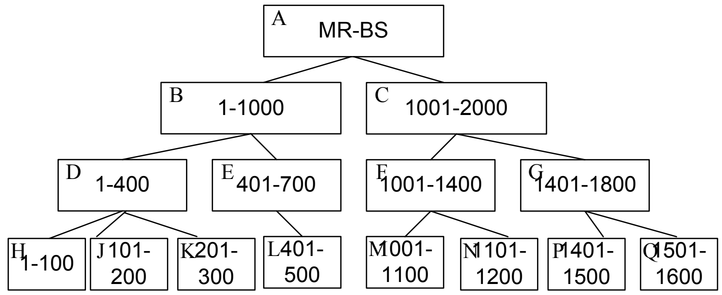
Depending on the complexity of network topology, either embedded path management or explicit path management may be used.

Insert new subclause 6.3.25.1:

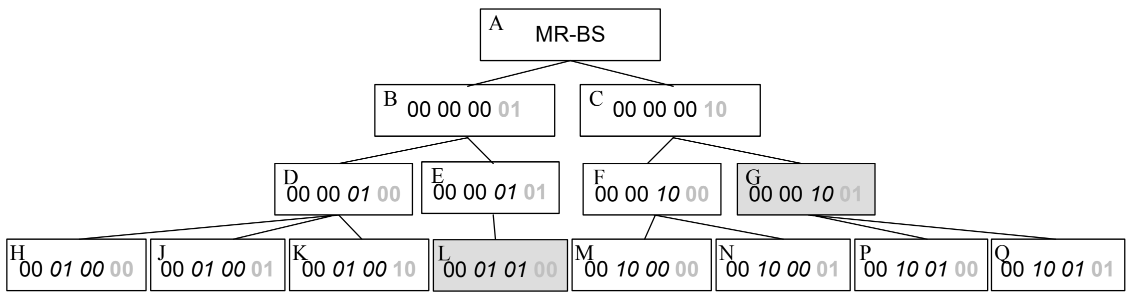
6.3.25.1 Embedded Path Management for Relay

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



(a)



(b)

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.

The embedded path management may have QoS scheme.

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

When a new path is discovered and calculated as specified in section 6.3.25.2, 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.

1If 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.

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 6.3.26:

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 REQ-REQ. Then, the RS sends a RS_NBR-MEAS-REP message (6.3.2.3.xx) 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 (6.3.2.3.66). 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 by following procedure:

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 can be considered based on the RSSI reported by RS_NBR-MEAS-REP message (see 6.3.2.3.63).

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

7. Security sublayer

7.1 Architecture

7.2 PKM protocol

7.3 Dynamic SA creation and mapping

7.4 Key usage

7.5 Cryptographic methods

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 the subclause:

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

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 subcluase 8.4.4.7.1.1:

8.4.4.7.1.1 MR-BS frame structure

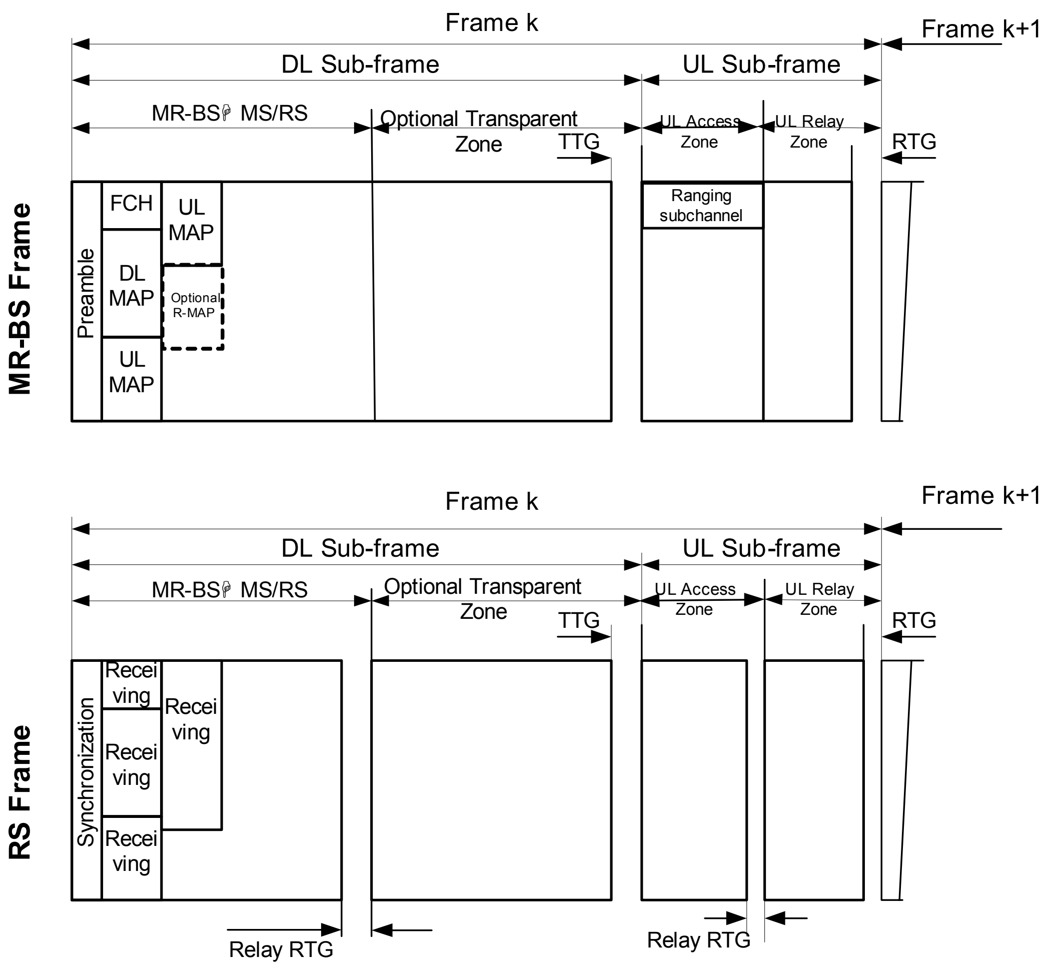
For the TDD mode, an example of the MR-BS frame structure is shown in Figure xxx.

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 zone for MR-BS to its subordinate MS/RS transmissions and may optionally include a transparent zone for RS to its subordinate stations transmissions. Optionally the MR-BS may transmit in the transparent zone as well. The transparent zone can be indicated by STC_DL_ZONE_IE() defined in Table 279. The UL sub-frame may include a zone for MS to its access station transmissions and optionally include a zone for RS to its access station transmissions.

Figure <xxx>—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

From RS view, an example of an RS TDD frame structure is shown in Figure xxx.

For a transparent relay RS, the preamble and MAP are not transmitted at the beginning of the frame. Instead it listens the preamble, MAP or 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 in RS network entry procedure. 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 DL sub-frame shall include one zone for RS and MS to receive burst from MR-BS and optionally include a transparent zone for RS to transmit burst to its subordinate stations. The UL sub-frame may include zero or one zone for receiving burst from its subordinate stations and zero or one zone for transmitting burst to MR-BS/RS. The ranging channel is shared by RS and MS, while RS may indicate itself as relay during the initialization. Optionally, an RS amble (at TBD location) 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.

Simultaneous operation of transparent RSs and non-transparent RSs within one MR-cell can be supported by allocating relay zones within the transparent relay frame structure.

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 zone 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 op 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

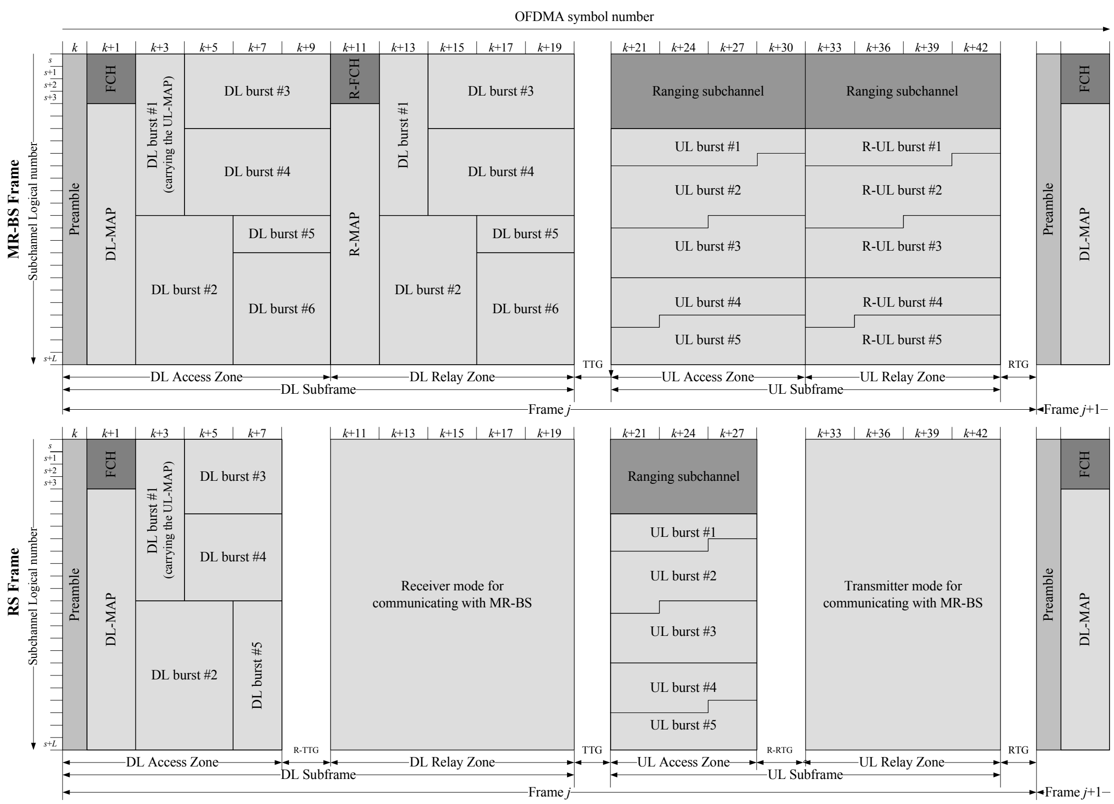
For the TDD mode, an example of the MR-BS frame structure is shown in Figure <xxx>.

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 DL Relay_Zone shall include a R-FCH and a R-MAP. In the DL Relay_Zone, the subchannel allocation may be the same as that in the DL Access_Zone. The R-FCH may be the same as the FCH in the DL Access_Zone. Other attributes of the MR-BS frame and the RS frame such as transition between modulation and coding presence of multiple zones, may be the same as those described in 8.4.4.2.

The number, size, and location of the relay zones shall be configurable.

Figure yyy—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 <xxx> .

The DL sub-frame of the RS shall be also time aligned with the DL sub-frame of the MR-BS.

The Relay Station 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 number, size, and location of the relay zones and whether the RS is utilizing the relay zone for transmission or reception shall be configurable. The number of frames that make up a multi-frame shall be configurable.

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 multi-hop 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 8.4.4.7.3:

8.4.4.7.3 R-FCH channel

If a DL RS_Zone contains a R-FCH channel, the R-FCH channel shall be transmitted as FCH described in 8.4.4.2 . The R-FCH contains the RS-Zone Prefix as described in 8.4.4.7.4.

Insert new subclause 8.4.4.7.4:

8.4.4.7.4 RS-Zone prefix

The RS-Zone prefix is a data structure transmitted on R-FCH of a DL RS_Zone. The RS-Zone prefix includes information regarding the location of the first RS_Zone in the next frame and the information required for decoding R-MAP.. Table XXX defines the format of RS_Zone prefix.

Syntax	Size(bits)	Notes
RS_Zone_Prefix_format() {	-	-
RS_Zone_location	7	The field indicates the OFDM symbol index reference to the beginning of next frame in unit of 1 OFDM symbols
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
}		

RS_Zone location

An indicator regarding the location of RS_Zone in the next frame. The first OFDM symbol in each frame is indexed as 0. The RS_Zone location indicates the OFDM symbol index relative to the first OFDM symbol in next frame. The unit is 2 OFDM symbols.

R-MAP length

The length in sub-channels of R-MAP message that immediately follows the RS_Zone prefix.

FEC Code type and modulation type

An indicator indicating the modulation and code rate used for R-MAP message.

Insert new subclause 8.4.4.8:

8.4.4.8 Relaying frame structure

8.4.5 Map message fields and IEs

8.4.5.3.2.2 DL-MAP extended-2 IE format

Change Table 277c as indicated:

Table 277c—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*

Insert new subclause 8.4.5.3.28:

8.4.5.3.28 RNG_RSP_ALLOC IE

This IE is transmitted to RS from MR-BS. This IE provides the allocation to RS for transmission of RNG_RSP to SS.

Table <xxx>—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 8.4.5.9:

8.4.5.9 MAP IE (within R-MAP)

Insert new subclause 8.4.5.9.1:

8.4.5.9.1 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 <XXX>—RS_UL_DCH assignment IE format

Syntax	Size	Notes
RS_UL_DCH assignment IE {		
Type	4 bits	
RSCID	8 bits	Reduced basic CID of the RS
UL Resource allocation	x bits	Resources allocated to DCH
Frequency (N)	4 bits	Allocation repeats once every N frames
}		

The coding for the UL resource allocation to the DCH is TBD.

[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.

Max RelayAmbleRepetitionPeriod = 40 ms Equation xxx

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.

$$PN_i^R(j) = PN_i(J - j), \quad i = 0, 1, ..., 113, \; j = 0, 1, ..., J \qquad \text{Equation xxx}$$

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.

$$PN_i^R(j) = \begin{cases} PN_i(j+s), & j = 0, 1, ..., J-s \\ PN_i(j+s-J-1), & j = J-s+1, ..., J \end{cases} \quad i = 0, 1, ..., 113 \qquad \text{Equation xxx+1}$$

where J is 143 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 IEEE802.16-2005 section #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

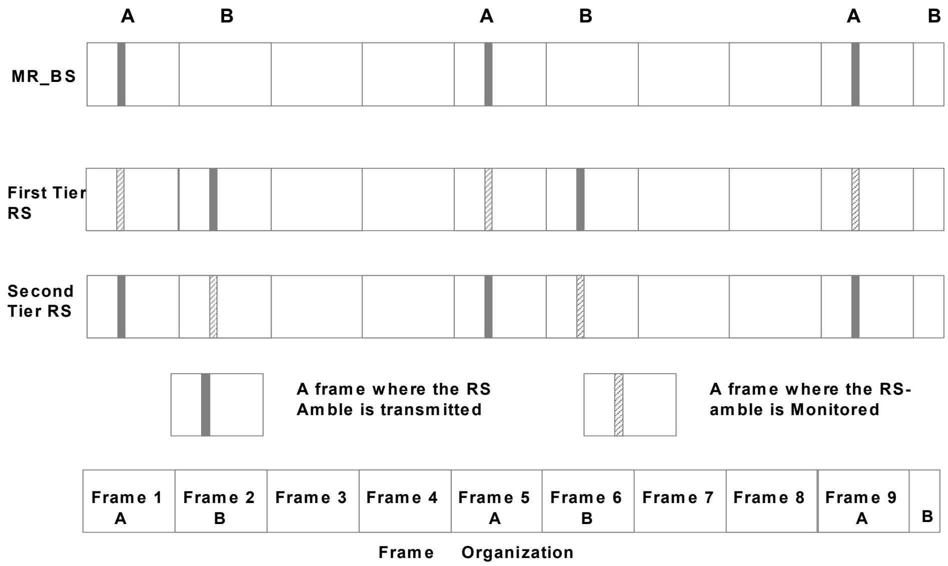
For synchronization, the R-amble repetition pattern is defined using two parameters, offset, Ks and a Synchronization Cycle consists of N consecutive frames.

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 uuu—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

8.4.8 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, in the same manner as macro diversity with neighboring BS. It is possible to achieve diversity and solve the pilot collision problem by sending correlated signals across different BS and RS transmit antennas during the transmission of a burst to a particular MS. The three modes of operation are cooperative source diversity, cooperative transmit diversity, and cooperative hybrid diversity.

In the following description, the transmission considered is the final hop from the multiple antennas at the BS/RS to the MS. For cooperative source diversity, the antennas simultaneously transmit the same signal using the same time-frequency resource. The cooperative transmit diversity mechanism uses STBC-encoded signals across the transmitting antennas using the same time-frequency resource (refer to Section 8.4.8 for a list of valid STBCs). Cooperative hybrid diversity uses a combination of source and transmit diversity.

These mechanisms can each be further subdivided into two categories describing the processing requirement at the RS. The relayed data at the RS may not require processing, which we have called Full Encoding (i.e. during the backhaul hop, the BS transmits the exact signals for the RS to relay). Alternately, the relayed data at the RS may require some local processing, which we have called Half Encoding (the backhaul hop contains uncoded data, and the RS decodes and re-encodes the data according to the STBC in use). In this last category, each RS shall be notified of its virtual antenna number(s).

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 [136]

$$\mathrm{Re}\{AmblePilot\ sModulated\} = 4\sqrt{2}(\frac{1}{2} - w_k)$$
$$\mathrm{Im}\{AmblePilot\ sModulated\} = 0$$

Equation xxx

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 xxx+1

$$\mathrm{Re}\{AmblePilot\ sModulated\} = 3.55\sqrt{2}(\frac{1}{2} - w_k)$$
$$\mathrm{Im}\{AmblePilot\ sModulated\} = 0$$

Equation xxx+1

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 maximum DL transmit power that the RS is allowed to 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 as indicated:

Table 342—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	

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 as indicated:

Table 345—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.
Tunnel CID	2m+1 - n	Used by MMR-BS or RS for tunneling transport connection packet.
Management Tunnel CID	n+1 - p	Used by MMR-BS or RS for tunneling management connection packets.
Transport CIDs, Secondary Mgt CIDs	p~~2m~~+1 - FE9F	For the secondary management connection, the same value is assigned to both the DL and UL connection.
Multicast CIDs	0xFEA0 - 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

11.5 RNG-REQ message encodings

Change Table 364 as indicated:

Table 364—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 364—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 as indicated:

Table 367—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 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*

Insert new subclause 11.6.3:

11.6.3 CID 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 sub clause 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

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 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 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.

Type	Length	Value	Scope
168	1 byte	Bit #0 = 1: moving RS mode Bit #0 = 0: moving BS mode	SBC-REQ/RSP

Insert new subclause 11.15.x:

11.15.x 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

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

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 RX

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 11.20.x:

11.20.x 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 11.21:

11.21 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 11.21.1:

11.21.1 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

Table <S1>: Path-Addition Subattributes

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 11.21.2:

11.21.2 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

Table <S2>—Path-CID-Binding-Addition Subattributes

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 11.21.3:

11.21.3 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 <S3>—Path-CID-Binding-Removal Subattributes

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 11.21.4:

11.21.4 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 11.21.5:

11.21.5 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 11.21.6:

11.21.6 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 11.21.7:

11.21.7 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 11.21.8:

11.21.8 PM-Confirmation-Code TLV

TBD.

Insert new subclause 11.21.9:

11.21.9 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.X:

11.X 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.xx:

11.XX 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

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 as indicated:

Table 413—Minimum performance requirements for all profiles

Capability	Minimum performance
RSTTG and RSRTG: TDD	≤50µs