Project	IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>
Title	**MR-BS and RS frame management for multi-frame structure consistent to 802.16e in MMR Networks**
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Re:	This is a response to the call for technical contributions 80216j-07_007r2.pdf
Abstract	This contribution proposes relay messaging scheme for multi-frame structure consistent to 802.16e legacy frame structure to support multi-hops in MMR networks.
Purpose	Text proposal for 802.16j Baseline Document
Notice	
Release	
Patent Policy and Procedures	

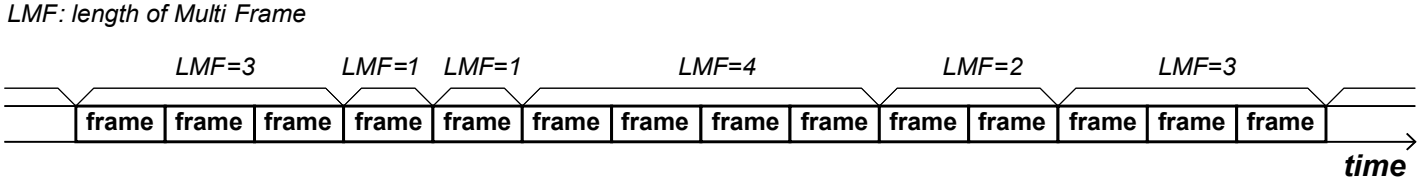
MR-BS and RS frame management for multi-frame structure consistent to 802.16e in MMR network

1. Introduction

Based on multi-frame structure consistent to the 802.16e legacy frame structure in MMR network, which is introduced in IEEE C802.16j-07/162r3, in this contribution scheduling issue of how to figure the length of multi-frame and relay frame management procedures are described.

2. Overview of multi-frame structure

(1) A Multi-frame consists of *L* subsequent frames.



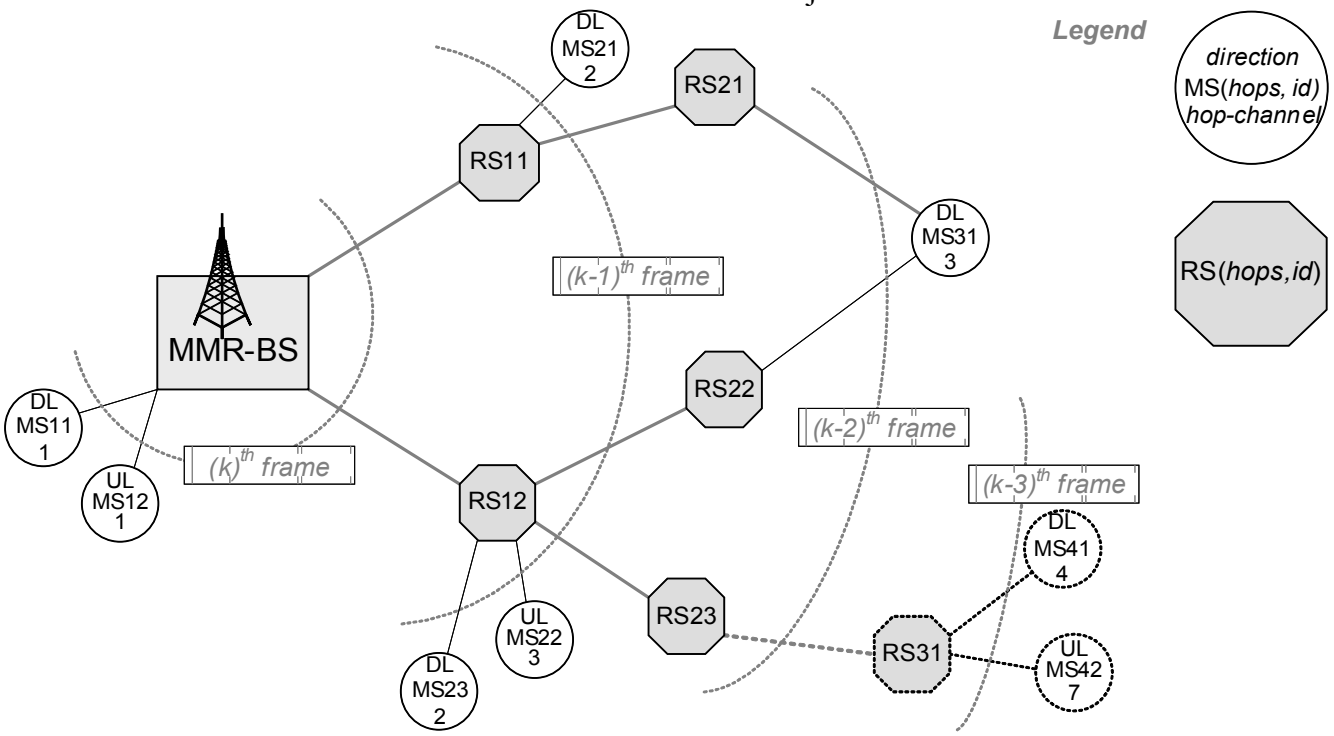
The length of multi-frame(*LMF*) should be determined before the multi-frame start time, in consideration of topology and traffic load. One possible scheme to determine the *LMF* is as follows:
LMF = the length of Multi-frame = max (*MHR*+1, 2 * *MHM* - 1)
MHR : the maximum hop counts of active RSs
MHM : the maximum hop counts of MSs who have at least one UL traffic at start of multi-frame
For Example:
If there are no RS in a cell, *LMF* = max (0+1, 2-1) = 1
else if there exist 1-hop RSs and 2-hop MSs {
if at least an MS has UL data to send, *LMF* = max (1+1, 2*2-1) = 3
else no MS has UL data to send, *LMF* = max (1+1, -1) = 2
}

(2) Relay control message

Relay request message RLY-CMD in the DL relay link and relay report message RLY-RPT in the UL relay link. are used to exchange the control information between MR-BS and RS, which is introduced in another contribution C80216j-07_296 in detail.

(3) Sample topology

A sample for showing network topology and frame transmissions during k^{th} frame transmission at MR-BS is shown in Fig.1.



(fig. 1) A sample of network topology and frame transmissions of hop links during k^{th} frame transmission at MR-BS

In figure 1, k is an arbitrary frame sequence number of a Multi-frame with the range of $1 \leq k \leq LMF$(length of multi-frame). In addition, before every multi-frame is transmitted into the air, LMF shall be re-calculated and new control message is generated according to the updated topology.

Multi-frame structure proposed in contribution IEEE C802.16j-07/162r3 uses the legacy BS frame structure as a unit frame and only by configuration of the multi-frame length and simple MAC control message to control relay operations.

In Fig.1, MR-BS allocates each active MS a hop channel which is defined as the channel allocated to MS. Hop channel assignment is shown by an example in Fig.2.

(4) An example of Hop Channel (HC) Assignment

	Forward to MS					Backward to MMR-BS			
assignment (hop based)	frame control information		RS Command	HC1	HC 2	HC3	common access	RS Report	HC3	HC1
frame i	PR	FCH MAP	BS→RS1.	BS→MS1.	BS→RS1.	BS→RS1.	UL access & control	RS1.→BS	-	MS1.→BS
frame i+1	PR	FCH MAP	RS1.→RS2.	BS→MS1.	RS1.→MS2.	RS1.→RS2.	UL access & control	RS2.→RS1.	MS2.→RS1.	MS1.→BS
frame i+2	PR	FCH MAP	-	BS→MS1.	-	RS2.→MS3.	UL access & control	RS1.→BS	RS1.→BS	MS1.→BS
	identical at every frame in the multi frame excluding frame number		RS control information	may be different contents		should be the same contents	only for one hop access never used for relay channel	RS control information including access data from MSs	should be the same content	may be different contents

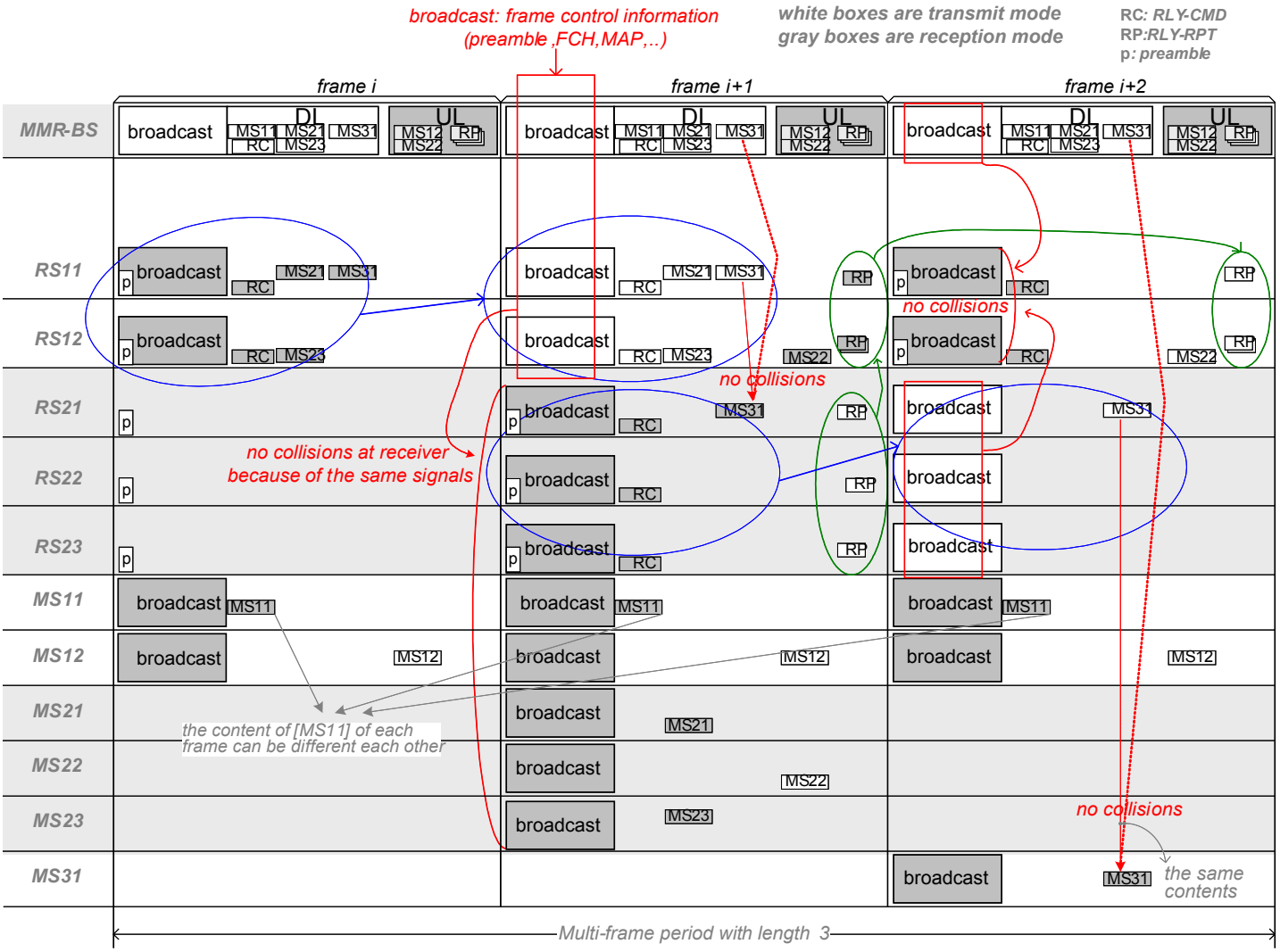
(fig. 2) An example of hop channels assignment

(5) Use of identical frame control information

In the multi-frame structure, we apply identical frame control information (Preamble, FCH, MAPs DCD and UCD) to all of the unit frames except the frame number.

An RS shall update the frame number of received frame control information by an increment of 1 and reassembling for relaying. Because after relaying for one hop, MR-BS already transmit its next unit frame, while the frame control information received by RS kept unchanged. By an increment of 1 the frame control information will be exactly the same as the MR-BS. This is an important issue to reduce the interference.

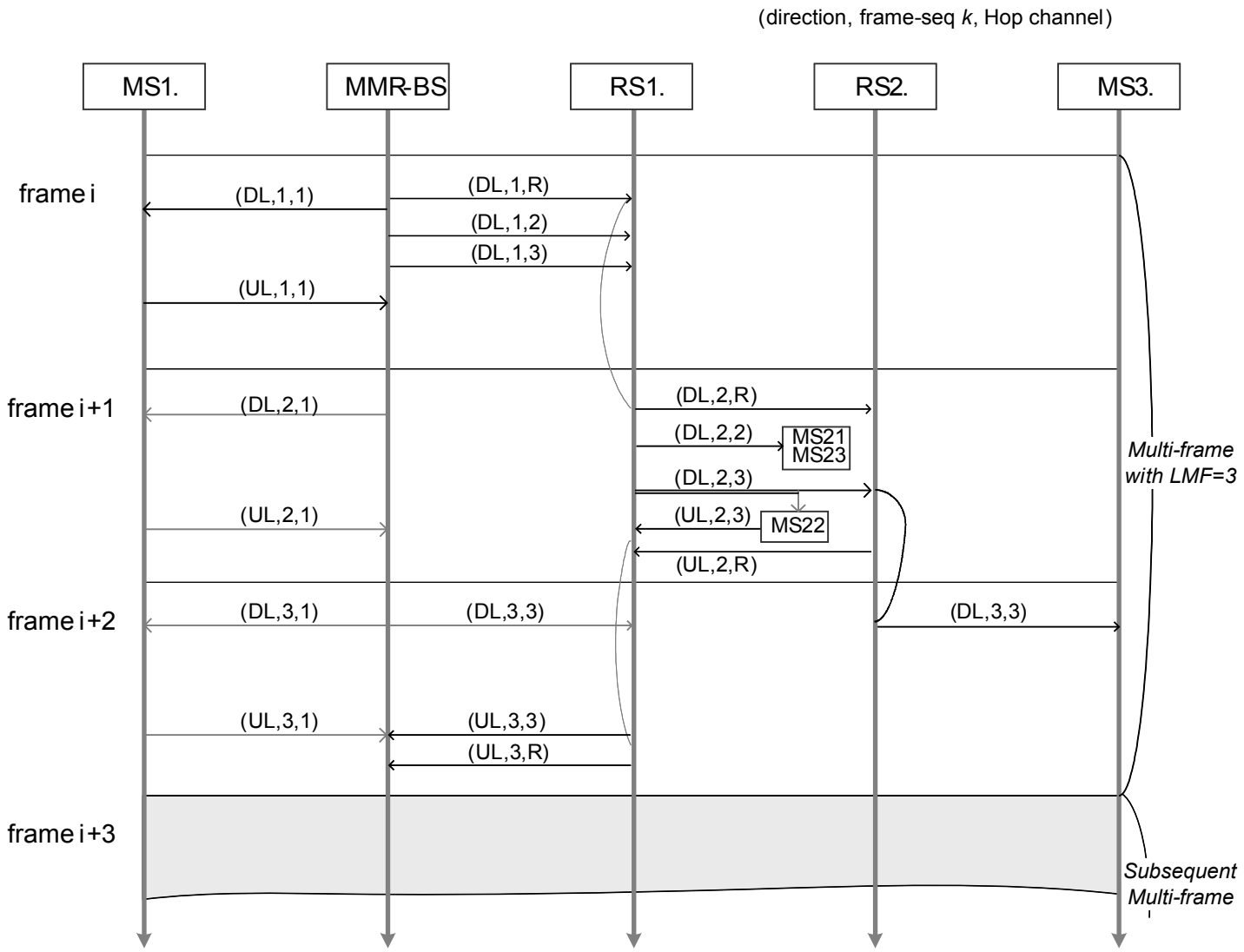
After receiving the frame control information, RS only transmits the burst related to the RS's subordinates. In fig. 3, burst transmission and reception state diagram at nodes of the sample topology are given.



(fig. 3) Burst transmission and reception state diagram at nodes of the sample topology

(6) Link Flows for the Sample topology

The link flows for sample topology is shown in Fig.4 to illustrate the link flow of the MMR network with multi-frame length of 3.



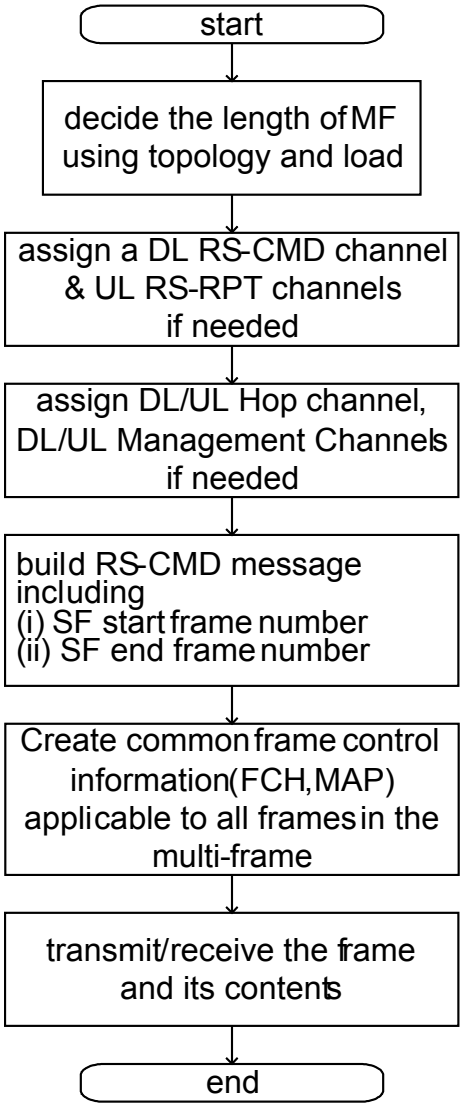
(fig. 4) Link Flows for the Sample topology

3.1 Operation flow of a multi-frame in MR-BS side

Before the multi-frame start time, MR-BS shall configure the length of multi-frame in consideration of topology and traffic load. Then MR-BS assigns a RS RLY-CMD channel in the DL, RS RLY-RPT channel in the UL if needed, and the DL/UL hop channel, DL/UL management channels if needed. MR-BS shall construct RS-CMD message including the information of the multi-frame start frame number and end frame number. It builds the identical frame control information applicable to all the unit frames within the multi-frame. After all of these procedures, it starts to transmit/receive frame to/from RS and MS one by one until the last unit frame finishes.

Operation procedure in the multi-frame MR-BS side is summarized as in the following flow chart.

<Operation flow of a multi-frame in MR-BS side >



3.2 Operation flow of a multi-frame in RS side

After receiving a new frame control information including the RLY-CMD, RS shall change the frame control information by increment 1 to the frame number. With the synchronization of the subsequent frame to the MR-BS, the RS shall transmit the reconstructed frame if the following conditions are met:

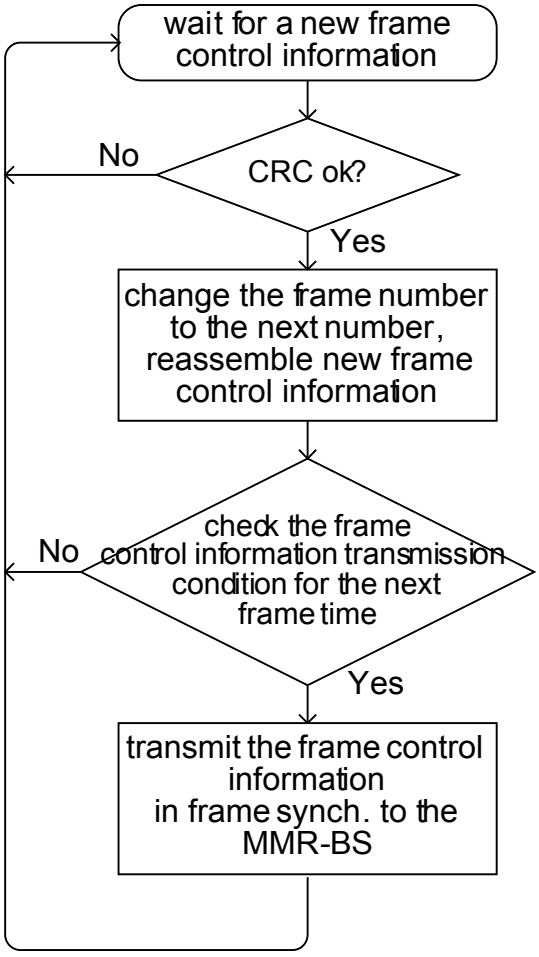
C1: the value of modulo 2^8 of revised frame number is within the start frame number and end frame number parameter listed in the RLY-CMD message

C2: No UL burst transmission is expected in the subsequent frame period.

If it can't transmit, RS should give up and wait for next frame control information to be arrived and repeat all the procedure again..

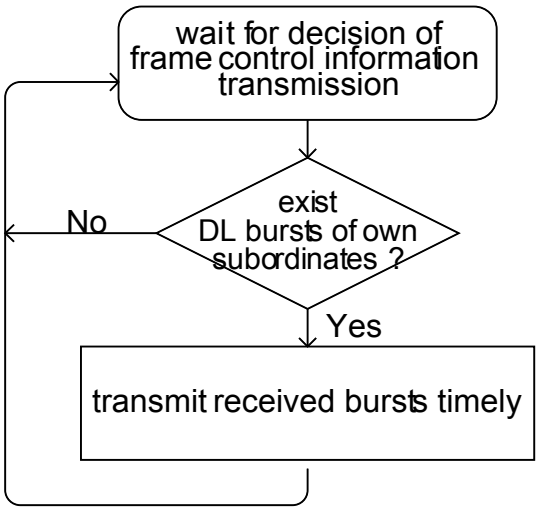
The frame relaying of frame control information operation procedure in the multi-frame RS side is summarized as follows.

<Operation flow of frame relaying for the subsequent frame>



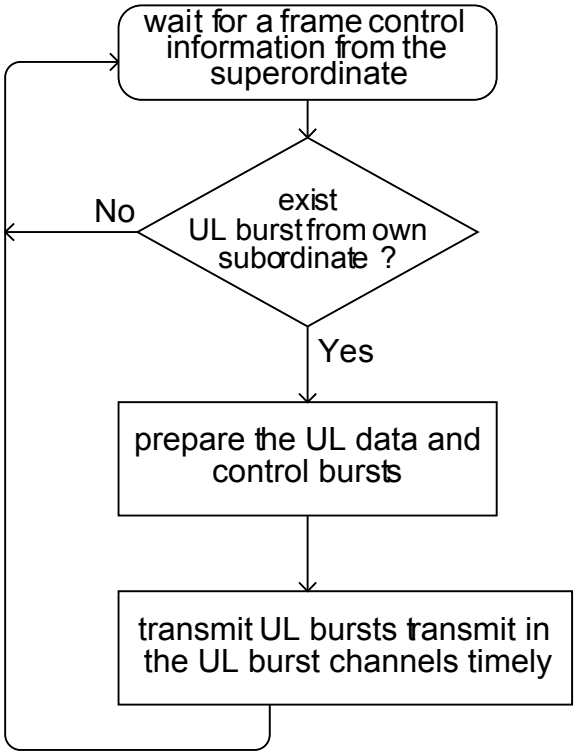
RS shall reconstruct the frame by selecting the existing DL bursts for its own subordinates and then transmit it. The DL burst relaying for subsequent frame time operation in the multi-frame RS side is summarized as follows.

<Operation flow of DL burst relaying for the subsequent frame time at RS>



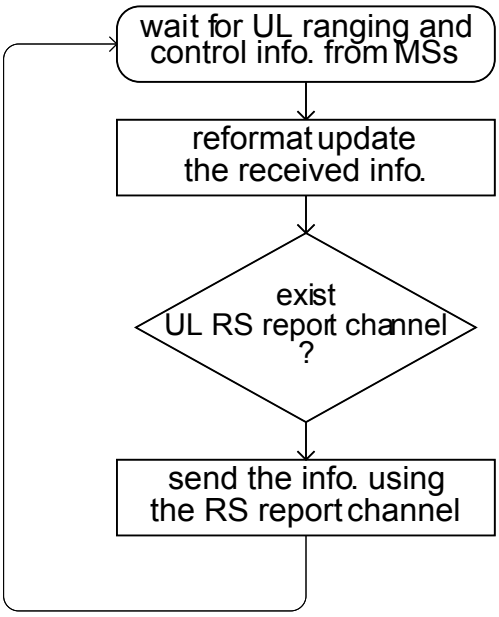
When there exists UL burst from its own subordinate, RS should perform UL burst relaying in the subsequent frame. RS prepares the UL data and control bursts and transmit the UL bursts related to the RS's subordinate MSs or RSs.

<Operation flow of UL burst relaying for the subsequent frame time at RS>



Relay operation for UL Ranging information at RS is applied only when RLY-RPT message is received successfully. Whenever ranging information is received from MSs, RS should update, reformat the received info and send it using the incoming RLY-RPT messagechannel.

<Operation flow of UL Ranging information relay at RS>



4. Text Proposal

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6.3.5.xx Centralized scheduling

Append following sentences in section 6.3.5.xx

A multi-frame(MF) is comprised of a set of subsequent frames generated according to network topology and traffic load. The length of Multi-frame should guarantee delivery of burst from/to the designated MS.

Before construction of next multi-frame, an MR-BS should determine the length of next multi-frame and prepare contents of hop channels of each frame with reference to the topology and traffic load.
The Length of Multi-frame (*LMF*) may be calculated as follows:

$LMF = \max. \{MHR+1, 2*MHM - 1)$

where,

MHR = the maximum hop distance of connected RSs within the MR network

MHM = the maximum hop distance of MSs which have at least one UL burst to be supposed to be served by MR-BS at the start of MF

A hop channel which is defined as the channel allocated to a MS within a multi-frame for a relay path. Each burst of the channel has the same MCS every frame of the Multi-frame, so that the MAP messages shall be the same in every frame except the frame number.

Append following sentences in section 6.3.5.xxx

6.3.5.xxx.1 Operation flow of a multi-frame in MR-BS side

Before the multi-frame start time, MR-BS shall configure the length of multi-frame in consideration of topology and traffic load. Then MR-BS assigns a RS RLY-CMD channel in the DL, RS RLY-RPT channel in the UL if

needed, and the DL/UL hop channel, DL/UL management channels if needed. MR-BS shall construct RS-CMD message including the information of the multi-frame start frame number and end frame number. It builds the identical frame control information applicable to all the unit frames within the multi-frame. After all of these procedures, it starts to transmit/receive frame to/from RS and MS one by one until the last unit frame finishes.

Operation procedure in the multi-frame MR-BS side is summarized as in the following flow chart.

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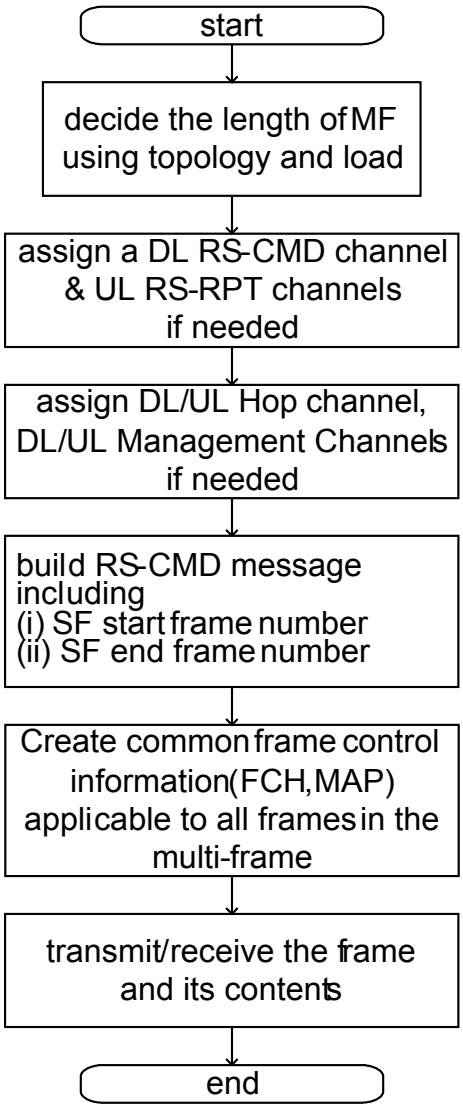

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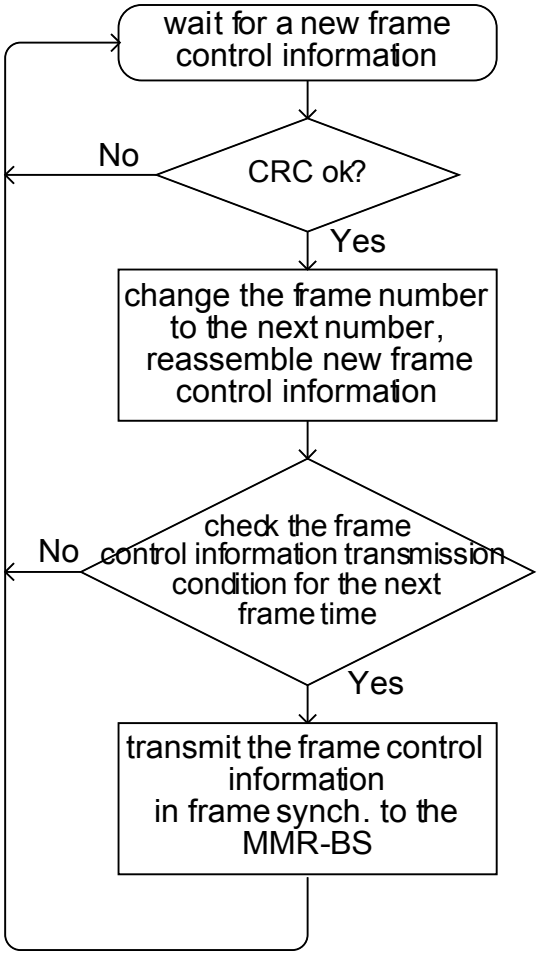


RS shall reconstruct the frame by selecting the existing DL bursts for its own subordinates and then transmit it. The DL burst relaying for subsequent frame time operation in the multi-frame RS side is summarized as follows.

<Operation flow of DL burst relaying for the subsequent frame time at RS>

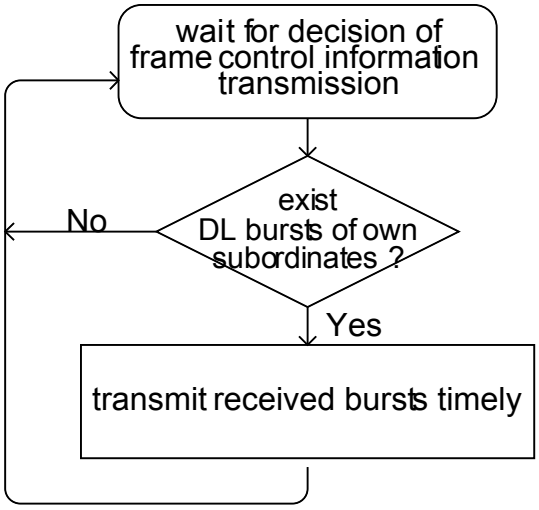
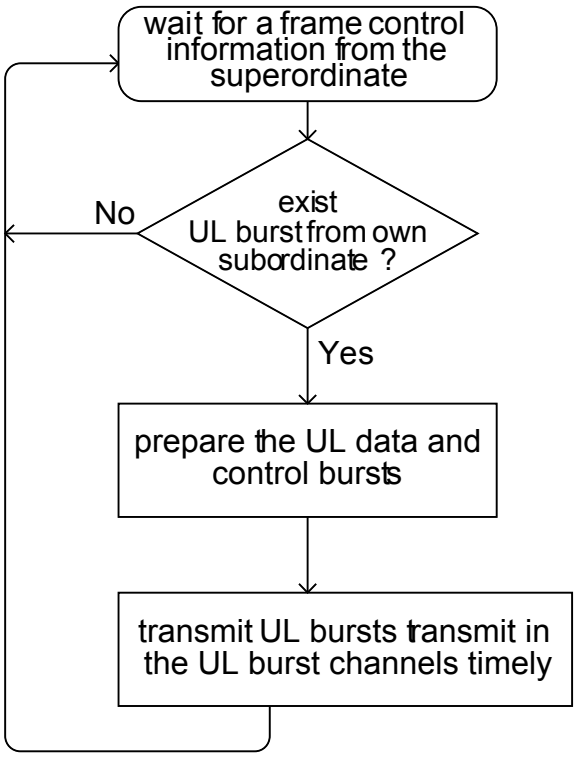


Figure xxx---Multi-frame control flow at MR-BS

When there exists UL burst from its own subordinate, RS should perform UL burst relaying in the subsequent frame. RS prepares the UL data and control bursts and transmits the UL bursts related to the RS's subordinate MSs or RSs.

<Operation flow of UL burst relaying for the subsequent frame time at RS>



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<Operation flow of UL Ranging information relay at RS>