| | |
|---|---|
| Project | **IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>** |
| Title | **Comments on R-FCH** |
| Date Submitted | **2008-05-09** |
| Source(s) | Gamini Senarath, Israfil Bahceci, Hang Zhang,Peiying Zhu, Wen Tong, Derek Yu, Sun Sheng, Mark Naden<br>E-mail:gamini@nortel.com<br>Nortel Networks<br>3500 Carling Avenue<br>Ottawa, Ontario K2H 8E9 |
| Re: | IEEE 802.16-08/020: "IEEE 802.16 Working Group Letter Ballot Recirc. #28b: Announcement" |
| Abstract | This contribution proposes remedies to the dynamic frame configuration in IEEE802.16j/D4. |
| Purpose | Discuss and adopt proposed text in TG16j |
| Notice | *This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups*. It represents only the views of the participants listed in the "Source(s)" field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who reserve(s) the right to add, amend or withdraw material contained herein. |
| Release | The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16. |
| Patent Policy | The contributor is familiar with the IEEE-SA Patent Policy and Procedures:<br><http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and<br><http://standards.ieee.org/guides/opman/sect6.html#6.3>.<br>Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and <http://standards.ieee.org/board/pat>. |

# Comments on R-FCH

*Senarath Gamini, Israfil Bahceci, Hang Zhang, Peiying Zhu, Wen Tong, Derek Yu, Sun Sheng, Mark Naden*

*Nortel*

## 1 Overview

The frame configuration in 16j networks can be done either in a static manner using MAC messages, or in a dynamic manner using R-FCH. In fact, both methods should imply the same frame structure; however, due to propagation delay for frame structure information along the paths, MAC message based frame configuration may cause inefficient scheduling and inefficient use of resources due to propagation delay to forward the MAC messages from the MR-BS station to the destination station.

The R-zone Location field[1] in R-FCH enables subordinate RSs to locate the next transmission of R-FCH, thereby allowing subordinate RSs to determine the resource allocation on a per frame basis.

In case of any modifications in frame configuration, there are two mechanisms to determine the frame configuration: (i) by the RCD message and (ii) by R-FCH/R-MAP message. On the one hand, one could follow R-FCH per frame to locate the next R-FCH/RMAP transmission from the serving station. On the other hand, it is possible to operate based on RCD to determine frame configuration. Therefore, it is necessary to specify which method shall be followed at the RSs.

## 2 Problems with R-FCH and Remedies

In current P802.16j/D4 document, R-Zone location indicates the offset (relative to the frame start preamble) for the first OFDM symbol of R-FCH/R-MAP allocation. Whenever the frame configuration is updated, the subordinate RSs has to be provided sufficient time to update their scheduling at which the new configuration is effective.

Consider a path where the MS is 2 hops away from the MR-BS, e.g., there is one RS in along the path. During the operational mode, if there is no update in frame configuration, the RS can schedule its access DL and UL without any problem. Now, assume that R-FCH/R-MAP occurs at very frame, and that the R-zone location needs to be updated at some frame-k. At this frame, the RS receives the R-FCH/R-MAP at its current location and expects to receive the one at frame-(k+1) in its new offset indicated by the R-Zone Location. However, such an update my conflict with RS's current UL scheduling since the UL MAP it already transmitted at frame-k provides allocation information at frame-(k+1). The RS has no time to update its UL allocation.

[1] This field provides an offset in number of OFDM symbols relative to the preamble of the next frame which contains an R-FCH (according to 16j/D4).

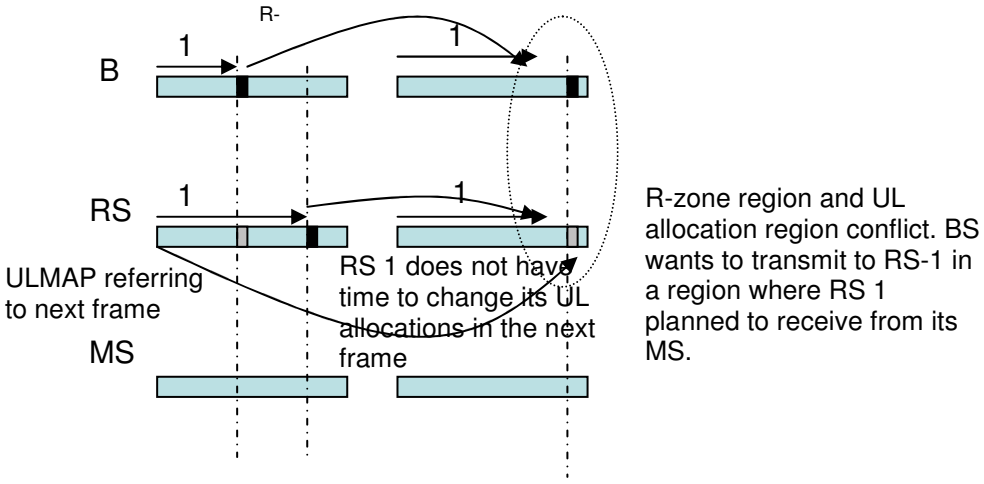


Figure 1 R-zone conflict in dynamic update along a 2-hop path

In case of more than two hops, as depicted in Figure 2, any update at MR-BS may result in conflict at both relay zones and access zones resource allocation since the intermediate RSs will not have sufficient allowance to update their scheduling according to new frame structures.

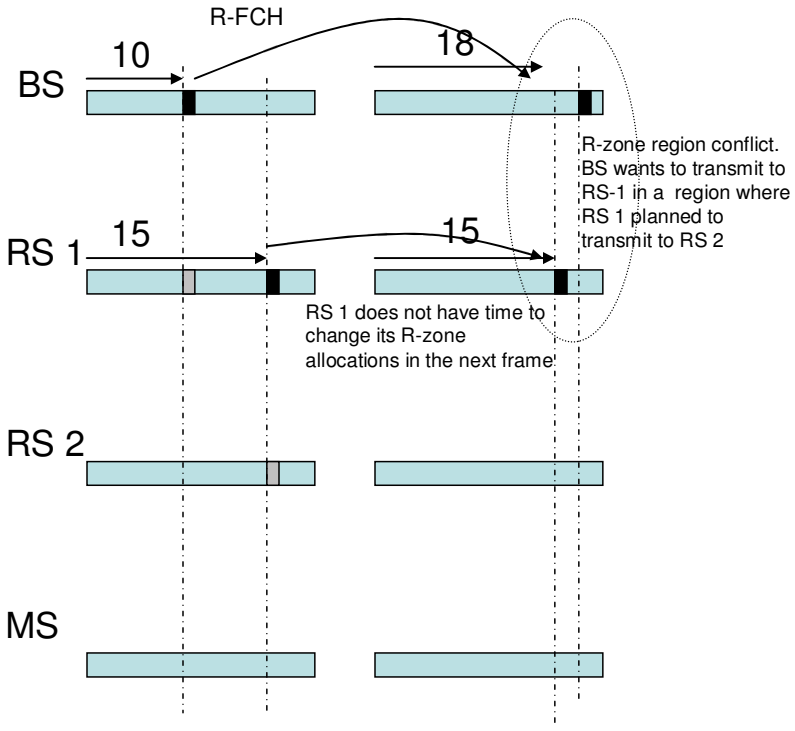


Figure 2 R-zone conflict in dynamic update along a 3-hop path

One solution seems to update the R-zone indication field definition so that that field gives the location of the

second or a later R-FCH transmission after the current one. In this case, we may still have problem as shown in Figure 3. Even if RS may have enough time to update its scheduling for the second frame, the R-zone location will indicate the R-FCH for the second frame, but not the next frame, which in fact should be informed to the subordinate RS. That is, the number of frames that need to be skipped for the R-zone location field to take affect needs to be varied according to the hop count of the RS.

We can resolve the above issues using the following approach:

1. The MR-BS can keep track of maximum hop count in its site. Denote by N the maximum hop number among all MSs in the site. The maximum hop number determines the maximum propagation delay of R-FCH from MR-BS to the furthest access RS. In addition, the UL allocations in the R-MAP from an RS at hop-h is relative to

$$T_h = \textit{Relay UL allocation start time}$$

for operational RS provided in its RCD message. Therefore, MR-BS needs to provide a grace period of at least

$$L = \max\{N, T_1 \ldots, T_{N-1}\},$$

frames for any new frame configuration to take affect so that any RS along a path can successfully implement any of its resource allocation based on the previous configuration and update its resource allocation for the new frame configuration for the upcoming frames. Thus, if R-Zone Location of R-FCH from the MR-BS is changed, the new offset shall be affective at the frame where $(L+1)^{th}$ transmission of R-FCH takes place.

2. If an RS at hop-h receives an R-Zone Location information that is not the same as the one it receives from the previous R-FCH, it should apply the new configuration after $L-h+1$ R-FCH transmissions and until then, it shall continue to process allocation information and its resource allocations according to the previous frame configuration. This is because an RS can transmit its updated R-FCH only after it receives the updated R-FCH from its superordinate station. Therefore, each hop adds one R-FCH transmission delay for the new R-FCH to arrive the next hop RS.

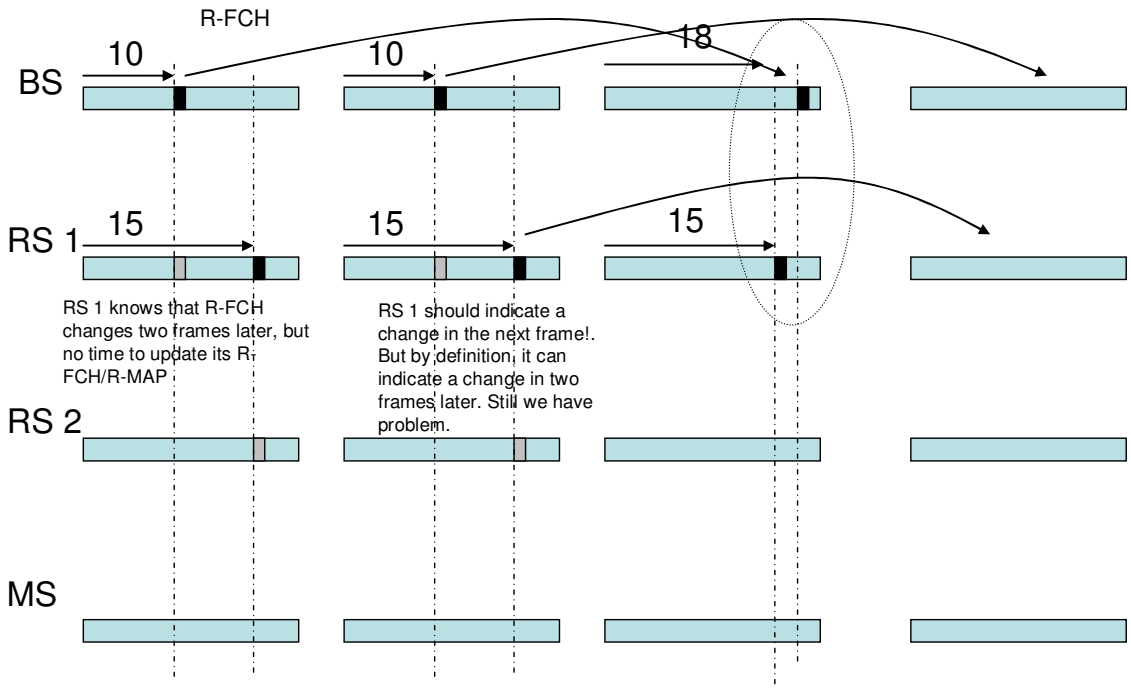


Figure 3 R-FCH with R-zone location field indicating the tx relay zone in the second frame instead of the first frame. A 3-hop path

3. Note that *Zone Configuration IE* provided in Frame Configuration TLV of RCD message to provide the zone configuration parameters (e.g., permutation type and parameter, AMC mode, STC zone mode, etc.). If one wishes to follow R-FCH for R-link synchronization and track frame zone configuration dynamically, it will be necessary to have **STC/DL zone switch IE()** to indicate the zone information to the RS. When R-zone location changes, it is likely that the zone parameters will change as well, and to indicate this change, one needs to use STC zone switch IE in the R-MAP. This is necessary because it may be too late if the zone parameters are received via a MAC message.

4. The DL MAP IEs in R-MAP refer to allocations within the current frame, while UL MAP IEs in R-MAP at frame i refer allocations to frame i+*Relay UL allocation start time,* where *Relay UL allocation start time* $\geq 0$. Therefore, in case of an update in R-Zone Location, e.g., a frame configuration change, it is mandatory to for RS to be aware of the new relay zone sizes in a dynamic manner so that its resource allocations do not conflict. For this purpose, an MR-BS or RS may need to insert an R-link specific IE to provide the updated relay zone information in advance before the frame that the configuration update indicated by the R-FCH/R-MAP arrives. Although we may not need this for R-UL MAP allocations when *Relay UL allocation start time > 0,* in general, we always need it for R-DL MAP allocations since DL MAP IEs in R-MAP always refer to the frame in which the R-MAP is received. The subordinate RS cannot be aware of Zone switch IEs if the RS solely relies on the STC/DL zone switch IEs transmitted in the R-MAP.

## 3 Required Text Changes

*[Insert the following text to Line 31 of Page 50 in Subclause 6.3.2.3.69]*

The RS Config CMD message may include the following TLV to indicate the mechanism to determine the frame configuration of the superordinate station.

Frame_Config_Flag (See 11.25.7)

### 6.3.9.18.1 Parameter configuration

*[Insert the following paragraph after Line 59 of Page 106 in Subclause 6.3.9.18.1]*

Frame configuration during operational mode may be done either in a static manner using RCD and RS Config CMD MAC messages (See 6.3.2.3.65 and 6.3.2.3.69), or in a dynamic manner using R-FCH (See 8.4.4.7.4) and Zone Info IE() (See 8.4.5.10.1.11). The Frame Config Flag TLV may be transmitted in RS Config CMD message to indicate which mechanism to be followed for determining the superordinate station's frame structure in the upcoming frame(s). If R-FCH/R-MAP is employed for locating the R-FCH/R-MAP, an RS at hop-h shall use the new configuration parameters starting from the frame at which the $(Config\_Update\_Time - h + 2)^{th}$ R-FCH transmission take place after the frame at which the R-FCH/R-MAP with the new relay zone parameters are received.

*[Change Subclause 8.4.4.7.4 as indicated]*

### 8.4.4.7.4 R-Zone prefix

The R-Zone_Prefix is a data structure transmitted on R-FCH of a DL relay zone. The R-Zone_Prefix includes information regarding the location of the first transmit relay zone in the next frame that contains a transmit relay zone and the information required for decoding R-MAP. In the case that RS config CMD message contains the Frame_Config_Flag set to 1, the frame configuration TLVs in the RCD message shall be followed to locate the relay zones. Otherwise, the R-FCH/R-MAP shall be used to determine the frame configuration parameters. Table 377a defines the format of the R-Zone_Prefix for FFT sizes other than 128 and Table 377b defined the format for a FFT size of 128.

*[Change 3rd row of Table 377on Page 197 as indicated]*

| | | |
|---|---|---|
| R-Zone_Location | 8 | The field indicates the location of the first transmit relay zone in the next frame that contains a relay zone. If this value changes, the RS at hop-h shall apply the frame configuration changes at the frame in which the $(Config\_Update\_Time-h+2)^{th}$ R-FCH transmission take place after receving the R-FCH with the new R-zone location value, where Config_Update_Time is obtained from RCD message. |

*[Insert new Subclause in 8.4.5.10.1 on Page 228, Line 5, as indicated]*

### 8.4.5.10.1.11 Zone Info IE format

If the relay zone configuration is changed, the MR-BS or RS may insert Zone Info IE to indicate its new relay zone information. If Zone Info IE is received, it shall be effective at the frame in which the $(Config\_Update\_Time-h+2)^{th}$ R-FCH transmission takes place after receiving the R-MAP with the Zone Info IE, where Config_Update_Time is obtained from RCD.

Table XXX Zone Info IE format

| Syntax | Size | Notes |
|---|---|---|
| Zone Info IE() { | | |
| Type | 5 bits | Zone Info IE = 0x0C |
| Length | 8 bits | Variable |
| Transmit R-zone length | 8 bits | |
| Offset for Receive R-zone | 8 bits | |
| Receive R-zone length | 8 bits | |
| } | | |

*[Insert the following row at the end of the table on Page 265 in Subclause 11.24.1 as indicated]*

| | | | | |
|---|---|---|---|---|
| Config_Update_Time | 8 | 1 | It is used by RS to determine the effective start time of R-FCH or Zone Info IE if the R-Zone Location or relay zone configuration is different from the one received at the previous R-FCH/R-MAP transmission. An RS at hop-h shall apply the frame configuration changes at the frame on which (Config_Update_Time-$h+2$)$^{th}$ R-FCH transmission takes place. | RCD |

*[Insert the following text to Subclause 11.24]*

11.24.9 Frame Config_Flag

If this field is set to 1, it indicates that the RS shall use the RCD message to obtain frame configuration. If it is set to 0, R-FCH/R-MAP messages shall be used for determining the frame structure.