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Abstract	Frame structure that can support frequency overlay is proposed
Purpose	To be discussed and adopted by TGm for use in 802.16m SDD
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Proposed 802.16m Frame Structure for multi-carrier support

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1. Introduction

The IEEE 802.16m Protocol Structure supports multi-carrier operation [1]. Additionally, we need to describe the frame structure to support the multi-carrier operation. However, it is missing in the current SDD. This contribution describes the frame structure to multi-carrier, especially focusing on supporting frequency overlay in 16m specification. To this end, we briefly describe the operation scenario of frequency overlay. Then, we propose the text for the frame structure to support frequency overlay.

2. Overview of multi-carrier operation

In this contribution, we are focusing on freq. overlay (FO) system and its operation. FO is defined for MSs of different BWs to operate in the same spectrum. For this end, wider BW is the aggregation of narrower BWs. This allows some distinctive features in 16m:

Allow narrow BW MS in 16m

Each service provider may have different BW (5/10/20..MHz)

FO technology supports narrow and wide BW MS simultaneously

Higher peak rate

More aggregation allows larger peak rates

40/60/80/100 MHz with FO of 20MHz BW

The following is our design policy for multi-carrier system design, especially focusing on the frequency overlay system.

- Operate freq. overlay of multiple FAs as if single FA
- No or minimal impacts on non-freq. overlay single FA operation
- Low overhead for freq. overlay operation
- Reuse designs of non-freq. overlay single FA operation

Generic protocol architecture to support multicarrier system is illustrated in Figure 1. Though the different carriers have different PHY instances, the MAC layer for each PHY share the same functionalities. Instead of parallel MAC layer having same functionality for each carrier, one MAC layer with multiple PHY can provide efficient multicarrier support. For example, there is no reason to define common features of a MS such as QoS differently for each carrier. Network entry, BW request etc. for multicarrier support can be also expected in more efficient way with the proposal. Thus, a common MAC entity may control a PHY spanning over multiple frequency channels.

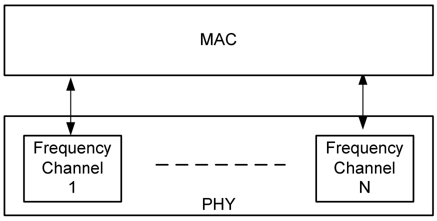
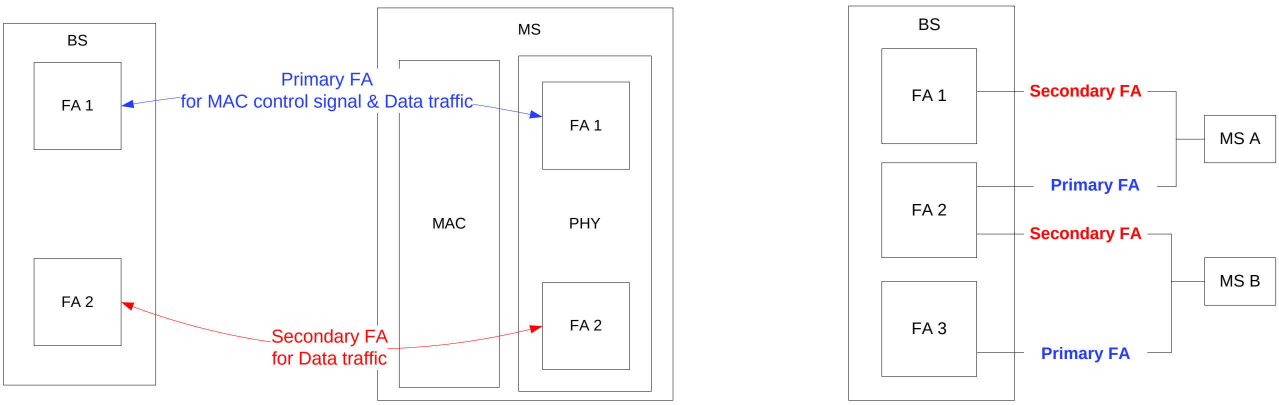


Fig.1 - Generic protocol architecture to support multicarrier system

For the efficient support of multicarrier system described above, we propose to introduce primary and secondary carrier. Primary FA delivers MAC control signaling as well as Data traffic. Secondary FA is used as a supplemental FA to deliver Data traffic. This concept is shown in fig2-(a). For a primary carrier, BS and MS can negotiate for the primary carrier of the MS to be associated with number of secondary carriers depending on MS's capability. Further, any carrier can be primary carrier for a MS and secondary carrier for other MSs. It is captured in Fig.2 (b). FA2 is a primary carrier for MS-A and the secondary carrier for MS-B at the same time. It will prevent a primary carrier from being congested with control messages. Further, BS can balance the load of the traffic of narrow BW MSs over all carriers. The narrow BW MSs include MSs with narrow RF BW and MSs with wide RF BW that want to access to a narrow BW to save the power.



(a) (b)

Fig.2 – Primary and secondary carriers

The primary and secondary carrier concept is tightly related with design of broadcasting channels. We prefer that broadcast channels (including superframe header, system descriptors like DCD/UCD) are located in each carrier. This will allow simple primary and secondary carrier operation. However, we do not exclude a possibility that the broadcast channels may be located in specific carrier(s) with possibly more operational burden.

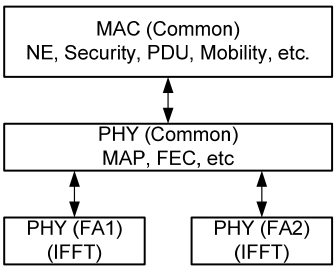


Fig.3 – Generic structure of physical layer

For physical layer, we can categorize the function blocks into 2 groups: For some functions, such as subchannels and IFFT/FFT, multiple functional entities (1 entity per carrier) are inevitable due to narrow BW operation, whereas, single functional entity (1 entity for all carriers) is more appropriate for channel coding/HARQ and for allocation signaling (MAP). For FO, a single MAC PDU can be sent over multiple carriers. In this case, we can reduce the signaling overhead, CRC, and management efforts when the PDU is encoded and divided to be sent in resources over multiple carriers.

Fig.4 shows candidates of allocation signaling in FO mode. Each carrier can have its own MAP when it is primary FA. An allocation made in a carrier is signaled in the MAP of the carrier. Allocations made over multiples carriers of FO mode can be signaled by MAP of each carrier. It is shown in Fig. 4 (a). In the figure, an encoded packet is divided into 2 parts and sent in FA1 and FA2 respectively and each allocation is signaled by MAP of each FA. As an alternative, allocations made over multiples carriers of FO mode can be signaled by a MAP of the primary carrier. It is shown in Fig. 4 (b). In the figure, an encoded packet is divided into 2 parts and sent in FA1 and FA2 respectively but the allocation is signaled by MAP of FA1, the primary carrier. In this case, MS does not need to monitor MAPs in the secondary carriers.

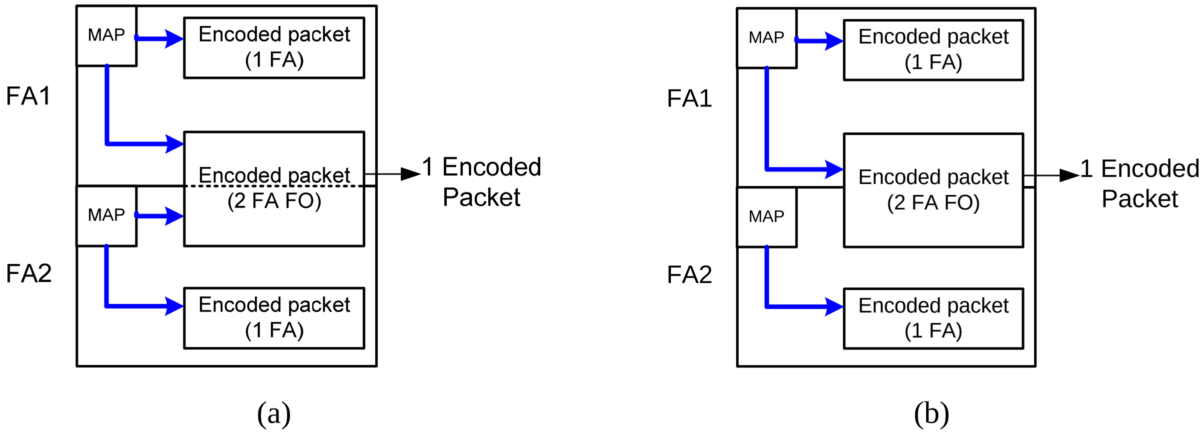


Fig. 4 – FO allocation signaling

When there is integer number of subcarriers between the adjacent carriers, subcarriers belonging to a carrier does not interfere to subcarriers belonging to other carrier [2][3]. Thus, no guard band or guard subcarriers are necessary between carriers. Now, additional subcarriers can be used for traffic carrier. The number of the additional subcarriers is varying depending on the separation between the adjacent carriers. This information can be carried in superframe header where the used subcarriers for the header shall be fixed.

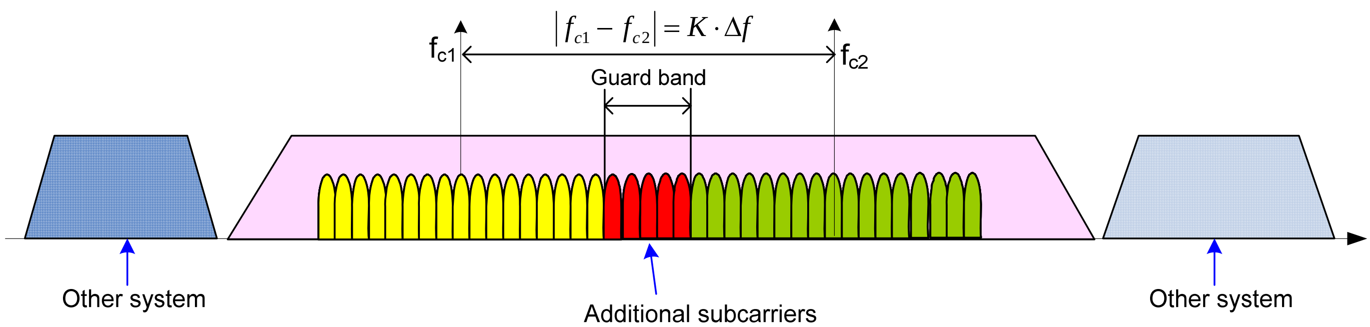


Fig. 5 – additional subcarriers for traffic

Fig. 6 shows the proposed frame structure example for multi-carrier support. A number of narrow BW carriers can be aggregated to support wide BW operation. Thus, narrow BW and wide BW MSs can operate in the same spectrum. Each carrier can have its own superframe header (the location and structure is subject to the results of the DL control RG). When the separation of center frequency between two adjacent bands is multiple of subcarrier spacing, no guard subcarriers are necessary between adjacent subcarriers.

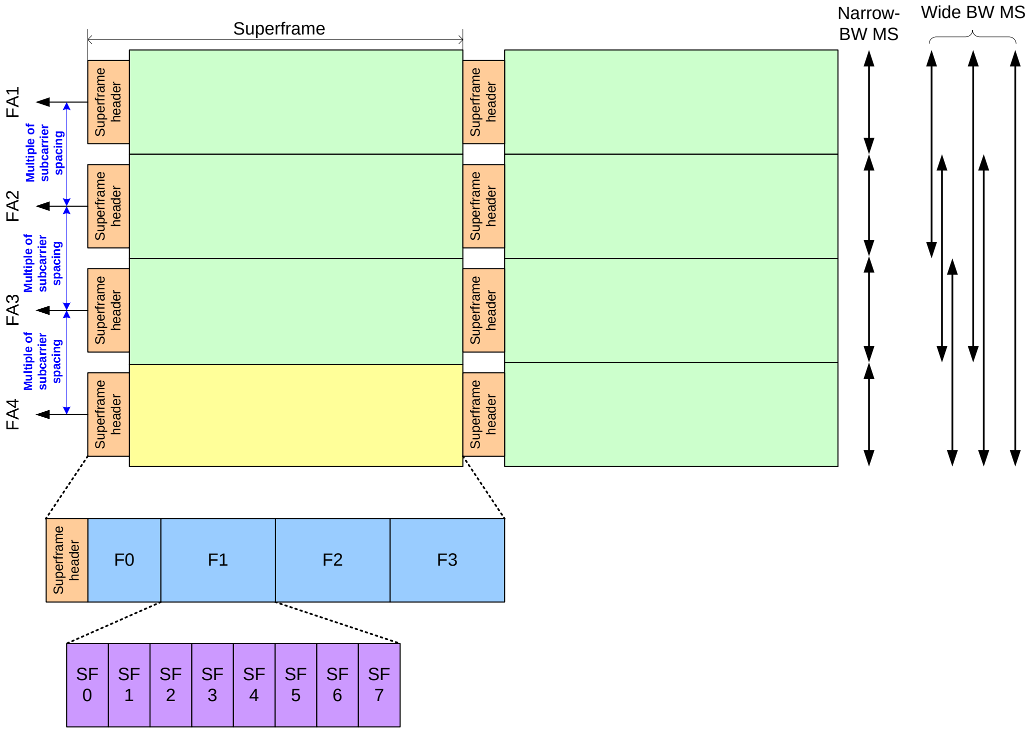


Fig. 6 – Example of the proposed frame structure to support multi-carrier operation

3. Proposed Text

[Insert the following subclause after subclause 11.4.1.2]

11.4.1.3 Frame Structure to support multi-carrier operation

Figure 11.12 shows the proposed frame structure example for multi-carrier support. A number of narrow BW carriers can be aggregated to support wide BW operation. Thus, narrow BW and wide BW MSs can operate in the same spectrum. Each carrier can have its own superframe header (the location and structure is subject to the results of the DL control RG). When the separation of center frequency between two adjacent bands is multiple of subcarrier spacing, no guard subcarriers are necessary between adjacent subcarriers.

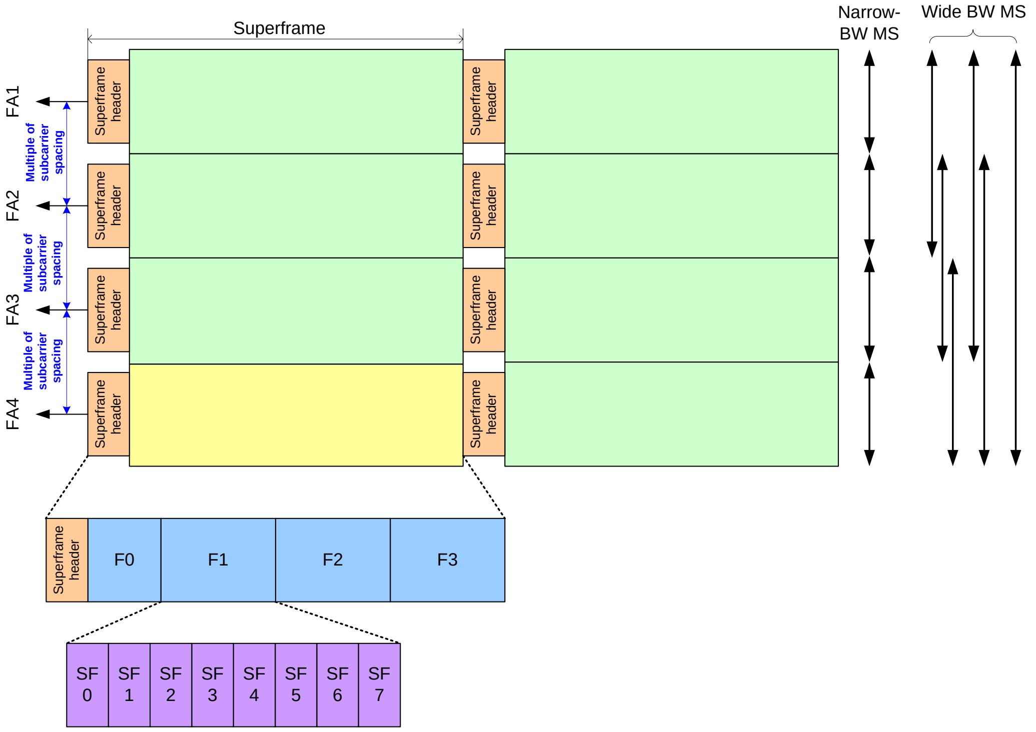


Figure 11.12: Example of the proposed frame structure to support multi-carrier operation

References

[1] IEEE 802.16m-08/003r1, The Draft IEEE 802.16m System Description Document
[2] IEEE C802.16m-08/208r2, Proposed 802.16m DL Control Channel Scheme to Use More Subcarriers in Guard Band.
[3] IEEE C802.16m-08/143r1, Sub-carrier Alignment for IEEE 802.16m Multi-band Frame Structure.