Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**Details of Comment on Contention Resolution**	
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Re:	IEEE P802.16/D4-2001	
Abstract	This contribution contains comment on subclause 6.2.8 of IEEE P802.16/D4-2001.	
Purpose	To correct and improve IEEE P802.16/D4-2001	
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0.0.1 Contention Resolution

The BS controls assignments on the uplink channel through the UL-MAP messages and determines which mini-slots are subject to collisions. Collisions may occur during Initial Maintenance and Request intervals defined by their respective IEs. The potential occurrence of collisions in Request intervals is dependent on the CID in the respective IE. This section describes uplink transmission and contention resolution. For simplicity, it refers to the decisions an SS makes. However, this is just an instructional tool. Since an SS can have multiple uplink Service Flows (each with its own CID), it makes these decisions on a per service queue or per CID basis.

The mandatory method of contention resolution which shall be supported is based on a truncated binary exponential back-off, with the initial back-off window and the maximum back-off window controlled by the BS. The values are specified as part of the UCD message and represent a power-of-two value. For example, a value of 4 indicates a window between 0 and 15; a value of 10 indicates a window between 0 and 1023.

When an SS has information to send and wants to enter the contention resolution process, it sets its internal back-off window equal to the Request (or Ranging for initial ranging) Backoff Start defined in the UCD message referenced by the UCD Count in the UL-MAP message currently in effect.[1]

The SS shall randomly select a number within its back-off window. This random value indicates the number of contention transmission opportunities that the SS shall defer before transmitting. An SS shall consider only contention transmission opportunities for which this transmission would have been eligible. These are defined by Request IEs (or Initial Maintenance IEs for initial ranging) in the UL-MAP messages. Note that each IE may consist of multiple contention transmission opportunities.

Using bandwidth requests as an example, consider an SS whose initial back-off window is 0 to 15 and it randomly selects the number 11. The SS must defer a total of 11 contention transmission opportunities. If the first available Request IE is for 6 requests, the SS does not use this and has 5 more opportunities to defer. If the next Request IE is for 2 requests, the SS has 3 more to defer. If the third Request IE is for 8 requests, the SS transmits on the fourth opportunity, after deferring for 3 more opportunities.

After a contention transmission, the SS waits for a Data Grant Burst Type IE in a subsequent map (or waits for a RNG-RSP message for initial ranging). Once received, the contention resolution is complete.

The SS shall consider the contention transmission lost if no data grant has been given within T15 (or no response within T3 for initial ranging). The SS shall now increase its back-off window by a factor of two, as long as it is less than the maximum back-off window. The SS shall randomly select a number within its new back-off window and repeat the deferring process described above.

This retry process continues until the maximum number (i.e., Request Retries for bandwidth requests and Contention Ranging Retries for initial ranging) of retries has been reached. At this time, for bandwidth requests, the PDU shall be discarded. For initial ranging, proper actions are specified in 6.2.9.5. Note that the maximum number of retries is independent of the initial and maximum back-off windows that are defined by the BS.

For bandwidth requests, if the SS receives a unicast Request IE or Data Grant Burst Type IE at any time while deferring for this CID, it shall stop the contention resolution process and use the explicit transmission opportunity.

The BS has much flexibility in controlling the contention resolution. At one extreme, the BS may choose to set up the Request (or Ranging) Backoff Start and Request (or Ranging) Backoff End to emulate an Ether-

[1]The map currently in effect is the map whose allocation start time has occurred but which includes IEs that have not occurred.

net-style back-off with its associated simplicity and distributed nature, but also its fairness and efficiency issues. This would be done by setting Request (or Ranging) Backoff Start = 0 and Request (or Ranging) Backoff End = 10 in the UCD message. At the other end, the BS may make the Request (or Ranging) Backoff Start and Request (or Ranging) Backoff End identical and frequently update these values in the UCD message so that all SS are using the same, and hopefully optimal, back-off window.

0.0.1.1 Transmission Opportunities

A transmission opportunity is defined as any mini-slot in which an SS is allowed to start a transmission. The number of transmission opportunities associated with a particular IE in a map is dependent on the total size of the interval as well as the size of an individual transmission.

As an example, consider contention-based bandwidth requests for a system where the PHY layer protocol has a frame duration of 1 ms, 4 symbols for each PS, 2 PSs for each mini-slot, an uplink preamble of 16 symbols (i.e., 2 mini-slots), and an SS Transition Gap (STG) of 24 symbols (i.e., 3 mini-slots). Thus, assuming QPSK modulation scheme is used, each transmission opportunity requires 8 mini-slots, 3 for STG, 2 for the preamble and 3 for the bandwidth request message.

If the BS schedules a Request IE of, say, 24 mini-slots, there will be three transmission opportunities within this IE. Details of the three transmission opportunities are shown in Figure 1.

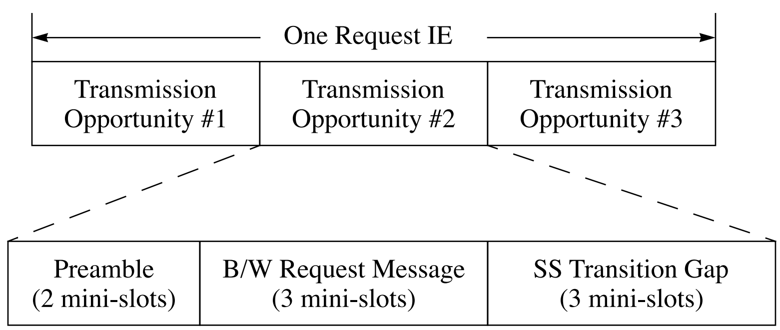

Figure 1—Request IE Containing Multiple Transmission Opportunities