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Abstract	
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DL Rate Control with QoS Differentiation

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1. References

[1] IEEE P802.16/D5-2001, IEEE Draft Standard for Local and Metropolitan Area Networks – Part 16: Air Interface for Fixed Broadband Wireless Access Systems, 2001-10-18

[2] IEEE P802.16a/D7-2002, Draft Amendment to IEEE Standard for Local and Metropolitan Area Networks. Part 16: Air Interface for Fixed Broadband Wireless Access Systems - Medium Access Control Modifications and Additional Physical Layer Specifications for 2-11 GHz, 2002-11-17

[3] P802.16d/D2-2003, Part 16: Air Interface for Fixed Broadband Wireless Access Systems - Amendment 3: Detailed System Pro?les for 2-11 GHz2003-06-03

2. Background

[2] ~~[2]~~ contains specification for DIUC Mandatory Exit Threshold and DIUC Minimum Entry Threshold (Table 125b—DCD Burst Profile Encodings - WirelessMAN-OFDM). This information may in certain cases be not sufficient and/or not convenient:

1. In NLOS operations it may happen that lower rate does not provide higher quality because of multipath effect
2. With CRC employed at the connection BER observed by upper layers differs significantly from “raw” BER provided by PHY at PHY SAP. In such case S/(N+I) indicator may be not sufficient for choice of optimal channel rate

Thus desired link quality at PHY layer may depend on QoS requirements (defined at MAC layer). Therefore the link quality should be a function of QoS parameters specified for certain MAC DL connection.

For example, we may have DL connection that carries voice traffic in small packets. To keep the delay low enough, we may decide that we don’t want to enable ARQ operations at the connection. Then desired BER may be set, say, to 10^{-4}. Another connection may be used by a TCP/IP application with long payloads which requires BER = 10^{-6}.

So it is natural to involve bit error ratio (BER) into rate control procedure as a direct indicator, which is really important to MAC.

Our suggestions is 1) add an option to specify target link quality in the terms of maximum BER 2) allow BS to request from SS monitoring BER value at specific DL connection and alarming BS when BER indicator crosses certain threshold.

3. Specific Changes in 802.16d-D2

6.2.10.1 Downlink burst profile management in framed operation

Change first paragraph:

The downlink burst profile is determined by the BS according to the quality of the signal that is received by each SS. To reduce the volume of uplink traffic, the SS monitors the carrier to noise and interference ratio [C/(N+I)] and compares the average value against the allowed range of operation. This region is bounded by threshold levels. SS also MAY monitor the BER value, per connection, if target BER provided by the BS and if CRC is used at the connection. If either the received C/(N+I) or BER goes outside of the allowed operating region, the SS requests a change to a new burst profile using one of three methods. If the SS has a station maintenance interval available, it shall send an RNG-REQ message to which the BS responds with a RNG-RSP message. Otherwise, the SS shall send a DBPC-REQ message in an uplink allocation addressed to that SS's basic connection ~~(regardless of whether the SS is GPC or GPT)~~. The BS responds with a DBPC-RSP message. If neither of these options is available and the SS requires a more robust burst profile on the downlink, the SS shall send an RNG-REQ message in an Initial Maintenance interval.

[802.16a-2003] Insert 11.4.8.20

11.4.8.20 Target BER

The target BER parameter indicates the BER value which BS considers normal for the given type of traffic. This parameter concerns downlink flows only and may be used only together with the Service Flow Identifier (11.4.8.1).

Type	Length	Value	Scope
15	1	Value n (0 ? n ? 12) denotes BER = 10^{-n}	DSA-REQ (BS or SS initiated) for DL Service Flow

[802.16a-2003] Insert 11.4.8.22

11.4.8.21 Set of Usable DIUCs

The parameter indicates set of DIUCs which are considered suitable to reach target BER for the given Service Flow. This parameter concerns downlink flows only and may be used only together with the Service Flow Identifier (11.4.8.1).

Type	Length	Value	Scope
16	2	16 bits mask with n_{th} bit set to '1' if DIUC = n is suitable to reach target BER for the given Service Flow and to '0' otherwise	DSA-RSP (unsolicited, sent from SS) for DL Service Flow

[802.16-2001]Change 6.2.2.3.11

6.2.2.3.11 Dynamic Service Addition—Response (DSA-RSP) message

A Dynamic Service Addition Response shall be either generated in response to a received DSA-Request or sent unsolicitely triggered by change in DL channel conditions resulted in change of optimal rate for certain service flow. The format of a DSA-RSP shall be as shown in Table 37.