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Title	ARQ for UGS Service Flows in 802.16e	
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Re:	IEEE P802.16e/D5-2004	
Abstract	The document contains suggestions for enabling ARQ for UGS Service Flows in 802.16e.	
Purpose	To enable ARQ for UGS Service Flows in 802.16e	
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ARQ for UGS Service Flows in 802.16e

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1. The Document's Goal

The document's goal is to propose mechanisms enabling ARQ to be used in UGS service flows in 802.16e.

2. Incentive for Development of ARQ for UGS

UGS has been defined in order to support real-time service flows that generate fixed size data packets on a periodic basis, for example E1/T1 or Voice Over IP (VoIP) without silence suppression. As such, UGS service flows cannot request bandwidth. This presents a major problem if ARQ is enabled for such a service flow. First, an SS does not have the necessary bandwidth needed to send ARQ feedbacks to the BS. Second, an SS does not have the necessary bandwidth needed to send retransmissions. This problem is serious as the SS cannot even indicate this to the BS, nor can it ask for the needed bandwidth. Moreover, bandwidth request mechanisms incur a certain delay which might be unreasonable given the demands of UGS service flows. The Slip Indicator (SI) bit mechanism defined is unsuitable for these cases as it does not indicate how much bandwidth is desired.

To countermand these problems and in order to enable ARQ to be used with UGS service flows, the following is proposed. First, the BS will allocate some bandwidth for ARQ feedbacks whenever it sends data to the SS on UGS service flows. The exact size of the ARQ feedback can be calculated by the BS. The exact timing for this allocation depends on the SS ability to respond with an ARQ feedback. This ability shall be negotiated in the dynamic service establishment phase.

Second, the BS will allocate bandwidth for retransmissions of the SS on UGS connections. The data grant needed for retransmission is basically the same grant size that the BS normally allocates for this UGS service flow. An extra grant will be allocated to an SS whenever the BS does not receive data from this SS on a grant allocated for a UGS service flow. The BS will perceive this as a failed transmission and will allocate an extra grant to compensate. The exact timing for this extra grant depends on the service flow parameters.

3. Specific changes in the Standard

[New section 6.3.4.3.9]

6.3.4.3.9 ARQ_FEEDBACK_DELAY

ARQ_FEEDBACK_DELAY describes the delay experienced by the SS from reception of a PDU on the DL until it can send an ARQ feedback for this PDU on the UL.

[New section 6.3.4.7]

6.3.4.7 ARQ Support for UGS Connections

For ARQ-enabled UGS connections in the DL, the BS shall allocate enough bandwidth to allow the SS to transmit ARQ feedback IEs. The size of these allocations shall be calculated by the BS in accordance with the data transmitted. These allocations will be timed according to *ARQ_FEEDBACK_DELAY* in relation to the BS data.

For ARQ-enabled UGS connections in the UL, the BS shall allocate enough bandwidth to allow the SS to transmit ARQ retries. The size of the extra grant shall be as specified in the Unsolicited Grant Size TLV (11.13.29). The BS shall allocate this extra grant whenever an unsolicited grant has been unused by the SS, indicating transmission failure. Noting the time of this initial grant as t_0 , the extra grant shall be allocated at a time t_r which shall be $t_0 + ARQ_RETRY_TIMEOUT \leq t_r \leq t_0 + ARQ_BLOCK_LIFETIME$. This ensures that the retry for a failed transmission shall correspond with the extra grant.

To ensure that the BS does not allocate extra grants infinitely for an SS that does not transmit, the BS shall allocate an extra grant for a failed transmission only if the previous transmission on this connection was successful, thus indicating that the SS is transmitting properly. When the SS fails a single transmission, it shall be allocated the extra grant, but if it fails in this as well no extra grants shall be allocated.

[Insert new section 11.13.18.10]

11.13.18.10 ARQ_FEEDBACK_DELAY

This parameter specifies the minimum delay experienced by the SS in a DL ARQ connection from reception of ARQ data until transmission of an ARQ feedback for this data.

Type	Length	Value	Scope
[145/146].xx	1	Number of frames between the ARQ data frame and the ARQ feedback frame.	DSA-REQ, DSA-RSP, DSC-REQ, DSC-REP