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Source(s)		
	Zivan Ori, Yigal Eliaspur Intel Corp.	Voice: +972-54-7884877 mailto: yigal.eliaspur@intel.com mailto:zivan.ori@intel.com
	Vladimir Yanover Alvarion Ltd. 21 A Habarzel St. Ramat - Hahayal Tel - Aviv 69710 P.O. Box 13139, Tel-Aviv 61131, Israel	Voice:+972-36457834 Fax: +972-36456222 mailto: vladimir.yanover@alvarion.com
	Yong Chang, Geunhwi Lim, Hong Sung Chang, JungWon Kim, TaeWon Kim Samsung Electronics Co. Ltd.	yongchang@samsung.com
	Joël Demarty	joel@sequans.com
	Jeff Mandin Streetwaves Networking	jeff@streetwaves-networks.com

Re:	IEEE P802.16e/D5
Abstract	The document contains suggestions for definition of UGS Grant Synchronization for 802.16e.
Purpose	To enhance UGS Grants Synchronization for 802.16e
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UGS Grants Synchronization for 802.16e

Zivan Ori, Yigal Eliaspur

Intel Corp.

1. The Document's Goal

The document's goal is to propose an enhancement to UGS Grant Synchronization mechanisms for 802.16e.

2. Incentive for Development of UGS Grant

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. The BS under optimal conditions will allocate the SS a data grant sufficient for the UGS data packet at intervals equal to the UGS application packet generation. For instance, if a VoIP vocoder generates a packet every 20ms, the BS should allocate a data-grant every 20ms. Inherent in this design is a synchronization mismatch between these two periodic behaviors, namely the vocoder clock and the BS clock. This leads to a possible delay at the transmitter side equal to the UGS application data generation period. In the above case, the resulting delay is 20ms, which is very long for VoIP applications which require an end-to-end delay of 150-200ms.

The following example demonstrates this. Assume that the BS allocates a data grant for the SS at T=0ms, 20ms, 40ms, 60ms, 80ms, etc. for a CID with an SDU inter-arrival time of 20ms.

The vocoder's data arrives at the SS at a mismatched time. The best timing (least delay) would have been achieved if the VoIP packets arrived at the SS for transmission at T=19ms, 39ms, 59ms, 79ms, etc. The resulting delay at the SS would have been on the order of 1ms. However, since the vocoder is not synchronized with the BS allocations, its packets might arrive at T=1ms, 21ms, 41ms, 61ms, etc., with a resulting delay of roughly 19ms.

In order to reduce this delay, a form of Grant Synchronization for UGS must be employed. In some modems vocoders, Grant Synchronization is performed between the transmitter and the vocoder itself. However, in order not to impose constraints on the vocoder which is beyond the scope of this standard, a more suitable Grant Synchronization mechanism will be between the SS and the BS.

The mechanism proposed here allows the SS to ask the BS to synchronize the grants with the arrival time of the packets. The SS will ask the BS to shift the allocations for this CID several frames forward in time. The result, for the above worst case, is that the BS

allocations are at T=0ms, 20ms, 40ms, <grant synch>, 45ms, 65ms, 85ms. The result being that the VoIP packets, first delayed by 19ms, are delayed by only 4ms after the grant synch.

The following proposal suggests that for UGS Service Flows, two additional fields in the Grant Management subheader will be used to request the BS to shift its data-grants in time for this particular Service Flow.

The proposal also clarifies that UGS is designed to transport fixed SDU packets and that the SDU size parameter should be mandatory for UGS service flow.

3. Specific changes in the Standard

[Change in section 6.3.2.2.2]

Table 9 – Grant Management subheader format

Syntax	Size	Notes
Grant Management Subheader {		
if (scheduling service type == UGS) {		
SI	1 bit	
PM	1 bit	
FLI	1 bit	
FL	4 bit	
Reserved	8bits	Shall be set to zero
}		
else {		
if (scheduling service type == Extended rtPS) {	16 bits	
Extended Piggyback Request	11	
FLI	1	
FL	4	
Else{		
Piggyback Request	16 bits	
}		
}		

Table 10 – Grant Management Subheader Fields

Name	Length (bits)	Description
FLI	1	Frame Latency indication 0 = Frame latency field disabled for this grant 1 = Frame latency field enabled for this grant
FL	4	Frame Latency The number of frames previous to the current one in which the transmitted data was available. When the latency is greater than 15 then the FL field shall be set to 15.

[Change in section 6.3.5.2.1]
[add to end of section]

The FL and FLI fields may be used to provide the BS with information on the synchronization of the SS application that is generating periodic data for UGS/Extended rtPS Service Flows.

The SS may use these fields to detect whether latency experienced by this service flow at the SS exceeds a certain limit, e.g. a single frame duration. If the FL indicates inordinate latency, the BS may shift scheduled grants earlier for this service flow (taking into account the –Frame Latency – FL).

[Change in section 6.3.18.1.1]

Table 130b – Unsolicited Grant Service Parameters

Parameter	Meaning
Unsolicited Grant Interval	As in 11.13.29

[Change in section 6.3.18.1.2]

Table 130c—Real-Time Variable Rate Service Parameters

Parameter	Meaning
Unsolicited Polling Interval	As in 11.13.30

[Insert new section 11.13.29]

11.13.29 Unsolicited Grant Interval

The value of this parameter specifies the nominal interval between successive data grant opportunities for this Service Flow .The ideal schedule for enforcing this parameter is defined by a reference time frame t0, with the desired transmission time frame ti = t0 + i*interval. The actual grant time, t'i shell be in the range ti <= t'i <= ti + jitter, where interval is the value specified with this TLV, and jitter is the Tolerated Jitter.

Type	Length	Value	Scope
[145/146].xx	2	Grant interval in the resolution of ms	DSA-REQ, DSA-RSP, DSC-REQ, DSC-REP

[Insert new section 11.13.29]

11.13.30 Unsolicited Polling Interval

The value of this parameter specifies the nominal interval between successive polling grants opportunities for this Service Flow. The ideal schedule for enforcing this parameter is

defined by a reference time t0, with the desired polling time ti = t0 + i*interval. The actual polling time, t'i shall be in the range ti <= t'i <= ti + jitter, where interval is the value specified with this TLV, and jitter is the Tolerated Jitter.

Type	Length	Value	Scope
[145/146].xx	2	Grant interval in ms	DSA-REQ, DSA-RSP, DSC-REQ, DSC-REP