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| 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

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## 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.

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 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. One field, the SB (Shift-Backwards) bits, instructs the BS to shift the grants earlier in time; the second field, the SF (Shift-Forwards) bits, instructs the BS to shift the grants later in time.

The SS will set one of these fields when the delay noted for packet transmission is high. Upon detection of these fields, the BS will shift the allocation for this Service Flow by one frame, either earlier or later as instructed. When the delay noted by the SS for the UGS application is sufficiently low, i.e. within the order of a single 802.16 frame, the SS will stop requesting the clock shift.

In order to better define the grant allocation period, two Service Flow management encodings are to be added for UGS Service Flows:

- Unsolicited Grant Size: specifies the size in bytes of the UGS periodic data-grant.
- Unsolicited Grant Interval: specifies the interval in milliseconds between successive data-grants for the 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 | |
| **SB** | 2 bit | |
| **SF** | 2 bit | |
| *Reserved* | 10 bits | Shall be set to zero |
| } | | |
| else { | | |
| **Piggyback Request** | 16 bits | |
| } | | |
| } | | |

**Table 10 – Grant Management Subheader Fields**

| Name | Length (bits) | Description |
|---|---|---|
| SB | 2 | Shift Backward<br>0 = No Action<br>1-3 = Shift the grant's interval 1-3 frames backwards. |
| SF | 2 | Shift Forward<br>0 = No Action<br>1-3 = Shift the grant's interval 1-3 frames forwards. |

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

The Shift-Grant (SB and SF) bits may be used to synchronize the grants received by the BS with the data packets received by the SS transmitter for UGS Service Flows.

The value of this parameters specifies a shift to the time t0 from which can be derived the desired transmission times ti = t0 + i*interval, where interval is the Unsolicited Grant's interval (Refer to section 11.13.29 ).
The SS shall use these fields once it detects that latency experienced by this service flow at the SS exceeds a certain limit, e.g. a single frame duration.  If the SF bits are sets, the BS shall shift the grants interval period for this service flow 1-3 frames forward.  If the SB bits are sets, the BS shall shift the grants interval period for this service flow 1-3 frames backward.  If both of these fields are set at once, the BS shall take no action.

*[Change in  section 6.3.18.1.1]*

**Table 130b – Unsolicited Grant Service Parameters**

| Parameter | Meaning |
|---|---|
| Unsolicited Grant Size | As in 11.13.28 |
| Unsolicited Grant Interval | As in 11.13.29 |

*[Insert new section 11.13.28]*

### 11.13.28 Unsolicited Grant Size

This parameter specifies the size of the data-grant allocated for the Service Flow periodically by the BS.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].xx | 2 | Size of data-grant in bytes | DSA-REQ, DSA-RSP, DSC-REQ, DSC-REP |

*[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 t0, with the desired transmission times ti = t0 + i*interval. The actual grant times, 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 0.5 ms | DSA-REQ, DSA-RSP, DSC-REQ, DSC-REP |