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Source(s)	Zivan Ori, Yigal Eliaspur Intel Corp.	Voice: +972-54-7884877 <a href="mailto:yigal.eliaspur@intel.com">mailto: yigal.eliaspur@intel.com</a> <a href="mailto:zivan.ori@intel.com">mailto:zivan.ori@intel.com</a>
	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 <a href="mailto:vladimir.yanover@alvarion.com">mailto: vladimir.yanover@alvarion.com</a>
Re:	IEEE P802.16e/D5	
Abstract	The document contains suggestions for definition of UGS with Activity Detection (UGS-AD) for 802.16e.	
Purpose		
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# UGS with Activity Detection for 802.16e

*Zivan Ori, Yigal Eliaspur*

*Intel Corp.*

## **1. The Document's Goal**

The document's goal is to propose a definition of UGS with Activity Detection (UGS-AD) Service Flows for 802.16e.

## **2. Incentive for Development of UGS with Activity Detection Service Flows**

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. rtPS has been defined in order to support real-time service flows that generate variable bitrates and variable size data packets on an a-periodic basis, for example Compressed Video or VoIP with silence suppression.

However, rtPS Service Flows are not well suited for VoIP with silence suppression. First, the delay incurred by bandwidth requests is quite large (e.g. 20ms) and can exceed the delay budget assigned for an SS for VoIP Service Flows. Second, the bandwidth expended on unicast polling is quite large as polling for VoIP must be done very frequently, e.g. every 10ms, leading to 5-20kbps expended on bandwidth requests alone.

The proposal described here intends to alleviate these problems by defining a new scheduling mode called UGS-AD (UGS with Activity Detection). In essence, UGS-AD is a Service Flow that can switch from UGS scheduling mode to rtPS scheduling mode based on the SS Activity Detection mechanisms. This scheduling mode is well suited for VoIP with silence suppression and is optimized for exactly this pattern of traffic.

The UGS-AD Service Flow is initially started as an rtPS service flow. When the SS detects VoIP traffic, it will issue a Bandwidth Request that is treated as a request to switch to UGS scheduling mode. The BS will treat this Service Flow as a UGS Service Flow, issuing grants on a timely basis as defined in the Service Flow parameters. Note that this kind of operation incurs less delay than regular rtPS operation, and does not necessitate Bandwidth Requests, thereby addressing the two issues noted above.

When the SS detects that voice traffic has stopped, it will signal this to the BS with a bandwidth request of zero bytes. The BS will start treating this Service Flow as an rtPS Service Flow, and stop issuing it unsolicited grants. During this time, the SS must be unicast-pollled for this Service Flow as defined for rtPS Service Flows.

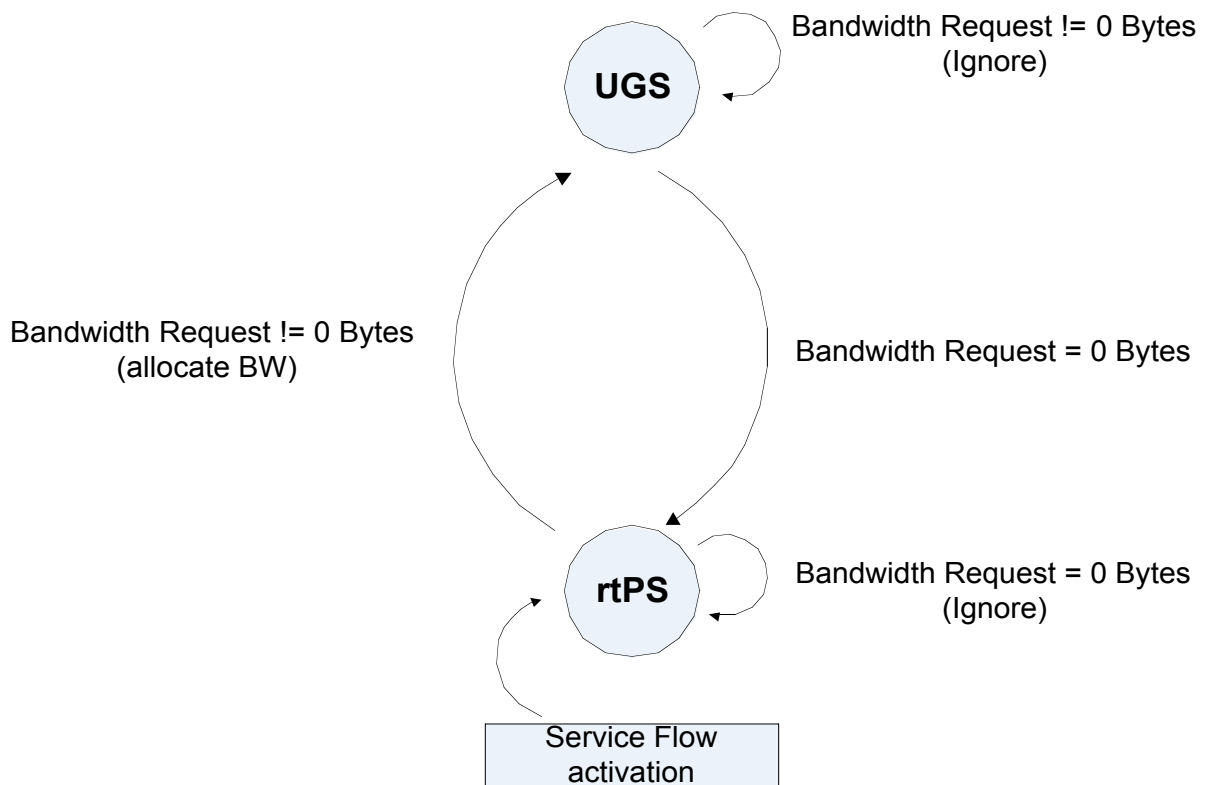
The following is a summary of the changes needed in the standard to support this mechanism:

- Define new kind of Service Flow, UGS-AD, which contains all the parameters of UGS Service Flows combined with all the parameters of rtPS Service Flows.

- A UGS-AD bandwidth request is treated in the BS as follows:
  - If the service flow is in rtPS mode and the bandwidth request is non-zero bytes, the BS shall allocate the amount of BW requested according to the Service Flow QoS parameters and the Service Flow is switched to UGS mode.
  - If the service flow is in UGS mode and the bandwidth request is for zero bytes, switch it to rtPS mode.

The following drawing describes the state machine of the UGS AD connection:

### UGS-AD State Machine (BS side)



### 3. Specific changes in the Standard

*[New section 6.3.5.2.5]*

#### UGS-AD

The UGS-AD is designed to support real-time service flows that generate fixed size data packets on a semi-periodic basis, such as Voice over IP with silence suppression. The service is in essence a combination of a UGS service flow and an rtPS service flow, with the ability to switch between the two scheduling modes according to the traffic detected by the SS. When traffic is periodic, i.e. when voice is being transmitted, the service flow shall operate as a UGS service flow and receive fixed-size grants on a real-time periodic basis. When traffic is a-periodic, i.e. when silence is detected and suppressed, the service flow shall operate as an rtPS service flow and receive unicast request opportunities.

This type of scheduling is more suited for Voice over IP with silence suppression than rtPS because it reduces the delays incurred by bandwidth requests, and it does not necessitate unicast-polling when voice is being transmitted.

This type of service flow is initiated as an rtPS service flow. When the SS detects traffic, it shall issue a bandwidth request, indicating to the BS that it requests unsolicited grants. The BS shall start treating this service flow as a UGS service flow, according to the service flow parameters. When the SS stops detecting periodic traffic, it shall send a bandwidth request of zero bytes, indicating to the BS to stop issuing grants for this service flow. The BS shall start treating this service flow as an rtPS connection.

In order for this service to work correctly, the Request/Transmission policy setting (see 11.13.12) shall be such that the SS is prohibited from using any contention request opportunities for that connection. The key service IEs include all the key service IEs of UGS and rtPS service flows: Maximum Sustained Traffic Rate, Maximum Latency, Tolerated Jitter. If present, the Minimum Reserved Traffic Rate shall have the same value as the Maximum Sustained Traffic Rate parameter.

***[Add to section 6.3.6.1]***

***[add to end of section]***

A UGS-AD Service Flow shall send a bandwidth request indicating that this service flow is active and wishes to receive unsolicited grants, i.e. to be treated as a UGS service flow. When the BS receives this form of bandwidth request, it will start issuing data grants to this service flow on a timely basis as defined in the service flow parameters. The bandwidth requested indicates how much data has been accumulated by the SS for this CID; the BS is expected to issue a data-grant covering this amount of data for its first allocation for this CID. Thereafter, no bandwidth requests are issued by the SS for this CID as the service flow is in essence a UGS service flow. When the SS stops detecting activity for this service flow, it sends a bandwidth request of zero bytes indicating to the BS to stop allocating unsolicited grants. The BS shall start treating this Service Flow as an rtPS Service Flow, polling it on a timely basis. By design UGS-AD Service Flows use aggregate bandwidth requests only.

***[Change in section 6.3.18.1]***

**Table 130a – Types of Data Delivery Services**

<b>Type</b>	<b>Symbolic Name of Service Type</b>	<b>Meaning</b>
<b>4</b>	<b>UGS-AD</b>	Unsolicited Grant with Activity Detection Service For UL connections should be supported by UGS Scheduling Service or rtPS Scheduling Service as defined in 6.3.5.2.5

*[New section 6.3.18.1.5]***Unsolicited Grant with Activity Detection Service (UGS-AD)**

This type of service is to support real-time applications generating fixed-rate data or variable-rate data. This data can be provided as either fixed or variable length PDUs. The following are the parameters of the service specified in Table 130f:

**Table 130f – Unsolicited Grant with Activity Detection Service Parameters**

<b>Parameter</b>	<b>Meaning</b>
<b>Tolerated Jitter</b>	As specified in 11.13.13
if (Fixed Length SDU) {	
<b>SDU size</b>	As specified in 11.13.16
}	
<b>Minimum Reserved Traffic Rate</b>	As specified in 11.13.8
<b>Maximum Latency</b>	As specified in 11.13.14
<b>Request/Transmission Policy</b>	As specified in 11.13.12
<b>Maximum Sustained Traffic Rate</b>	Optional, if absent defaulting to Minimum Reserved Traffic Rate. As specified in 11.13.8
<b>Traffic Priority</b>	As specified in 11.13.5
<b>Unsolicited Grant Size</b>	As specified in 11.13.28
<b>Unsolicited Grant Interval</b>	As specified in 11.13.29