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Title	Corrections and clarifications on scheduling services.	
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Re:	IEEE P802.16REVd/D5-2004	
Abstract	This contribution proposes some corrections and clarifications on the description of scheduling services	
Purpose	Adopt changes.	
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Corrections and clarifications on scheduling services.

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1. Introduction

The QoS framework applies to both uplink and downlink service flows. However, there are several occurrence of the text (probably vestige from DOCSIS) that imply that QoS applies only to uplink service flows. Also, section 6.3.5.2 called "Uplink request/grant scheduling" defines the various scheduling services which is misleading.
Also the spec defines a best-effort scheduling type which is misleading because it can be associated with a minimum reserved traffic rate, a traffic priority, etc… The spec should be clarified and show the how to define well known data delivery services (RT-VR, NRT-VR, BE, etc…) within the QoS framework of 802.16-2004.

2. Text changes

[Modify 6.3.5]

6.3.5 Scheduling services

Scheduling services represent the data handling mechanisms supported by the MAC scheduler for data transport on a connection. Each connection is associated with a single ~~data~~ scheduling service. ~~Each~~ A~~data~~ scheduling service is ~~associated with~~ determined by a set of QoS parameters which quantify aspects of its behavior. These parameters are managed using the DSA and DSC message dialogs. ~~Four services (11.13.11) are supported: Unsolicited Grant Service (UGS), Real-time Polling Service (rtPS), Non-real-time Polling Service (nrtPS), and Best Effort (BE). The following text provides a brief description of each of the supported scheduling services, including the mandatory QoS parameters that shall be included in the service flow definition when the scheduling service is enabled for a service flow.~~
A detailed description of each QoS parameter is provided in 11.13.

Well-known scheduling services can be implemented by specifying a specific set of QoS parameters:

~~UGS is designed~~ Table 111a describes the QoS parameters that would provide a scheduling service to support real-time data streams consisting of fixed-size data packets issued at periodic intervals, such as T1/E1 and Voice over IP without silence suppression has the QoS parameters:. ~~The mandatory QoS service flow parameters for this scheduling service are Maximum Sustained Traffic Rate (11.13.6), Maximum Latency (11.13.14), Tolerated Jitter (11.13.13), and Request/Transmission Policy (11.13.12). If present, the Minimum Reserved Traffic Rate parameter (11.13.8) shall have the same value as the Maximum Sustained Traffic Rate parameter.~~

Table 111a—Example of QoS parameters providing a scheduling service to support real-time constant bit-rate data streams

Parameter	Meaning
Tolerated jitter	As in 11.13.13
If (Fixed length SDU){	
SDU size	As in 11.13.16
}	

Minimum reserved traffic rate	As in 11.13.8
Maximum Latency	As in 11.13.14
Request/Transmission Policy	As in 11.13.12
If (uplink service flow) {	
Grant Scheduling Type	UGS as specified in 6.3.5.2.1
Unsolicited Grant Interval	As in 11.13.XX
}	

~~The rtPS is designed~~ Table 111b describes the QoS parameters that would provide a scheduling service to support real-time data streams consisting of variable-sized data packets that are issued at periodic intervals, such as moving pictures experts group (MPEG) video. ~~The mandatory QoS service flow parameters for this scheduling service are Minimum Reserved Traffic Rate (11.13.8), Maximum Sustained Traffic Rate (11.13.6), Maximum Latency (11.13.14), and Request/Transmission Policy (11.13.12).~~

Table 111b—Example of QoS parameters providing a scheduling service to support real-time variable-rate data streams

Parameter	Meaning
Maximum Latency	As in 11.13.14.
Minimum Reserved Traffic Rate	As in 11.13.8.
Maximum Sustained Traffic Rate	Optional. As in 11.13.8.
Traffic priority	As in 11.13.5
Request/Transmission policy	As in 11.13.12
If (uplink service flow) {	
Scheduling type	rtPS as in 6.3.5.2.2
Unsolicited Polling Interval	As in 11.13.XX
}	

~~The nrtPS is designed~~ Table 111c describes the QoS parameters that would provide a scheduling service to support delay-tolerant data streams consisting of variable-sized data packets for which a minimum data rate is required, such as FTP. ~~The mandatory QoS service flow parameters for this scheduling service are Minimum Reserved Traffic Rate (11.13.8), Maximum Sustained Traffic Rate (11.13.6), Traffic Priority (11.13.5), and Request/Transmission Policy (11.13.12).~~

Table 111c—Example of QoS parameters providing a scheduling service to support delay-tolerant variable-rate data streams

Parameter	Meaning
Minimum Reserved Traffic Rate	As in 11.13.8
Maximum Sustained Traffic Rate	Optional. As in 11.13.8.
Traffic priority	As in 11.13.5
Request/Transmission policy	As in 11.13.12
If (uplink service flow) {	
Scheduling type	nrtPS as in 6.3.5.2.3
}	

~~The BE service is designed~~ Table 111d describes the QoS parameters that would provide a scheduling service to support data streams for which no minimum service level is required and therefore may be handled on a space-available basis. ~~The mandatory QoS service flow parameters for this scheduling service are Maximum Sustained Traffic Rate (11.13.6), Traffic Priority (11.13.5), and Request/Transmission Policy (11.13.12).~~

Table 111d—Example of QoS parameters providing a scheduling service to support best-effort data streams

Parameter	Meaning

Maximum Sustained Traffic Rate	Optional. As in 11.13.8.
Request/Transmission policy	As in 11.13.12
If (uplink service flow) {	
Scheduling type	BE as in 6.3.5.2.4
}	

6.3.5.1 Outbound transmission scheduling

Outbound transmission scheduling selects the data for transmission in a particular frame/bandwidth allocation and is performed by the BS for downlink, and SS for uplink. In addition to whatever other factors the scheduler may deem pertinent, the following items are taken into account for each active service flow:

— The scheduling service specified for the service flow.
— The values assigned to the service flow's QoS parameters.
— The availability of data for transmission.
— The capacity of the granted bandwidth.

6.3.5.2 Uplink request/grant scheduling

Uplink request/grant scheduling is performed by the BS with the intent of providing each subordinate SS with bandwidth for uplink transmissions or opportunities to request bandwidth. By specifying a scheduling ~~service~~ type and its associated QoS parameters, the BS scheduler can anticipate the throughput and latency needs of the uplink traffic and provide polls and/or grants at the appropriate times.

Table 112 summarizes the scheduling types ~~services~~ and the poll/grant options available for each. The following subclauses define service flow scheduling services for uplink operations.

Table 112—Scheduling services and usage rules

Scheduling type	PiggyBack Request	Bandwidth stealing	Polling
UGS	Not allowed	Not allowed	PM bit is used to request a unicast poll for bandwidth needs of non-UGS connections.
rtPS	Allowed	Allowed	Scheduling only allows unicast polling.
nrtPS	Allowed	Allowed	Scheduling may restrict a service flow to unicast polling via the transmission/request policy; otherwise all forms of polling are allowed.
BE	Allowed	Allowed	All forms of polling allowed.

6.3.5.2.1 UGS

The UGS is designed to support real-time uplink service flows that transport ~~generate~~ fixed size data packets on a periodic basis, such as T1/E1 and Voice over IP without silence suppression. The service offers fixed size grants on a real-time periodic basis, which eliminate the overhead and latency of SS requests and assure that grants are available to meet the flow's real-time needs. The BS shall provide Data Grant Burst IEs to the SS at periodic intervals based upon the Maximum Sustained Traffic Rate of the service flow. The size of these grants shall be sufficient to hold the fixed length data associated with the service flow (with associated generic MAC header and Grant management subheader) but may be larger at the discretion of the BS scheduler. In order for this service to work correctly, the Request/Transmission Policy (see 11.13.12) setting shall be such that the SS is prohibited from using any contention request opportunities for this connection. The mandatory QoS parameters are Maximum Sustained Traffic Rate (11.13.6), Maximum Latency (11.13.14), Tolerated Jitter (11.13.13), Uplink Grant Scheduling Type (11.13.11) and Request/Transmission Policy (11.13.12). If present, the

Minimum Reserved Traffic Rate parameter (11.13.8) shall have the same value as the Maximum Sustained Traffic Rate parameter.
~~The key service IEs are the Maximum Sustained Traffic, Maximum Latency, the Tolerated Jitter, and the Request/Transmission Policy. If present, the Minimum Reserved Traffic Rate parameter shall have the same value as the Maximum Sustained Traffic Rate parameter.~~

6.3.5.2.2 rtPS

The rtPS is designed to support real-time uplink service flows that transport ~~generate~~ variable size data packets on a periodic basis, such as moving pictures experts group (MPEG) video. The service offers real-time, periodic, unicast request opportunities, which meet the flow's real-time needs and allow the SS to specify the size of the desired grant. This service requires more request overhead than UGS, but supports variable grant sizes for optimum data transport efficiency.
The BS shall provide periodic unicast request opportunities. 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 BS may issue unicast request opportunities as prescribed by this service even if prior requests are currently unfulfilled. This results in the SS using only unicast request opportunities in order to obtain uplink transmission opportunities (the SS could still use unsolicited Data Grant Burst Types for uplink transmission as well). All other bits of the Request/Transmission Policy are irrelevant to the fundamental operation of this scheduling service and should be set according to network policy. The mandatory QoS parameters are Minimum Reserved Traffic Rate (11.13.8), Maximum Sustained Traffic Rate (11.13.6), Maximum Latency (11.13.14), Uplink Grant Scheduling Type (11.13.11) and Request/Transmission Policy (11.13.12).
~~The key service IEs are the Maximum Sustained Traffic Rate, the Minimum Reserved Traffic Rate, the Maximum Latency and the Request/Transmission Policy.~~

6.3.5.2.3 nrtPS

The nrtPS offers unicast polls on a regular basis, which assures that the uplink service flow receives request opportunities even during network congestion. The BS typically polls nrtPS CIDs on an interval on the order of one second or less.
The BS shall provide timely unicast request opportunities. In order for this service to work correctly, the Request/Transmission Policy setting (see 11.13.12) shall be set such that the SS is allowed to use contention request opportunities. This results in the SS using contention request opportunities as well as unicast request opportunities and unsolicited Data Grant Burst Types. All other bits of the Request/Transmission Policy are irrelevant to the fundamental operation of this scheduling service and should be set according to network policy. The mandatory QoS parameters for this scheduling service are Minimum Reserved Traffic Rate (11.13.8), Maximum Sustained Traffic Rate (11.13.6), Traffic Priority (11.13.5), Uplink Grant Scheduling Type (11.13.11), and Request/Transmission Policy (11.13.12).

6.3.5.2.4 BE ~~service~~

The intent of the BE ~~service~~ grant scheduling type is to provide efficient service for best effort traffic in the uplink. In order for this service to work correctly, the Request/Transmission Policy setting shall be set such that the SS is allowed to use contention request opportunities. This results in the SS using contention request opportunities as well as unicast request opportunities and unsolicited Data Grant

Burst Types. All other bits of the Request/Transmission Policy are irrelevant to the fundamental operation of this scheduling service and should be set according to network policy.

11.13.11 ~~Service flow~~ Uplink grant scheduling type

The value of this parameter specifies the Uplink grant scheduling type ~~service~~ that shall be enabled for the associated uplink service flow (See 6.3.5.2). If the parameter is omitted, BE ~~service~~ is assumed.

Type	Length	Value	Scope
[145~~/146~~].~~1~~1	1	0: *Reserved* 1: for Undefined (BS implementation-dependent[a]) 2: for BE (default) 3: for nrtPS 4: for rtPS 5: *Reserved* 6: for UGS 7–255: *Reserved*	DSA-REQ DSA-RSP DSA-ACK

[a]The specific implementation-dependent scheduling service type could be defined in a message of Type 145~~/146~~.143 (vendor-specific QoS parameters).