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Re:	Sponsor ballot on document ***IEEE P802.16REVd/D3-2004***	
Abstract	Collection of comment suggested remedies too long to include in Commentary format.	
Purpose	Suggested remedies to be considered during REVd sponsor ballot comment resolution.	
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REVd/D3 Sponsor Ballot Comment Addendum

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The current document text is inconsistent regarding system scheduling. Although the parameters defined in clause 11 are specified as being equally applicable to uplink and downlink, the only discussion of scheduling in clause 6.4.5 specifically addresses only uplink operation. Similarly, the reference to 6.4.5 on page 35, line 6 implies that 6.4.5 describes scheduling options for all connections.

Current specification of rtPS service for uplink is incomplete in that there is no way for the scheduler to know the interval at which it should issue unicast grant request IEs for the rtPS service flow.

To remedy these issues, the following text is proposed as replacement for the current contents of clause 6.4.5.

6.4.5 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 service. Each data service is associated with a set of QoS parameters which quantify aspects of its behavior. These parameters are managed using the DSA and DSC message dialogs. Four services (11.13.13) 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.

The UGS is designed to support real-time data streams consisting of fixed-size data packet transmitted at periodic intervals, such as T1/E1 and Voice over IP without silence suppression. The mandatory QoS service flow parameters for this scheduling service are Minimum Reserved Traffic Rate (11.13.10), Maximum Sustained Traffic Rate (11.13.8), Maximum Latency (11.13.16), SDU Size (11.13.18), Tolerated Jitter (11.13.15), and Request/Transmission Policy (11.13.14).

The rtPS is designed to support data streams consisting of variable-sized data packets that are transmitted at fixed intervals, such as moving pictures experts group (MPEG) video. The mandatory QoS service flow parameters for this scheduling service are Minimum Reserved Traffic Rate (11.13.10), Maximum Sustained Traffic Rate (11.13.8), Maximum Latency (11.13.16), Tolerated Jitter (11.13.15), and Request/Transmission Policy (11.13.14).

The nrtPS is designed 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 (11.13.10), Maximum Sustained Traffic Rate (11.13.8), Traffic Priority (11.13.7), and Request/Transmission Policy (11.13.14).

The BE service is designed to support data streams for which no minimum service level is required and therefore may be handled on an a space-available basis. The mandatory QoS service flow parameters for this scheduling service are Maximum Sustained Traffic Rate (11.13.8), Traffic Priority (11.13.7), and Request/Transmission Policy (11.13.14).

6.4.5.1 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.

6.4.5.2 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 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 1 summarizes the scheduling services and the poll/grant options available for each. The following subclauses define service flow scheduling services for uplink operations.

Table 1—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.

6.4.5.2.1 UGS

The UGS offers fixed-size grants on a 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 Minimum Reserved Traffic Rate specified for 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 11.4.9.13) setting shall be such that the SS is prohibited from using any contention request opportunities for this connection.

The Grant Management subheader (6.4.2.2.2) is used to pass status information from the SS to the BS regarding the state of the UGS service flow. The most significant bit of the Grant Management field is the Slip Indicator (SI) bit. The SS shall set this flag once it detects that this service flow has exceeded its transmit queue depth. Once the SS detects that the service flow's transmit queue is back within limits, it shall clear the SI flag. The flag allows the BS to provide for long term compensation for conditions, such as lost maps or clock rate mismatches, by issuing additional grants. The poll-me (PM) bit (6.4.6.3.3) may be used to request to be polled for a different, non-UGS connection.

The BS shall not allocate more bandwidth than the Maximum Sustained Traffic Rate parameter of the Active QoS Parameter Set, excluding the case when the SI bit of the Grant Management field is set. In this case, the BS may grant up to 1% additional bandwidth for clock rate mismatch compensation.

6.4.5.2.2 rtPS

The rtPS offers 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. The time interval between successive request opportunity offerings shall be specified by Nominal Service Interval (11.13.19). Inclusion of this parameter is mandatory in uplink service flow definitions where use of the rtPS is enabled.

In order for this service to work correctly, the Request/Transmission Policy setting (see 11.4.9.13) 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.

6.4.5.2.3 nrtPS

The nrtPS offers unicast polls on a regular basis, which assures that the 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 11.4.9.13) 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.

6.4.5.2.4 BE service

The intent of the BE service is to provide efficient service for best effort traffic. 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.

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The following text provides editorial and minor technical changes to conform to the proposed text for 6.4.5 presented above. Suggested deletions are shown in ~~red with strikethrough~~. Suggested additions are shown in blue and underlined. Bracketed text in <magenta> are additional comments and are not part of the proposed text changes

11.13.7 Traffic priority

The value of this parameter specifies the priority assigned to a service flow. Given two service flows identical in all QoS parameters besides priority, the higher priority service flow should be given lower delay and higher buffering preference. For otherwise non-identical service flows, the priority parameter should not take precedence over any conflicting service flow QoS parameter. The specific algorithm for enforcing this parameter is not mandated here.

For uplink service flows, the BS ~~should~~shall use this parameter when determining precedence in request service and grant generation, and the SS shall preferentially select contention Request opportunities for Priority Request CIDs based on this priority and its Request/Transmission Policy (see 11.13.14).

Type	Length	Value	Scope
[145/146].6	1	0 to 7 — Higher numbers indicate higher priority Default 0	DSx-REQ DSx-RSP DSx-ACK

~~NOTE—The default priority is 0.~~

<According to the IEEE style manual, notes are not considered part of the standard.>

11.13.8 Maximum sustained traffic rate

This parameter defines the peak information rate of the service. The rate is expressed in bits per second and pertains to the SDUs at the input to the system. Explicitly, this parameter does not include MAC overhead such as MAC headers or CRCs. This parameter does not limit the instantaneous rate of the service since this is governed by the physical attributes of the ingress port. However, at the SS in the uplink direction, the service shall be policed to conform to this parameter, on the average, over time. At the BS in the downlink direction, it may be assumed that the service was already policed at the ingress to the network and the BS is not required to do additional policing. If this parameter is omitted or set to zero, then there is no explicitly mandated maximum rate. This field specifies only a bound, not a guarantee that the rate is available. The algorithm for policing to this parameter is left to vendor differentiation and is outside the scope of the standard.

Type	Length	Value	Scope
[145/146].7	4	Rate (in bits per second)	DSx-REQ DSx-RSP DSx-ACK

11.13.9 Maximum traffic burst

This parameter defines the maximum burst size that ~~must~~shall be accommodated for the service. Since the physical speed of ingress/egress ports, the air interface, and the backhaul will in general be greater than the

maximum sustained traffic rate parameter for a service, this parameter describes the maximum continuous burst the system ~~should~~shall accommodate for the service assuming the service is not currently using any of its available resources.

Type	Length	Value	Scope
[145/146].8	4	B (bytes)	DSx-REQ DSx-RSP DSx-ACK

11.13.10 Minimum reserved traffic rate

This parameter specifies the minimum rate reserved for this service flow. The rate is expressed in bits per second and specifies the minimum amount of data to be transported on behalf of the service flow when averaged over time. The specified rate shall only be honored when sufficient data is available for scheduling. When insufficient data exists, the requirement imposed by this parameter shall be satisfied by assuring the the available data is transmitted as soon as possible.

~~Minimum Reserved Traffic Rate = R (bits/sec) with time base T(sec) means the following. Let S denote additional demand accumulated at the MAC SAP of the transmitter during an arbitrary time interval of the length T. Then the amount of data forwarded to PHY (in bits) during this interval should be not less than min {S, R * T}.~~

The BS ~~should~~shall be able to satisfy bandwidth requests for a service flow up to its Minimum Reserved Traffic Rate. If less bandwidth than its Minimum Reserved Traffic Rate is requested for a service flow, the BS may reallocate the excess reserved bandwidth for other purposes. The aggregate Minimum Reserved Traffic Rate of all service flows may exceed the amount of available bandwidth. The value of this parameter is calculated from the byte following the MAC header HCS to the end of the MAC PDU payload. If this parameter is omitted, then it defaults to a value of 0 bits per second (i.e., no bandwidth is reserved for the flow~~ by default~~).

Type	Length	Value	Scope
[145/146].9	4	Rate (in bits per second)	DSx-REQ DSx-RSP DSx-ACK

11.13.11 Minimum tolerable traffic rate

Minimum Tolerable Traffic Rate = R (bits/sec) with time base T(sec) means the following. Let S denote additional demand accumulated at the MAC SAP of the transmitter during an arbitrary time interval of the length T. Then the amount of data forwarded at the receiver to CS (in bits) during this interval should be not less than min {S, R * T}.

In the case of downlink connections, Minimum Tolerable Traffic Rate may be monitored by the BS to make decisions on rate change or deletion of the connection in the case of high SDU loss rate.

Type	Length	Value	Scope
[145/146].10	4	Rate (in bits per second)	DSx-REQ DSx-RSP DSx-ACK

11.13.12 Vendor-specific QoS parameters

This allows vendors to encode vendor-specific QoS parameters. The Vendor ID shall be the first TLV embedded inside Vendor-specific QoS Parameters. If the first TLV inside Vendor-specific QoS Parameters is not a Vendor ID, then the TLV shall be discarded (see 11.1.6).

Type	Length	Value	Scope
[145/146].143	*variable*	Compound	DSx-REQ DSx-RSP DSx-ACK

11.13.13 Service flow scheduling type

~~The value of this parameter specifies which uplink scheduling service is used for uplink transmission requests and packet transmissions. If this parameter is omitted, then the BE service shall be assumed. This parameter is only applicable at the BS. If defined, this parameter shall be enforced by the BS.~~
The value of this parameter specifies the scheduling service that shall be enabled for the associated service flow. If the parameter is omitted, BE service is assumed.

Type	Length	Value	Scope
[145/146].11	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: through 255 are reserved for future use	DSA-REQ DSA-RSP DSA-ACK

[a]The specific implementation-dependent scheduling service type could be defined in a message of Type ~~24~~145/146.143 (Vendor-specific QoS Parameters).

11.13.14 Request/transmission policy

The value of this parameter provides the capability to specify certain attributes for the associated service flow. These attributes include options for PDU formation, and for uplink service flows, restrictions on the types of bandwidth request options that may be used. An attribute is enabled by setting the corresponding bit position to 1. For attributes affecting uplink bandwidth request types, a value of zero indicates the default

actions described in the scheduling service description in 6.4.5 shall be used. A value of one indicates that the action associated with the attribute bit overrides the default action.

~~The value of this parameter specifies a variety of uplink request and transmission restrictions, including the capability to further restrict the scheduling service rules outlined in Table 89. Each restriction is enabled by setting its associated bit to 1. If a bit is set to 0, the service flow uses the normal rules for the type of service flow (UGS, etc.). Bit #0 is the LSB of the value field~~.

Type	Length	Value	Scope
[145/146].12	4	Bit #0 – Service flow shall not use broadcast bandwidth request opportunities. (Uplink only) Bit#1-*Reserved*. Bit #2 – The service flow shall not piggyback requests with data. (Uplink only) Bit #3 – The service flow shall not fragment data. Bit #4 – The service flow shall not suppress payload headers (CS parameter) Bit #5 – The service flow shall not pack multiple SDUs (or fragments) into single MAC PDUs. Bit #6 – The service flow shall not include CRC in the MAC PDU. All other bit positions are reserved.	DSA-REQ DSA-RSP DSA-ACK

11.13.15 Tolerated jitter

This parameter defines the ~~M~~maximum delay variation (jitter) for the connection.

Type	Length	Value	Scope
[145/146].13	4	ms	DSx-REQ DSx-RSP DSx-ACK

11.13.16 Maximum latency

The value of this parameter specifies the maximum latency between the reception of a packet by the BS or SS on its network interface and the forwarding of the packet to its RF Interface.

If defined, this parameter represents a service commitment (or admission criteria) at the BS or SS and shall be guaranteed by the BS or SS. A BS or SS does not have to meet this service commitment for service flows that exceed their minimum ~~downlink~~ reserved rate.

Type	Length	Value	Scope
[145/146].14	4	ms	DSx-REQ DSx-RSP DSx-ACK

11.13.17 Fixed-length versus variable-length SDU indicator

The value of this parameter specifies whether the SDUs on the service flow are fixed-length or variable-length. The parameter is used only if packing is on for the service flow. The default value is 0, i.e., variable-length SDUs.

Type	Length	Value	Scope
[145/146].15	1	0 = variable-length SDUs 1 = fixed-length SDUs default = 0	DSA-REQ DSA-RSP DSA-ACK

11.13.18 SDU size

The value of this parameter specifies the length of the SDU for a fixed-length SDU service flow. This parameter is used ~~only~~ if the service flow scheduling service is UGS or if packing is on and the service flow is indicated as carrying fixed-length SDUs. The default value is 49 bytes, i.e., VC-switched ATM cells with PHS.

Type	Length	Value	Scope
[145/146].16	1	Number of bytes. default = 49	DSA-REQ DSA-RSP DSA-ACK

11.13.19 Nominal service interval

Mandatory for uplink service flows using rtPS, this parameter specifies the nominal elapsed interval between successive unicast grant request opportunities issued for the service flow. The parameter is expressed in units of milliseconds.

Type	Length	Value	Scope
[145/146].28	2	ms	DSA-REQ DSA-RSP DSA-ACK