

Downlink-Associated Uplink Scheduling in IEEE 802.16m

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[N/A](#)

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[Discussion and approval](#)

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Motivations(1/3)

❖ Bi-directional traffic flows

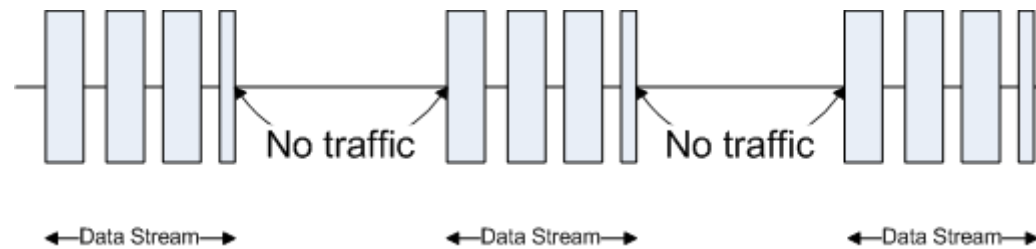
- TCP based service flows such as FTP,HTTP, and Email
 - The TCP uses the acknowledgement mechanism.
 - (Tx Segment →, ACK ←)
 - The TCP controls the data transmission rate with the acknowledgement.
 - Long round-trip delay limits high-speed data transmission rate
- ARQ-enabled connections
 - The ARQ always requests the feedback messages to continue its transmission

➔ When downlink traffic exists, the associated uplink accesses follow.

Motivations (2/3)

❖ A Discontinuity feature of traffic

- The traffic patterns of HTTP, FTP and Email have the intervals in seconds between sequences of packets.



➔ Continuous allocation of uplink opportunities might be resource-redundant.

Motivations(3/3)

- ❖ IEEE 802.16m system requirements from SRD[1]
 - IEEE 802.16m should support legacy services more efficiently
 - Data latency should be further reduced Low latency

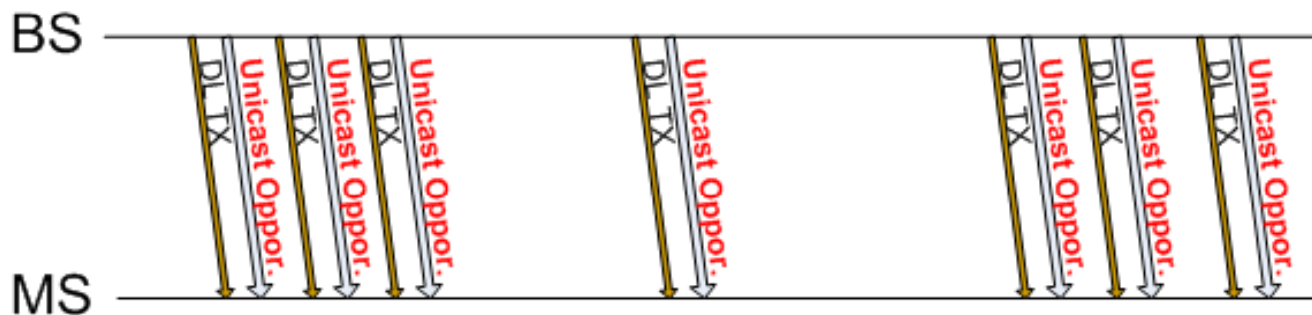
Table 2–Maximum data latency

Link direction	Max. latency (ms)
Downlink (BS->MS)	10
Uplink (MS->BS)	10

➔ In order to support higher-speed data services, contention-based random access needs to be avoided if possible due to its collision probability and long latency

Suggestion

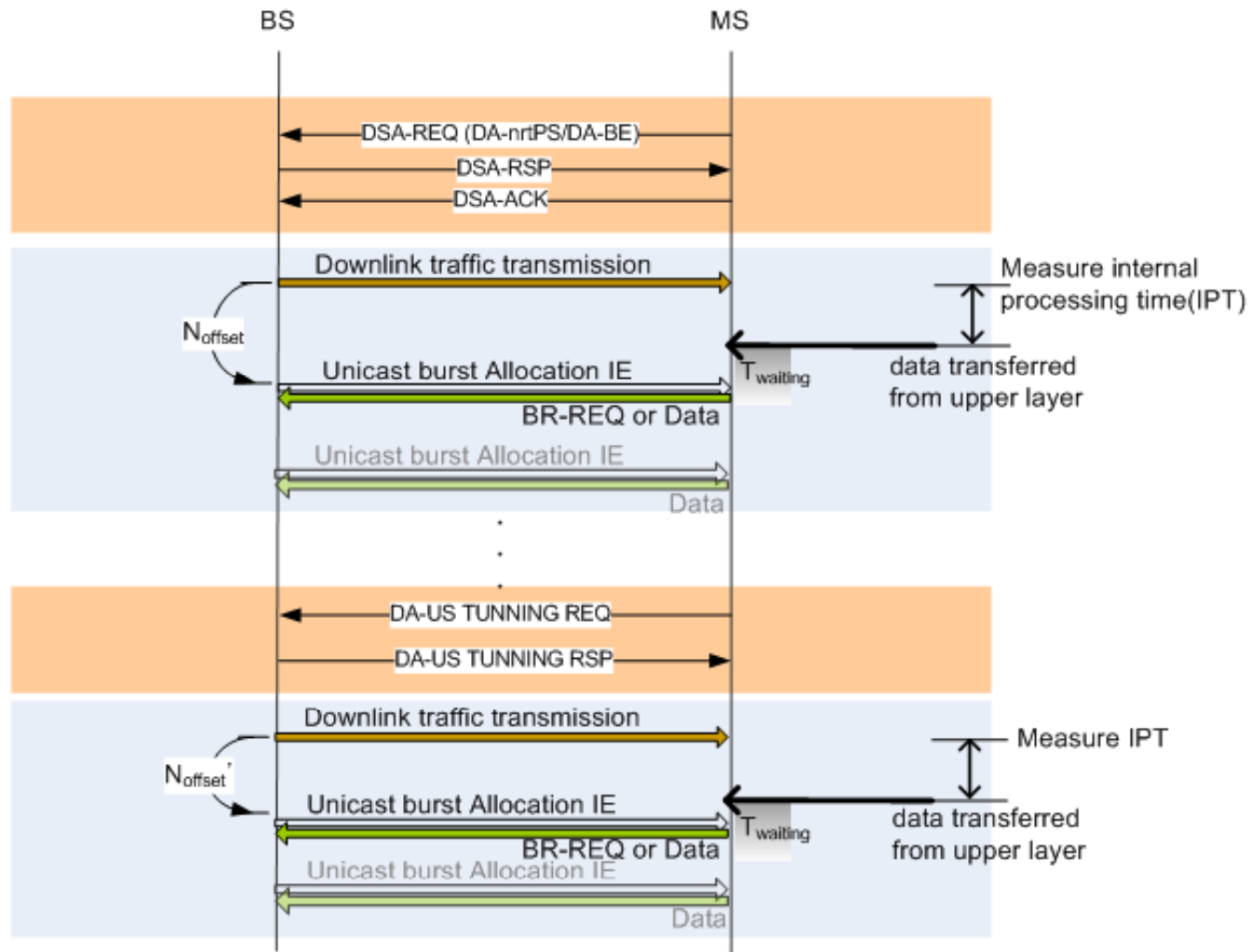
- ❖ Consider uplink request/grant scheduling for the service flows which are linked with downlink data stream.
 - The BS allocates unicast data transmission opportunities according to the associated downlink data stream.
 - The more frequent downlink transmission occurs, the more uplink opportunities shall be given.



Downlink-Associated Uplink Scheduling

- After serving one or more SDUs in a downlink service flow, the BS provides a data transmission opportunity for their feedback in the associated uplink service flow.
- The data transmission opportunity is determined with 'usual bandwidth request size' and resource status. If available resource isn't sufficient, the BS can allocate a unicast request opportunity.
- The SS should wait for the unicast opportunity until the timer expiry.
- When the SS hasn't gotten any downlink service lately and it needs to transmit uplink data, it is allowed to use random access.
- Following parameters are negotiated between the BS and the MS during the DSA/DSC procedure
 - Usual bandwidth request size
 - Interval between the downlink service time and the associated uplink allocation.
 - Grant-waiting timeout

Example of DA-Scheduling Service Flow



DL-Associated Uplink Scheduling Types

❖ Downlink-Associated nrtPS(DA-nrtPS)

- The DA-nrtPS provides unicast request opportunities or data transmission opportunities depending on the data transmission in the associated downlink service flow.
- The DA-nrtPS supports delay-tolerant variable-rate data streams for which a minimum data rate is required.
- Resource allocation information can be sent through downlink data transmission as well as USCCH[2].

❖ Downlink-Associated BE(DA-BE)

- The DA-BE provides unicast request opportunities or data transmission opportunities depending on the data transmission in the associated downlink service flow.
- The DA-BE may be handled on a space-available basis.

Text Proposal to IEEE 802.16m SDD

Insert the following text into MAC Layer clause (Chapter 10 in [IEEE 802.16m-08/003r4])

----- Text Start -----

10.x.x Uplink request/grant scheduling

10.x.x.x Downlink-Associated Non-Realtime Polling Service(DA-nrtPS)

The DA-nrtPS is designed to support uplink service flows which traffic patterns are mainly coupled with downlink data streams, such as TCP based service flows. The BS provides unicast request opportunities or data transmission opportunities according to the associated downlink data stream and negotiated QoS parameters.

The data transmission opportunity is determined based on 'usual bandwidth request size' and resource status. If resource isn't sufficient, the BS can allocate a unicast request opportunity. The resource allocation information can be sent through downlink data transmission as well as USCCH.

The SS should wait for the unicast opportunity until timer expiry. When the SS hasn't received any downlink data in the associated service flow lately and has buffered uplink data, it is allowed to use contention-based random access.

10.x.x.x Downlink-Associated Best Effort Service(DA-BE)

The DA-BE provides the same uplink scheduling service as DA-nrtPS. But, the DA-BE doesn't guarantee the minimum data rate of the service flow and doesn't allow to transmit the resource allocation information through the downlink data transmission. The DA-BE may be handled on a space-available basis.

----- Text End -----

References

- [1] IEEE 802.16m-07/002r5, “TGm System Requirements Document (SRD)”
- [2] IEEE 802.16m-08/954r1, “Bandwidth Allocation using MAC PDU header in IEEE 802.16m”