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Abstract	Proposes relay support for QoS	
Purpose	Add proposed spec changes in P802.16j Baseline Document (IEEE 802.16j-06/026)	
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Relay Support for QoS

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1. Introduction

As RSs are introduced between BS and MMS, extra mechanisms are required to support QoS. Two control models could be used in 802.16j system: centralized control by MMR-BS, and distributed control in RS with coordination from MMR-BS. The QoS support, under these two control models, is different from each other. This contribution proposes the needed mechanisms for supporting QoS in the Relay network along with the related modification to the specification.

2. QoS Support

2.1 QoS Support for Centralized Scheduling

The QoS model remains the same for centralized scheduling service in 802.16j system. The MMR-BS makes decision about service flow QoS scheduling on each RS and provides instruction to RSs using MAP. The dynamic service establishment and two-phase activation model remain the same. They are performed between MMR-BS and MS without involvement of RS. RS only simply forwards the management messages between MMR-BS and MS.

2.2 QoS Support for Distributed Scheduling

The QoS model remains similar for distributed scheduling service, except some enhancement to the service flow management and service flow QoS scheduling as described below. Two-phase activation model remains the same.

Service flow management is performed between MMR-BS and MS (i.e., DSx messages are processed only by MMR-BS and MS). RS doesn't manage the service flows and simply relays the DSx messages. The reason for such centralized service flow management is as following. Every change to the service flow QoS parameter (including creating a new service flow and changing a QoS Parameter Set of an existing service flow) shall be approved by an authorization module. In a dynamic authorization model, the authorization module needs to communicate through a separate interface to an independent policy server. If each RS on the path performs authorization, the processing overhead and the signaling overhead would increase significantly. Therefore, a single authorization module is placed in the MMR-BS.

- MMR-BS makes centralized authorization, which includes making an admission control decision (e.g., setting the AdmitedQoSParamSet) based on for example predefined policy and resource availability on the path between MMR-BS and MS. However, MMR-BS may request all the RSs on the path to perform resource based admission control by sending an AC-REQ message along with the required QoS to each RS on the path. After receiving an AC-REQ, a RS makes resource based admission control decision and

replies with an AC-RSP message. MMR-BS then uses the results to make final admission control decision.

- After a successful authorization of a service flow and before activating it, MMR-BS shall inform all the RSs on the path of the QoS requirement of the service flow. In the case the mapping between the assigned CID and the path carrying the traffic has already been identified and distributed (e.g., during DSC procedure), the MMR-BS sends an AC-REQ (with SF Parameter:QoS Parameter Set Type indicating Active Set) message. In the case the mapping between the assigned CID and the path carrying the traffic is not identified and distributed (e.g., during DSA procedure), the MMR-BS may combine the activation with the path selection by sending a PATH-SEL-REQ [1]. After receiving an AF-REQ, a RS retrieves the service flow information including the QoS requirement and stores it for future scheduling service. It then replies with an AF-RSP message.

The transmission scheme for AC-REQ are specified in [3]. The type of transmission scheme to be used is determined by the MMR-BS and depends on the application scenarios, refer to [3]. The Transmission Type field in AC-REQ should be set accordingly by the MMR-BS and/or RSs that issues the AC-REQ message.

Service Flow QoS scheduling is performed by MMR-BS and all the RSs on the path. Each RS on the path performs service flow QoS scheduling based on the QoS requirement for the service flow obtained from AF-REQ message or PATH-SEL-REQ issued by MMR-BS.

3. Changes to the specification

Insert new subclause 6.3.14.10

6.3.14.10 QoS Support in 802.16j System

6.3.14.10.1 QoS Support for Centralized Scheduling

The QoS model remains the same for centralized scheduling service in 802.16j system. The MMR-BS makes decision about service flow QoS scheduling on each RS and provides instruction to RSs. The dynamic service establishment and two-phase activation model remain the same and performed between MMR-BS and MS without involvement of RS. RSs simply forward the management messages between MMR-BS and MS.

6.3.14.10.2 QoS Support for Distributed Scheduling

The QoS model remains similar for distributed scheduling service in 802.16j system except the enhancement to the service flow management and service flow QoS scheduling as described below. Two-phase activation model remains the same.

Service flow management is performed between MMR-BS and MS (i.e., DSx messages are processed only by MMR-BS and MS). RS doesn’t manage the service flows and simply forward the DSx messages it receives.

MMR-BS makes centralized authorization, which includes making an admission control decision (e.g., setting the AdmitedQoSParamSet). MMR-BS may request all the RSs on the path to perform resource based admission control by sending an AC-REQ message. After receiving an AC-REQ, a RS makes resource based admission

control decision and replies with an AC-RSP message. MMR-BS then uses the results to make final admission control decision.

After a successful authorization of a service flow and before activating it, MMR-BS shall inform all the RSs on the path of the QoS requirement of the service flow. In the case the mapping between the assigned CID and the path carrying the traffic has already been identified and distributed (e.g., during DSC procedure), the MMR-BS sends an AC-REQ (with SF Parameter:QoS Parameter Set Type indicating Active Set) message. In the case the mapping between the assigned CID and the path carrying the traffic is not identified and distributed (e.g., during DSA procedure), the MMR-BS may combine the activation with the path selection by sending a PATH-SEL-REQ. After receiving an AC-REQ, a RS retrieves the service flow information including the QoS requirement and uses it for future scheduling service. It then replies with an AC-RSP message.

The transmission scheme for AC-REQ and AF-REQ could be end-to-end unicast or hop-by-hop unicast with end-to-end response. The Transmission Type field in AC-REQ or AF-REQ should be set accordingly by the originator.

Service Flow QoS scheduling is performed by MMR-BS and all the RSs on the path. Each RS on the path performs service flow QoS scheduling based on the QoS requirement for the service flow obtained from AF-REQ message or PATH-SEL-REQ.

This should be greater than “Allocation Start Time” field in the UL-MAP message.

Update to Table 14 (MAC Management Messages) as indicated below

Type	Message Name	Message Description	Connection
73	AC-REQ	Admission Control Request	Basic
74	AC-RSP	Admission Control Response	Basic

Insert new subclause 6.3.2.3.62

6.3.2.3.62 Admission Control Request (AC-REQ) message

An MMR-BS may send an AC-REQ message to request RSs on a particular path to perform resource based admission control. When a RS receives an AC-REQ with Transmission Type equal to Hop-by-hop unicast with end-to-end response, and it is not the last hop on the relay path, it shall also generate AC-REQ in the form shown in Table T2.

Table T2 –AC-REQ message format

Syntax	Size	Notes
AC-REQ_Message_Format() {		
Management Message Type = TBD	8 bits	
Transaction ID	16 bits	

Transmission Type	2 bits	Type of Transmission Scheme
Reserved	6 bits	
TLV Encoded Information	*variable*	TLV specific
}		

An MMR-BS shall generate AC-REQs in the form shown in Table T1, including the following parameters:

Transaction ID
Unique identifier for this transaction assigned by the sender
Transmission Type (see section 11.1.8)
The type of transmission scheme for MAC management messages targeting to all the RSs on a relay path

All other parameters are coded as TLV tuples.

The AC-REQ shall contain the following TLVs:

Service Flow Parameters (see 11.3)
Specification of the service flow's traffic characteristics and scheduling requirements
CMAC/HMAC Tuple (see 11.1.2)
The CMAC/HMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The CMAC/HMAC Tuple attribute shall be the final attribute in the AC-REQ message's attribute list.

Insert new subclause 6.3.2.3.63

6.3.2.3.63 Admission Control Response (AC-RSP) message

An AC-RSP shall be generated in response to a received AC-REQ. The format of a AC-RSP shall be as shown in Table T2.

Table T2 –AC-RSP message format

Syntax	Size	Notes
AC-RSP_Message_Format() {		
Management Message Type = TBD	8 bits	
Transaction ID	16 bits	
Confirmation Code	8 bits	
TLV Encoded Information	*variable*	TLV specific
}		

Parameters shall be as follows:

Transaction ID
Transaction ID from corresponding AC-REQ
Confirmation Code (see 11.13)

The appropriate Confirmation Code (CC) for the entire corresponding AC-REQ

All other parameters are coded as TLV tuples.

The AC-RSP may contain the following TLVs:

Service Flow Parameters (see 11.3)
The complete specification of the service flow may be included in the AC-RSP to contain the closest value that is supported in the case of CC = "reject-not-supported-parameter-value".

The AC-RSP should contain the following TLVs:

CMAC/HMAC Tuple (see 11.1.2)
The CMAC/HMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The CMAC/HMAC Tuple attribute shall be the final attribute in the AC-RSP message's attribute list.

Insert new subclause 11.1.8

11.1.8 Transmission Type

This parameter specifies the type of the transmission scheme for MAC management message targeting to all the RSs on the same relay path.

Type	Length	Value	Scope
Transmission Type	2	00 – End-to-end Unicast 01 – Hop-by-hop unicast with end-to-end response 10/11 - Reserved	PATH-ADV-REQ PATH-SEL-REQ AC-REQ AF-REQ

4. Summary

This contribution proposes the Relay support for QoS model. Two scheduling services – centralized scheduling and distributed scheduling with coordination at MMR-BS are proposed. The bandwidth request and allocation scheme under both scheduling service are discussed. The QoS support model for both scheduling service are described as well. The addition and changes to the specification are also identified.

5. References

[1] Topology Discovery and Path Management in multi-hop relay System, C80216j-06_195.doc; Haihong Zheng, Yousuf Saifullah, Shashikant Maheshwari, Nokia
[2] Resource Request for Bandwidth, C80216j-06_189.doc; Yousuf Saifullah, Shashikant Maheshwari, and Haihong Zheng; Nokia
[3] Transmission Scheme of MAC Management Message towards a RS Group in multi-hop relay System, C80216j-06_196.doc; Haihong Zheng, Yousuf Saifullah, Shashikant Maheshwari; Nokia