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Re:	Call for Technical Proposals regarding IEEE Project P802.16j (IEEE 802.16j-06/027)	
Abstract	This contribution proposes a method of network entry of mobile station (MS) through a relay station (RS) in a multihop relay (MR) network	
Purpose	Adoption of proposed text into P802.16j	
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Network entry procedure for MS in 802.16j

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1 Introduction

This contribution proposes a method of network entry for mobile station (MS) through an RS in a mobile multihop relay (MMR) network. This proposal considers RS capabilities to make local decision for MS during network entry processes. RS equipped with local decision capability realizes faster network entry process as well as reduction of amount of management messages exchange between BS and RS.

In order to incorporate this proposal in to IEEE 802.16j standard, specific changes to the baseline working document IEEE 802.16j-06/026 are listed in Section 3.

2 General Description

Figure 1 shows reference model of IEEE802.16j.

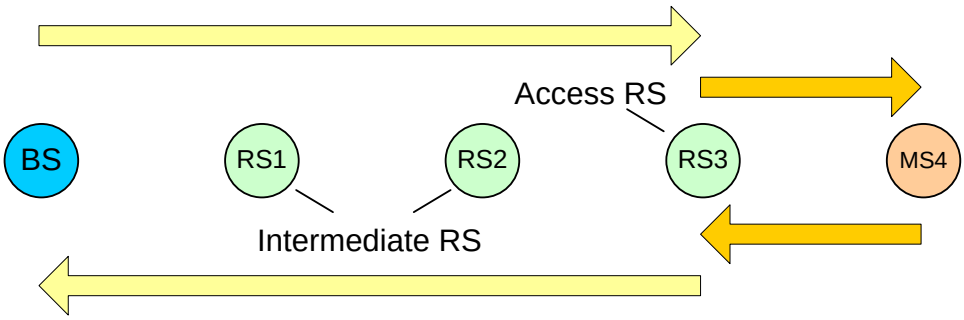

Figure 1 Reference Model of Network Entry for IEEE802.16j

Base station (MMR-BS) and mobile station (MS) communicate through one or more relay stations (RSs). All RSs are assumed to transmit preamble and control messages. This case covers coverage extension scenario as well as user throughput enhance scenario [1].

RS that directly communicates with MS is named as access RS. The interface between the access RS and MS is IEEE802.16e[2],[3] compliant. The access RS communicates with another RS is named as intermediate RS[4].

2.1 Network entry through simple (Lack of local decision) relay station

A simple RS is comprised of minimum functionality. The minimum functionality is expected to lower the equipment cost of RS. Simple RS mainly forwards control information as well as bearer information from MS to MMR-BS and vice versa during network entry of an MS. Only MMR-BS makes decision and all the downlink control messages are generated at BS. One of the key simplicity is that RS does not manage radio resource usage. BS allocates all radio resources and transmits to RS.

The following section discusses functions and requirements of new MAC management message(s) for the access RS. All the RSs are similar in type and an intermediate RS acts as access RS when MS makes network entry through it.

2.1.1 Network Entry Procedure

The access RS participates during the initial ranging process and simply forwards all the request and response messages in other stages, e.g., MS basic capability negation, authorization and personal key exchange, registration.

2.1.1.1 Ranging

CDMA Ranging

MS makes initial ranging with transmission of CDMA code (144 bits). Simple RS detects CDMA codes in its ranging regions. Optionally, simple RS may listen to other RS's ranging region when instructed by the MMR-BS [5]. Access RS reports the CDMA code number and the slot number in which the new MS makes ranging. Since the communication between MMR-BS and access RS has already been established, scheduled radio resource can be used.

Measurement

Access RS is required to measure signal strength of the CDMA code. Access RS reports to MMR-BS the measured signal strength and necessary adjustments required for the ranging MS. This information is used by the MMR-BS to decide initial path if multiple paths exist between MMR-BS and MS.

During non-contention based ranging, access RS measures on the RNG-REQ message transmitted from MS in the allocated UL regions.

Report to Base Station

RS Ranging Report (RS_RNG-REP) MAC management message defined in [5] is used for notifying the MMR-BS that an initial ranging is detected and reporting measurements/adjustment required for that MS. The primary management CID assigned between MMR-BS and the access RS carries the RS_RNG-REP.

Access RS reports the parameter adjustment required for the MS during continuation of initial ranging process.

Response from Base Station

MMR-BS sends generates ranging response (RNG-RSP) message based on the RS_RNG-REP. The RNG-RSP message is sent to the access RS using RS's primary management CID. MMR-BS centrally assigns basic and primary CIDs to the new MS. Access RS simply relays the RNG-RSP to the ranging MS.

2.2 Network entry through local processing capable relay station

In previous section, network entry process with simple RS operation is discussed. Since all the information is relayed between BS and MS, network entry process time as well as radio resource usage increases as the number of hops increases. Here local processing capable RS is proposed for reducing messages exchange between access RS and BS during network entry process of MS. BS delegates some of its functionality to RS to make decision for MS by RS itself. .

2.2.1 Network Entry Procedure

A local decision capable RS makes some decision for MS during network entry process and generates MAC management messages for MS. RS makes decision during ranging, basic capability negotiations. A higher capable RS may participate in authorization and assignment of personal key, and registration of MS. RS with local capable of decision making during initial ranging and basic capability negotiation is considered here.

2.2.1.1 Pre-processing

Since BS delegates some of its functionalities to RS, pre-process (pre-negotiation) is needed for RS during initialization of RS. RS makes decision for MS based on the pre-negotiated conditions. The pre-negotiated conditions are the basic capabilities for MS that the RS will support primary and secondary management CIDs to be assigned to MS. MMR-BS and RS exchange the SS basic capability request and response (SBC-REQ/SBC-RSP) messages listed in IEEE 802.16e-2005 document to settle the pre-negotiations for MS. BS allocates pools of CIDs to the RS during initialization of RS. RS can request for more CIDs at anytime during normal operation and MMR-BS can allocate more CIDs in response to request or can allocate in unsolicited manner if BS senses the pre-allocated CIDs are to be used soon.

2.2.1.2 Ranging

Ranging is to adjust transmit timing and power level of MS. Ranging request (RNG-REQ) message and ranging response (RNG-RSP) message are used for this purpose. To exchange MAC Management messages, Basic and Primary Management CIDs are assigned to the communication between access RS and MS. In general, CIDs are assigned by BS. Basic idea to facilitate local processing at RS is that BS delegates some CIDs to the access RS in advance. The access RS completes ranging process with MS without reporting ranging conditions to BS. Moreover, RS continues periodic ranging process with the MS during normal operation without reporting to BS.

2.2.1.3 Basic Capability Negotiation

The access RS receives basic capability request (SBC-REQ) message from the MS and responds with basic capability response (SBC-RSP) by own. The access RS pre-negotiated basic capability supported to MS, RS uses those pre-negotiated conditions to generate SBC-RSP message for MS. RS sends the SBC-RSP message on the basic CID assigned by the access RS.

2.2.1.4 Notification of MS-information

The access RS sends MS's information (e.g. MAC address, assigned basic and primary CIDs) to the BS by using station information (STA-INFO) message. This message carries MAC address of the MS ready to enter to the network and assigned primary and basic CIDs. The BS keeps the record of MAC address and corresponding basic and primary CIDs for creating service flow for the MS or sending other MAC management messages. The BS sends an acknowledge message (STA-ACK) to notify the MS's information is received. Transmitting and receiving process of these messages are described in [6]

2.2.1.5 Authentication

MS requests for authorization to the access RS by using PKM-REQ message. RS relays the request to BS. BS verifies MS's authenticity and authorizes. BS also assigns authentication key (AK) for using between access RS to MS communication. BS sends authorization response using PKM-RSP message. RS relays the response message to MS.

2.2.1.6 Registration

The MS performs registration with the access RS by transmitting a Registration Request message (REG-REQ). Access RS forwards the request to BS. BS responds with a Registration Response message (REG-RSP) and forward to the access RS. Access RS relays the response to MS. A managed MS receives a Secondary Management CID from the BS.

2.3 Procedure Comparison

A comparison for network entry through a simple RS and a local processing capable RS is shown in Figure 2. The local processing capable RS also generates response during periodic ranging process too.

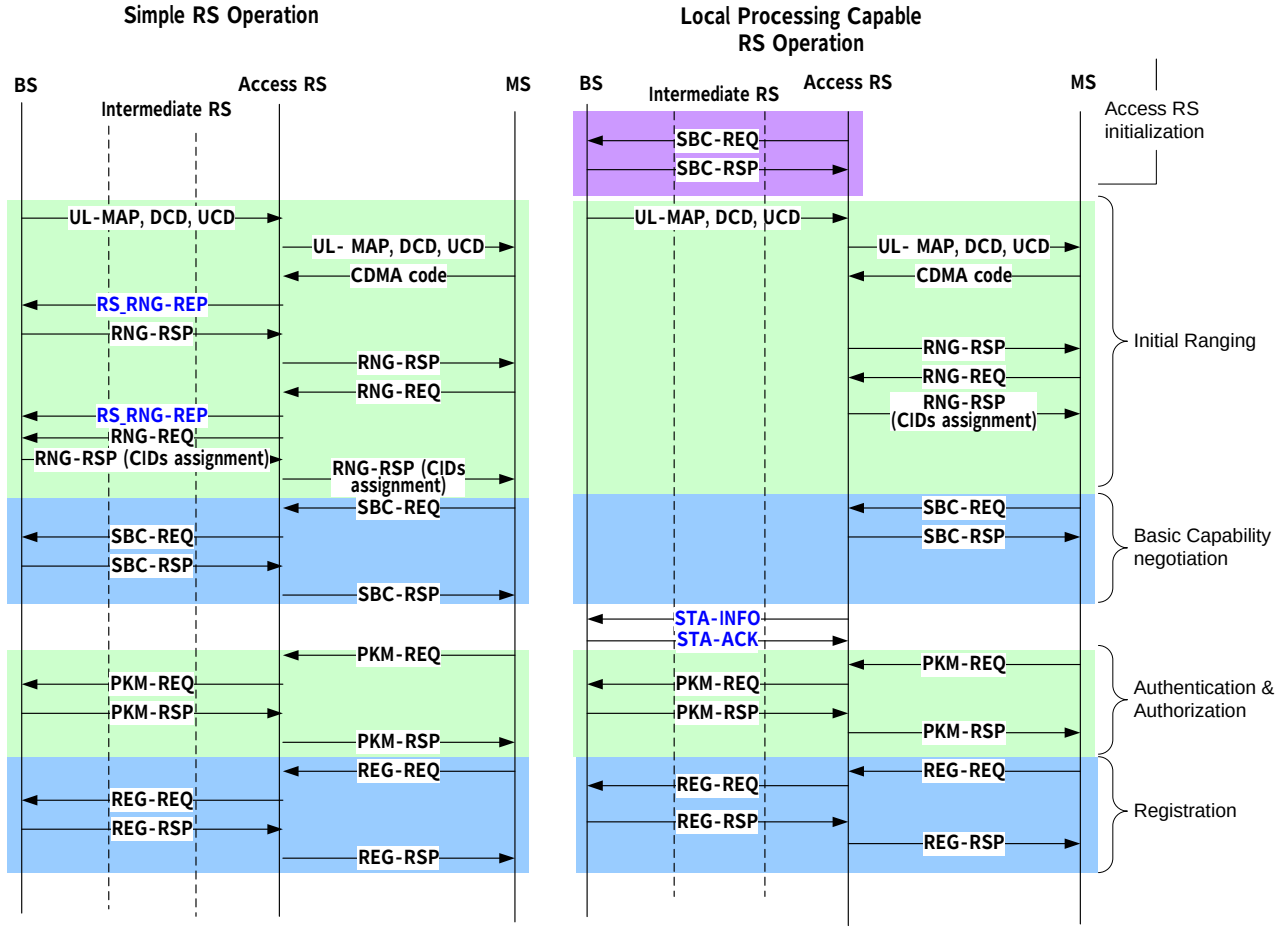

Figure 2 Comparison of Procedure between Simple RS and local processing capable RS

3 Proposed Text Changes

[Insert the following text at the end of subclause 6.3.2.3.23]

6.3.2.3.23 SS Basic Capability Request (SBC-REQ) message

An RS shall send the SBC-REQ message during initialization. An RS shall generate SBC-REQ message in the form shown in Table 51.

An RS shall generate SBC-REQs including the following parameter:

Basic CID (in the MAC header)

The CID in the MAC header is the Basic CID fro this RS, as assigned in the RNG-RSP message.

RS shall include the TLV encoding of own capability (11.8.9). RS capable of making local network entry decision for MS shall use the SBC-REQ message to make pre-negotiation with MMR-BS. The basic capability request includes the conditions to be used by the RS for making basic capability negotiation with MS.

[Insert the following text at the end of subclause 6.3.2.3.24]

6.3.2.3.24 SS Basic Capability Response (SBC-RSP) message

MMR-BS shall send the SBC-RSP message in response to a received SBC-REQ.
An MMR-BS shall generate SBC-RSPs in the form shown in Table 52, including the following parameter:

Basic CID (in the MAC header)
The CID in the MAC header is the Basic CID for this RS, as assigned in the RNG-RSP message

The successfully negotiated capabilities are to be used by the RS capable of making local network entry decision for MS to make capabilities negotiation with MS.

[Add a new section 6.3.2.3.AD]

6.3.2.3.AD RS RS Ranging Report (RS_RNG-REP) Message

See [5]

[Add a new section 6.3.2.3.AE]

6.3.2.3.AE RS CID Allocation Request (CID_ALLOC-REQ) message

The CID_ALLOC-REQ message shall be transmitted by an RS at any time to make request for pre allocation of primary and basic CIDs for MS. The message format is shown in Table AE.

Table AE CID_ALLOC-REQ message format

Syntax	Size	Note
CID_ALLOC-REQ_Message_Format() {		
Management Message Type (TBD)	8 bits	
N_Code	16 bits	Number of primary and basic CIDs requested
}		

Basic CID (in the MAC header)
The CID in the MAC header is the Basic CID for this RS, as assigned in the RNG-RSP message.

[Add a new section 6.3.2.3.AF]

6.3.2.3.AF RS CID Allocation Response (CID_ALLOC-RSP) message

The CID_ALLOC-RSP message shall be transmitted by the MMR-BS in response to the CID_ALLOC-REQ message from RS or at any time to pre-allocate primary and basic CIDs for MS. MMR-BS shall transmit the

same message to an RS to de-allocate primary and basic CIDs previously allocated to an RS. The message format is shown in Table AF.

Table AF CID_ALLOC-RSP message format

Syntax	Size	Note
CID_ALLOC-RSP_Message_Format() {		
Management Message Type (TBD)	8 bits	
Alloc_IND	1 bit	1= Allocation 0=De-allocation
If (Alloc_IND= =1) {		
Start	16 bits	Starting point of the CID number
N_Code	16 bits	Total number of CIDs allocated for basic and primary CIDs
}		
Else if (Alloc_IND = =0) {		
Start	16 bits	Starting point of the CID number
N_Code	16 bits	Total number of CIDs de-allocated
}		

Basic CID (in the MAC header)
The CID in the MAC header is the Basic CID for this RS, as appears in the CID_ALLOC-REQ message

[Add a new section 6.3.2.3.AG]

6.3.2.3.AG Station Information (STA-INFO) message

The STA-INFO message shall be transmitted by the RS to identify a new station (MS or RS) is ready to enter to the network. RS shall include MS's information along with assigned primary and basic CIDs. The message format is shown in Table AG.

Table AG STA_INFO message format

Syntax	Size	Note
STA-INFO_Message_Format() {		
Management Message Type (TBD)	8 bits	
Type	1 bit	0=MS 1=RS
MAC ID	48 bit	Station's MAC address
Primary management CID	16 bits	Primary management CID assigned from RS to the network entering station (MS/RS)
Basic CID	16 bits	Basic CID assigned from RS to the station (MS/RS)
Transaction ID	16 bits	

If (Type= =RS){		
TLV Encoded Information	Variable	TLV Specific
}		
}		

Basic CID (in the MAC header)
The CID in the MAC header is the Basic CID for this RS, as assigned in the RNG-RSP message.

All other parameters are coded as TLV tuples.
STA-INFO may contain the following TLVs

Network Entry Capability Support (11.8.9)

[Add a new section 6.3.2.3.AG]

6.3.2.3.AH Station Information Acknowledge (MS-ACK) message

The STA-ACK message shall be transmitted in response to STA-INFO by the MMR-BS to notify the RS that new station's (MS/RS) information is received successfully. MMR-BS shall include MS's 8LSB of primary CID to identify the MS. The message format is shown in Table AH.

Table AH MS-ACK message format

Syntax	Size	Note
STA-ACK_Message_Format() {		
Management Message Type (TBD)	8 bits	
Transaction ID	16 bits	
Primary management CID	8 bits	8 LSB of network entering stations's (MS/RS) primary management CID
}		

Basic CID (in the MAC header)
The CID in the MAC header is the Basic CID for this RS, as appears in the STA-INFO message

[Insert the following text in section 6.3.9.16]

An RS makes network entry by following the same steps of network entry for SS. During basic capability negotiation, the RS declares its capability by using TLV encodes in SBC-REQ message. MMR-BS sends response to RS by using SBC-RSP message.

During MS's network entry through RS, the network entry procedure follows exactly same procedure of 6.3.9.1 through 6.3.9.15. After assigning primary management and basic CIDs to a ranging MS the RS makes basic capability negotiation with MS. RS notified the MMR-BS that an MS is ready for network entry by sending Station Information (STA-INFO) message to MMR-BS and MMR-BS notifies the RS with Station acknowledge (STA-ACK) message. On receiving authorization request from MS an RS forwards the request to

MMR-BS for authentication and private key assignment. MMR-BS verifies MS's authenticity and assigns authentication key for using between access RS to MS communication. Upon receiving a registration request from MS, RS forwards the message to MMR-BS and MMR-BS assigns secondary CIDs for a managed MS. Access RS forwards the registration response to MS.

[Insert new subclause 11.8.9]

11.8.9 Network Entry Capability Support

This field indicates an RS is capable to make some local decisions for network entering MS.

Type	Length	Value	Scope
5	1	Bit#0: Ranging support Bit#1: Primary and basic CID assignment support Bit#2: Basic capability negotiation support Bit#3: Authentication support Bit#4: Registration support Bits#5-7: reserved	SBC-REQ SBC-RSP

[Insert new subclause 11.8.9.1]

11.8.9.1 CID Pre-allocation Size

The CID pre-allocation size indicates an RS is capable to assign primary management and basic CIDs to MS/RS locally. MMR-BS uses this field to indicate the numbers of basic and primary CIDs are allocated to an RS during initialization.

Type	Length	Value	Scope
180	2	Total number of allocated primary management and basic CIDs	SBC-REQ SBC-RSP

[Insert new subclause 11.8.9.2]

11.8.9.2 CID Pre-allocation start

The CID pre-allocation start field indicates the basic CID starting point for an RS.

Type	Length	Value	Scope
181	2	Starting point of CID allocation	SBC-RSP

4 Reference

[1] Jerry Sydir and et. al., "802.16j Usage Models", http://ieee802.org/16/relay/docs/80216j-06_015.pdf

[2] IEEE Std 802.16-2004 "IEEE Standard for Local and Metropolitan Area Networks–Part 16: Air Interface for Fixed Broadband Wireless Access Systems", IEEE Std 802.16™-2004 (Revision of IEEE Std 802.16-2001), October 1, 2005

[3] IEEE Std 802.16e-2005/802.16cor1, “IEEE Standard for Local and Metropolitan Area Networks–Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands,” 802.16E-2005 &802.16/COR1, ISBN: 0-7381-4857-1

[4] R. Peterson and et al, “Definitions and Terminology,” IEEE 802.16j-06/014r1, http://ieee802.org/16/relay/docs/80216j-06_014r1.pdf

[5] K. Baum and et. al., “Enabling Transparent Relaying on the Uplink,” IEEE C802.16j-06/160.

[6] S. Ramachandran and et. al., “Connections in a Multihop Relay Network”, IEEE C802.16j-06/156.