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Title	<b>Initial Ranging in 802.16j system</b>	
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Re:	This contribution is a response to "IEEE 802.16j-06/034 Call for Technical Proposals regarding IEEE Project 802.16j" (2006-12-12) .	
Abstract	This contribution described the proposed initial ranging in 802.16j system.	
Purpose	This document is provided in response for Call for Technical Proposals regarding IEEE Project 802.16j .	
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# Initial Ranging in 802.16j system

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## 1 Introduction

This contribution focuses on the ranging procedure in 802.16j system. We propose the different ranging processes for a RS or MS, when the access RS is a transparent or non-transparent RS.

If the access RS is a transparent RS, during the ranging process, the access RS's main function is to relay the received traffic and management messages, except originating CDMA-REP message, when receiving the CDMA code in the ranging regions.

If the access RS is a non-transparent RS, it has more capabilities, including the scheduling, judging the status of the CDMA ranging code, selecting the new node's access route.

Accordingly, during the ranging process in 802.16j system, the MR-BS is mainly responsible for allocating CIDs for the new node and so on. Certainly, when the access RS is a transparent RS and at the same time this access RS's access station is the MR-BS, the MR-BS should also judge the status of the CDMA ranging code and select the new node's access route.

## 2 Proposed Solutions

A new node, MS or RS, which wishes to perform the initial ranging, after acquiring downlink synchronization and uplink transmission parameters, shall select an initial ranging code randomly from the Initial Ranging Domain and send it to the 802.16j system on the initial ranging region.

In the 802.16j system, the initial ranging code may be received by the MR-BS and different types of RS simultaneously or respectively. Different receivers will lead to different ranging procedure.

If the initial ranging code is received successfully by the MR-BS and the MR-BS has no any children nodes, the initial ranging process in the 802.16j system is same as that in 802.16e system.

### 2.1 Initial ranging through a non-transparent RS

If the initial ranging code is received successfully by a non-transparent RS ,now being the new node's access RS, and the non-transparent RS has no any children nodes, the access RS should reply with the RNG\_RSP message, containing the ranging code attributes ( Indicated in Table 367) , all the needed adjustments and a status notification.

If the status in the RNG-RSP is "continue", the new node will continue the ranging process as done on the first entry with ranging codes randomly chosen from the Initial Ranging domain sent on the Periodic Ranging region until receiving a RNG-RSP with success status.

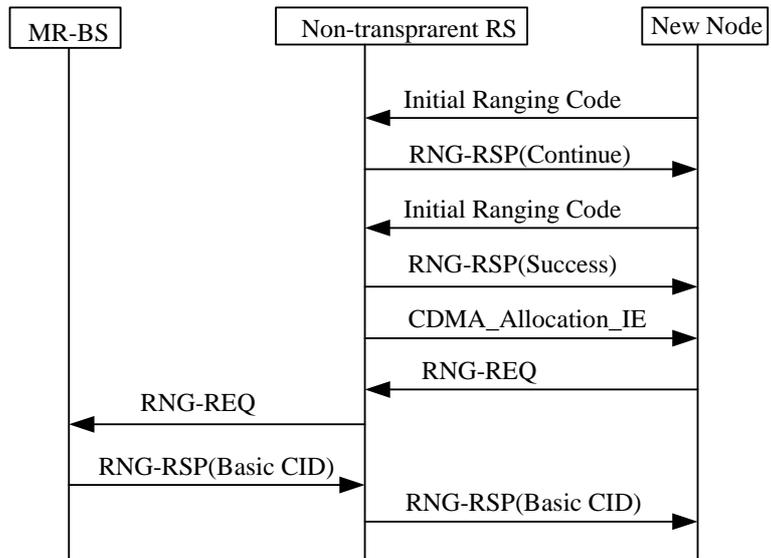


Figure 1- An example of initial ranging process through a non-transparent RS

When the access RS receives an initial-ranging CDMA code that results in sending an RNG-RSP message with success status, the access RS shall provide BW allocation for the new node using the CDMA\_Allocation\_IE to send an RNG-REQ message.

The RNG\_REQ is sent on initial Ranging CID by the new node to the access RS, using the bandwidth allocated by the access RS, and relayed to the MR-BS on the access RS Basic CID. For the connection between the MR-BS and the access RS has been established, the relayed RNG\_REQ could be transmitted on the bandwidth allocated by the MR-BS.

Upon receiving the RNG-REQ, the MR-BS shall decide whether to admit the new node or not based on the system radio resource, CID resource and so on. If the MR-BS decides to admit the new node, it should distribute a valid Basic CID for the new node, contained in the RNG\_RSP. The RNG\_RSP is sent on the access RS Basic CID to the access RS and then relayed on the initial Ranging CID by the access RS to the new node. Otherwise, if the MR-RS decides not to admit the new node, the MR-RS won't allocate the Basic CID for the new node and will reply a RNG-RSP with abort status.

Figure 1 illustrates the process of the new node initial ranging through a non-transparent RS.

**2. 2 Initial ranging through a transparent RS**

If the initial ranging code is received by a transparent RS, the transparent RS should originate a CDMA-REP message according to the received ranging code and send the message to its access station on its Basic CID. The CDMA-REP message contains the CDMA code attributes and all needed adjustments.

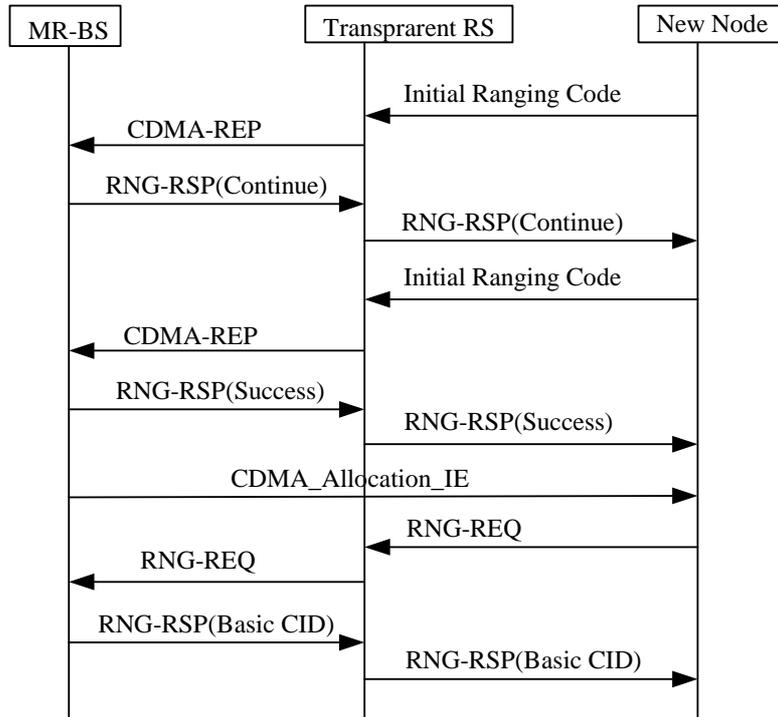


Figure 2- An example of initial ranging process through a transparent RS (Case 1)

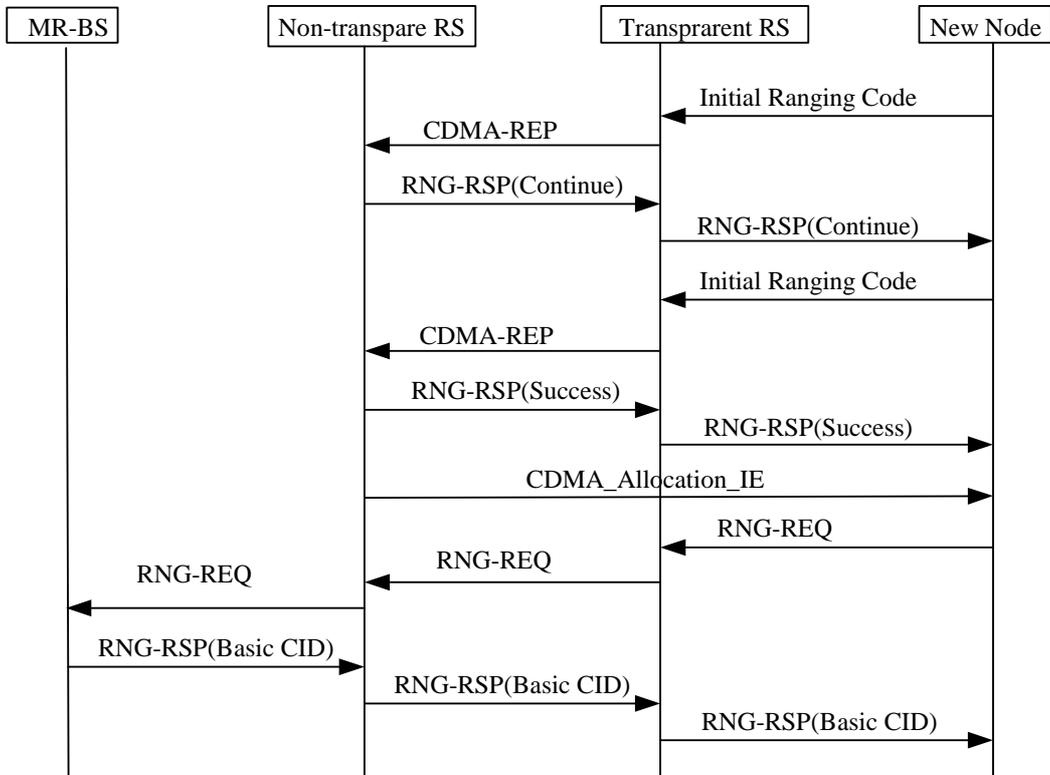


Figure 3- An example of initial ranging process through a transparent RS (Case 2)

If the transparent RS's access station receives CDMA ranging code directly, upon receiving the CDMA ranging code, it should activate ranging timer1. On the ranging timer1 expires, the transparent RS's access station should compare the ranging code received directly with all the received CDMA-REP messages, which contain the same ranging code as that received directly sent at the same time, and select an optimal reception result. The selection algorithm is out of scope. If the transparent RS's access station hasn't received the CDMA ranging code directly, upon receiving the first CDMA-REP message, it should activate ranging timer2. On the ranging timer2 expires, the transparent RS's access station should compare all the received CDMA-REP messages containing the same ranging code sent at the same time and select an optimal reception result.

When selecting an optimal result, the new node's route to the transparent RS's access station is also determined. If the optimal code is received by the transparent RS's access station, the transparent RS's access station should directly send the RNG-RSP to the new node. Otherwise, the new node will receive the RNG-RSP through that transparent RS.

If the status contained in the RNG-RSP is continue, the new node should continue to perform the ranging process as done on the first entry, with initial ranging codes sent on the Periodic Ranging region. The transparent RS and the RS's access station also should do as done on the first entry.

When the RS' access station receives a ranging CDMA code or a CDMA-REP message that results in sending an RNG-RSP message with success status, based on the selected route, the RS' access station shall provide BW allocation for the new node to send an RNG-REQ message. Using the bandwidth indicated by the CDMA\_Allocation\_IE, the new node sends the RNG-REQ on the Initial Ranging CID to the RS' access station directly or through the transparent RS. The CDMA\_Allocation\_IE may send to new node directly, or relayed through the transparent RS according to the usage scenario.

Case 1: If the transparent RS's access station is the MR-BS, on receiving the RNG-REQ, the MR-BS shall decide whether to admit the new node or not. If the MR-BS determines to admit the new node, it should allocate the Basic CID and Primary management CID for the new node and send the RNG-RSP to the new node directly or through the transparent RS. Otherwise, if the MR-RS decides not to admit the new node, the MR-RS won't allocate the Basic CID for the new node and will reply a RNG-RSP with abort status. Figure 2 illustrates the initial ranging process when the transparent RS' access station is the MR-BS.

Case 2: If the transparent RS' access station is a non-transparent RS, the non-transparent RS should relay the RNG-REQ on its Basic CID to the MR-BS. If the MR-BS decides to admit the new node, the RNG-RSP is originated by the MR-BS and sent to the non-transparent RS on this non-transparent RS Basic CID. Then the non-transparent RS relays the RNG-RSP on the Initial Ranging CID to the new node directly or through the transparent RS. Otherwise, if the MR-RS decides not to admit the new node, the MR-RS won't allocate the Basic CID for the new node and will reply a RNG-RSP with abort status. Figure3 illustrates the initial ranging process when the transparent RS's access station is a non-transparent RS.

The above mentioned initial ranging process is suitable for both a new MS and RS. The difference between the RS and MS initial ranging process is that the RS may select different ranging code and/ or different ranging region.

### 3 Proposed Text

#### 6.3.2.3 MAC management message

*Add one row into Table 14:*

Type	Message Name	Message Description	Connection
------	--------------	---------------------	------------

<TBD>	CDMA-REP	CDMA Report	Basic
-------	----------	-------------	-------

*Insert new subclause 6.3.2.3.xx:*

#### 6.3.2.3.xx CDMA-REP message

CDMA-REP message is originated by a transparent RS, containing CDMA code attributes and all adjustments, and sent to this transparent RS's access station.

Table xx-CDMA-REP message format

Syntax	Size	Notes
CDMA-REP_Message_format() {	-	-
Message Type	8bits	<TBD>
N_CDMA	4bits	Number of the received CDMA code
For(i=0;i< N_CDMA; i++){		
CDMA code attributes	32bits	
CDMA code type indication	2bits	0b00: initial ranging code 0b01: periodic ranging code 0b10: handover ranging code 0b11: bandwidth request code
If (CDMA type indication!=0b11){		
Timing Adjustment	32bits	
Power Level Adjustment	8bits	
Offset Frequency Adjustment	32bits	
}		
}		
Padding	variable	If needed for alignment to byte boundary
}		

*Insert the following subclause at the end of 6.3.10.3:*

#### 6.3.10.3.4 Relaying support for OFDMA based ranging

##### 6.3.10.3.4.1 Initial ranging

##### 6.3.10.3.4.1.1 Initial ranging through non-transparent RS

After the new node acquiring downlink synchronization and uplink transmission parameter, the new node should select an initial ranging CDMA code and send it to the 802.16j system on the initial ranging region.

If the non-transparent RS receives the CDMA code, it sends the RNG-RSP message to the new node, including the status and CDMA code attributes. According to the 6.3.10.3.1, the new node continues to send the initial ranging code on the periodic ranging region until it receives a RNG-RSP with success status.

When the RS receives an initial-ranging CDMA code that results in sending an RNG-RSP message with success status, the RS shall provide BW allocation for the new node using the CDMA\_Allocation\_IE to send an RNG-REQ message.

After receiving the RNG-REQ from the new node, the RS relays the message to the MR-BS. The MR-BS allocates the Basic CID and Primary management CID for the new node and sends the RNG-RSP to the RS. The RS then relays the RNG-RSP to the new node. The Initial ranging process is over.

#### 6.3.10.3.4.1.12 new node initial ranging through transparent RS

After the new node sends the initial ranging code on the initial ranging region to the 802.16j system, if the transparent RS receives the code, it should initiate CDMA-REP message to its access station, a non-transparent RS or the MR-BS. The CDMA-REP message should include the CDMA code type, CDMA attributes.

If the transparent RS's access station has received CDMA ranging code directly, it should set a RNG timer1. On the time expires, the transparent RS's access station should compare the ranging code received directly with all the received CDMA-REP messages, containing the same ranging code sent at the same time, and select an optimal reception result. The selection algorithm is out of scope. If the transparent RS's access station hasn't received the CDMA ranging code directly, upon receiving the first CDMA-REP message, it should set a RNG time2. On the time expires, the transparent RS should compare all the received CDMA-REP messages containing the same ranging code sent at the same time and select an optimal result.

When selecting an optimal result, the new node's route to the transparent RS's access station is also decided. If the optimal code is received by the transparent RS's access station, the transparent RS's access station should directly send the RNS-RSP to the new node. Otherwise, the new node will receive the RNG-RSP through its access RS.

If the status contained in the RNG-RSP is continue, the new node should continue to perform the ranging process as done on the first entry, with initial ranging codes sent on the Periodic Ranging region. The new node's access RS and the RS's access station also should do as done on the first entry.

When the transparent RS' access station receives a ranging CDMA code or a CDMA-REP message that results in sending an RNG-RSP message with success status, based on the selected route, the transparent RS' access station shall provide BW allocation for the new node to send an RNG-REQ message. Using the bandwidth indicated by the CDMA\_Allocation\_IE, the new node send the RNG-REQ to the transparent RS' access station directly or through the access RS.

If the transparent RS' access station is a non-transparent RS, the non-transparent RS should relay the RNG-REQ on its Basic CID to the MR-BS. On receiving the RNG-REQ, the MR-BS shall decide whether to admit the new node or not. If the MR-BS determines to admit the new node, it should allocate the Basic CID and Primary management CID for the new node and send the RNG-RSP to the new node directly, through the transparent RS or through the non-transparent RS. Otherwise, if the MR-BS decides not to admit the new node, the MR-BS won't allocate the Basic CID for the new node and will reply a RNG-RSP with abort status.

The above mentioned initial ranging process is suitable for both a new MS and RS. The difference between the RS and MS initial ranging process is that the RS may select different ranging code and/ or different ranging region.

## References

- [1] IEEE 802.16mmr-06/002r1, " Draft P802.16j PAR and Five Criteria: Mobile Multi-hop Reply "
- [2] IEEE 802.16j-06/016r1, " Proposed Technical Requirements Guideline for IEEE 802.16 Relay TG "
- [3] IEEE 802.16j-06/017r2, " Table of Contents of Task Group Working Document "