Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Anonymous Initial Ranging**
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Re:	Working Group Letter Ballot #7 "Draft Amendment to IEEE Standard for Local and Metropolitan Area Networks –Part 16:Air Interface for Fixed Broadband Wireless Access Systems – Medium Access Control Modifications and Additional Physical Layer Specifications for 2-11 GHz "
Abstract	This contribution presents a mechanism for allowing dialog to take place between the base station and a subscriber performing initial ranging, before the base station is able to decode Ranging Request messages transmitted by the subscriber.
Purpose	Referenced by Ballot #7 comments suggesting updates to the current draft document
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Anonymous Initial Ranging

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Introduction

The current MAC initial ranging protocols for OFDM and SC require the base station to be able to fully decode an initial ranging message from a subscriber before the process can progress. In some instances, this may not be possible until some level of correction to the subscriber transmitter has been implemented. As a result, such subscribers would be precluded from successful entry into the network.

Under the current algorithms, full decode of each initial ranging message is required so that the base station can identify and address its transmitter corrections to the specific requesting subscriber, and the subscriber can recognize the ranging response containing the corrections in the downlink data stream.

This proposal presents an alternate identification mechanism which allows initial ranging transactions to take place before message decode is possible at the base station.

References

IEEE Std 802.16-2001
IEEE P802.16a/D4-2002

Background

Under current procedures, a subscriber begins network entry by monitoring transmissions from the base station and synchronizing its receiver to those transmissions. Once this has been completed, the subscriber initiates transmission of Ranging Request (RNG-REQ) messages in Initial Maintenance slots published by the base station in Uplink Maps (UL-MAP) transmitted by the base station.

The subscriber uses the initial ranging CID value zero in the RNG-REQ message header and includes in the message its EUI (48-bit unique identifier assigned to the subscriber)

The base station is expected to analyze each RNG-REQ transmission to derive transmitter corrections (to be forwarded to the subscriber) and to decode the message (recovering the EUI). A RNG-RSP message is then formatted and transmitted on the downlink channel for reception by the subscriber. The CID value included in the message is the initial ranging value of zero. The message includes the computed correction factors and the subscriber's EUI.

The ranging subscriber monitors downlink traffic for a RNG-REQ message addressed to an initial ranging subscriber (CID equals zero) and accepts messages that contain its EUI.. If no response is seen in a reasonable amount of time, the subscriber increases power and retransmits after a random delay.

Proposed Change

Inasmuch as an initial ranging subscriber is synchronized with the base station and is receiving downlink maps (DL-MAP), both the subscriber and base station can agree on the frame number (a member of the DL-MAP synchronization field) in which any transmission was sent or received. As a result, if the subscriber remembers the frame number in which it sent its RNG-REQ message, and the base station includes the frame number when the transmission was received in its answering RNG-RSP message, the subscriber can be reasonably sure the response is addressed to it by validating the transmission frame number, regardless of whether or not an EUI is available.

Including this technique, initial ranging process would consist of the following steps

- Subscriber transmits RNG-REQ

- Base station receives RNG-REQ

- Base station formats and sends a RNG-RSP message. If the RNG-REQ message is decoded, the subscriber EUI is included in the response, and the current algorithm proceeds with no changes. If the message could not be decoded, the received frame number is included in the RNG-RSP message in place of the EUI. In this case, the base station preserves no information regarding the exchange since it has no explicit subscriber information to associate with it.

- The initial ranging subscriber decodes each inbound initial ranging RNG-RSP message (CID=0), discarding any with an EUI that does not match its own and for those without an EUI, discarding any that do not have a frame number matching the frame number in which the subscriber's RNG-REQ message was sent. For responses including an EUI, the current algorithm proceeds with no changes. If no EUI is present, the subscriber implements the corrections specified in the messages and then initiates another RNG-REQ message in an Initial Maintenance slot following the normal rules for this action.

- As long as the base station cannot decode the RNG-REQ message, the previous steps continue until successful, or timeout/retry limits are reached.

This method is not foolproof in that it is possible for two stations to transmit in exactly the same frame, and as a result, receive and implement the same correction factors which may be appropriate for either or neither of them. In practice this should not be a problem, in that the exponential backoff delay should guarantee that the next transmission from each will not coincide and they will receive "proper" correction information at that time.

Specific D4 Document Changes

Page 39   Line 55   Section 6.2.2.3.6

Insert the following before the OFDMA parameter list:

Frame Number – Frame number in which the corresponding RNG-RSP message was received. When Frame Number is included, *SS MAC Address* shall not appear in the same message.

Frame Opportunity – Ranging opportunity within the frame in which the corresponding RNG-RSP message was received. If not provided, and Frame Number is included in the message, Frame Opportunity is assumed to be one.

Page 68   Line   65 Section 6.2.9.5

Replace the following text in the base document (approx 6th paragraph):

The SS shall first send the RNG-REQ at minimum power level, and if it is not successful, the SS shall resend it at the next Initial Maintenance transmission opportunity at one step higher power level until successful.

With:

The SS shall send the RNG-REQ at minimum power level. If the SS does not receive a response, it shall resend it at the next Initial Maintenance transmission opportunity at one step higher power level. If the SS receives a response containing the frame number in which the RNG-REQ was transmitted, it shall consider the transmission attempt unsuccessful but implement the corrections specified in the RNG-RSP and issue another RNG-REQ message after the appropriate back-off delay. If the SS receives a response containing its EUI, is shall consider the RNG_RSP reception successful.

When the BS detects a transmission in the ranging slot that it is unable to decode, it may respond by transmitting a RNG-RSP that includes transmission parameters but identifies the frame number and frame opportunity when the transmission was received instead of the EUI of the transmitting SS.

Replace Table 61 in the base document, with the following:

B S		S S
ime to send the Initial Maintenance Interval] send map containing Initial Maintenance information element with a broadcast CID	----------UL-MAP------------>	
etect un-decodable ranging packet]	<--------RNG-REQ-------	transmit ranging packet in contention mode with CID parameter = 0
send ranging response, include frame number, frame opportunity, CID = 0	---------RNG-RSP------>	recognize frame number/opportunity when packet was sent adjust parameters, prepare to transmit another RNG-REQ at next opportunity
ime to send next map] send map containing Initial Maintenance information element with a broadcast CID	----------UL-MAP------------>	
eceive recognizable ranging packet] allocate Basic and Primary Management CID	<--------RNG-REQ-------	transmit ranging packet in contention mode with CID parameter = 0
send ranging response, including EUI add Basic CID to poll list	---------RNG-RSP------>	recognize own EUI, store Basic and Primary Management CID, and adjust other parameters
ime to send the next map]. send map with Station Maintenance information element to SS using Basic CID	------------UL-MAP----------->	recognize own Basic CID in map
	<--------RNG-REQ-------	reply to Station Maintenance opportunity poll
send ranging response	---------RNG-RSP------>	adjust local parameters
send periodic transmission opportunity to broadcast address		

Table 61—Ranging and automatic adjustments procedure

Add the following to Figure 51 in the base document:
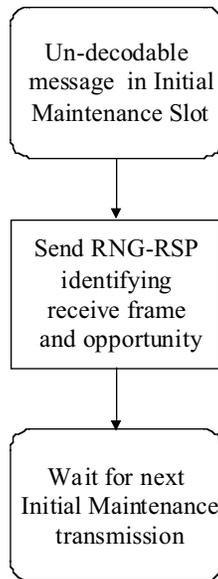
Append the following entries to Table 261:

Name	Type	Length	Value
Frame Number	23	3	Frame number in which the associated RNG_REQ message was detected by the Base Station. Usage is mutually exclusive with SS MAC Address (Type 8). The opportunity within the frame is assumed to be 1 (the first) if the Frame Opportunity field is not supplied.
Frame Opportunity	24	1	Initial Ranging opportunity (1-255) in which the associated RNG_REQ message was detected by the Base Station. Usage is mutually exclusive with SS MAC Address (Type 8).