Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Enhancement to the Periodic Ranging**
Date Submitted	**2004-05-17**
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Re:	This contribution is response to call for contribution about IEEE802.16e-D2
Abstract	This contribution is to propose an additional timer-based conditional ranging operation to cope with the channel variations of moving MSS.
Purpose	Discuss and Adopt the proposed new features for the IEEE802.16e group.
Notice	
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Patent Policy and Procedures	

An enhancement to the periodic ranging operation dealing with channel variations caused by MSS mobility

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1. Problem Statement

In IEEE P802.16-REVd/D4-2004, the periodic ranging is controlled by a T27 timer that is maintained by BS for each MSS. Whenever the timer for an MSS expires, BS shall grant bandwidth to the MSS for an uplink transmission. Every time a unicast grant is given to the MSS, the timer is restarted. If the detected signal of the uplink data received by the unicast grant is not within acceptable limits, the BS initiates a ranging procedure by sending an unsolicited RNG-RSP message to the MSS. During this ranging operation, the BS sets the T27 timer value to Active Timer (say, T27 active timeout) defined in Table 269a. When the BS notices that the uplink signal quality becomes good enough, then it stops the ranging operation and sets the T27 timer as Idle Timer value (say, T27 idle timeout) also defined in Table 269a.

On the other hand, each MSS shall maintain a T4 timer. The T4 timeout indicates to the MSS that it has not been given any unicast grant during the T4 timeout duration. Under the assumption that its uplink transmission parameters are no longer useable, the MSS shall re-initialize its MAC operations.

The above periodic ranging operation shall be able to equally apply to both the fixed SSs and MSSs. Since mobile MSS may suffer from channel variations more than fixed SS (or stationary MSS), it is quite challenging to serve both types of MSSs simultaneously with a single mechanism originally designed for the fixed SS. Here comes a necessity to enhance the current periodic ranging mechanism. It is true that the two T27 timeout values were introduced to deal with uplink signal quality variations, but they are not enough to support all MSSs which have their own time-varing channel characteristics.

2. Proposed Remedy

We introduce a timer-based periodic channel measurement and ranging, say conditional ranging, which is maintained by each MSS. When a timer (say, Tn) expires, MSS may initiate a ranging operation by sending a RNG-REQ message if the signal quality (e.g., average CINR) drops more than an amount of a threshold level. The current periodic ranging is not affected by the proposed ranging; the former is triggered by the BS, and the latter is managed by each MSS.

The detailed operation is somewhat different depending on the mode of MSS: normal(awake) mode or sleep mode. MSS in normal mode can always monitor its downlink channel, so it doesn't need to be restricted to measure the downlink signal quality only when its Tn timer expires. In case the MSS does not continuously measure the signal quality, we presume that the measurement should be performed at least every Tn timeout. The MSS may start the ranging operation if it finds that the measured CINR value drops more than a threshold level from a stored one, which is measured at the last Tn timeout. To prevent frequent ranging operations, the Tn timer also plays a role to ignore any ranging attempt until Tn amount of time passes from the end of the last ranging.

On the other hand, MSS in sleep mode cannot monitor its downlink channel during its sleep interval. Since a long sleep interval may cause a severe channel degradation or even synchronization failure, MSS awakens to monitor the downlink channel at every Tn timeout. If the measured CINR goes down below the stored CINR value by the threshold level, it initiates a ranging operation by sending a RNG-REQ message to its BS. When the conditional ranging completes, the Tn timer is restarted and the measured CINR value is stored as a reference for the next conditional ranging operation. Furthermore, considering that MSS in listening interval shall listen to the downlink channel anyway, we propose that the MSS in listening interval performs the conditional ranging procedure as if its Tn timer expires. The MSS resets its Tn timer at the end of a listening interval. These modifications don't affect the current sleep mode behavior of BS.

3. Proposed Text Changes

[Add the following text in Page 28, Line 33]

6.3.10.2 Uplink periodic ranging

[At the end of the paragraph in 6.3.10.2, add:]

(7) The MSS may perform a conditional ranging by monitoring its downlink channel signal quality. The MSS may maintain a Tn timer for controlling this conditional ranging. The MSS may start a ranging operation if it detects its channel mean CINR drops more than CINR_threshold below the stored one which is measured at the last Tn timeout. Whenever a ranging completes, it restarts the Tn timer. The Tn timer plays a role to ignore any ranging attempt until Tn amount of time passes from the end of the last ranging.

[Modify the paragraph of 6.3.19.1 in Page 34, Line 13 as follows]

An MSS in sleep-mode shall engage in a sleep-interval, defined as a time duration, measured in whole frames, where the MSS is in sleep-mode. The sleep-interval is constructed of one or more variable-length, consecutive sleep-windows, with interleaved listening-windows. During a sleep-window, an MSS does not send or receive PDUs, and may power down one or more physical operation components, or may awaken for periodic and conditional ranging. During a listening-interval, an MSS shall synchronize with the Serving BS downlink and listen for an appropriate MOB-TRF-IND traffic indication message. The MSS shall decide whether to stay awake or go back to sleep based on the value of its own 2-bit indicator in the SLPID bitmap in a MOB-TRF-IND from the Serving BS. In addition, the MSS may initiate the conditional ranging operation based on a measured CINR value during the listening-window. If the CINR value drops from the previously measured one by an amount of a threshold level, CINR_threshold, defined in Table 269a, the MSS may send a RNG-REQ message to start a ranging procedure. Otherwise, it shall continue its normal sleep-mode operation. Whenever a ranging – periodic or conditional – is done or a listening-window ends, the Tn timer for conditional ranging restarts. Every time the Tn timer expires within a sleep-window, the MSS may awaken and measure the downlink channel CINR value to perform the conditional ranging operation. If the MSS starts a ranging procedure, it shall stay awake until the ranging procedure ends. Otherwise, the MSS may go back to sleep. During consecutive sleep-windows and listening-windows, comprising a single sleep-interval, sleep-window shall be updated using the algorithm as defined in 6.4.17.2 Sleep-window update algorithm.

[Add the following items in Table 269a in Page 81, Line 37]

System	Name	Time Reference	Minimum Value	Default Value	Maximum Value
MSS	Tn	When this timer expires, the MSS	200ms		30s

		performs the conditional raging based on the channel quality measurement.			
MSS	CINR_threshold	The threshold value to decide whether MSS initiates a ranging procedure based on the channel quality measurement			