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Title	<b>Enhancement to the Periodic Ranging</b>	
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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 Ranging operation to cope with the channel variations of moving MSS.	
Purpose	Discuss and Adopt the proposed new features for the IEEE802.16e group.	
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# **An enhancement to the periodic ranging operation dealing with severe 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 stop 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-varying channel characteristics.

## **2. Proposed Remedy**

We introduce a new timer for the purpose of periodic channel measurement and ranging, which is maintained by each MSS. When the timer (say,  $T_n$ ) expires, MSS monitors its downlink signal quality. It may initiate a ranging operation by sending a RNG-REQ message depending on whether the signal quality (e.g., average CINR) is higher than a threshold (say,  $CINR_{threshold}$ ). 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 MSS mode: awake mode or sleep mode. The MSS in awake mode can always monitor its downlink channel, so it doesn't need to measure the downlink signal quality only when its  $T_n$  timer expires. Therefore, the MSS may start the ranging operation if it finds out its signal quality lower than the  $CINR_{threshold}$ . To prevent frequent ranging operations, the  $T_n$  timer, in this case, plays a role to ignore any ranging attempt until  $T_n$  amount of time passes from the end of the last ranging.

On the other hand, the MSS in sleep mode cannot monitor its downlink channel during its sleep interval. Since the long sleep

interval may cause a severe channel degradation or even synchronization failure, the MSS wakes up to monitor the downlink channel at every Tn timeout. If the measured average CINR is below the CINR\_threshold, it sends a RNG-REQ message to its BS. Otherwise, it doesn't send any message. In addition, considering that the MSS in listening interval shall listen to the downlink channel, we propose that the MSS in listening interval does as if its Tn timer expires. At the end of listening interval, the MSS resets its Tn timer. This modification doesn't affect the current sleep mode behavior of BS.

### 3. Proposed Text Changes

*[Add the following text in Page 32, Line 22]*

#### 6.4.10.2 Uplink periodic ranging

*[At the end of the paragraph in 6.4.10.2, add:]*

(7) The MSS may perform a conditional ranging by monitoring the downlink channel signal quality. The MSS may maintain a Tn timer for triggering the conditional ranging. The expiration of this timer indicates to the MSS that it may monitor the downlink channel and compare the measured average CINR value with CINR\_threshold defined in Table 269a. If the average CINR is below the threshold level, the MSS may initiate a ranging operation by sending a RNG-REQ message. Otherwise, it doesn't do anything except the timer reset.

*[Modify the paragraph of 6.4.17.1 in Page 35, Line 32 as follows]*

#### 6.4.17.1 Introduction

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, through one or more sleep-window-iterations. During a sleep-window, an MSS does not send or receive PDUs, has no obligation to listen to DL traffic and may powerdown one or more physical operation components. When the Tn timer expires, however, the MSS may perform the conditional ranging. If the MSS sends a RNG-REQ message, it shall stay awake until the normal ranging operation ends. Otherwise, the MSS may go back to sleep. 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 may also perform the conditional ranging. The MSS shall decide whether to stay awake or go back to sleep based on a positive MOB\_TRF-IND from the Serving BS. If the MSS sends a RNG-REQ message, it shall stay awake until the normal ranging operation ends, irrespective of the MOB\_TRF-IND. 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 59, Line 34]*

System	Name	Time Reference	Minimum Value	Default Value	Maximum Value
<u>MSS</u>	<u>Tn</u>	<u>When this timer expires, the MSS performs the conditional ranging based on the channel quality measurement.</u>	<u>200ms</u>		<u>30s</u>
<u>MSS</u>	<u>CINR_threshold</u>	<u>The threshold value to decide whether MSS sends RNG-REQ based on the channel quality measurement</u>			