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Title	The adaptable periodic ranging interval in sleep mode
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Abstract	This document proposes the adaptable periodic ranging interval considering ranging success or fail. If periodic ranging is success, the frame number for next periodic ranging shall be increased.
Purpose	Discuss and adapt proposed text and message format.
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The adaptable control of periodic ranging considering ranging success or fail

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1. Problem Statement

Periodic ranging allows the SS to adjust transmission parameters so that the SS can maintain uplink communications with the BS. If periodic ranging fails, initial ranging is tried and periodic ranging is retried after initial ranging. In the sleep mode, periodic ranging is performed only once for each sleep interval. 'IEEE C80216e-04/330' proposed the Sleep mode supporting the periodic ranging for multiple periodic ranging during long sleep intervals.

Ranging interval for periodic ranging is defined by T27 timer It is not optimized value for efficient periodic ranging in sleepmode. If T27 timer is too short, unnecessary periodic ranging is occurred and it increases the system overhead. Whereas the infrequent period ranging is more preferred for high capacity, but it can increase the ranging failure. If T27 timer is too long, possibility of periodic ranging failing may increase, which in turn requires MSS to perform initial ranging. Consequently ranging process takes longer time and more related messages will be created. Ranging interval of periodic ranging is adequately selected by considering both ranging success and message overhead. Optimized ranging interval for periodic ranging is necessary and it can vary according to wireless channel and user mobility. Thus it is preferable for the system performance that optimized ranging interval should be varied by channel environment.

2. Proposed Remedy

We propose that ranging interval is dynamically adjusted on ranging success or failure with maximum and minimum value of interval for MSS in sleep mode. And this value should be reflected on the Frame number of next periodic ranging sent to the MSS by BS in MOB-SLP-RSP or RNG_RSP with ranging status set to 'success'.

2.1 adaptable periodic ranging in sleep mode

Adaptable periodic ranging makes the network operator change ranging period. Ranging period is changed by linearly or exponentially. If the network operator selects the linear method for adaptable ranging period, periodic ranging interval is increased by number of fixed frames. Network operator sets the ranging period step by unit of frame such as 8, 9, 10 frames. Minimum value of ranging period step size is 1 frame and its maximum value is the initial sleep window size. If the network operator selects the exponential method for adaptable ranging period, periodic ranging interval is increased by previous sleep window size, I_{k-1}. Ranging period step size has one of 0, $I_{k-1}/16$, $I_{k-1}*2/16$, $I_{k-1}*3/16$, …, $I_{k-1}*15/16$, and I_{k-1}. Periodic ranging interval is increased by exponentially because Ik is double of Ik-1. Its minimum value is 0 and maximum value is Ik-1. If network operator set ranging period step size into Ik-1, periodic ranging is occurred once every sleep interval unrelated with sleep window size. Table 2.1 shows the parameter value for adaptable periodic ranging. Minimum and maximum value of ranging period is initial sleep window size and present sleep window size, respectively.

Table 2.1 Parameter value for adaptable periodic ranging

	Default	Minimum	Maximum
Ranging Period		Initial sleep window	Present sleep window
Ranging period step size (linear)	10 Frame	0 Frame	Initial sleep window
Ranging period step size (exponential)	Half frame of present sleep window	0 Frame	previous sleep window

Present sleep window size Ik = min{2 * previous sleep window size Ik-1, final sleep window}

_ Available ranging period step size

Configurable Step Size for Linear method: 0, 1, 2, 3, …, initial sleep window size [unit: frame]

Configurable Step size for Exponential method: 0, max ($I_{k-1}*m/16$, 1) [m = 1,2,3,…,16]

3. Proposed Text Changes

[Adopt following changes to section 6.3.19.3 Periodic Ranging in sleep mode]

6.3.19.3 Periodic Ranging in sleep mode

For each MSS in Sleep Mode, during its listening-window, BS may allocate an UL transmission opportunity for periodic ranging. Alternatively, BS may return the MSS to Normal Operation using MOB-TRF-IND to keep it in active state until assignment of a UL transmission opportunity for periodic ranging, or let the MSS know when the periodic ranging opportunity shall occur with Next Periodic Ranging TLV in last successful RNG-RSP.

During periodic ranging or negotiation of Sleep Mode, after RNG-REQ (or MOB_SLP-REQ) reception, BS may send RNG-RSP

(or MOB_SLP_RSP, respectively) including Next Periodic Ranging TLV so that MSS shall know when to perform periodic ranging. In the frame specified by Next Periodic Ranging TLV, the MSS shall decode all consequent UL-MAP messages waiting for a UL unicast transmission opportunity for periodic ranging. When such an opportunity occurs, the MSS shall transmit a RNG-REQ message to the BS and then perform the regular procedure for periodic ranging (i.e. wait for RNG-RSP, etc...). A successful periodic ranging procedure does not interrupt Sleep Mode. In the case where periodic ranging procedure fails, the MSS shall perform Initial Ranging procedure or handover to another BS.

When the periodic ranging operation between MSS and BS successfully processes, the BS may inform the MSS of the frame number in which the next periodic ranging operation is expected to start. For that, BS shall append a Next Periodic Ranging TLV encoding to the RNG-RSP message. Next Periodic Ranging is controlled by network operator. Next Periodic Ranging is changed by linearly or exponentially. If the network operator selects the linear method for Next Periodic Ranging, Next Periodic Ranging is increased by number of fixed frames. Network operator sets the ranging period step by unit of frame such as 8, 9, 10 frames. Minimum value of ranging period step size is 1 frame and its maximum value is the initial sleep window size. If the network operator selects the exponential method for Next Periodic Ranging, periodic ranging interval is increased by previous sleep window size, I_{k-1}. Ranging period step size has one of 0, $I_{k-1}/16$, $I_{k-1}*2/16$, $I_{k-1}*3/16$, …, $I_{k-1}*15/16$, and I_{k-1}. Next Periodic Ranging is increased by exponentially because I_k is double of I_{k-1}. Its minimum value is 0 and maximum value is I_{k-1}. If network operator set ranging period step size into I_{k-1}, periodic ranging is occurred once every sleep interval unrelated with sleep window size. Table 2.1 shows the parameter value for adaptable periodic ranging. Minimum and maximum value of ranging period is initial sleep window size and present sleep window size, respectively.

Table xxx. Parameter value for adaptable periodic ranging

	Default	Minimum	Maximum
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Ranging period step size (linear)	10 Frame	0 frame	Initial sleep window
Ranging period step size (exponential)	Half frame of present sleep window	0	previous sleep window

Present sleep window size Ik = min{2 * previous sleep window size Ik-1, final sleep window}

_ Available ranging period step size

Configurable Step Size for Linear method: 0, 1, 2, 3, …, initial sleep window size [unit: frame]

Configurable Step Size for Exponential method: 0, I_k max (I_{k-1}*m/16, 1) [m = 1,2,3,…,16]

BS also may inform MSS of the existence of DL Traffic addressed to MSS. For that, BS shall include the Next Periodic Ranging TLV with a value set to zero. If an MSS receives the RNG-RSP message with this indication from the BS, then the MSS shall immediately exit Sleep Mode and resume Normal Operation with the BS. The BS may include a SLPID_Update TLV item in a RNG-RSP message for an MSS in Sleep Mode. If the Serving BS receives a RNG-REQ message from an MSS in Sleep Mode and there is any need to update SLPID assigned to the MSS, the BS shall append a SLPID_Update TLV to the RNG-RSP message only for a RNG-RSP message with ranging status flag set to ‘success’. When the received RNG-RSP message with ranging status flag set to ‘success’ includes a SLPID_Update TLV, the MSS shall decode the TLV and update its SLPID to the new one. The MSS shall identify if the SLPID_Update TLV addresses it by searching through the SLPID_Update TLV and determining if the MSS’s current SLPID matches the Old_SLPID in the SLPID_Update TLV. If they match, then the MSS shall set its SLPID to the New_SLPID provided in the SLPID_Update TLV. For an example of sleep mode operation, see Annex E.