Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	Enhanced Paging with Assigned Ranging Code – Harmonization Ad-hoc Consensus Contribution	
Date Submitted	**2004-08-28**	
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Re:	IEEE P802.16e/D4-2004	
Abstract	This contribution proposes enhanced paging by assigning dedicated ranging resource	
Purpose	Review and Adopt the suggested changes into P802.16e/D4	
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1 Introduction

In p802.16e/D4, the Idle Mode is an optional mode as described in Section 6.3.21. The BS pages the MSS using MOB_PAG_ADV message which includes the MSS's MAC address hash. After receiving this message, with action code set to '01', the MSS shall perform initial ranging to establish location and acknowledge paging. If the action code is set '10', the MSS shall perform initial ranging and enter the network. The initial ranging includes sending initial ranging code in OFDMA ranging channel, waiting for reply (RNG_RSP or CDMA_Allocation_IE) and retrying if no expected reply is received. The above procedure may introduce long delay due to possible collision and back-off.

The currently defined initial ranging is performed on a randomly chosen Ranging Code within the initial ranging code domain. The access operation is therefore contention based. This is not efficient for the case of paging (MOB_PAG_ADV) with action code of either '01' or '10'. This is because when the BS pages a MSS, the event of response from the MSS is a deterministic event and is fully under the control of the BS. As such, the access operation of initial ranging can be made contention free. Here, we propose to modify the current paging-and-response procedure by assigning a dedicated ranging channel (code) to a MSS at the same time when BS pages a MSS in Idle Mode. In this way, the possible collision and back-off can be completely avoided.

2 Proposed Procedure

The following summarizes the proposed procedure:

- Each BS reserves a small amount of codes based on the loading situation
- When a BS pages a MSS, optionally, a dedicated code may be assigned to the MSS in the MOB-PAG_ADV message
- The MSS, after receives the paging, shall use the assigned code to perform ranging until the MSS receives the CDMA _Allocation_IE to obtain a dedicated resource to send RNG_REQ

The following figures show the procedure to support the efficient paging (including waking up an idle MSS and BS initiated Idle MSS location update).

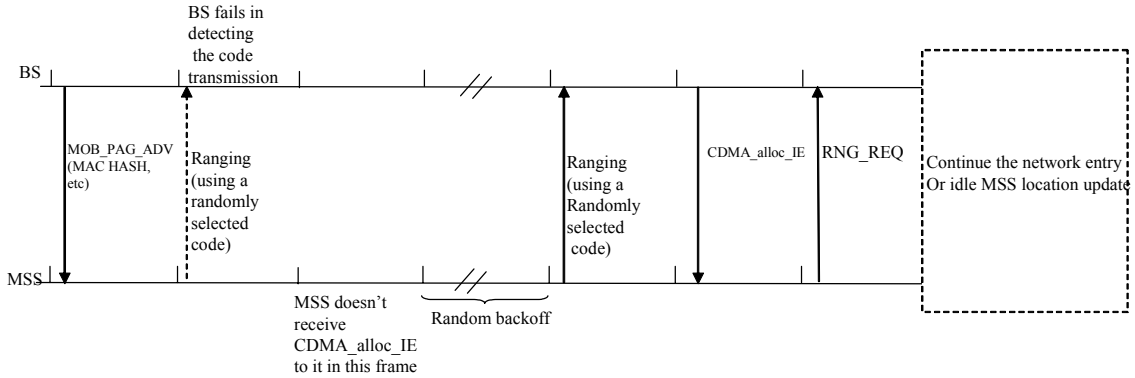
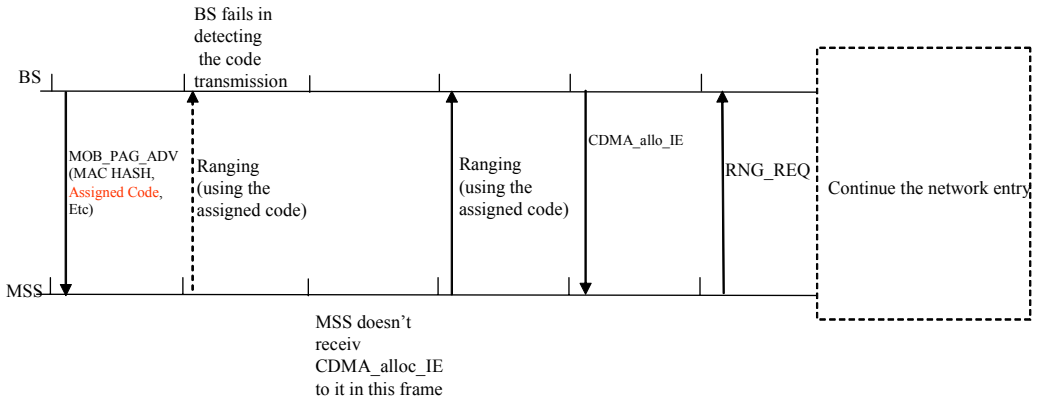


Fig. 1 Current paging procedure.

In current paging procedure, after a MSS receives MOB_PAG_ADV message with its MAC hash included, the MSS will perform normal OFDMA based ranging operation. A back-off is required for collision resolution if a MSS doesn't receive an expected CDMA_alloc_IE with resource assignment.



Fig, 2. The proposed solution.

In the proposed solution, when a BS in the paging group assigns the ranging resource (i.e., code by MOB_PAG-ADV and region by UL-MAP in the next frame), the paged MSS shall send the assigned ranging code in consecutive frames during the page-response window (a parameter defined in MOB-PAG-ADV message). If the MSS receives a RNG-RSP message with status set to 'continue', before the end of the page-response window, the MSS shall stop consecutive frame transmission of the assigned ranging code and respond by a single transmission of the assigned ranging code with adjusted time, power and frequency based on the information received in the RNG_RSP message. The MSS shall continue using the assigned ranging code to respond to each RNG_RSP message received, until a RNG_RSP with status set to 'success' is received. Once the MSS receives a RNG_RSP message with status set to 'success', the MSS shall stop transmitting the assigned ranging code and wait for the CDMA_Allocation_IE() to send RNG_REQ message.

After a transmission of the assigned ranging code, if the MSS does not receive a RNG-RSP message after a certain period (T3), the MSS shall perform normal initial ranging procedure to respond to the paging (i.e., the assigned ranging resource is no longer valid). On the BS side, if after paging a MSS with assigned ranging code and region, the BS receives the code transmitted by the paged MSS, the BS shall send RNG-RSP to adjust time, power and frequency of the MSS. If the BS does not receive the expected code from a paged MSS after the expiry of the page-response window, the assigned ranging resource shall be automatically released.

By implementing the proposed enhancement, the paging/response procedure can be accelerated since the delay caused by contention mechanism can be avoided.

3 Proposed Text Changes

The following modification is based on p802.16e/D3.

[Modify Table 92I – BS Broadcast Paging (MOB_PAG_ADV) message format by adding the assigned ranging channel index and code index.]

Table 92I – BS Broadcast Paging (MOB_PAG-ADV) message format

Syntax	Size	Notes
MOB_PAG_ADV_Message_Format() {		
Management Message Type	8 bits	
Num_Paging_Group_IDs	8 bits	
For (i=0;i< Num_Paging_Group_IDs;i++) {		
Paging_Group_ID	8 bits	
}		

For (j=0;j< Num_MACs;j++) {		
MSS MAC Address hash	24 bits	
Action Code	2 bits	Paging action instruction to MSS 00 = No Action Required 01 = Perform Ranging to establish location and acknowledge message 10 = Enter Network 11 = reserved
}		
TLV Encoded Information	variable	TLV specific
reserved	*variable*	Padding bits to ensure octet aligned
}		

[Insert the following sentences to the end of Section 6.3.2.3.59]

When a BS pages multiple MSSs, the BS may assign dedicated CDMA codes to one or more MSS being paged. The BS shall first list the MAC Address Hash of those MSSs that are assigned dedicated CDMA codes, followed by the MSSs that are not assigned dedicated CDMA codes.

For OFDMA PHY, one ~~or more~~ of the following TLV may be included in the MOB_PAG-ADV management message:

CDMA code assignment (11.14.1)

OFDMA-PHY specific parameter used to indicate ~~an assigned~~ CDMA code assignment to ~~a~~one or more MSS being paged in this message. One CDMA code assignment in the TLV corresponds to one MSS paged. ~~If multiple MSSs are paged in this message, multiple of such fields may be included.~~ The order of the assignments is the same as the order of appearance of MSS MAC address hash in this message.

For OFDMA PHY, the following TLV fields may be included in the MOB_PAG-ADV management message. If a CDMA code assignment TLV is included, the Page-Response window TLV shall be included. There shall be no more than one occurrence of the Page-Response window TLV.

Page-Response window (11.14.2)

[Modify the following text in section 6.3.21.8.1 to describe enhanced paging procedure]

An MSS shall terminate Idle Mode and re-enter the network if it decodes a BS Broadcast Paging message that contains the MSS own MSS MAC Address hash and an Action Code of 10, enter network. In the event that an MSS decodes a BS Broadcast Paging message that contains the MSS own MSS MAC Address hash and an Action Code of 01, Perform Ranging, the MSS shall conduct and complete Initial Ranging to establish location to the network and acknowledge message decoding. In both cases, if a PHY specific ranging code is assigned to the MSS in the MOB_PAG-ADV message, the MSS shall perform initial ranging by transmitting the code assigned in the MOB_PAG-ADV message on the dedicated ranging region assigned in the UL-MAP-IE (UIUC = 12 and dedicated ranging indicator bit set to '1').

The procedure for PHY specific ranging code operation is described as follows:

- After receiving the MOB_PAG-ADV, the MSS shall transmit the assigned ranging code at the assigned ranging region in consecutive frames during the Page-Response window. The consecutive transmission can be terminated early if the MSS receives a RNG-RSP before the end of the Page-Response window.
- In the case where RNG-RSP message with 'continue' status is received, then the BS may allocate in the DL-MAP dedicated ranging region, in this case, the MSS shall use the assigned ranging code provided in the MOB_PAG-ADV message.
- In the case where no RNG-RSP message is received or no dedicated ranging region is assigned to the MSS, the MSS shall continue with the normal initial ranging procedure, as described in 6.3.10.
- In all other cases the MSS shall use normal initial ranging procedure, as described in 6.3.10.

[Modify Table 285-OFDMA UL-MAP IE format]

Table 285-OFDMA UL-MAP IE format

Syntax	Size	Note
UL-MAP_IE() {		
CID	16 bits	
UIUC	4 bits	
If (UIUC == 12) {		
OFDMA Symbol offset	8 bits	
Subchannel offset	7 bits	
No. OFDMA Symbols	7 bits	
No. Subchannels	7 bits	
Ranging Method	2 bits	0b00 – Initial ranging over two symbols 0b01 – Initial ranging over four symbols 0b10 – BW request/Periodic Ranging over one symbol 0b11 – BW Request/Periodic Ranging over three symbols
~~*reserved*~~Dedicated ranging indicator	1 bit	1: the OFDMA region and Ranging Method defined are used for the purpose of ranging using dedicated CDMA code assigned in the MOB-PAG-ADV message. 0: the OFDMA region and Ranging Method defined are used for the purpose of normal ranging
}elseif (UIUC==14) {		
CDMA_Allocation_IE()	32bits	
elseif(UIUC==15) {		
Extended UIUC dependent IE	Variable	See clauses following 8.4.5.4.3
}else (		
Duration	10 bits	In OFDMA slots(see8.4.3.1)
Repitition coding indication	2 bits	0b0 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11 – Repetition coding of 6 used
}		
Padding nibble, if needed	4 bits	Complting to nearest bytes, shall be set to 0
}		

[Insert the follow to the end of Section 8.4.5.4]

8.4.5.4 UL-Map IE format

[…..]

Dedicated ranging indicator

BS shall set this field to 1 to indicate that the defined region is dedicated to page-response ranging. Otherwise, the BS shall

set this field to 0 to indicate that the defined region is for normal ranging.

[Insert Section 11.17 MOB_PAG-ADV management message encodings]

11. 17 MOB_PAG-ADV management message encodings

The encoding described in this section is specific to the MOB_PAG-ADV message (6.3.2.3.59)

11. 17.1 CDMA code assignment

This field indicates the assigned code for a MSS who is paged to use over CDMA ranging channel.

Type	Length	Value	PHY Scope

150	~~1~~variable; N_assign + N_assign x 8) bits	Bit #0 - #7: N_assign
		Subsequent (N_assign x 8) bits:
		for (i = 0, i < N_assign, i++) {
		8-bits code index assigned to a MSS who is paged
		}
			OFDMA

11. 17.2 Page-Response Window

This field indicates the Page-Response window for a MSS who is paged to transmit the assigned code for CDMA ranging channel.

Type	Length	Value	PHY Scope
152	1	Page-Response window, in frames	OFDMA