Performance Evaluation of Proposed Physical Structure for BW REQ Channel

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None

Purpose:

To be discussed and adopted by TGm for the 802.16m AWD

Performance Evaluation of Proposed Physical Structure for BW REQ Channel

July, 2009

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Objective (I)

- **PHY structure for BW REQ channel**
  - have two separate parts : Preamble part and Message part

- **BW REQ Preamble**
  - Used for both 3 & 5 steps
  - 24 binary orthogonal sequence for non-coherent detection and multiuser channel estimation

- **BW REQ Message**
  - Used only for 3 step BR procedure
  - Can carry 12bit BR information

Objective (II)

Q1 : How can the BS identify 3step and 5step BR procedure?

- On/Off Detection for BR Message
- Is it enough for performance requirements?

Q2 : How can the BW REQ preamble be exploit efficiently?

- Make full use of 24 sequences to Minimize contention probabilities for both 3step and 5step BR procedure

- **This contribution provides the efficient method to select BW REQ preambles**
  - Can help BS to identify BR steps
  - Minimize the contention probability of BW REQ preamble

BW REQ Information Contents

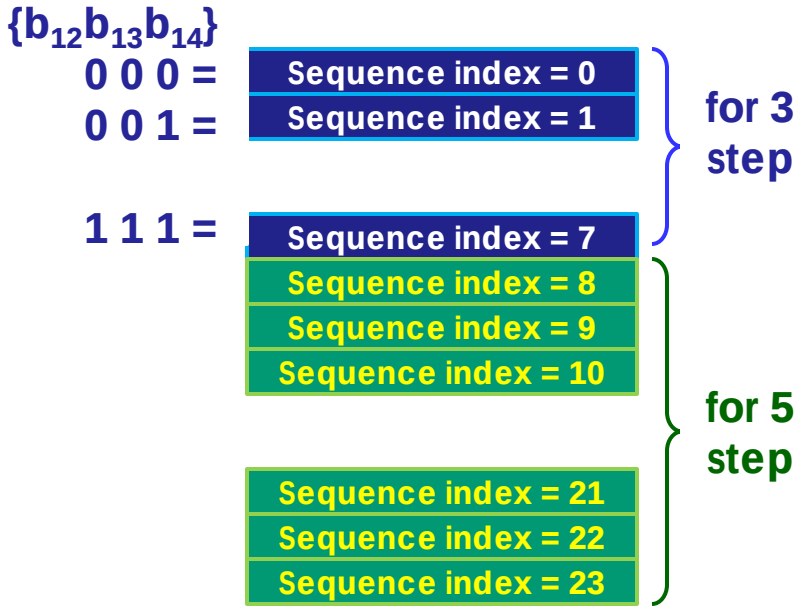
- **BW REQ information for 3step BR procedure**
  - Station ID [12bits] : $\{s_0 s_1 s_2 s_3 s_4 s_5 s_6 s_7 s_8 s_9 s_{10} s_{11}\}$
  - Predefined BW size [3 ~~or 4~~bits] : $\{q_0 q_1 q_2\}$
    - If the BR is not urgent, MSs will try 5 step procedure
    - 3 bit is enough for differentiating delay sensitive BR types
    - [Refer to the contribution C80216m-09/0609]

- **Reordering of BW REQ information**
  - To minimize BW REQ preamble's contention probability among MSs with the same QoS type
  - BR information [15bits]:
    $\{b_0 b_1 b_2 b_3 b_4 b_5 b_6 b_7 b_8 b_9 b_{10} b_{11} b_{12} b_{13} b_{14}\}$

$$= \{\underbrace{s_0 s_1 s_2 s_3 s_4 s_5 s_6 s_7 s_8 s_9 q_0 q_1}_{\text{Through BR message}} \underbrace{q_2 s_{10} s_{11}}_{\text{Through BR preamble}}\}$$

Preamble Selection (I)

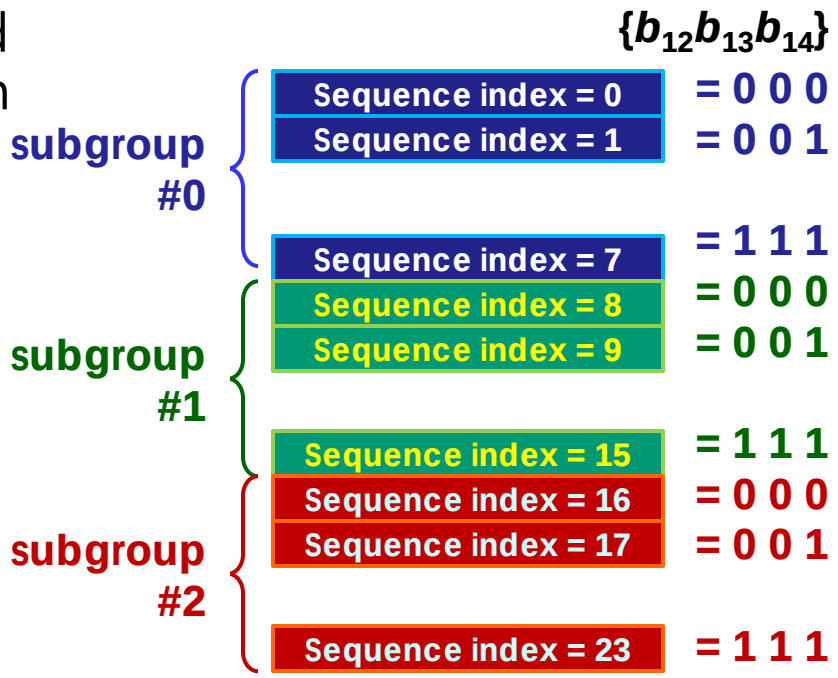
- **No additional mapping rule**
  - Only 8 preamble sequences are used for 3step BRs
  - When 2MSs are trying 3step BR in a BW REQ channel, the *CPr is 1/8 = 12.5%
  - [2MS + both 5 step] CPr is 1/16 = 6.25%
  - **Too High CPr!**
  - BS can identify the BR steps based on the sequence index



*CPr (Contention probability) : the probability that 2MSs choose the same preamble sequence

Preamble Selection (II-A)

- **Subgroup Partition**
  - 24 preamble sequences are divided into 3 subgroups
  - Each subgroup can carry 3bit BR information
  - The subgroup index is selected by the proper rule (provided in the next slide)
  - [2MSs' case] CPr is 1/24 = 4.17% irrespective of the BR step
  - Message detection is inevitable to identify the BR steps



Preamble Selection (II-B)

- **Subgroup Selection**
  - Subgroup index (0~2) is related to the message part of BR information
  - For example, the subgroup index can be calculated as

    subgroup index = mod(bin2dec[$b_{12}b_{13}b_{14}+b_0b_1b_2$], 3)

- **Subgroup recalculation @ BS**
  - After the BS decodes BW REQ preamble and BW REQ message,
  - BS will recalculate the subgroup index based on the received BW REQ message,
  - And Compare with received BW REQ preamble index
  - Error detection equivalent to **1.5bit CRC or Parity Check!! (SPC : Subgroup parity check)**

Error Event Analysis

- **Performance Requirements**
  - '3' : 3step BR, '5' : 5 step BR, '0' : No request
  - Incorrectly detected 3 step : Allocate (wrong size) resource to wrong STID

Case	Error Pattern	Error Type	Penalty due to error (amount)	Requirements
1	(0 ⇒ 5)	Preamble FA	Resource waste (BRH in UL, CDMA alloc in DL)	< 0.1%
2	(0 ⇒ 3)	Preamble FA & message FA	Resource waste (predefined resource)	< 0.1%
3	(5 ⇒ 0)	Preamble MP	BR latency increase (back off)	< 1%
4	(3 ⇒ 0)	Preamble MP & message MP	BR latency increase (back off)	< 1%
5	(3 ⇒ 5)	**Message MP**	BR latency increase (between 3 & 5 steps)	**< 10 %**
6	(5 ⇒ 3)	**Message FA**	Resource waste (predefined resource **allocated to wrong user**)	**< 0.1%**
7	(3 ⇒ 3')	**Message decoding error**	Resource waste (predefined resource **allocated to wrong user**)	**<0.1%**

Simulation Condition

Parameters	Value	Comment
Number of Rx Ant	2Rx	See the backup slide for 4Rx
Detection Method	ML C-SM	Message part
	Non-coherent threshold	Preamble part
Channel coding	TBCC 1/6	For No CRC
	TBCC 1/5 (puncturing last 3bits)	For 3bit CRC
	TBCC 1/4	For 6bit CRC
Channel Model	ITU Pedestrian B 3km/h	< 0.1%
Event generation	Equal probability	3 step & 5 step

Definition of Evaluation Parameters

- **Message FA(False Alarm Probability)**
  = **(Number of detected messages – Number of correctly detected messages) / Number of FA message candidates**
  where the number of FA message candidates = (total number of detected preambles – total number of correctly detected messages)
  [Physical meaning] : BS detects a not-transmitted 3step BR

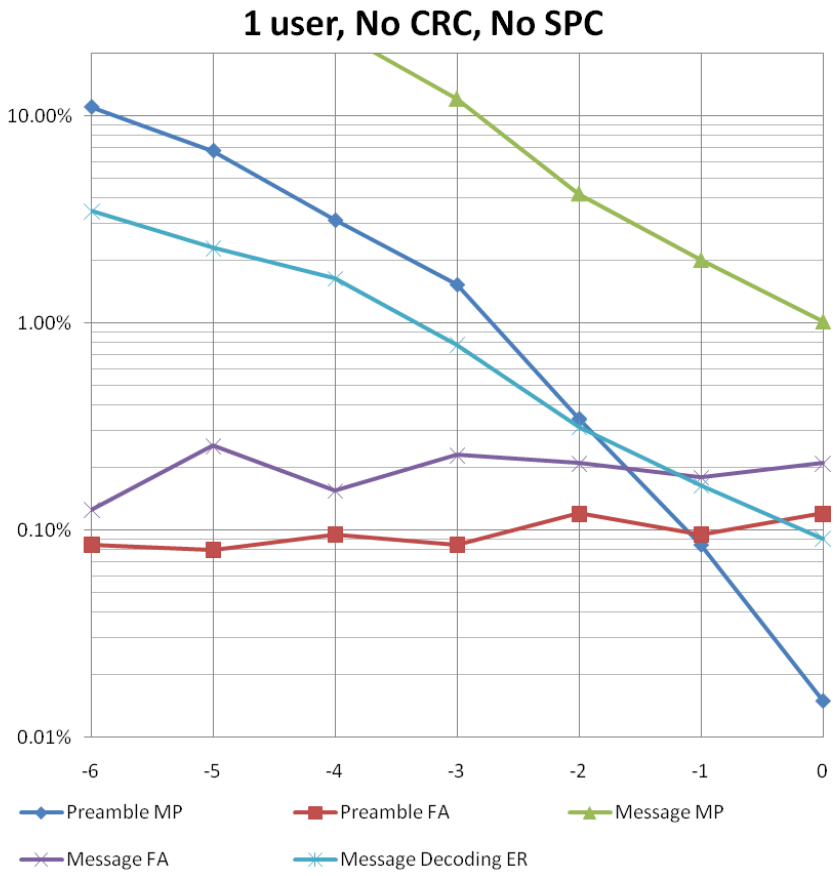
- **Message MP (Missing Probability)**
  = **Number of detected 3 step trials / Number of 3step trials**
  [Physical meaning] : An MS transmits 3step BRs, which is not detected

- **Message Decoding ER (Error Rate)**
  = **Number of successfully decoded BR messages / Number of transmitted & detected 3step trials**

Detection Performance of BW REQ (I)

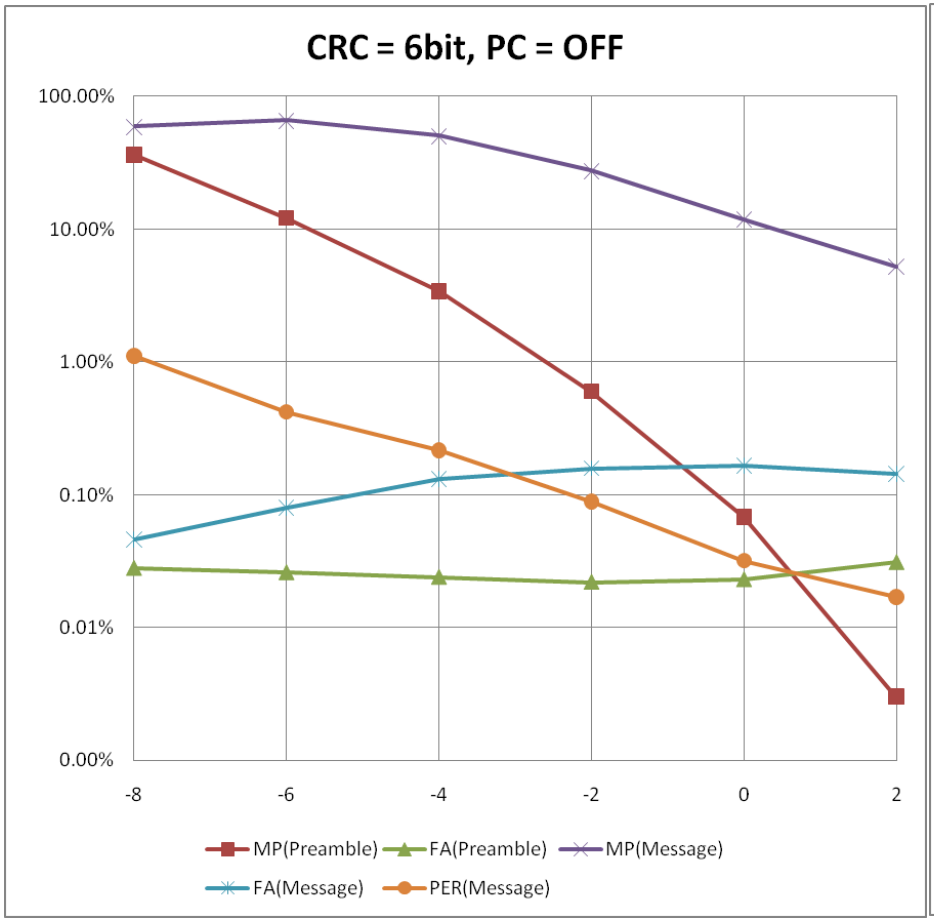
- **1 User,**
  - No CRC & No SPC,
  - For message ON/OFF detection, TBCC decoder's **Survived path metric** value is compared to a specific threshold
  - Target SNR point is **-0.2dB**
  - Performance target is

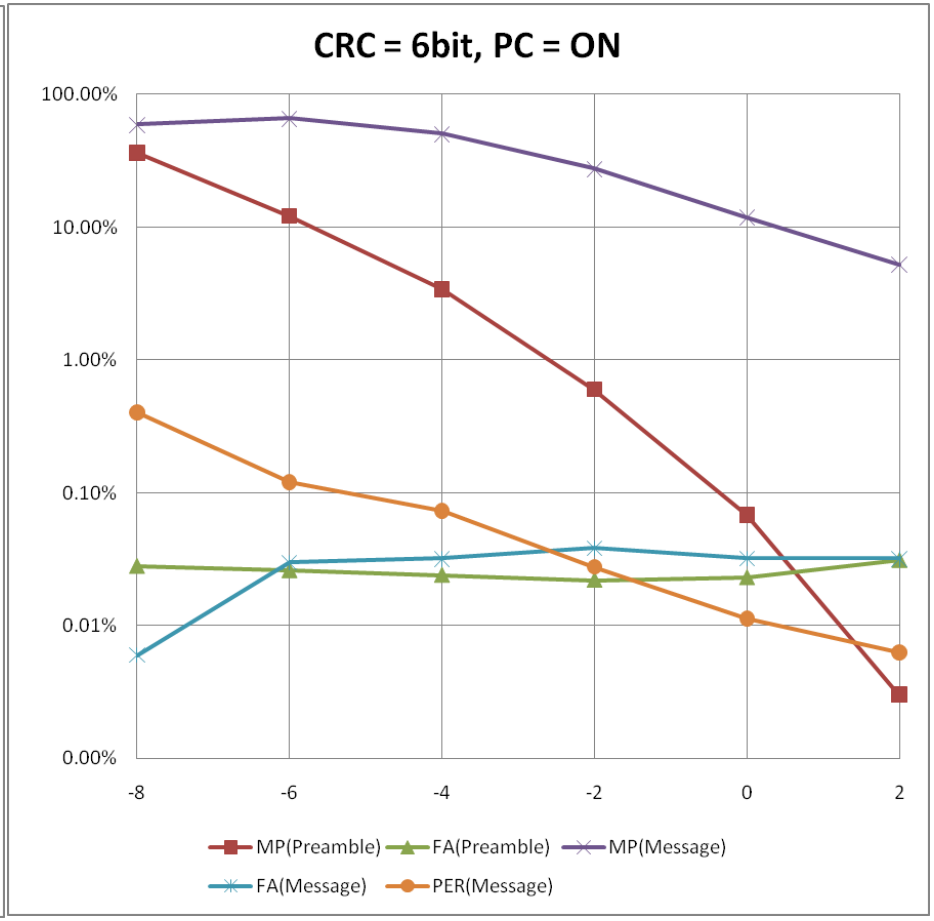
[Preamble] MP = 1 %,
FA = 0.1%,
[Message] MP = 1~10%,
FA = 0.1%,
Decoding ER = 0.1%



Detection Performance of BW REQ (II)

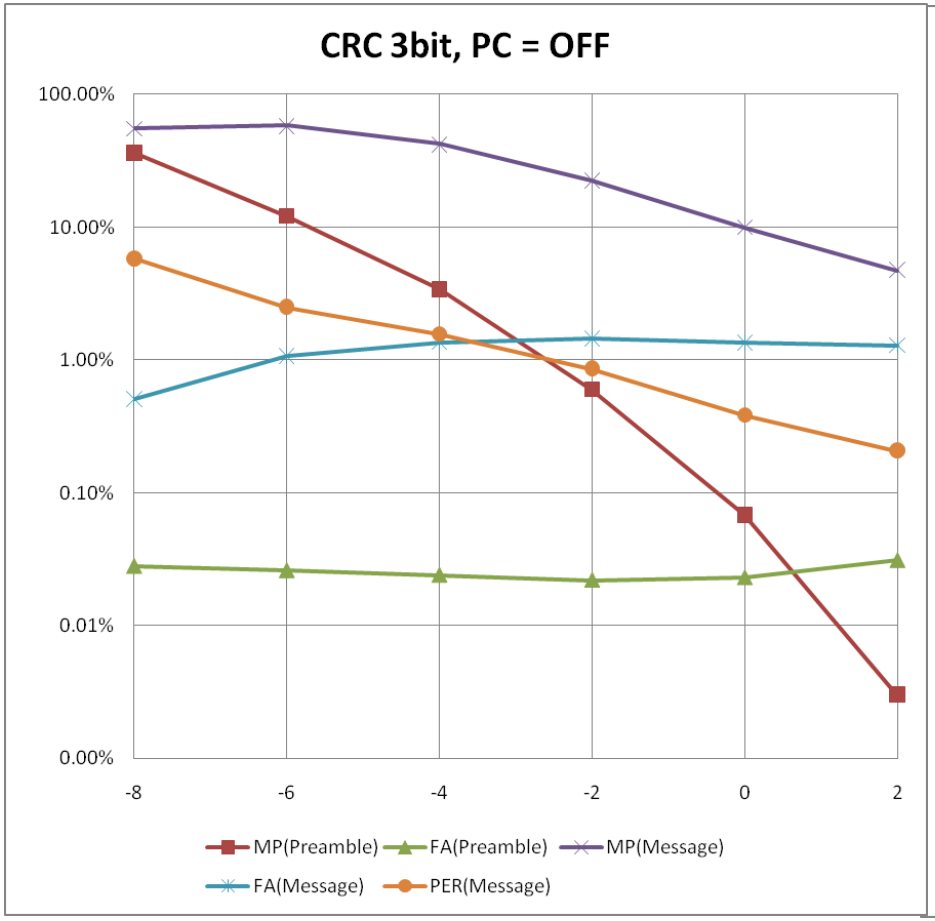
- **2 Users, Ped B 3km/h**
  - **6 bit CRC** for preamble + message part

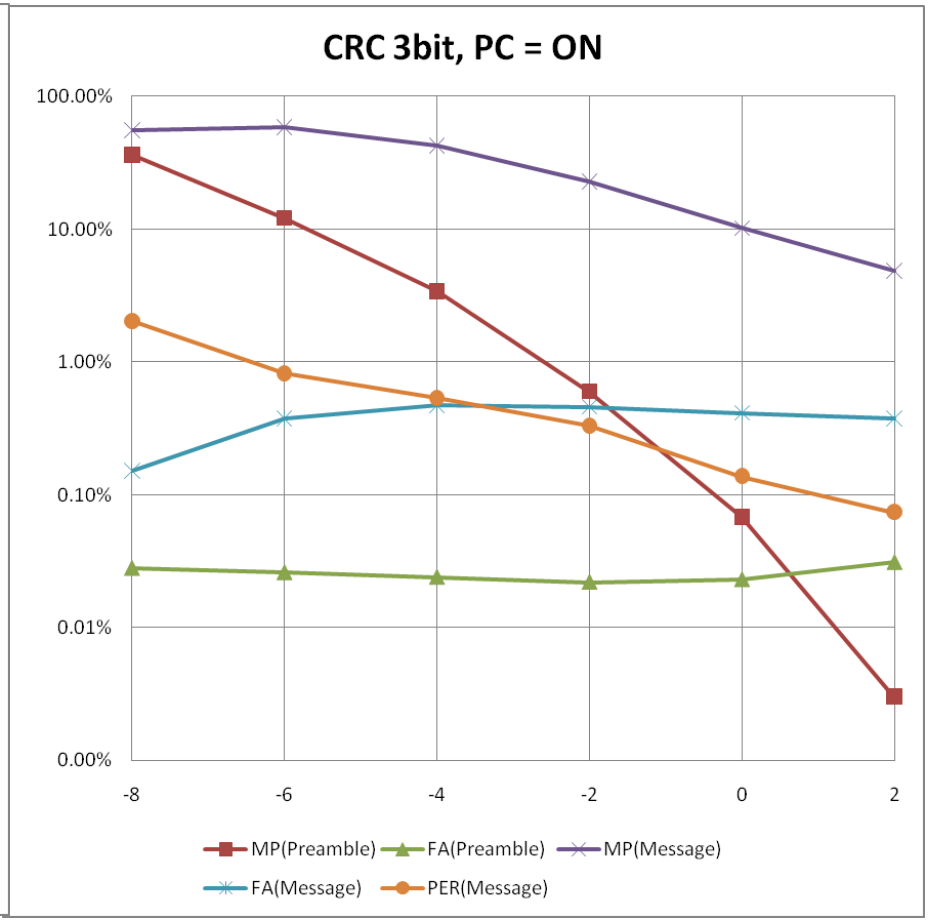




Detection Performance of BW REQ (III)

- **2 Users, Ped B 3km/h**
  - **3 bit CRC** for preamble + message part



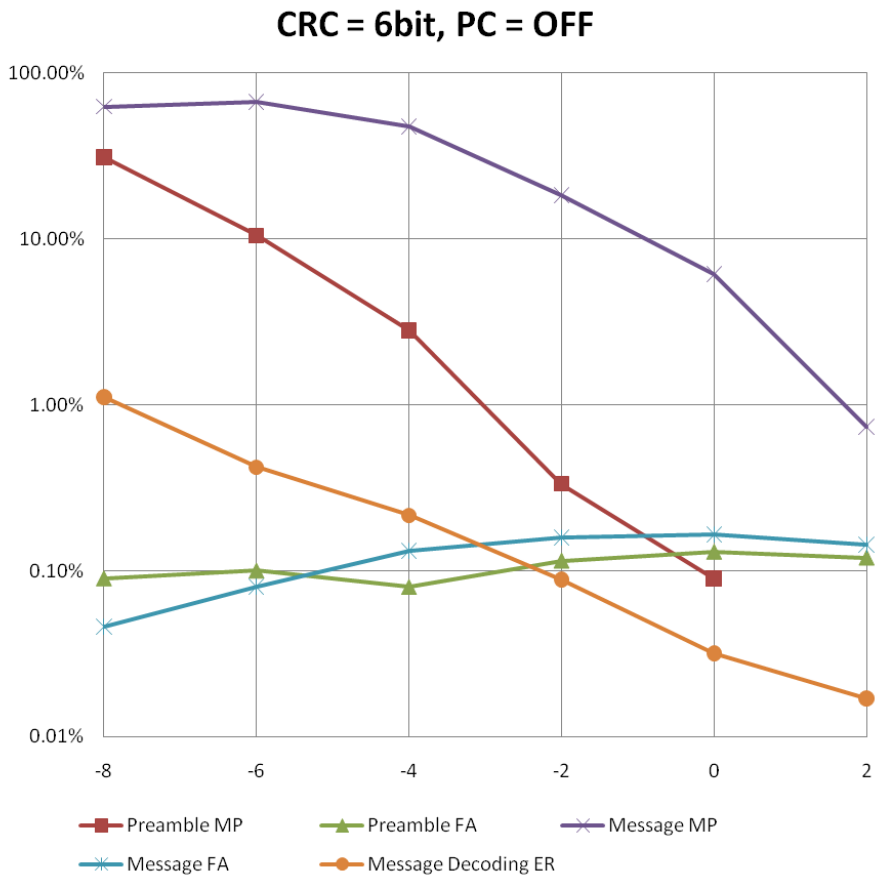


Backup Slide Part I

：CRC only for Message Part

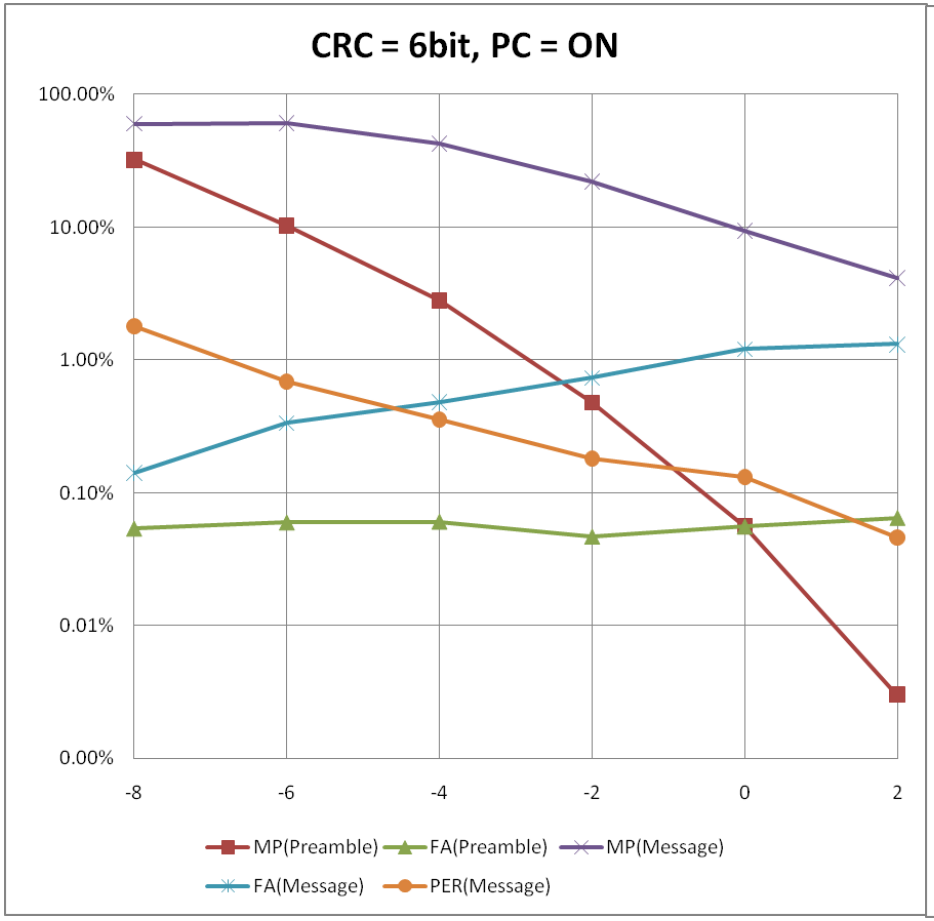
Detection Performance of BW REQ (BU-I)

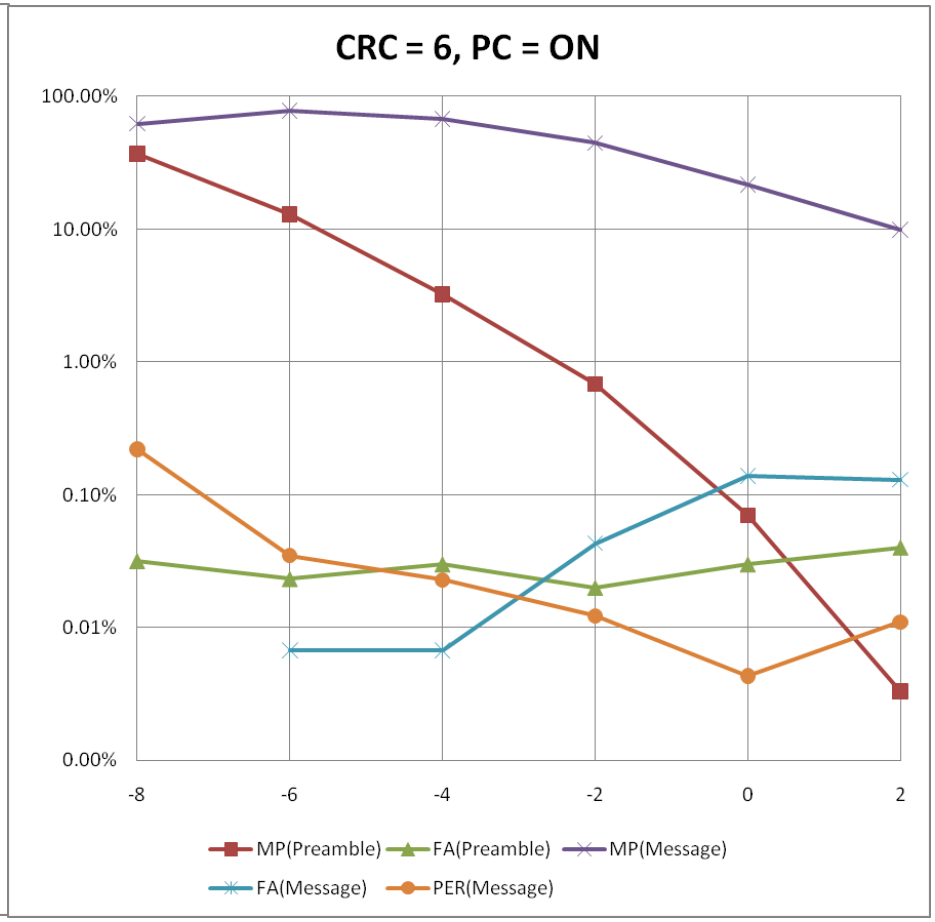
- **1 User,**
  - 6bits CRC & No SPC
  - Target SNR point is **-1.0dB**
  - [Message] MP = 1~10%,



Detection Performance of BW REQ (BU-II)

- **2 Users, Ped B 3km/h**
  - **6 bit CRC** only for message part





Backup Slide Part II

: Performance of BW REQ CH with 4Rx antennas