

Performance Evaluation of Proposed Physical Structure for BW REQ Channel

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Source:

Hwasun Yoo, Kaushik Josiam,

Minho Jang, Heewon Kang

Samsung Electronics Co., Ltd

Voice: +82-31-279-4983

E-mail: hwasun.yoo@samsung.com

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None

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Performance Evaluation of Proposed Physical Structure for BW REQ Channel

July, 2009

Hwasun Yoo, Kaushik Josiam,

Minho Jang, Heewon Kang

Samsung Electronics Co., Ltd

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] : $\{s_0s_1s_2s_3s_4s_5s_6s_7s_8s_9s_{10}s_{11}\}$
- Predefined BW size [3 ~~or~~ 4bits] : $\{q_0q_1q_2\}$
 - 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]:

$\{b_0b_1b_2b_3b_4b_5b_6b_7b_8b_9b_{10}b_{11}b_{12}b_{13}b_{14}\}$

$$= \{s_0s_1s_2s_3s_4s_5s_6s_7s_8s_9q_0q_1q_2s_{10}s_{11}\}$$

Through BR message Through BR preamble

Preamble Selection (I)

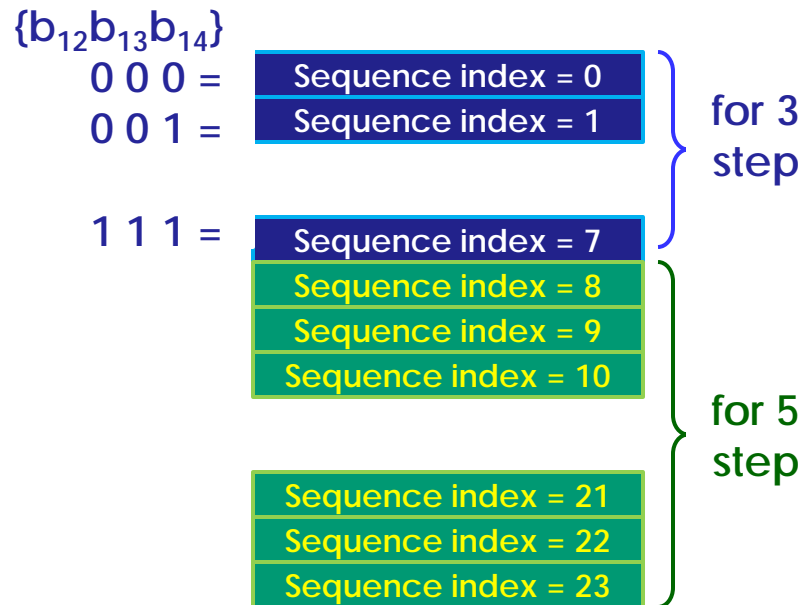
- **No additional mapping rule**

- 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)

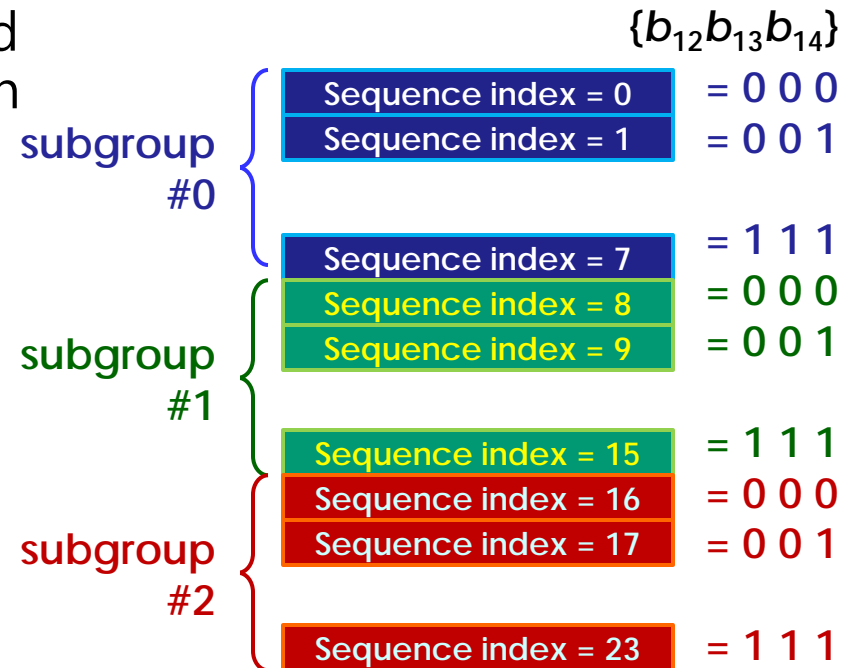
- **Subgroup Partition**

- 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

$$\text{subgroup index} = \text{mod}\left(\sum_{i=0}^3 \text{bin2dec}(b_{3i}b_{3i+1}b_{3i+2}), 3\right)$$

- **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

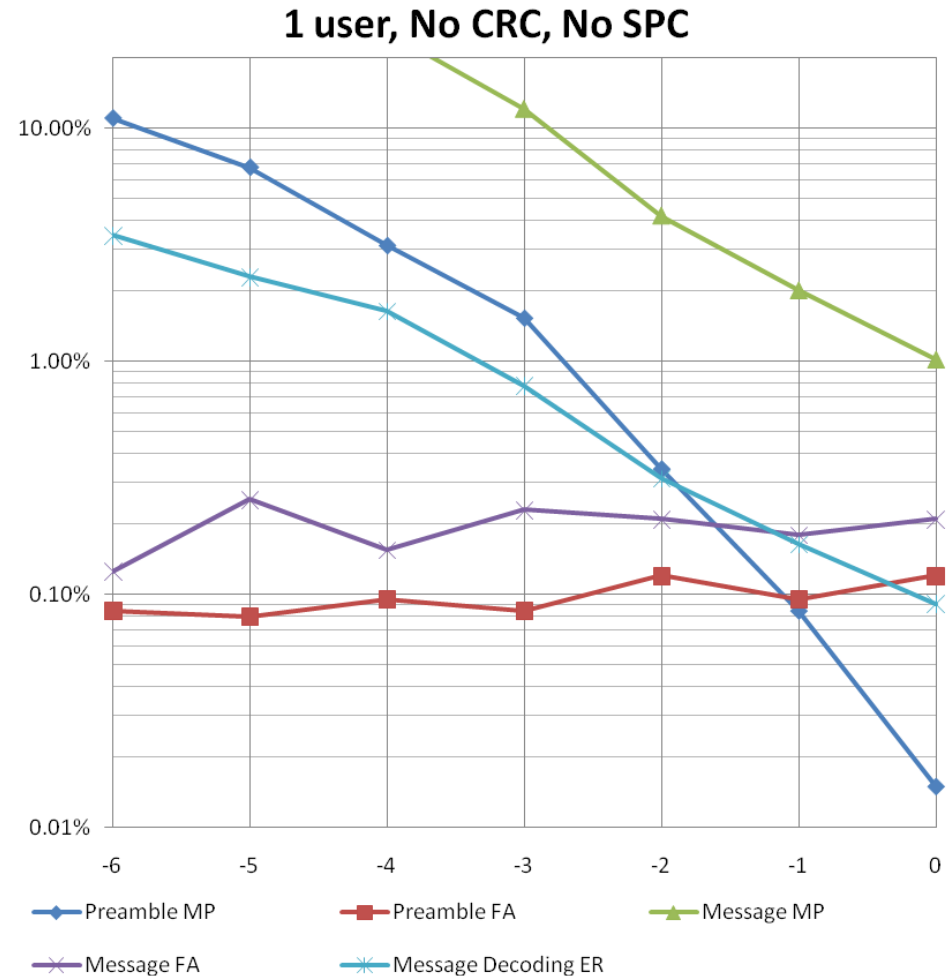
Parameters	Value	Comment
Number of Rx Ant	2Rx	See the backup slide for 4Rx
Detection Method	ML C-SM	Message part
	Non-coherent threshold	Preamble part
Channel coding	TBCC 1/6	For No CRC
	TBCC 1/5 (puncturing last 3bits)	For 3bit CRC
	TBCC 1/4	For 6bit CRC
Channel Model	ITU Pedestrian B 3km/h	< 0.1%
Event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

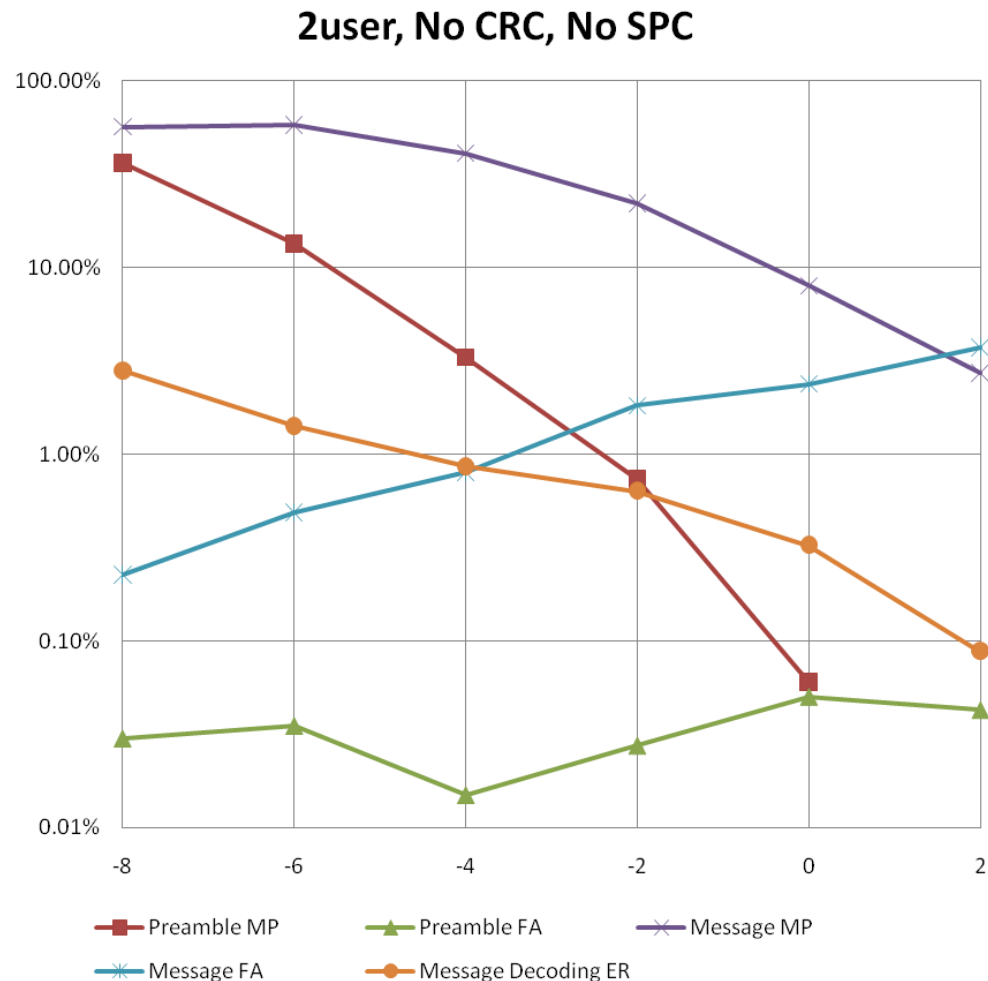
Detection Performance of BW REQ (I)

- **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)

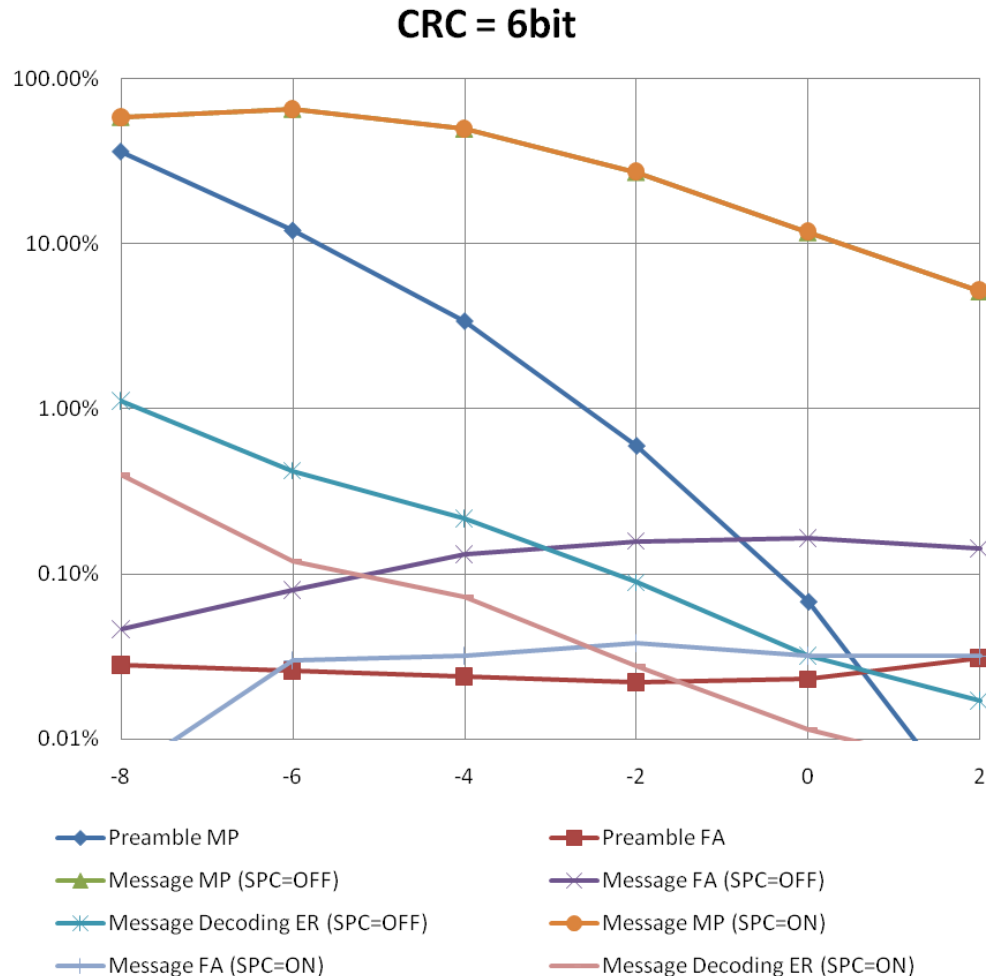
- **2 User,**
 - No CRC & No SPC,
 - For message ON/OFF detection, TBCC decoder's Survived path metric value is compared to a specific threshold
 - **Cannot** meet the **FA** requirement
[Message] FA = 0.1%,
 - **Need** to consider error protection techniques such as **CRC or Parity Check**



Detection Performance of BW REQ (III)

- 2 Users

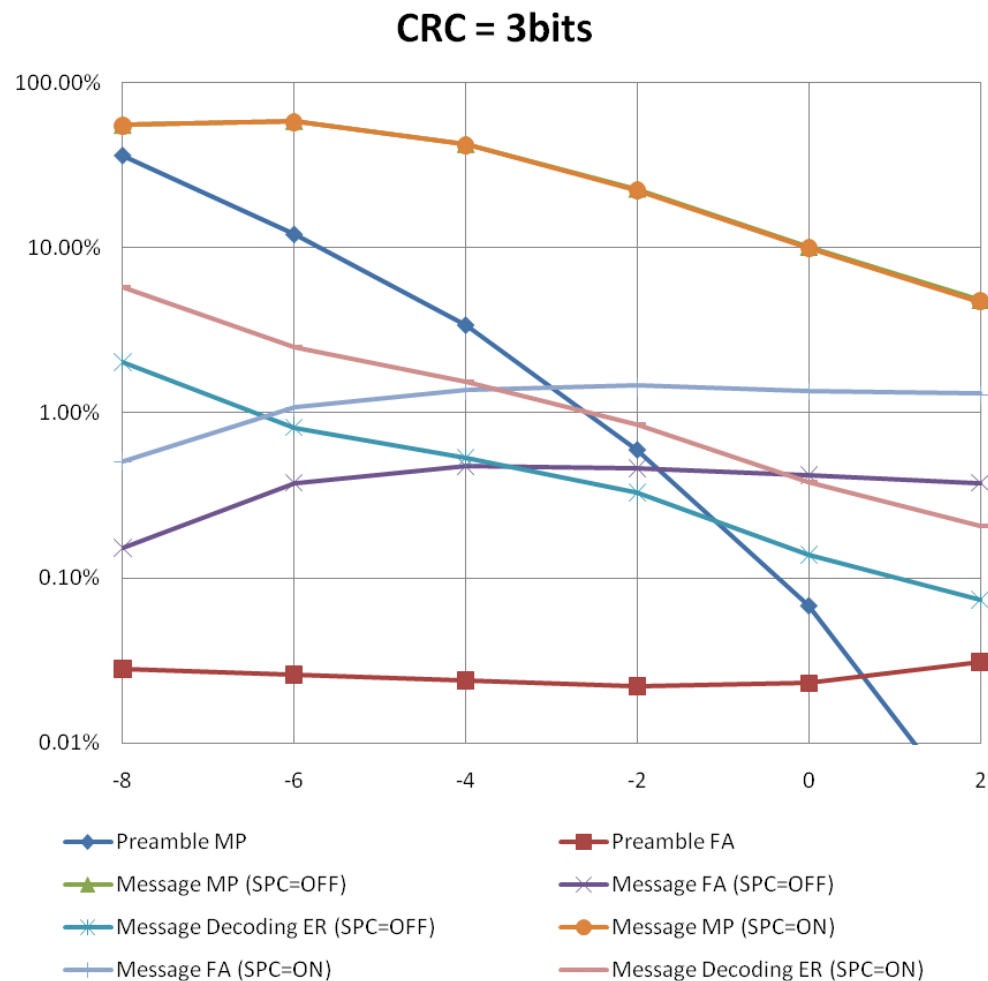
- 6 bit CRC for (preamble + message) part
- SPC ON/OFF
- **SPC can** reduce message FA probability enough to **meet the requirement**
- **No loss** of message missing probability



Detection Performance of BW REQ (IV)

- **2 Users**

- **3 bit CRC** for (preamble + message) part
- SPC ON/OFF
- According to trade-off relation between MP & FA,
- We can set the new threshold to satisfy the requirement with relatively less penalty

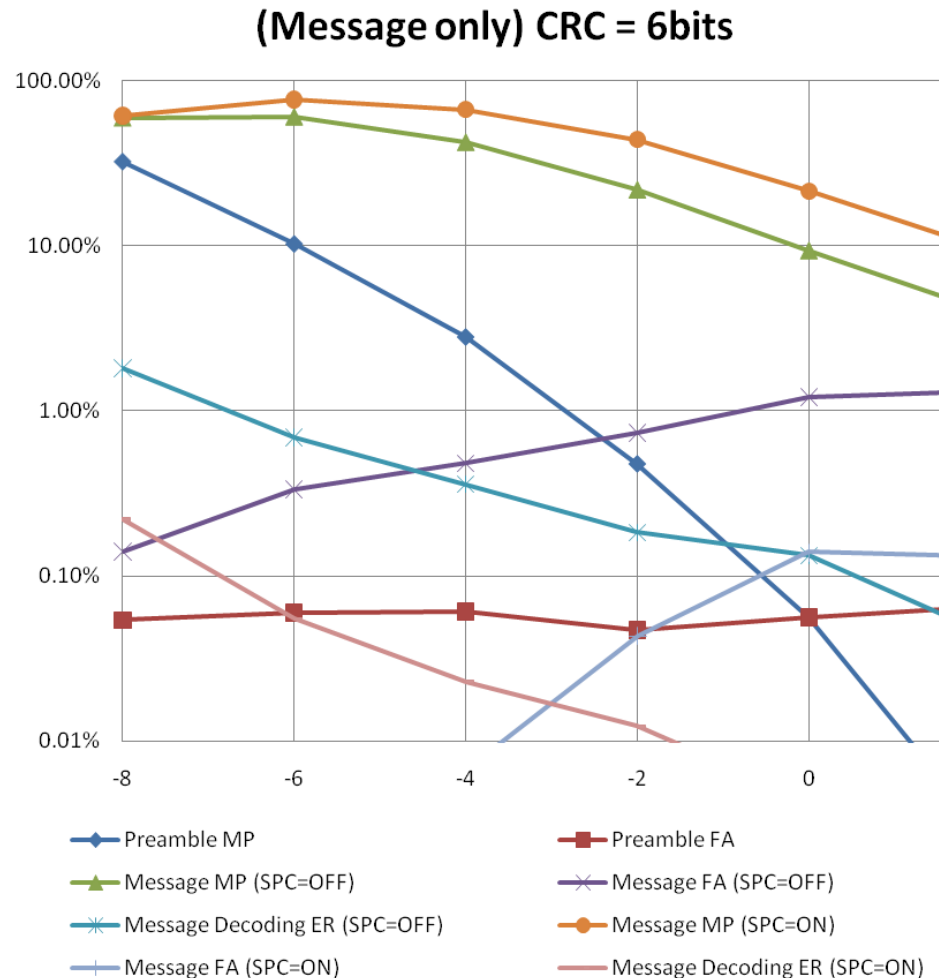


Backup Slide Part I

: CRC only for Message Part

Detection Performance of BW REQ (BU-I)

- 2 Users
 - 6 bit CRC only for message part



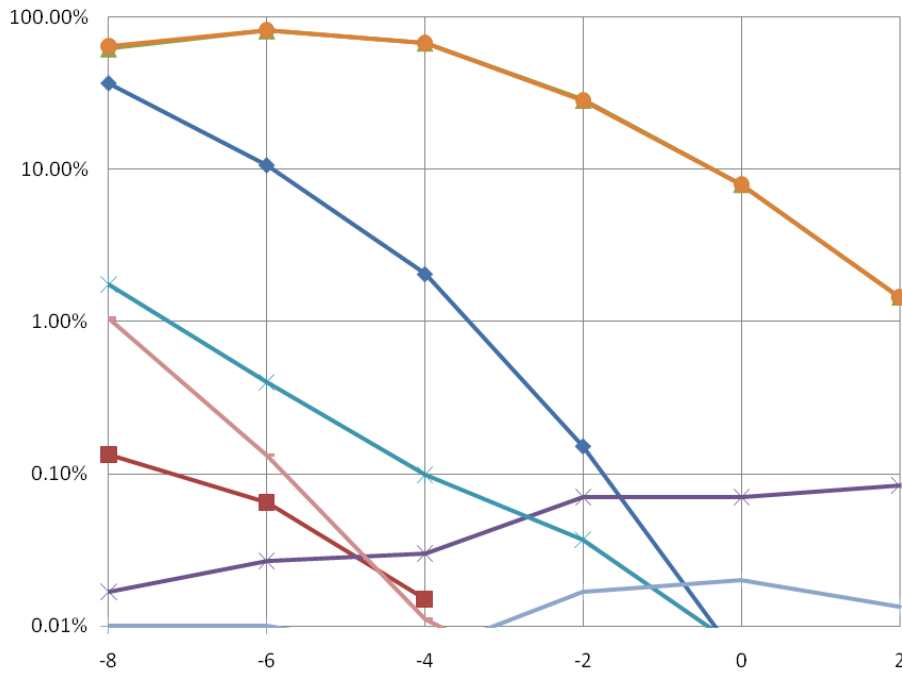
Backup Slide Part II

**: Performance of BW REQ CH
with 4Rx antennas**

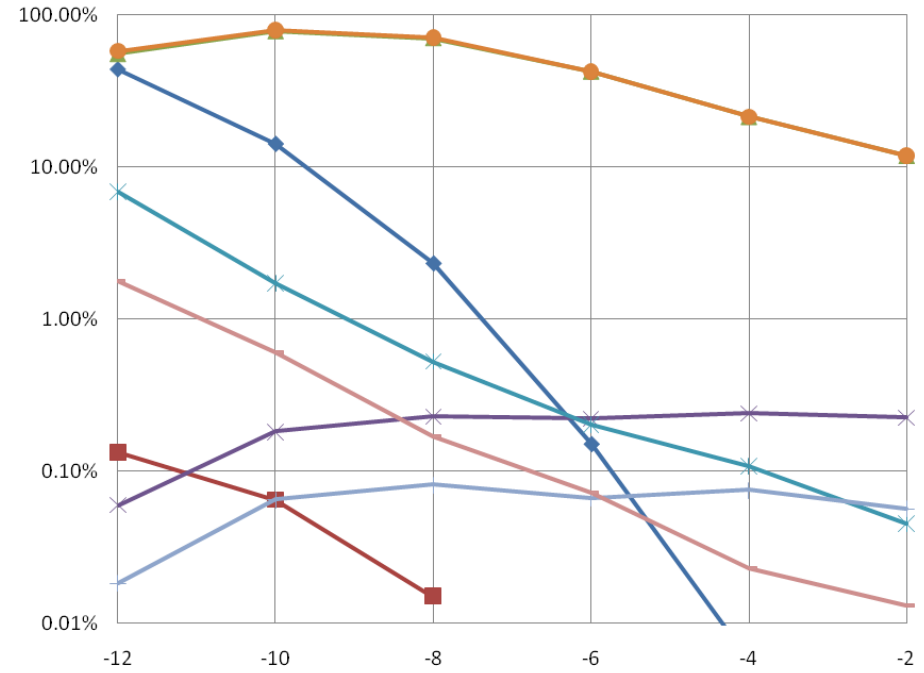
Detection Performance of BW REQ (BU-II)

- 4Rx,

4Rx, 2Users



4Rx, 4Users



- ◆ Preamble MP
- ▲ Message MP (SPC=OFF)
- ✱ Message Decoding ER (SPC=OFF)
- ◆ Preamble FA
- ✱ Message FA (SPC=OFF)
- Message MP (SPC=ON)
- ◆ Message Decoding ER (SPC=ON)
- ◆ Message FA (SPC=ON)

- ◆ Preamble MP
- ▲ Message MP (SPC=OFF)
- ✱ Message Decoding ER (SPC=OFF)
- ◆ Preamble FA
- ✱ Message FA (SPC=OFF)
- Message MP (SPC=ON)
- ◆ Message Decoding ER (SPC=ON)
- ◆ Message FA (SPC=ON)