

**Agenda Item:**

**Source:** Mitsubishi Electric Corporation  
**Title:** Evaluation of cell search in the compressed mode  
**Document for:** Information

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## 1. Abstract

At #6 Hannover meeting, we proposed inter-frequency measurement patterns for UTRA-FDD to UTRA-FDD cell search. Although all compressed mode patterns for IFHO is moved to informative Annex in RAN1#7bis meeting, the information about the performance using certain pattern is very useful to consider IFHO especially for UTRA FDD to UTRA FDD patterns that has not been reported. This document reports interim simulation results of search performance.

## 2. Introduction

In RAN1#7 meeting, 2 modes of measurement are defined for UTRA FDD to UTRA FDD IFHO[1], those are the selection mode and the reselection mode. In the selection mode, UE will try to make cell search using stage 1, 2, 3. On the other hand, in the reselection mode, it begins monitoring the power using stage 3 with a priori knowledge of the scrambling code and timing. In [1], 9 patterns are defined for the purpose of flexibility, 7 for the selection mode and 2 for the reselection mode.

The property and purpose of each pattern is summarized briefly as follows:

Pattern 1 to 5 uses 7-slot TGL. Pattern 6 and 7 use 14slot TGL. Using 14-slot TGL may improve cell search time. On the other hand, using 7-slot TGL will cause less interference on the system. The difference between pattern (1,2), (4,5) and (6,7) is observation period, characterized by TGP2. Namely, pattern 1, 4 and 6 monitor 4 groups of TGL 3 times per super frame. These are convenient to fast search with sacrifice a little big amount of interference to another user. On the other hand, pattern 2, 5 and 7 monitor 4 groups of TGL in every 2 super frames. These are convenient to less interference, but search speed is slower.

The difference between pattern (1,2) and (4,5) is; pattern (1,2) can make frame-wide observation which could improve stage 2 performance, on the other hand, pattern (4,5) observes the same position of the frame, but it might be easy to make compressed frame because of the same pattern. This difference is characterized by TGD.

Pattern 8 and 9 is used for the UE during reselection mode. Only 7-slot TGL is defined for these patterns.

The purpose of this contribution is to show whether TGL7 is enough or not for stage 2 in the selection mode, and to show whether TGL7 is enough or not for the reselection mode.

## 3. Simulations

### 3.1. Correlation property for the 2nd stage in selection mode

In this section, we will show cross-correlation property for 2nd stage in the selection mode. As described above, there are 7 patterns considered for selection mode. Among them, pattern (1,2) can measure at least 10 slots per frame (Figure 1. Note that the number of measuring slots here is worst case for these patterns, since switching time and additional processing time is assumed to be 1 slot for FDD-to-FDD measurement). In the simulation, code timing is assumed to be acquired exactly in the stage 1, and interference from other users and cells are assumed to be gaussian noise. The desired SSC signal is affected by rayleigh fading. The average Eb/Io is 3dB. Figure 2 shows the result. The horizontal axis is the correlation value in which all of 64 SSC code correlation is evaluated against group 0 code in chip level. The vertical axis is the detection probability of both auto-correlation and cross-correlation. Green line is the auto-correlation property and red line is the cross-correlation property for SSC code group number 0 for normal detection. Blue line is the auto-correlation property and pink line is the cross-correlation property for compressed mode, where only 10 slot can be measured. To set a threshold on a certain value, the false

detection probability can be seen as the probability of lower value to be detected than the threshold in the auto-correlation, and the error detection probability can be seen as the probability of higher value to be detected in the cross-correlation. Assuming 3% of the false detection for both normal and compressed mode, the probability of the error detection is negligible for normal detection, whereas that is less than 0.5 % for compressed mode. Degradation due to compressed mode seems to be not so big. Note that the search performance is trade-off between required search time, implementation complexities, performance degradation both for other users and for its own, and so on.

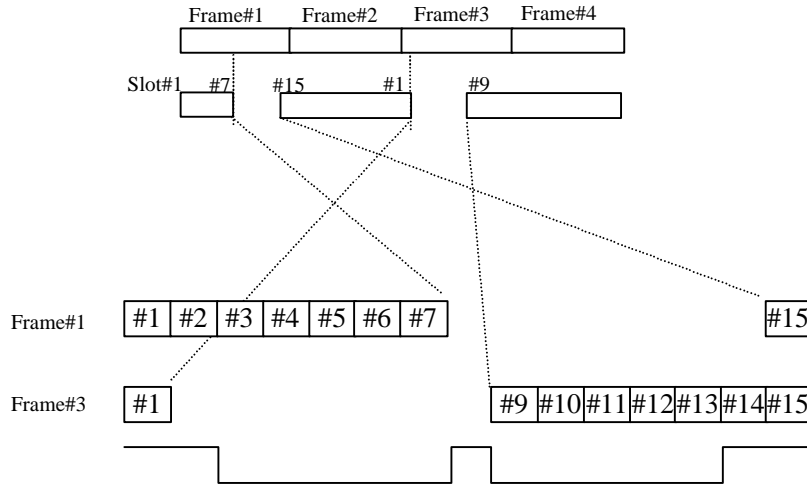


Figure1. Cell search pattern (1, 2) in compressed mode.

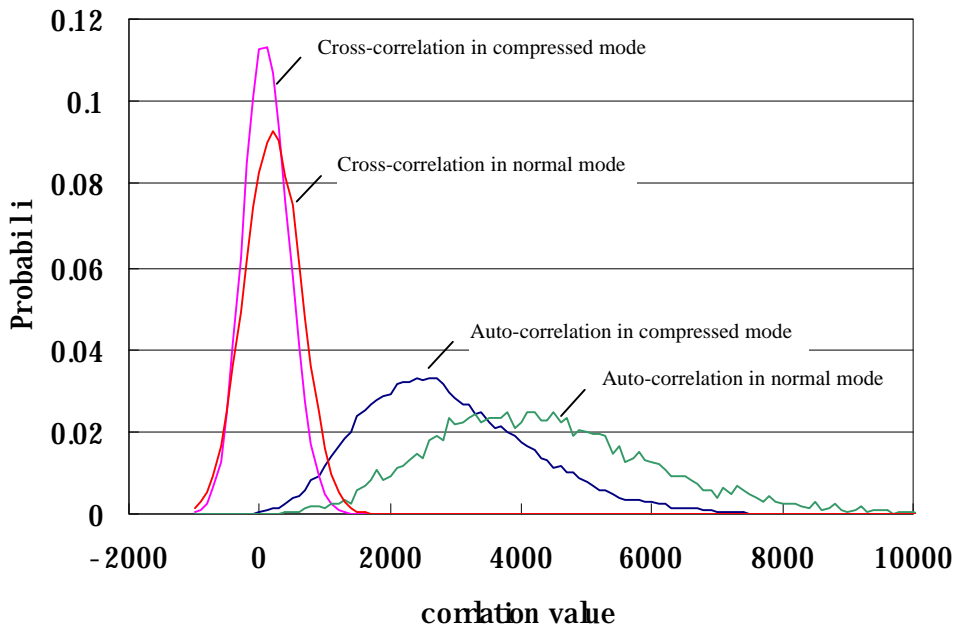


Figure 2. Probabilities of correlation value between group number 0 code and other codes.

### 3.2. Reselection mode performance

In this section, we will show the performance of the reselection mode in terms of false detection and error detection probabilities. In reselection mode, at least 6 slots can be measured during a compressed frame. In the simulation, interference from other users and cells are assumed to be gaussian noise. The desired SSC signal is affected by 2 path rayleigh fading. The average  $E_b/I_0$  is 10dB. The false detection probability is

defined as that no desired path is detected in higher level than a certain threshold, and the error detection probability is defined as that the desired paths are detected less than non-desired paths. In this simulation, we set the false detection probability to be 3%. Figure 3 shows the results. In above definition the detection probability of normal mode is 97.7%, whereas that of compressed mode is 95.3%. Note that in actual condition, the number of codes to be measured is defined especially in reselection mode in which handover candidate cells have already acquired at least once. So the probability of the error detection may be improved by using a priori knowledge of codes.

Detection probability			
Desired path > Non-desired path		Desired path <= Non-desired path	
Compressed mode	Normal mode	Compressed mode	Normal mode
95.3%	97.7%	4.6%	2.2%

Figure 3. The error detection probability in reselection mode.

#### 4. Conclusions

In this paper, we showed results of the cell search performance for compressed mode search patterns. Correlation property in 2nd stage for selected mode, and false detection and error detection probabilities for reselection mode were considered. The degradation due to compressed mode is not so big in both two cases. We know that the cell search performance is improved by making search time longer, but the degradation of the performance of the current frequency become worse, accordingly. They are in relation of trade-off. We show these results for information.

#### Reference

[1] TSGR1#6(99)b98, " Compressed Mode for FDD-FDD Handover preparation", source Mitsubishi Electric