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Title	**Interference Mitigation with Coordinated Symbol Repetition**
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Re:	Call for Contributions of SDD
Abstract	Interference mitigation with coordinated symbol repetition, where repeated symbol mapping patter is identical among the neighboring cells, is proposed. In this method, an MMSE receiver can eliminate interference signals in not only spatial domain but also frequency domain and requires less numbers of reception antennas than that of the mitigation scheme in spatial domain. This method has more inter cell interference mitigation ability than legacy bit repetition without interference mitigation. This contribution proposes to discuss inter cell interference mitigation method to achieve the system requirement in SDD.
Purpose	For discussion of inter cell interference mitigation
Notice	
Release	
Patent Policy	

Interference Mitigation with Coordinated Symbol Repetition

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Introduction

Improving the cell edge user throughput is important aspect in the requirement [1]. Legacy system employs the bit repetition to improve the signal to interference power ratio (SIR) in cell boundary.

This contribution presents interference mitigation with coordinated symbol repetition (CSR) among cells aiming at improved cell edge user throughput. We propose interference mitigation with the CSR as new main functionality on interference mitigation.

Interference Mitigation with Coordinated Symbol Repetition (CSR) [2]

Figure 1 shows a block diagram of interference mitigation mechanism with the CSR. When desired signals on frequency f1 and f2 are identical and interference signals on frequency f1 and f2 are also identical, an MMSE receiver can cancel the interference signals by nature. The MMSE receiver can cancel (RF -1) interference signals where RF is the number of repeated symbols in frequency domain (Repetition Factor).

Figure 2 shows an example of the coordination when RF is two. As shown in Figure 3, frequency domain mapping of the repeated symbols is not limited to the neighboring subcarriers. A frequency domain interleaver can be employed as long as the repeated symbol mapping is identical among the neighboring cells.

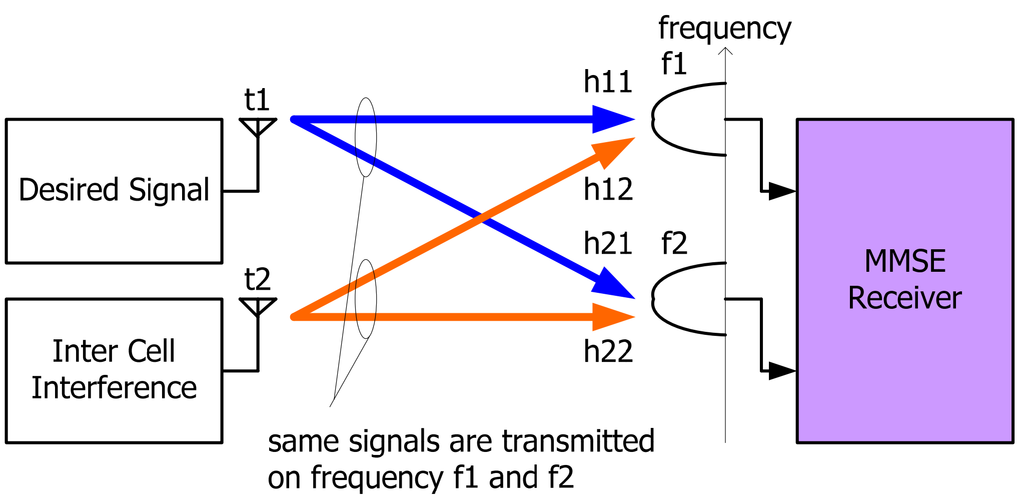

Figure 1 Interference mitigation mechanism with the CSR.

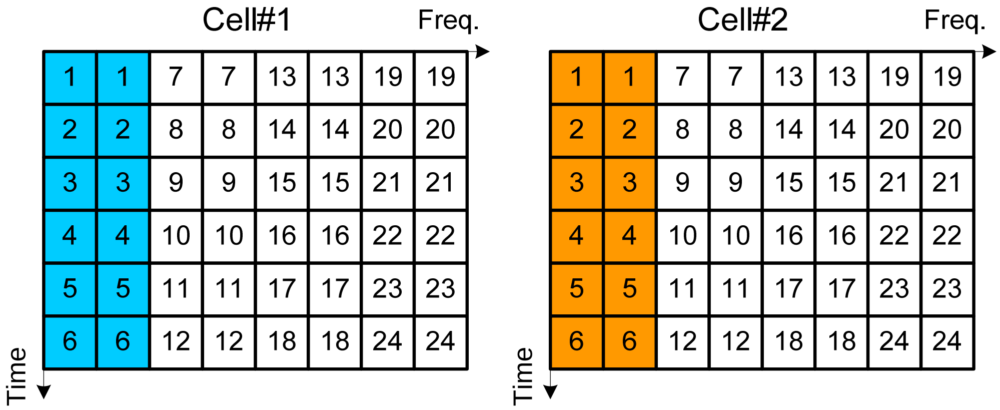

Figure 2 Coordinated symbol repetition among cells

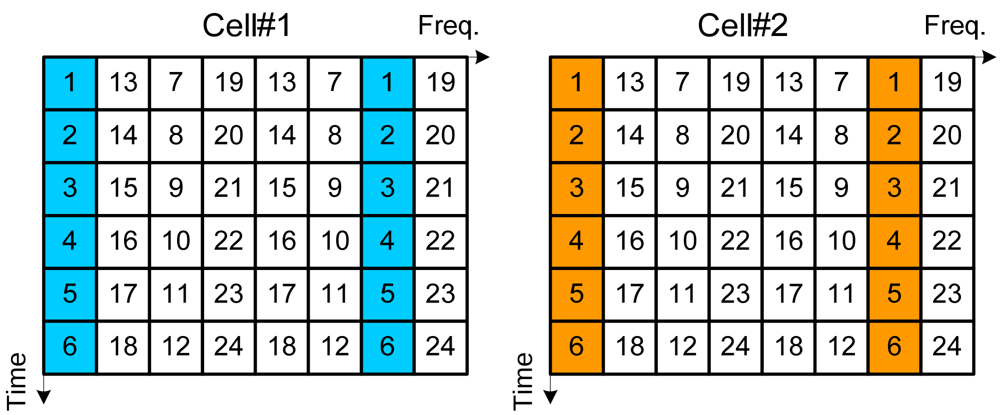

Figure 3 Coordinated symbol repetition among cells with frequency symbol interleaver

In terms of calculation complexity, an ordinary MMSE receiver can mitigate inter cell interference. In addition, when identical repeated symbol are mapped in the frequency domain, as long as the channel state doesn't fluctuate during some time period, the MMSE weight for repetition symbols can be reused throughout that period and this leads to reduce complexity of MMSE weight calculation.

Comparison with interference mitigation applied to legacy bit repetition

In this section, we consider the case where interference mitigation is applied to the legacy bit repetition and compare with the proposed method.

Figure 4 shows interference mitigation for bit repetition employing spatial interference mitigation with multiple (N) reception antennas. An MMSE receiver can mitigate (N-1) interference signals.

On the other hand, interference mitigation with the CSR, (N*RF-1) interference signals can be mitigated because its dimension is extended to space and frequency domain and the MMSE processing can eliminate interference in both domain.

Therefore, interference mitigation with the CSR has as RF times freedom as that of the legacy bit repetition and needs less numbers of reception antennas to mitigate same number of interference signals than that for the legacy bit repetition. For example, in case of two reception antennas, interference mitigation with the CSR can mitigate two (assuming number of nearest cells in hexagonal cell deployment) dominant interference signals, while those for bit repetition can not.

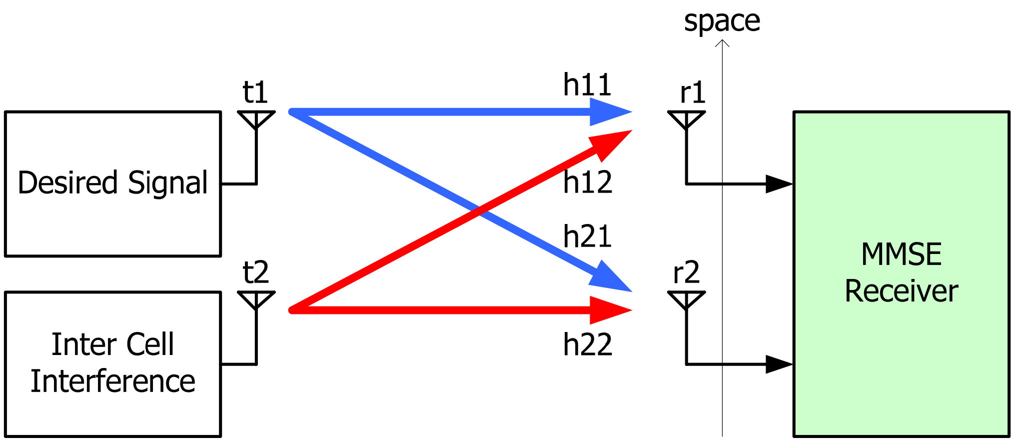

Figure 4 Spatial interference mitigation with 2 reception antennas.

Comparative evaluation of legacy bit repetition and proposed method

We compared the block error rate (BLER) performance of the legacy bit repetition without interference mitigation and the interference mitigation with the CSR.

(a) Simulation assumptions

A two-cell model with one target cell and one interfering cell is assumed in this simulation. The same information bit rate and the same overall coding rate of 1/4 are set to for both cases. Rest of the simulation assumptions are summarized in Table 1. Figure 5 shows a block diagram of transmitter side. For the bit repetition, part of the output bits of the rate 1/3 turbo encoder are repeated by 2 times in rate matching and resulted in an overall code rate of 1/4. For the symbol repetition, the output bits of the rate 1/3 turbo coder are punctured to rate 1/2 and symbol level repetition in frequency domain is carried out with a repetition factor of two. The mappings of the repeated symbols are coordinated between target and interfering cells.

Table 1 Simulation assumptions [*]

Cell Layout	one target cell and one interfering cell
Number of reception antennas at MS [**]	1
Transmission BW	10MHz
Sub-frame duration	0.5ms
Sub-carrier spacing	15kHz
Sampling frequency	15.36MHz
FFT size	1024
Number of occupied sub-carriers	601(DC sub-carrier is null)
Decoder algorithm	Max-Log-MAP with 8 iterations
Modulation	QPSK
Channel environments	Typical Urban 3km/h
Channel estimation	Ideal

[*] Note that although simulation assumption is not reference, characteristic tendency is same.
[**] We assumed one reception antenna since the effect of interference mitigation in both two reception antennas with RF=2 case and one reception antenna with RF=2 case.

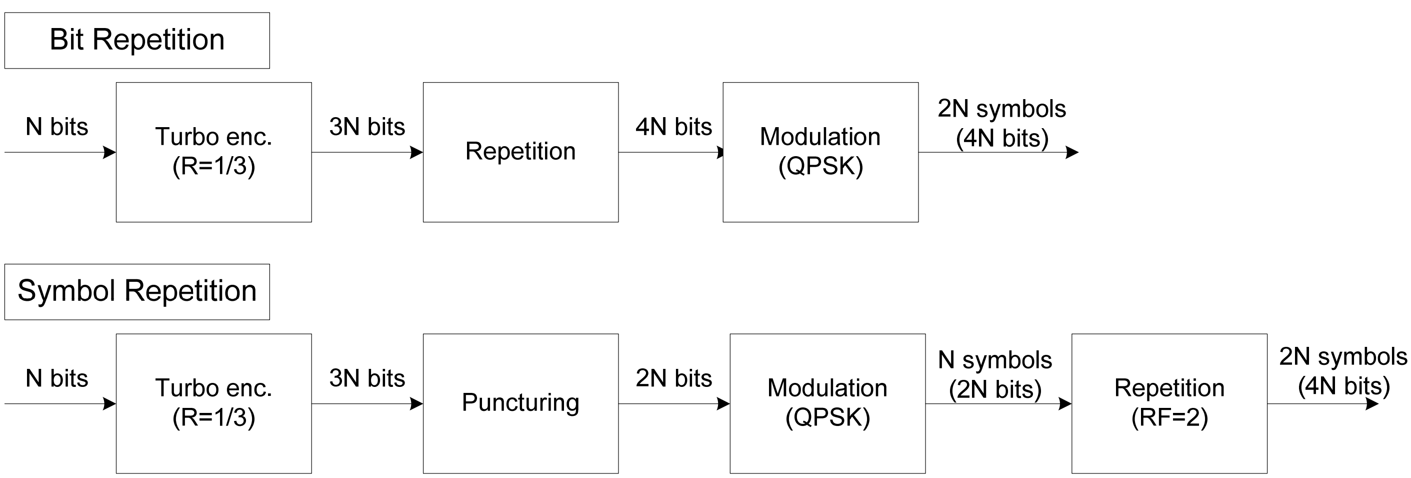

Figure 5 Block diagram of transmitters for bit repetition and the CSR

(b) Simulation results

Figure 6 shows the block error rate performance of the bit repetition without interference mitigation and the interference mitigation with the CSR. The interference mitigation with the CSR mitigates the inter cell interference by means of MMSE reception, while BLER performance of legacy bit repetition without interference mitigation has “floor” saturation.

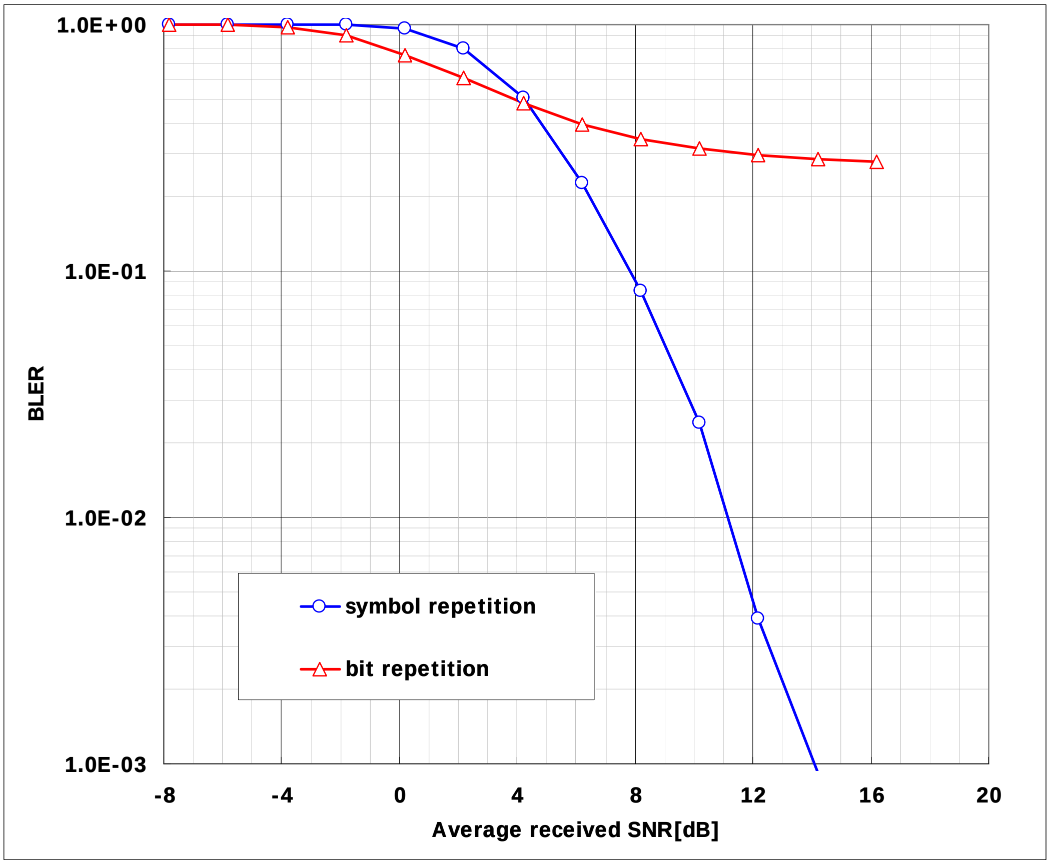

Figure 6 BLER comparison

Conclusion

Improving cell edge throughput is a key issue to achieve the system requirement. Interference mitigation with the CSR serves better inter cell interference mitigation ability than legacy bit repetition without interference mitigation. We propose to adopt interference mitigation with the CSR as new main functionality on interference mitigation to SDD discussion.

Reference

[1] 802.16m-07/002r4, “802.16m System Requirements” IEEE 802.16m-07/002r4

[2] 3GPP R1-050829, TSG-RAN WG1 #42 London, UK, August 29-September 2, 2005