TSG-RAN Working Group 1 AH21 **TSGR1(00)0838**

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Agenda Item: AH21
Source: CWTS
To: TSG RAN WG1
Title: Performance analysis
Document for: Discussion

Introduction

This paper introduce some simulation results for low chip rate TDD for performance analysis.

Conclusion

It is proposed to discuss and include the following text into the section of 'Performance analysis' of TR25.928.

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Simulation assumptions

Calculation of the E_b/N_0

Intercell interference is modeled as white Gaussian noise. In the following, bit error rates (BER) are given as a function of the average E_b/N_0 in dB (E_b is the energy per bit and N_0 is the one-sided spectral noise density) with the intracell interference, i.e. the number K of active users per time slot as a parameter. The relation between the E_b/N_0 and the carrier to interference ratio C/I, with C denoting the carrier power per CDMA code and with I denoting the intercell interference power, is given by

$$\frac{C}{I} = \frac{E_b}{N_0} \cdot \frac{R_c \cdot \log_2 M}{B \cdot Q \cdot T_c}$$

with

R_c the rate of the channel encoder (depends on the service),
M the size of the data symbol alphabet (4),
B the user bandwidth
Q the number of chips per symbol (16) and
T_c the chip duration (0.24414 µs).

The expression $\log_2 M$ is the number of bits per data symbol and $Q.T_c/\log_2 M$ is the bit duration at the output of the encoder. One net information bit is transmitted in a duration of $Q.T_c/(R_c.\log_2 M)$. Therefore, (1-1) is equivalent to $C/I = (E_b/T_b)/(N_0.B)$, i.e., $C = E_b/T_b$ and $I = N_0.B$ with T_b the duration of a net information bit. The carrier to interference ratio per user is K_c times the carrier to interference ratio per CDMA code, with K_c denoting the number of CDMA codes per time slot per user.

The E_b/N_0 (as the C/I) is calculated at the antenna connector of the antenna elements.

Channel model

In case smart antennas are used the channel model is like the vehicular A model used for ITU and ETSI 30.02. The channel model has been adapted to the smart antenna environment such that the directions of arrival (DOA) for the multipaths are uniformly distributed.

Antenna array

As shown in Figure 1, the most practical array used in smart antenna is circular array. The circular array is suitable for omnidirectional cell design. Let the array be composed of N antenna elements, where the first (reference) antenna element is located at the position of (R, 0), and the k-th element is located at the location of ($R\cos 2kp/N, R\sin 2kp/N$) in circular array.

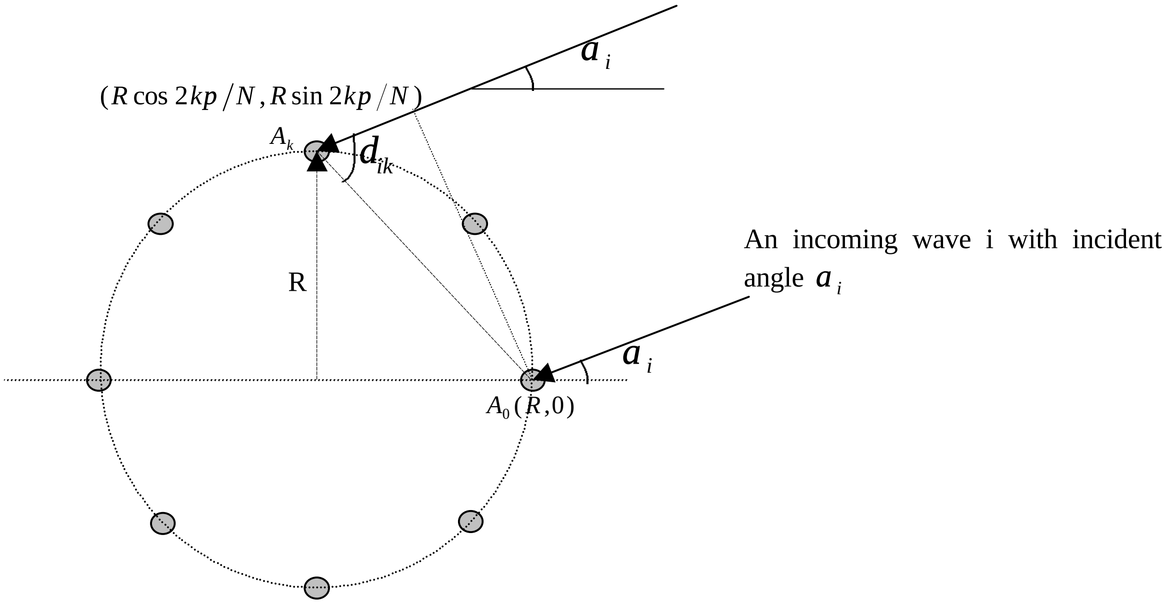

Figure 1. The geometric illustration for circular antenna array

Then, when an incoming wave i from the direction of a_i, for circular array, the differential optical distance (D_{ik}) between the first and the k-th antenna element will be

$$D_{ik} = R\cos d_{ik}[2(1-\cos 2kp/N)]^{1/2}$$

where R is the radius of the circular array;

$k = 1,2,\cdots,N-1$;

N is the total number of antenna element.

The incident wave comes from the direction of a_i as shown in Figure 1, and

$$d_{ik} = a_i + p(1/2 - k/N)$$

Let's denote $S_{kj}(n)$ as the Rx signal at the k-th antenna element from the i-th path of the j-th UE ,then

$$S_{kj}(n) = \sum_i a_{ji}(n)\exp[-j(wt_{ji} + j_{kji})]$$ for the n-th sampling

where, $a_{ji}(n)$ is the amplitude of the i-th path from the j-th UE;

t_{ji} is the time delay of the i-th path from the j-th UE;

j_{kji} is the phase different between the k-th element and the reference element for the i-th path from the j-th UE;

$$j_{jik} = 2p D_{jik} / l$$

and D_{jik} is the differential optical distance between the first and the k-th antenna element for the i-th path from the j-th UE;

w is the angle frequency and l is the wavelength.

Simulation results

1. Simulation for BCH

Simulation parameters:

Channel model: vehicular A (Speed 120km/h)

Coding: CC ,coding rate =1/3

Link: downlink

Power control: No

SF: 16

Number of timeslots: 1

Codes per slot: 2

L1 control signals: No

TFCI: No

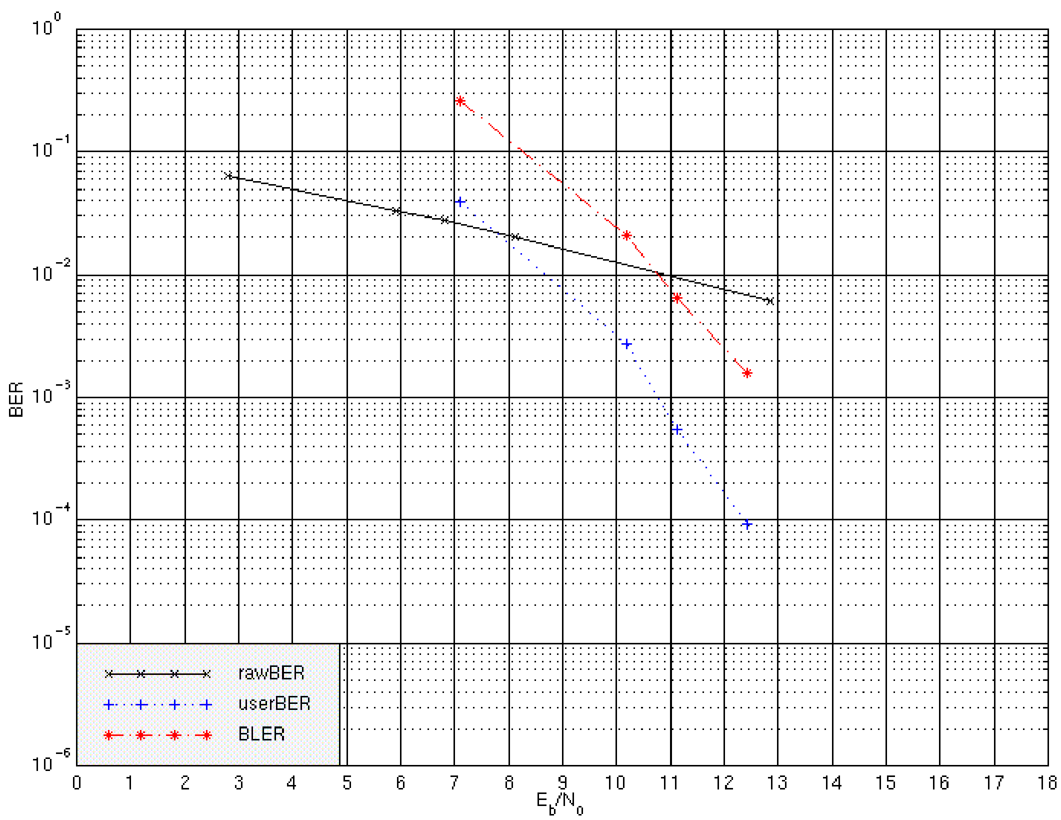

Figure 1: BER vs. Eb/N0 for BCH

2. Multiplexing of 12.2kbps data and 2.4kbps data

2.1 For 2.4kbps data path

Simulation parameters:

Channel model: vehicular A with Smart antenna (Speed 120km/h)

Coding:CC ,coding rate =1/2

Link: Uplink

Power control: No

SF:16

Number of users: 1

Number of time slot: 1

Codes per time slot: 3

L1 control signals: No

TFCI: No

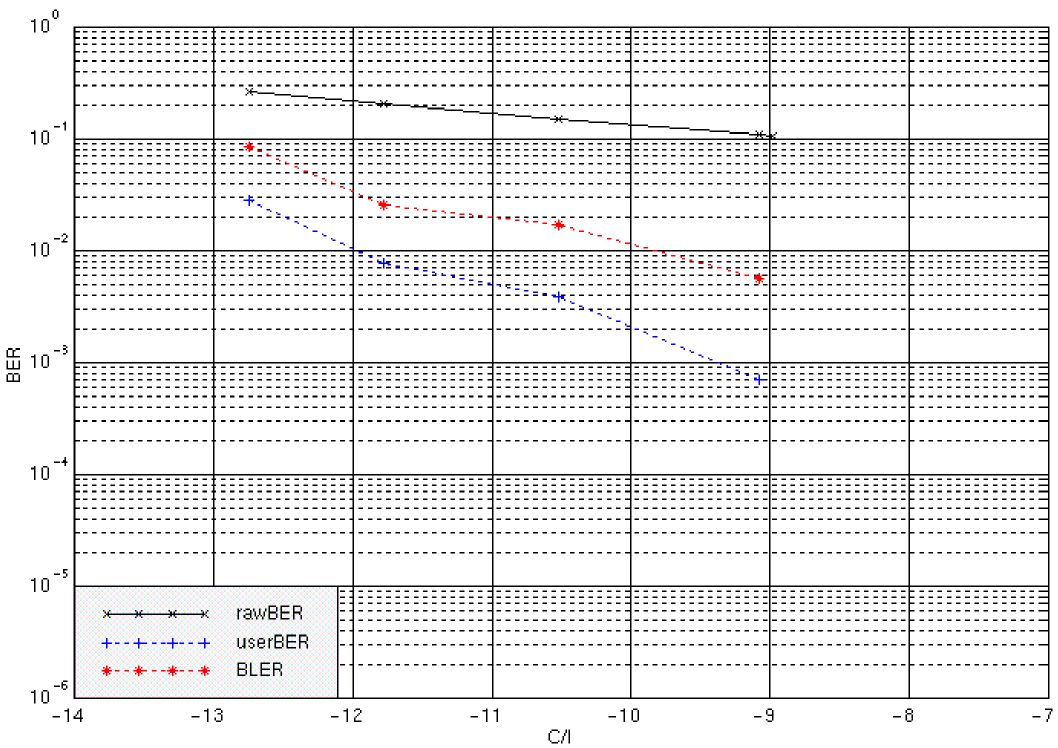

Figure 2: BER vs. C/I for 2.4kbps path

2.2 For 12.2kbps data path

Simulation parameters:

Channel model: vehicular A with Smart antenna (Speed 120km/h)

Coding: CC ,coding rate=1/2,class C

CC, coding rate=1/3,class A and B

Link: Uplink

Power control: No

SF:16

Number of users: 1

Number of time slot: 1

Codes per time slot: 3

L1 control singals: 4 bits.

TFCI: 16 bits(8 bits per subframe).

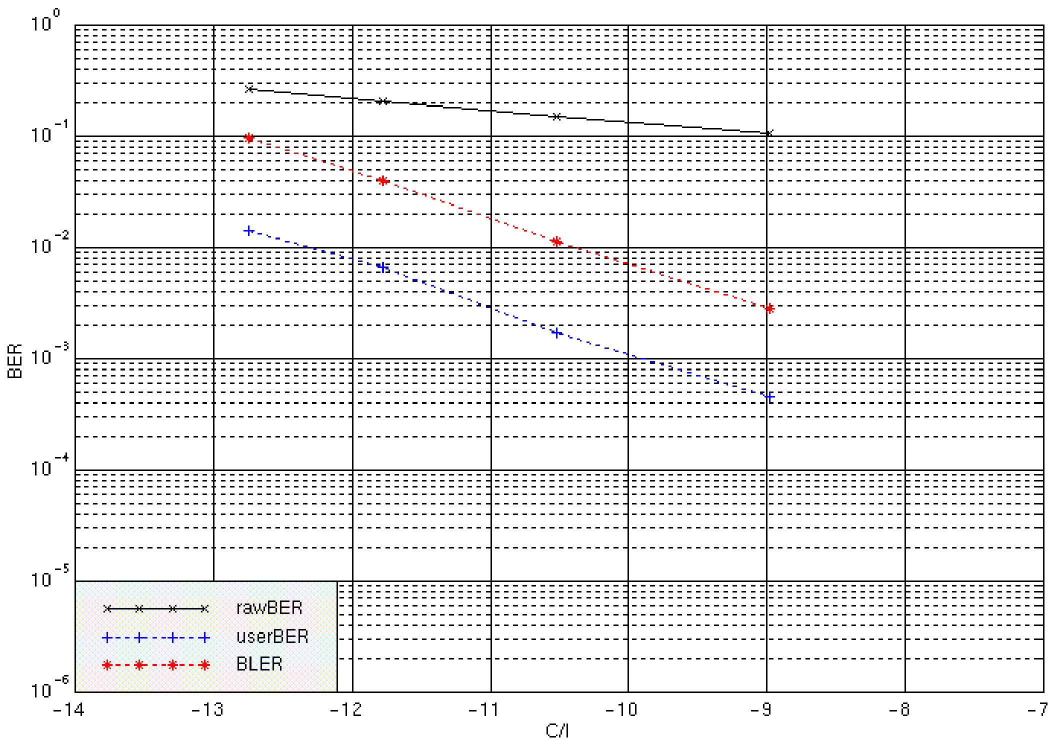

Figure 3: BER vs. C/I for 12.2kbps path

3. Simulation for 384kbps

Simulation parameters:

Channel model: vehicular A with Smart antenna (Speed 120km/h)

Coding: Turbo coding ,coding rate 1/3. Convolutional code with code rate 1/3 is optional for 384kbps packet data.

Link: Uplink

Power control: No

SF:16

Number of users: 1

Number of time slot: ~~5~~4

Codes per time slot: 16

L1 control signals: 4 bits.
TFCI: 16 bits

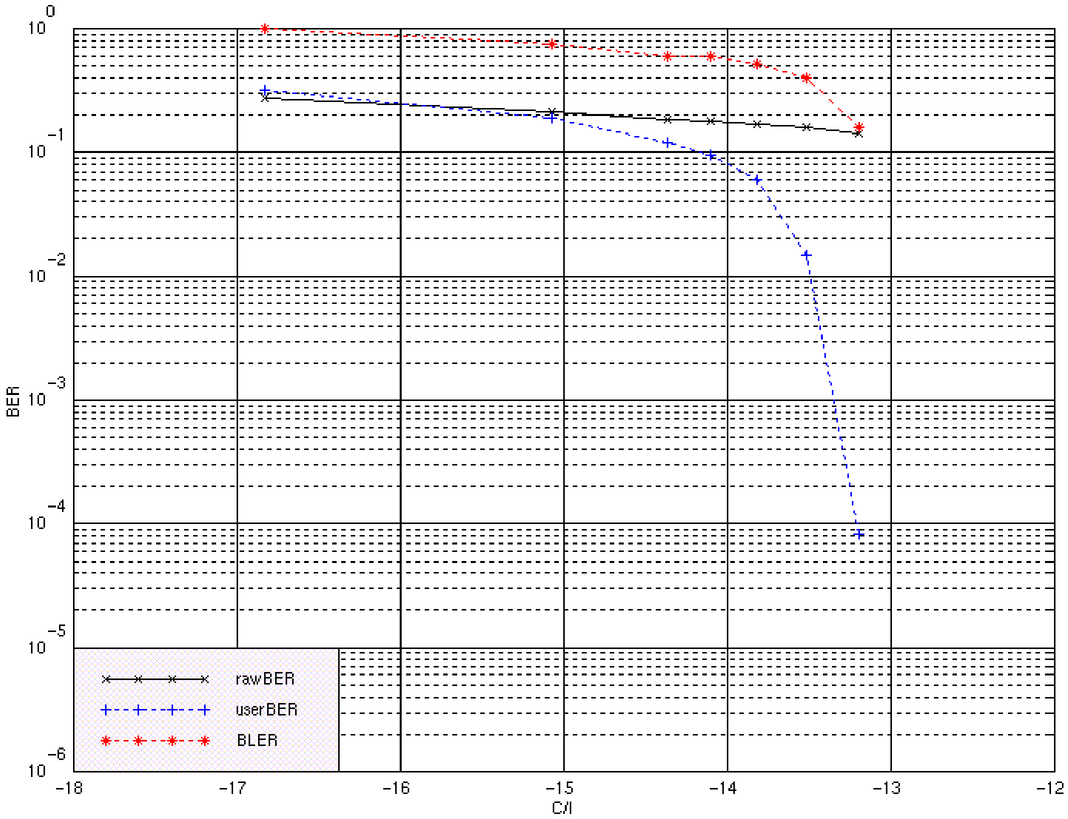

Figure 4: BER vs. C/I for 384kbps

4. Simulation for 2Mbps

The simulations for the indoor environments in uplink are considered. The channel model is compatible with the one in UMTS 30.03. The main parameters are listed as following:

4.1 Parameters

Service: 2 Mbps service

Channel model: Indoor A

Channel coding: None

Modulation/Demodulation: 8PSK;

Power Control: Ideal power control

Frame structure: 5ms

Number of time slot: 5

Codes per time slot: 16

4.2 Simulation Results

The following table and figures in next pages present the simulation results for 2 Mbps service without channel coding considered.

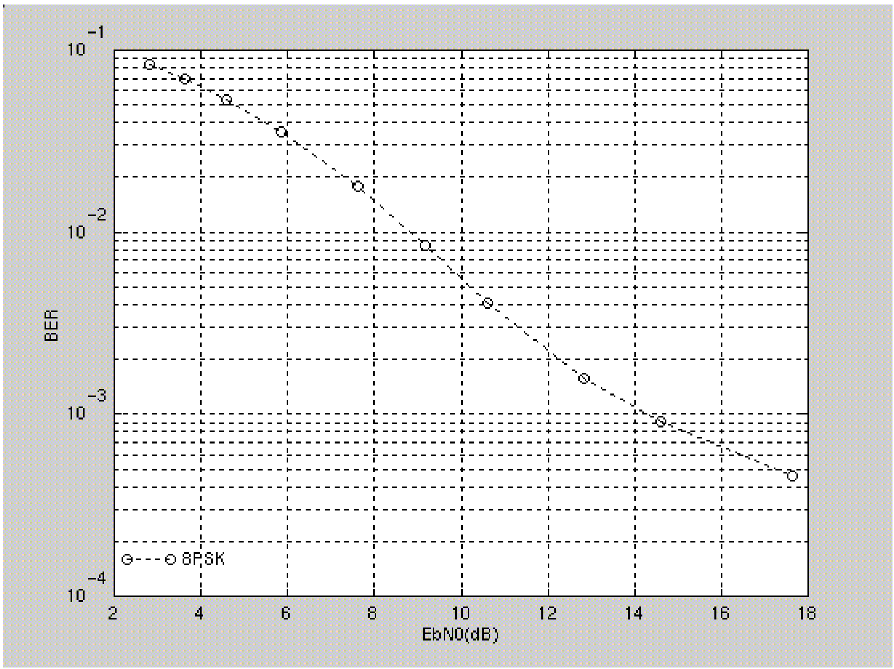

Figure 4: BER vs. EbNo for 2 Mbps service

(without coding using 8PSK modulation scheme)

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