

MODEL OF UMTS FOR INTERFERENCE ANALYSIS

Ing. Zdeněk RŮŽIČKA, Doctoral Degree Programme (2)
Dept. of Radio Electronics, FEEC, BUT
E-mail: xruzic20@stud.feec.vutbr.cz

Supervised by Dr. Stanislav Hanus

ABSTRACT

The article deals with UMTS network model. The main task of this model is interference analysis in this mobile network. In the first part the basic structure of the model is described. Second part shows some general simulations made by presented model.

1 INTRODUCTION

Third generation of mobile communications require different approach than previous systems. The main difference is that 3G systems use CDMA technique and only one frequency for all subscribers connected in the network. More details about this can be seen in [1, 2]. These facts require different approach in comparison with 2G systems. All signals with another spreading code are rated as interferences. Spreading codes used for channelisation are ideally orthogonal, but in the case of time shift between two signals the orthogonality is distorted. This leads to the C/I ratio decreasing and to the signal quality degradation.

The delay between two codes can be evoked by multipath propagation. Signal can go from transmitter to receiver through the different ways and therefore individual parts of signal can be time shifted to each other.

Presented simulations show multipath propagation influence to C/I ratio.

2 DESCRIPTION OF THE MODEL

Described model is programmed in Matlab. Its structure is based on 3GPP specifications [3, 4]. This model simulates DPDCH channel processing in downlink. Fig. 1 shows basic scheme of transmitting part of the presented model.

Data flow is divided into two branches and mapped for modulation purposes. In this case QPSK modulation with pulse shaping by root raised cosine filter is used, therefore binary "1" is mapped as 1 a binary "0" is mapped as -1. Root raised cosine filter uses 10 samples per symbol and roll off factor 0,22. In each branch channelisation code is used for data spreading and for orthogonal separation of different channels. In UMTS system the Walsh codes are used.

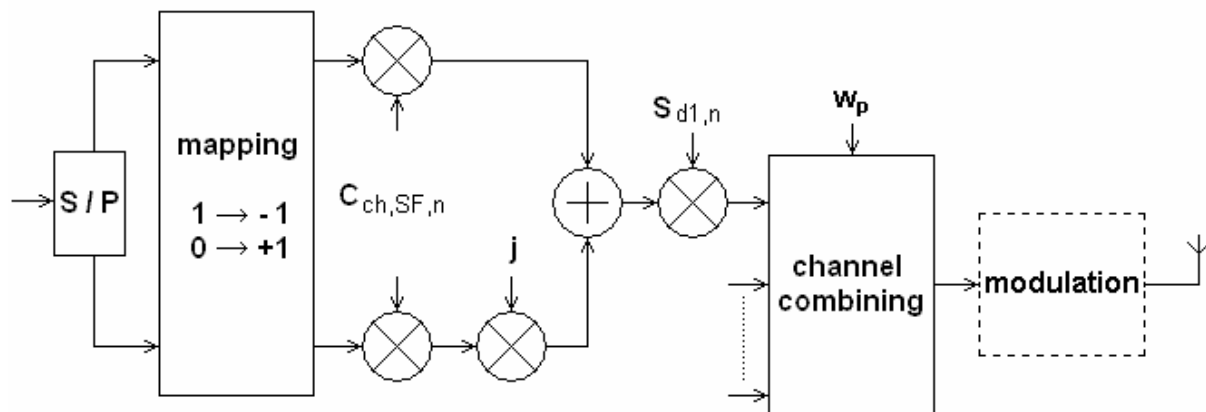


Fig. 1: *Transmitting part of UMTS model*

The value of spreading factor is between 4 and 256. That means one bit is multiplied by orthogonal sequence of length from 4 to 256. Longer spreading code means lower bit rate but higher spreading gain and higher number of applicable codes. Both branches use the same code. Second branch is multiplied by imaginary unit and both branches are then combined into complex chip flow. The chip rate is 3,84 Mchip per second.

This complex chip flow is multiplied by scrambling code. Scrambling codes are derived from Gold sequences and serve for Node B recognition. These codes do not spread complex chip flow. The length of these codes is 38400 chips. This corresponds with the UMTS frame length. The frame duration is 10 μ s. After this operation channels are weighted by power weights w_p and merged. Final signal is modulated to appropriate carrier. Modulation can be used in specific simulations. In the case of simulations presented thereafter is modulation process omitted for time saving reasons.

Radio environment transmitting simulation includes two main operations. The first action is indirect path delay. After this, noise is added to both paths. Both paths are combined and used as input signal for receiving side of the model.

Receiving side of the model performs descrambling and then selects required channel by using channelisation code. After this, data flow is restored and required value, in this case bit error ratio of received data flow, evaluated.

3 GENERAL SIMULATIONS

3.1 BER DEPENDENCE ON C/I RATIO

This simple simulation computes BER of received data flow in dependence on C/I ratio. C/I ratio represents rate between useful signal and interference level. Interferences are simulated by white Gaussian noise with appropriate level. The next parameter of simulation is spreading factor used at transmitting side. Fig. 2 shows simulation results.

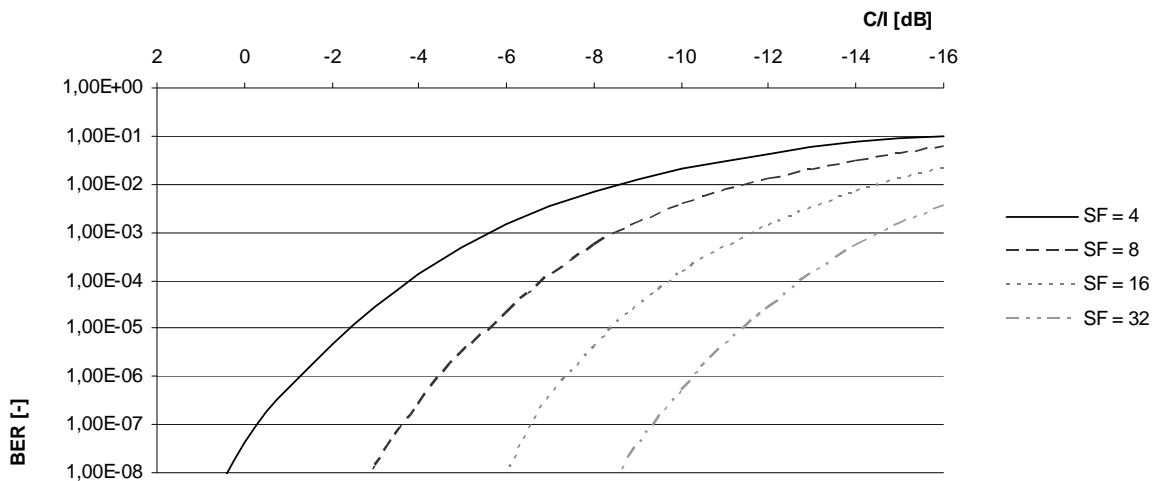


Fig. 2: *BER in dependence on C/I ratio*

3.2 BER DEPENDENCE ON TIME SHIFT

This simulation computes BER increase in dependence on time shift of the signal caused by multipath propagation. Model uses two paths between the transmitter and receiver. The indirect path is delayed against direct path. Simulation takes into account only delay from 0 to 1 chip. This corresponds approximately with time from 0 to 260 ns. This time interval matches with indirect path extension at most 78 meters. Attenuation on this distance is insignificant. Attenuation by reflection can be omitted too, therefore the modulus of reflection factor is set up to 1. In the case of different reflectance can be this one set to the corresponding value as a parameter of the simulation.

The main parameter of simulation is time shift of indirect path. This parameter changes from 0 to 1 chip with the step 0,1 chip. This interval is chosen with a view to the rake receiver

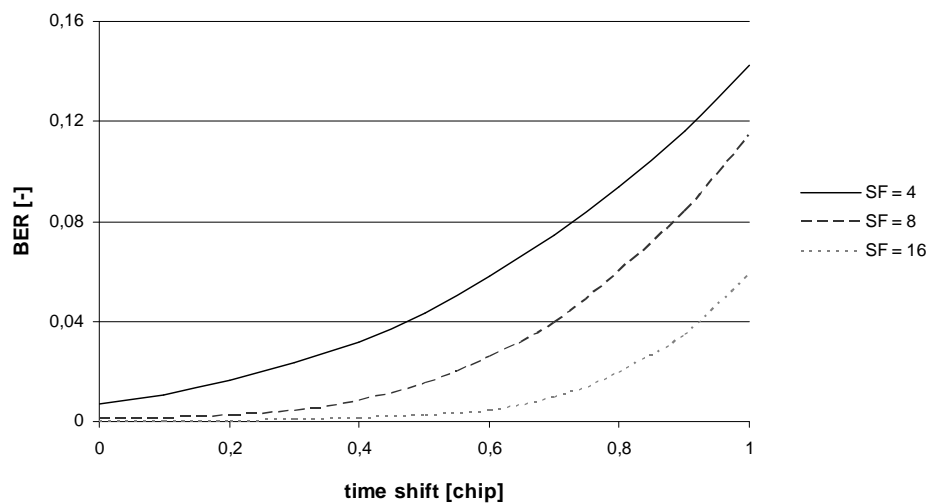


Fig. 3: *BER increase in dependence on time shift*

which can use the signal with delay greater than one chip. Next to the signal is added the noise which sets the interference level to specific level and simulates the interference from other sources. Initial C/I ratio is set to -8dB. For this purpose white Gaussian noise is used. Simulation result shows fig. 3.

3.3 C/I RATIO DECREASING BY MULTIPATH PROPAGATION

This simulation is based on idea of direct relation between BER and C/I ratio. BER increasing is caused by C/I ratio decreasing. By keeping BER at the same value the C/I doesn't change too. Delayed signals increase interference level and BER. By increasing useful signal power level the previous BER value can be reached. Finally the power level rise can be interpreted as C/I ratio difference.

The simulation was performed with single channel and with two independent channels. Single channel simulation shows the influence of the same spreading code which is delayed to the C/I ratio. Model uses two paths between the transmitter and receiver. The main parameter of simulation is time shift of indirect path, the same way as previous simulation. Single channel simulation result shows fig. 4. $\Delta C/I$ represents C/I ratio decreasing in dependence on time shift value.

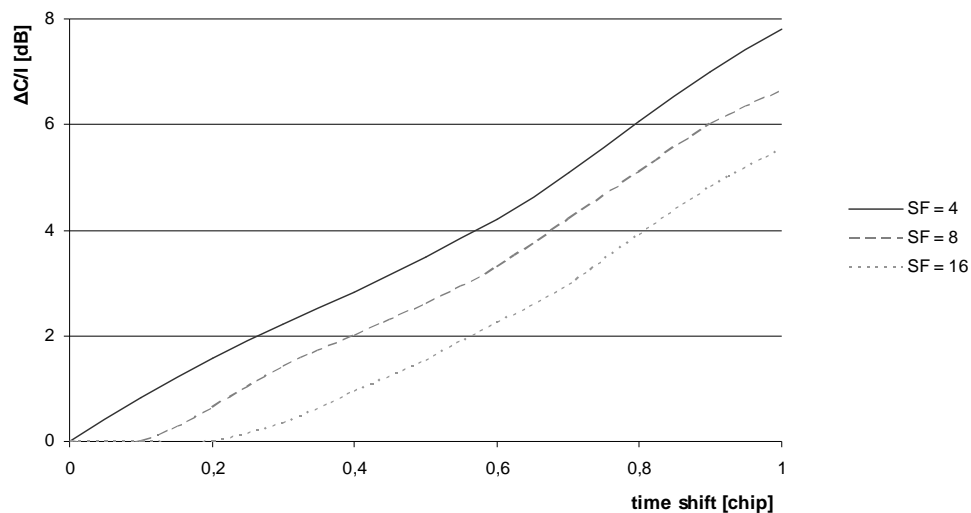


Fig. 4: *Single channel simulation results*

Two channels simulation is based on the same principle as the previous one. In this case two independent channels are transmitted. So except the C/I ratio decrease caused by the same delayed code, here is in addition the orthogonality distortion between channelisation codes in each channel included in the computed values. Two channels simulation result is depicted in fig. 5.

4 CONCLUSIONS

Presented model of UMTS serves for interference analysis in this network. Results presented in this paper are general, simulations and parameters can be modified for the specific situations. These results then can be used in UMTS network planning and

optimization process.

Future work will aim to put this model more precisely and cover up other simulations for interference analysis.

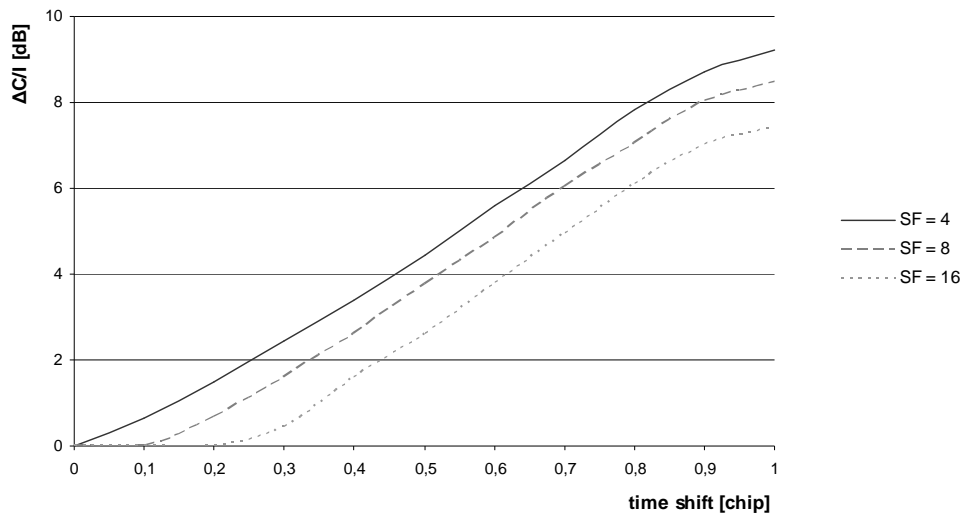


Fig. 5: *Two channels simulation results*

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