

Introduction to Broadband Transmission Techniques - Lab exercise 2006

CDMA TRANSMISSION - DOWNLINK

1. Copy simulink model http://www.ee.oulu.fi/~juma/introbroadband/wcdma_downlink.mdl to your Matlab working directory and start Matlab. Go to your chosen working directory from the 'Current Directory' pane. You should now see the copied model. By double clicking it, you start the Simulink environment and you are ready to go.
2. The model consists of downlink WCDMA communication chain together with some signal probes. Run the model and observe the constellation plot that pops as the simulation is started. Change the channel by adding noise to the transmitted signal. You can do this by double clicking the 'variable variance' block and adjusting the slider control. **How does the constellation change when you add noise? How much noise do you have to add before you can detect erroneous bits received (see BER Display). You may have to rerun the simulation. How do you see this in the constellation graph? If now visible make an educated guess.**

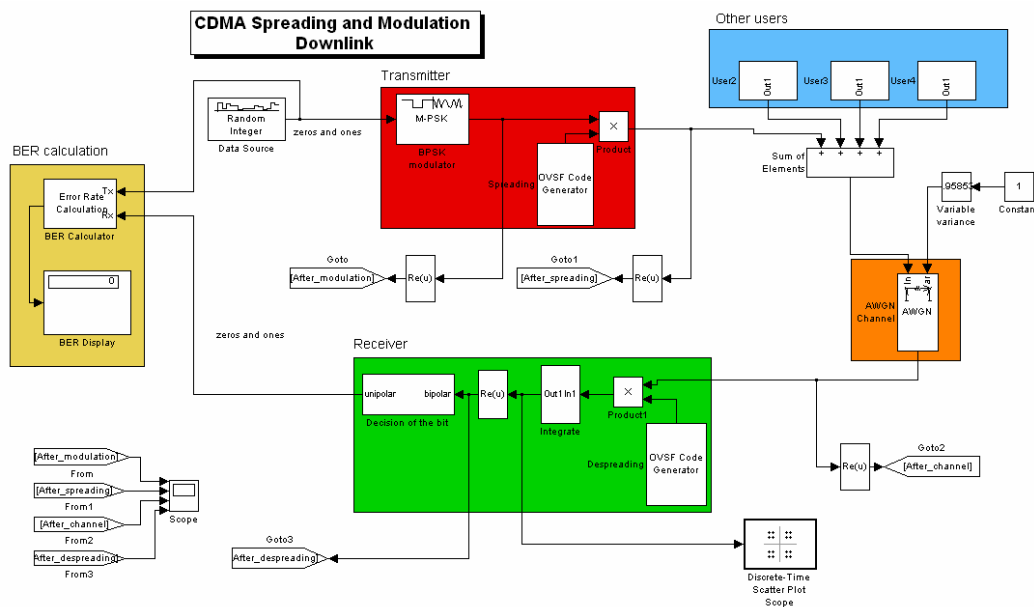


Figure 1: Simulink block diagram of CDMA downlink transmission chain.

CDMA TRANSMISSION - UPLINK

3. Copy a simulink model http://www.ee.oulu.fi/~juma/introbroadband/wcdma_uplink.mdl to your Matlab working directory and start Matlab. Go to your chosen working directory from the 'Current Directory' pane. You should now see the copied model. By double clicking it, you start the Simulink environment and you are ready to go.
4. The difference in this model is that now all the users are sending their signal asynchronously from different locations. Due to this, the orthogonality of the received signals in the base

station is lost. You can check how the effects of this are modeled by double clicking the blocks of other users.

5. Change the delay value of user 2. **What do you observe in the constellation, correlation display, and BER window?** Draw your conclusions.
6. Change the delay values of other users. **What do you observe in the constellation graph?**
7. To model the distance between user and base station every user has a gain block. Change the gain value of the User2. **How do you observe this in the constellation figure? How about in the scope display (double click to open scope)?**

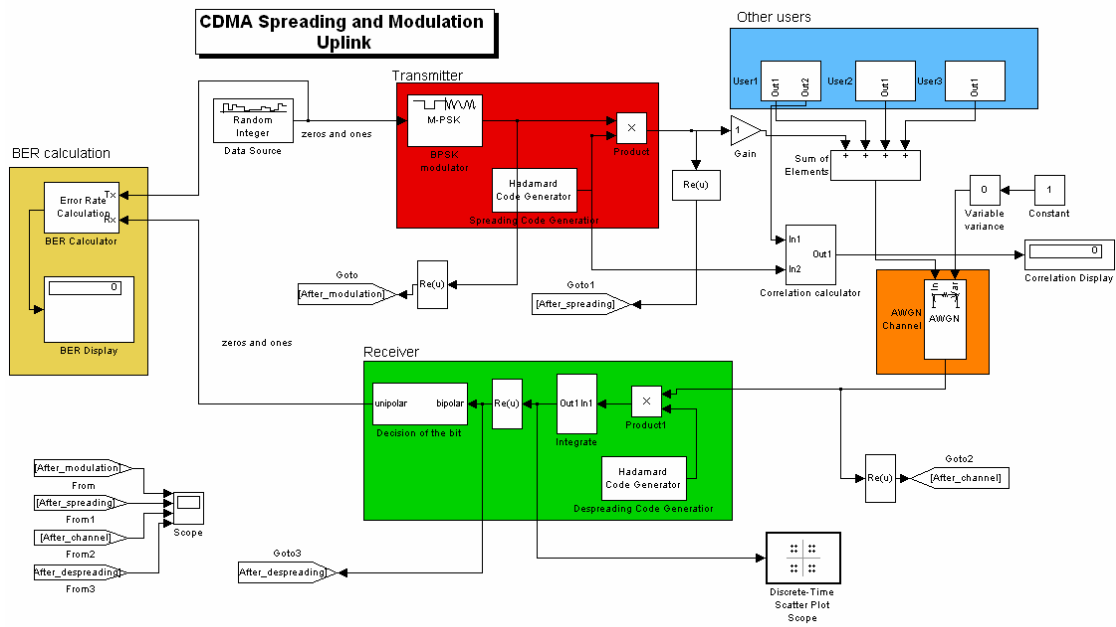


Figure 2. Simulink block diagram of CDMA downlink transmission chain.

MULTICARRIER TRANSMISSION

1. Copy a simulink model http://www.ee.oulu.fi/~juma/ofdm/wireless_ofdm.mdl to your Matlab working directory and start Matlab. Go to your chosen working directory from the 'Current Directory' pane. You should now see the copied model. By double clicking it, you start the Simulink environment and you are ready to go.

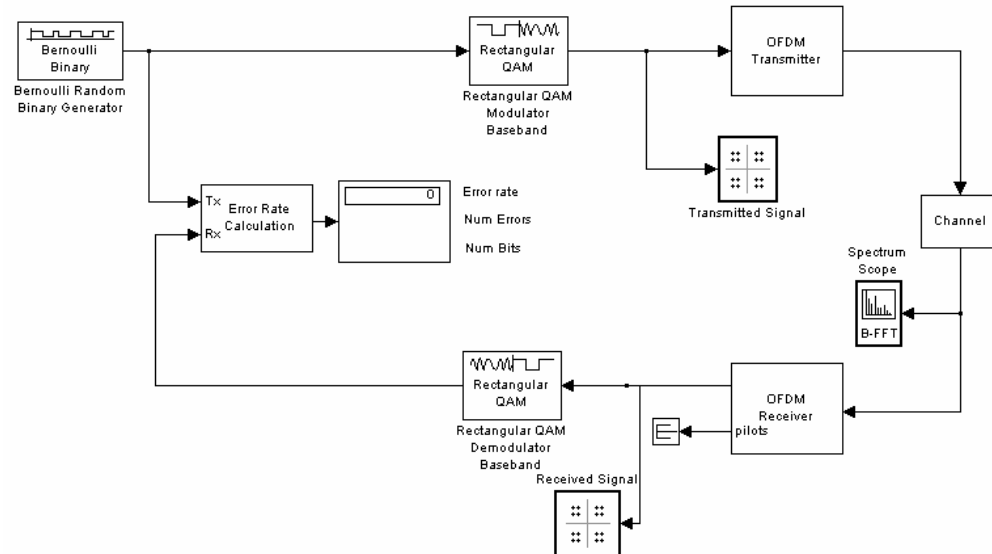


Figure 2. Multicarrier system

2. This models the basic OFDM characteristics of IEEE802.11a/g communication. According to the standard, the OFDM transmitter has four sub-carriers used for channel estimation (pilot carriers) and no transmission on the zero carrier (in the middle). The channel is a static 2-path AWGN channel. By changing the delay value, determine the used cyclic prefix length in the model. **How do you observe the change of delay in the constellation of the received signal? How about in the spectrum?**
3. Change the second path power (between 0-1) while observing constellation and spectrum view. **Describe your observations.**

To further clarify your answers, provide captures of the constellation, spectrum and time scope windows.