Lab 6 - Self-Synchronizing Descrambler

Introduction

Most of the functions of communications equipment are implemented using digital logic circuits. These digital circuits can process sampled signals ("Digital Signal Processing") or the data itself (bits, bytes, etc.). The digital circuits can be programmable processors (microprocessors) or special-purpose digital logic functions. In small- to medium-volume products these logic functions are implemented using Field-Programmable Gate Arrays (FPGAs).

In this lab you will design a self-synchronizing (multiplicative) descrambler using the Altera Quartus II FPGA design software and test it by simulating with a test waveforms supplied by the instructor.

The descrambler should multiply the input bits by the generator polynomial $G(x) = 1 + x^{-5} + x^{-9}$.

> You may wish to refer to the description of the V.22 descrambler in Lecture 11. The generator polynomial for the V.22 descrambler is $G(x) = x^0 + x^{-14} + x^{-17}$.

Procedure

Run the Altera Quartus II software. Create a new project and a new block design file (BDF) using the block diagram editor. Add the components and I/O pins required. The descrambler should have three input pins (use the pin names resetN, clock and datain) and one output (dataout). The 'resetN' signal should set the state of the descrambler as if the previously received data was all-ones. The 'datain' and 'dataout' are the input and output data bits clocked on the rising edge of 'clock'. Save the project and design files and compile the design. If there are any errors, fix them and recompile the design.

Run the QSIM simulation program by running the command `quartus_sh --qsim` in the folder where the quartus_sh command is installed. Open the project and the waveform input file in the share-out folder. Run the simulation and show the simulation output to the instructor.

Pre-Lab

Submit a schematic of your circuit. You can either draw it by hand and scan it or create it with Quartus II and print the schematic to a file. The Quartus II software is free and you can download and install it if you wish.

Report

Create a report document containing the identification information asked for in previous labs, a schematic (block diagram) of your working circuit, and the waveforms showing the test input and the output of your circuit.