LAB 6 – 3300L

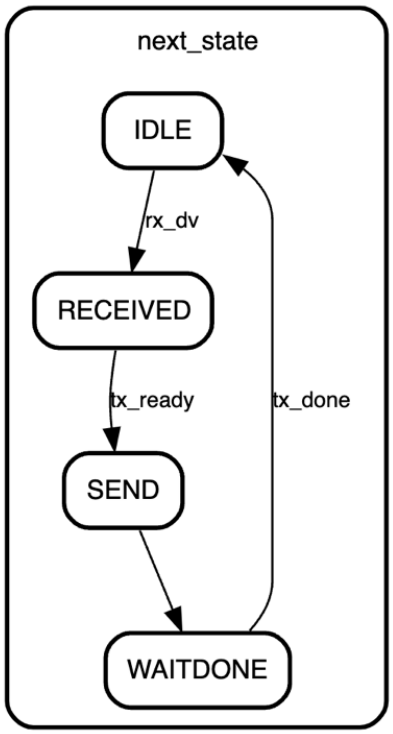
Spring 2025 / Dr. Van Blerkom

This short lab is intended to enable communication between your computer and the FPGA board over the UART serial port. In future labs we will use the UART communication for input and output. For this lab we will just echo the incoming received UART data back to the outgoing UART transmitter; this is called "loopback" mode. When a byte of data is received, it will be immediately sent back to the computer.

The ASCII code for the character should also be displayed on the 7-segment display. You will need to include the Verilog modules from earlier labs to convert the 8-bit ASCII character value to a BCD value and drive the 7-segment display.

Bring the current state out to LEDs so that you can debug your code on the board.

1. **States & Outputs:**
    - IDLE – Wait for received data (rx_dv == 1)
    - RECEIVED – wait for the transmitter to be ready (tx_ready == 1)
    - SEND – set tx_dv high for one clock cycle to send data, and go to WAITDONE
    - WAITDONE – wait for the transmitter to be done (tx_done == 1)



2. **Constraint file modifications**
   You will need to uncomment the first two lines in the constraint file under the USB-RS232 interface header, to connect the UART lines:

```
##USB-RS232 Interface

set_property -dict { PACKAGE_PIN C4    IOSTANDARD LVCMOS33 } [get_ports { UART_RX }]; #IO_L7P_T1_AD6P_35 Sch=uart_txd_in
set_property -dict { PACKAGE_PIN D4    IOSTANDARD LVCMOS33 } [get_ports { UART_TX }]; #IO_L11N_T1_SRCC_35 Sch=uart_rxd_out
```

To communicate over the UART serial port from your computer, you need a terminal program. You can use the terminal client "PuTTY" on Windows. Be sure to select "Serial" as the connection type. The settings for your serial terminal should be **9600 baud, no parity, one stop bit**. On my machine the USB-UART bridge serial line is "COM4" - it might be different on your machine. You can see which COM number it is in the Windows Device Manager.

PuTTY download link: https://www.chiark.greenend.org.uk/~sgtatham/putty/