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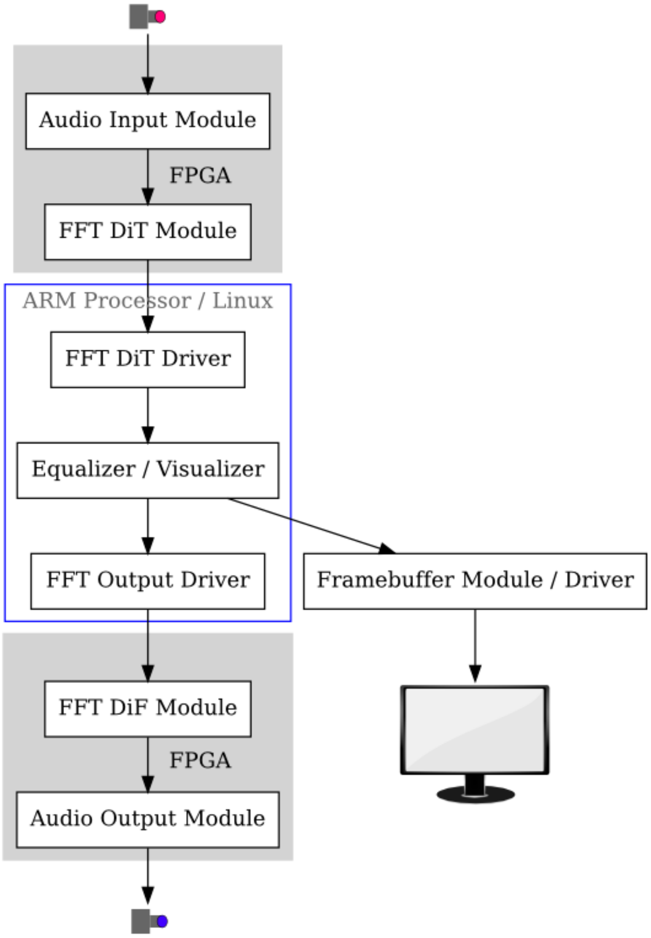
MuseBox

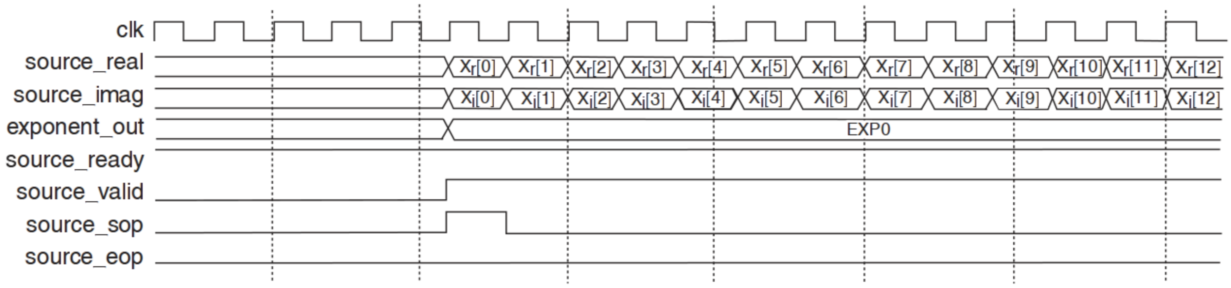
The Design



The above is the block diagram for our device. The "Framebuffer Module / Driver" is recycled from Lab 2, with a userspace program driving the display.

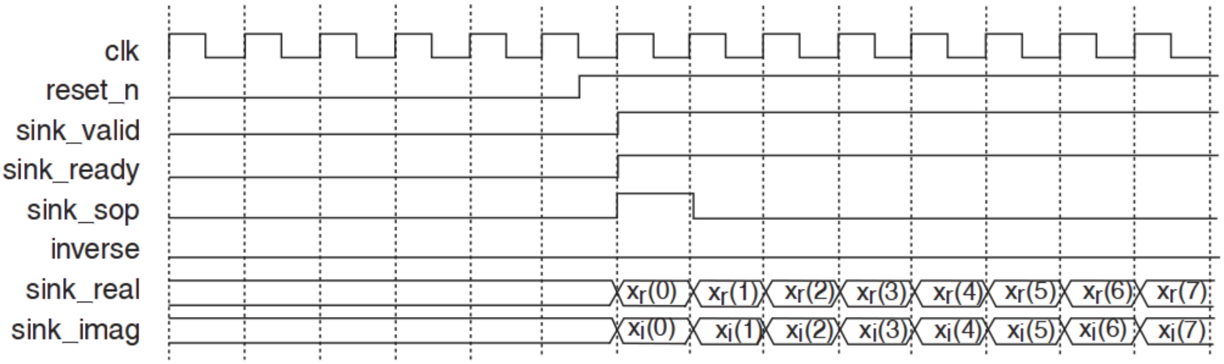
Timing Diagrams

FFT DiF Module -> Audio Output Module:


clk
source_real
source_imag
exponent_out
source_ready
source_valid
source_sop
source_eop
$X_r[0]$ $X_r[1]$ $X_r[2]$ $X_r[3]$ $X_r[4]$ $X_r[5]$ $X_r[6]$ $X_r[7]$ $X_r[8]$ $X_r[9]$ $X_r[10]$ $X_r[11]$ $X_r[12]$
$X_i[0]$ $X_i[1]$ $X_i[2]$ $X_i[3]$ $X_i[4]$ $X_i[5]$ $X_i[6]$ $X_i[7]$ $X_i[8]$ $X_i[9]$ $X_i[10]$ $X_i[11]$ $X_i[12]$
EXP0

Borrowed from the Altera Corporation FFT MegaCore Function User Guide (Figure 3-5, section 3-8)

FFT DiT Module:


clk
reset_n
sink_valid
sink_ready
sink_sop
inverse
sink_real
sink_imag
$x_r(0)$ $x_r(1)$ $x_r(2)$ $x_r(3)$ $x_r(4)$ $x_r(5)$ $x_r(6)$ $x_r(7)$
$x_i(0)$ $x_i(1)$ $x_i(2)$ $x_i(3)$ $x_i(4)$ $x_i(5)$ $x_i(6)$ $x_i(7)$

Borrowed from the Altera Corporation FFT MegaCore Function User Guide (Figure 3-4, section 3-8)

Audio Input

The *Audio Input* is received by the *Audio Input Module* as voltage values and converted into integers within the module. These are streamed to the FFT DiT module. Since the sample rate of the Audio Input is so much slower (kHz) than the FFT Function (MHz), it is necessary to buffer the inputs. This module will buffer inputs from the Audio Input, and when the buffer is full, stream the buffer to the FFT Function and assert/deassert the appropriate signals.

Equalizing/Visualizing

After the FFT is computed, the fixed point values will be read into memory. The userspace program will take this array of values and modify them according to user-specified boosts and cuts. The resulting voltage levels will be displayed to the user as a spectrum of frequencies; a simple visualizer. The userspace program will compute the necessary pixels to send to the framebuffer driver to draw the representative spectrum. The values will also be written to the Inverse FFT Function via the FFT Output Driver.

Audio Output

The Audio Output Module will take the result from Inverse FFT and send it to audio out. This module will buffer the FFT output when the FFT is ready, and send that to audio out. The buffering is necessary since samples are sent to audio out on the order of kHz, but received on the order of MHz.