# How to Store a Program on the Zybo-Z7

Once you are able to run your application through Vivado SDK, you can now store the program files to the Quad-SPI Flash on the Zybo-Z7 board. To do so, first we need to create a First-Stage Bootloader (FSBL). This is the initial file loaded into the Zynq processor, and configures it to read the remaining boot files and perform the appropriate operations to load and run them.

From Vivado SDK, select File > New > Application Project. Name it however you'd like, and leave everything else as a default (including to create a new bsp). Click **Next**, then select *Zynq FSBL* from the list of templates. Click **Finish**.
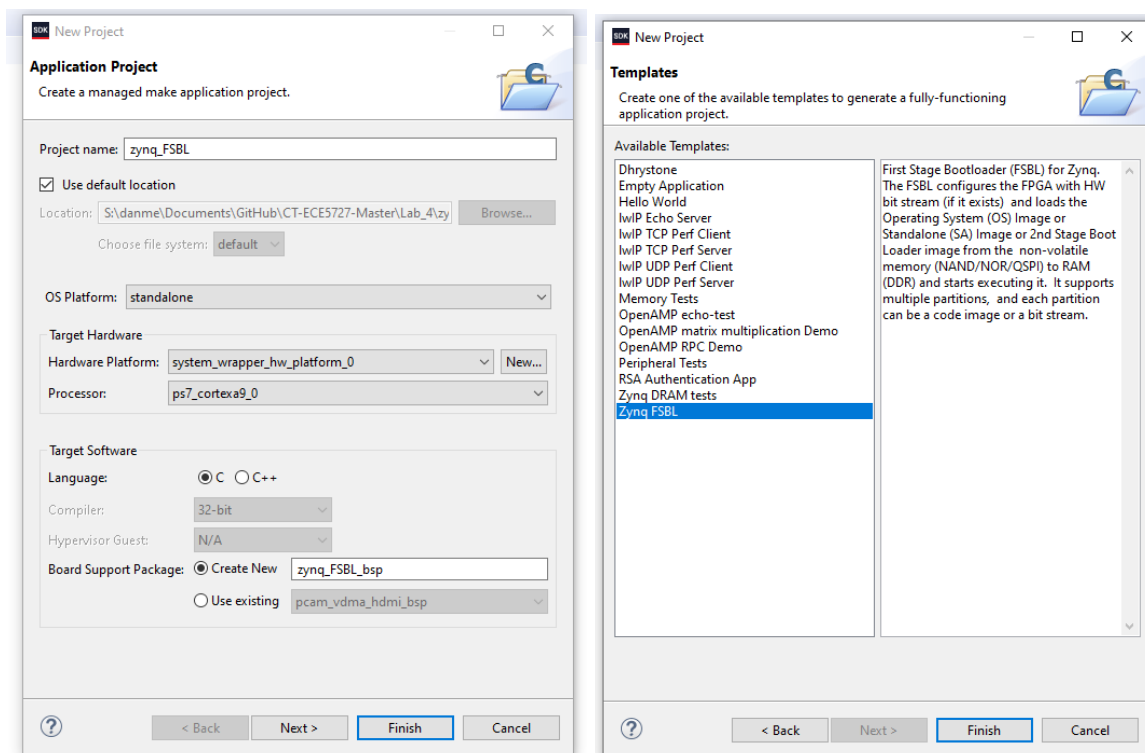

Once the FSBL has finished compiling, it is time to create the full boot image (.bif) file. Right-click on the primary application in the Project Explorer tab, and select **Create Boot Image** near the bottom of the menu. It should populate by default correctly, however it is worth checking that the correct files are to be included.

Under *Boot image partitions* there should be three files listed. It is important they are in this order, as this is the order they will be read/run. First should be the .elf file for the FSBL. Following this is the FPGA .bit image (system_wrapper.bit). Finally comes the .elf for the processor application.

Click **Create Image**. This will create the project's .bif file, which is just a listing of the partitions, and the actual BOOT.bin file. Both are by default placed within the project directory, under the *bootimage* subdirectory.

With BOOT.bin created, it is time to load it into the onboard flash. The Zybo-Z7 uses a Quad-SPI flash IC, which means unlike the standard SPI protocol that uses 1 MISO line,

this chip uses 4 MISO lines, allowing for 4 bits of data transfer per clock cycle. There are many different 'standard' protocols used to read/write from flash ICs, and Xilinx knows how to write the image file into all of them. We merely have to tell it what protocol our IC uses.
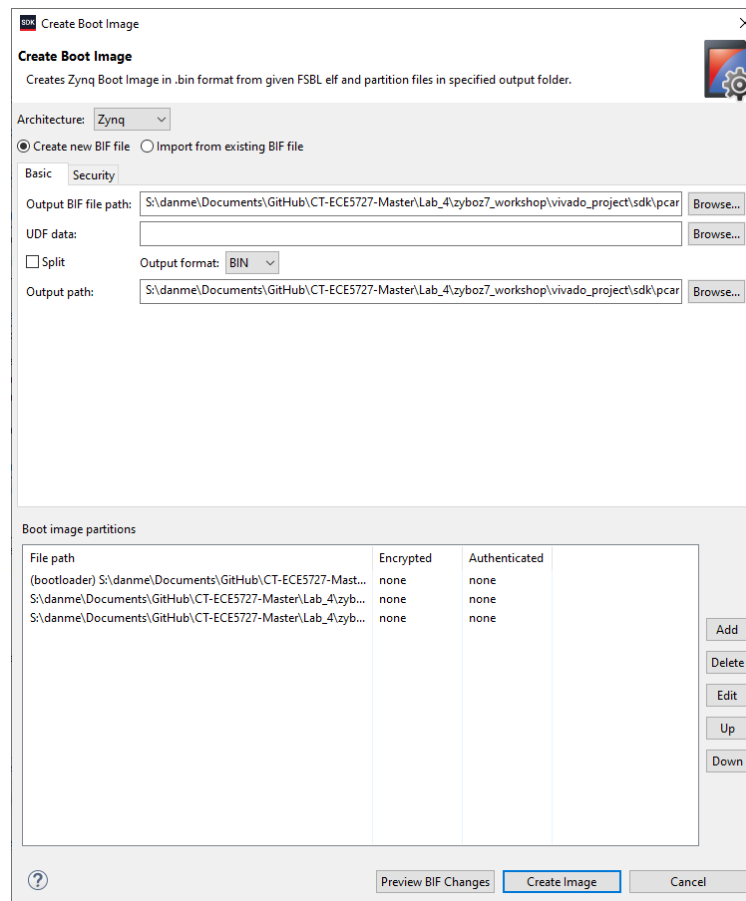
Select Xilinx > Program Flash. Select the following options from the pop-up:

- *Image File*: Browse to BOOT.bin

- *Flash Type*: Select **qspi-x4-single** from the drop-down

- *FSBL File*: For some reason it wants this. Browse to the FSBL project directory, and find the .elf file within the *Debug* subdirectory

- Everything else can be left as default

There are two jumpers on the Zybo-Z7, one to select power source by the switch, the other to select boot mode over the *PGOOD* and *DONE* LEDs. To boot from the onboard flash on power-on, set the jumper on the middle two pins to select QSPI Flash. Moving the jumper to the left two pins would select the SD card (slot on the bottom of the board) as the boot source. This would require formatting an SD card and copying the BOOT.bin file onto it.
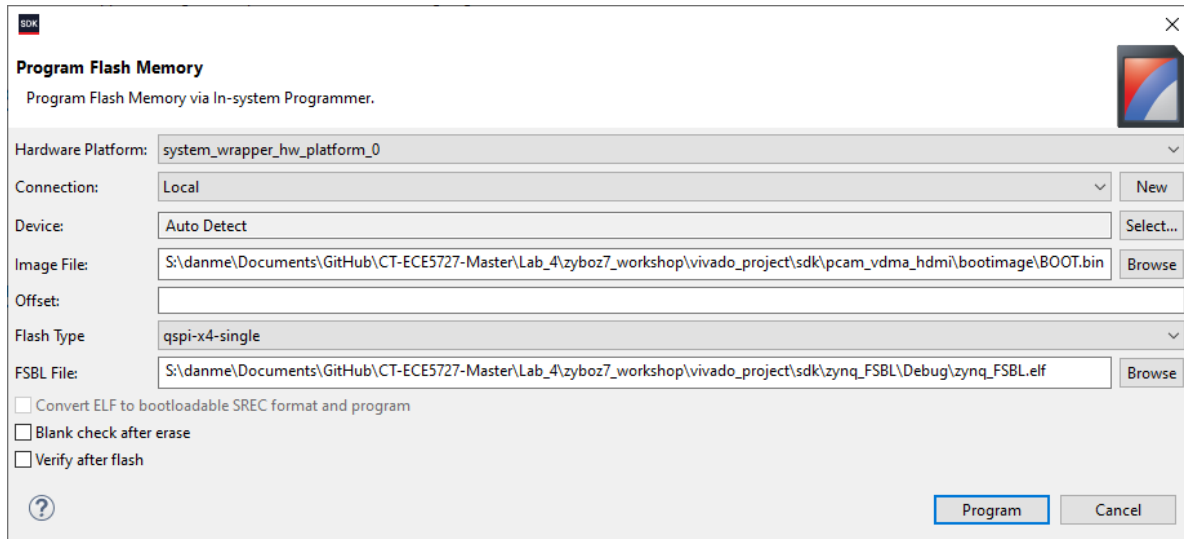
Leaving the jumper on the two rightmost pins selects JTAG as the boot mode, meaning nothing is loaded into the Zynq chip on power-up, instead it waits to be programmed over JTAG (via Vivado).

All instructions derived from https://www.xilinx.com/html_docs/xilinx2018_3/SDK_Doc/SDK_tasks/sdk_t_create_zynq_boot_image.html