SeL4 Setup Instructions v1.0

Table of Contents

Initial Setup Notes/Requirements

a. Windows Machine

b. Ubuntu Desktop 18.04

    a. Note: If using a virtual machine, you will not be able to test that an operation system can run on top of seL4 due to lack of resources available.

c. >8GB SD card that can be formatted with a FAT32 format

d. Raspberry Pi 4 with a UART serial connector

Host Dependencies

Setup these dependencies within the Ubuntu VM

1. For now, follow the steps at the link below
    - https://docs.sel4.systems/projects/buildsystem/host-dependencies.html
    - Note: look at missing dependencies section of the appendix for dependencies left out that are required for other seL4 tutorials.
    - Note: Also look at common errors section of the appendix if any unexpected problems occur.

SeL4Test Image Creation

This creation takes place within the Ubuntu VM. Ensure dependencies have been setup. Full steps can be found at https://docs.sel4.systems/projects/sel4test/.

1. Run the following commands to get the sel4test repo
    a. mkdir sel4test
    b. cd sel4test
    c. repo init -u https://github.com/seL4/sel4test-manifest.git
    d. repo sync
2. Build the sel4test image
    a. mkdir build
    b. cd build
    c. ../init-build.sh -DPLATFORM=rpi4 -DAARCH64=TRUE
    d. ninja
        i. You can ignore a warning that warns about an int type
3. The generated binary should be found in the images/ directory as sel4test-driver-image-arm-bcm2711
4. Copy the generated binary over to your Windows machine

U-boot Bootloader Creation

This creation takes place within the Ubuntu VM.

1. Retrieve the U-boot repository
    a. git clone https://github.com/u-boot/u-boot.git u-boot
    b. cd u-boot
2. Create U-boot binary
    a. make CROSS_COMPILE=aarch64-linux-gnu- rpi_4_defconfig
    b. make CROSS_COMPILE=aarch64-linux-gnu-
3. Copy u-boot.bin over to your Windows machine

SD Card Setup

This setup takes place on your Windows machine. Full instructions are found at https://docs.sel4.systems/Hardware/Rpi3.html

1. Download the Raspberry Pi Imager at https://www.raspberrypi.org/software/
2. After installation, open the imager application
3. Choose OS
    a. Click “Choose OS”
    b. Click “Raspberry Pi OS (other)”
    c. Choose “Raspberry Pi OS Lite (32-bit)”

4. Choose Storage
    a. Select the SD card you wish to write to
5. Click “Write”
    a. Once finished, you may have to unplug and plug back in your SD card to your Windows machine so that it is recognized
    b. Upon plugging in again, if it asks to format the card, click Cancel
6. Open the contents of the SD card
    a. Ensure that it has the following: bootcode.bin, start4.elf, config.txt
7. Add the sel4test image that we created above into the root directory of the SD card
8. Add uboot.bin that we created above into the root directory of the SD card
9. Edit config.txt by adding the following lines to the bottom of the file
    a. enable_uart=1
    b. arm_64bit=1
    c. kernel=u-boot.bin

UART Serial Connection Setup

This takes place on your Windows machine.

1. Plug in the Pi’s UART connector into the USB port of your Windows machine
    a. The Pi should be powered on for now to ensure the serial connection is recognized
2. From the Windows Start Menu, open Device Manager
3. Click the Ports (COM & LPT) dropdown
    a. You should see a line containing “UART Bridge (COM#)”
    b. Take note of the COM number on this line
4. From the Windows Start Menu, open Putty
5. Setup Putty for the serial connection
    a. Click the “Serial” radio button on the Session page that opens upon startup
    b. Type the COM number in the “Serial Line” text box (ex. COM3)
    c. Change “Speed” to 115200
    d. Click on “Serial” under “Connection” in the hierarchy in the left-hand pane
    e. Ensure that Data bits is 8, Stop bits is 1, and Flow control in None
    f. Return to the Session tab, type a name under “Saved Sessions”, and click Save
    g. Click “Open”

Pi 4 Boot with SeL4Test

With Putty open to the correct serial COM port, the UART cable plugged into your Windows machine, and the SD card in the Raspberry Pi 4, follow these steps. This will take place primarily on your Windows machine.

1. Boot up the Pi
    a. Wait until you see the uboot> command prompt
2. Load the sel4test image with the following commands

    a. fatls mmc 0
        i. You should see your sel4test image listed amongst the other contents of the SD card
    b. fatload mmc 0 0x0200000 sel4test-driver-image-arm-bcm2711
    c. bootefi 0x0200000

3. Upon execution, a wall of text should be processed, and at the end you should see “All is well in the universe”, indicating a success

Appendix

Missing Dependencies

- pip3 install aenum
- pip3 install sortedcontainers
- pip3 install plyplus
- pip3 install orderedset
- pip3 install simpleeval
    - If install fails, try downgrading your setuptools and installing it again.
        - pip3 install setuptools==57.5.0
    - Make sure setuptools is upgraded to newest version after.
        - pip3 install setuptools –upgrade
- pip3 install testresources

Common Errors

- Python not being a newer version preventing some dependencies to be installed.
    - sudo -H pip3 install --upgrade pip
- Google Repo not working
    - mkdir -p ~/.bin
    - PATH="${HOME}/.bin:${PATH}"
    - curl https://storage.googleapis.com/git-repo-downloads/repo > ~/.bin/repo
    - chmod a+rx ~/.bin/repo
- Problem with the hello world script
    - Go to idle.c and remove: __attribute__((naked)) NORETURN
- CMake error
    - Sudo apt-get purge cmake
    - Sudo snap install cmake –classic
    - Verify directory is at /usr/bin/cmake
        - Which cmake
        - sudo cp /snap/bin/cmake /usr/bin/cmake