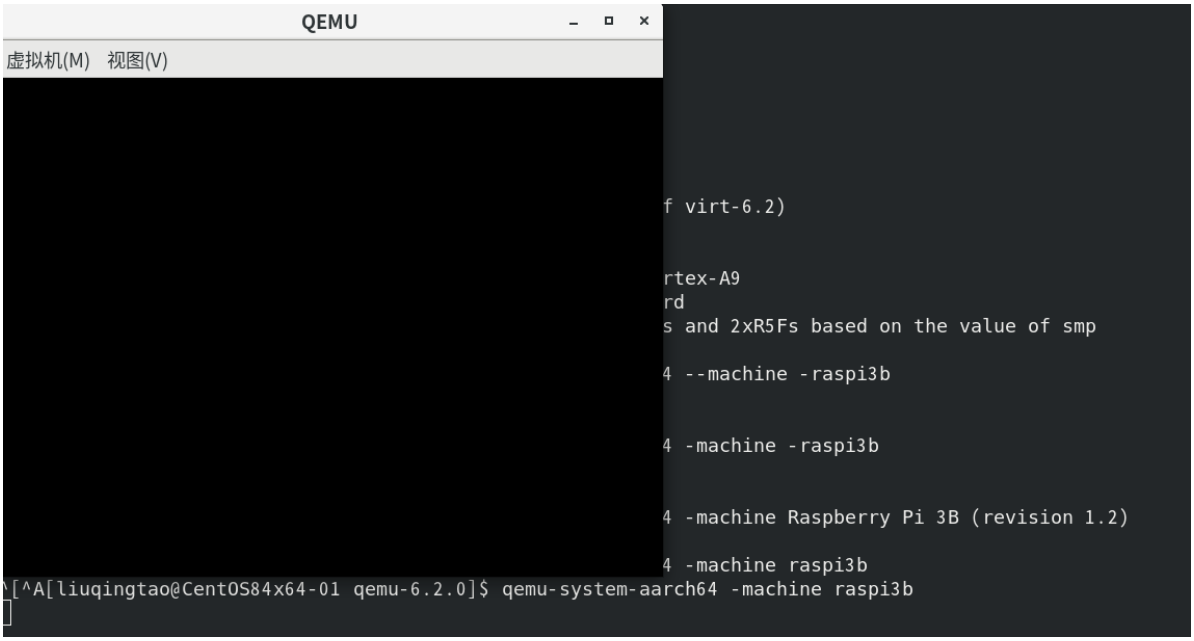
qemu安装

qemu按照官网方式编译，最后加make install完成安装。输入qemu-+tab补全，效果如下：

```
[liuqingtao@CentOS84x64-01 qemu-6.2.0]$ qemu-
qemu-aarch64               qemu-or1k                  qemu-system-mips64
qemu-aarch64_be            qemu-ppc                   qemu-system-mips64el
qemu-alpha                 qemu-ppc64                 qemu-system-mipsel
qemu-arm                   qemu-ppc64le               qemu-system-nios2
qemu-armeb                 qemu-pr-helper             qemu-system-or1k
qemu-cris                  qemu-riscv32               qemu-system-ppc
qemu-edid                  qemu-riscv64               qemu-system-ppc64
qemu-ga                    qemu-s390x                 qemu-system-riscv32
qemu-hexagon               qemu-sh4                   qemu-system-riscv64
qemu-hppa                  qemu-sh4eb                 qemu-system-rx
qemu-i386                  qemu-sparc                 qemu-system-s390x
qemu-img                   qemu-sparc32plus           qemu-system-sh4
qemu-io                    qemu-sparc64               qemu-system-sh4eb
qemu-keymap                qemu-storage-daemon        qemu-system-sparc
qemu-m68k                  qemu-system-aarch64        qemu-system-sparc64
qemu-microblaze            qemu-system-alpha          qemu-system-tricore
qemu-microblazeel          qemu-system-arm            qemu-system-x86_64
qemu-mips                  qemu-system-avr            qemu-system-xtensa
qemu-mips64                qemu-system-cris           qemu-system-xtensaeb
qemu-mips64el              qemu-system-hppa           qemu-trace-stap
qemu-mipsel                qemu-system-i386           qemu-x86_64
qemu-mipsn32               qemu-system-m68k           qemu-xtensa
qemu-mipsn32el             qemu-system-microblaze     qemu-xtensaeb
qemu-nbd                   qemu-system-microblazeel
qemu-nios2                 qemu-system-mips
```

qemu-system-aarch64 -machine help查看支持的机器，输入：qemu-system-aarch64 -machine raspi3b，效果如下：




```
qemu-system-aarch64 -machine raspi3b
```

可能后期要改，比如-m等参数

sel4编译

sel4给的官方文档[seL4 on the Raspberry Pi 3 – Trustworthy Systems Blog (csiro.au)]

安装repo[下载源代码 | Android 开源项目 | Android Open Source Project]

编译sel4[seL4 on the Raspberry Pi 3 – Trustworthy Systems Blog (csiro.au)]

我是64位centos，在交叉编译seL4-Test project报错：

```
[liuqingtao@CentOS84x64-01 build-rpi]$ ../init-build.sh -DPLATFORM=rpi3 -DBAMBOO=TRUE -DAARCH32=TRUE
loading initial cache file /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/projects/sel4test/settings.cmake
CMake Error at /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/gcc.cmake:51 (message):
  Unable to find valid cross-compiling GCC
Call Stack (most recent call first):
  /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/gcc.cmake:58 (FindPrefixedGCC)
  /usr/share/cmake/Modules/CMakeDetermineSystem.cmake:123 (include)
  CMakeLists.txt:11 (project)


CMake Error: CMake was unable to find a build program corresponding to "Ninja".  CMAKE_MAKE_PROGRAM is not set.  You probably need to select a different build tool.
CMake Error: CMAKE_C_COMPILER not set, after EnableLanguage
CMake Error: CMAKE_CXX_COMPILER not set, after EnableLanguage
CMake Error: CMAKE_ASM_COMPILER not set, after EnableLanguage
-- Configuring incomplete, errors occurred!
```

要安装交叉编译器

[CentOS8 安装ARM Linux交叉编译环境_小歆CSDN博客-CSDN博客]。

[Ubuntu12.04嵌入式交叉编译环境arm-linu-gcc搭建过程，图解王文松的博客-*CSDN*博客ubuntu 编译arm]。

[arm交叉编译工具使用报错*lyndon-CSDN*博客交叉编译报错]。

[centos7安装arm-linux-gcc-4.4.3交叉编译器苦苦的潜行者-*CSDN*博客arm-linux-gcc-4.4.3]。

找官方库？[arm-linux-gcc下载与安装-阿里云开发者社区 (aliyun.com)]。

安装交叉编译器后再次报错

```
[liuqingtao@CentOS84x64-01 build-rpi]$ ../init-build.sh -DPLATFORM=rpi3 -DBAMBOO=TRUE -DAARCH32=TRUE
loading initial cache file /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/projects/sel4test/settings.cmake
-- Set platform details from PLATFORM=rpi3
--   KernelPlatform: bcm2837
--   KernelARMPlatform: rpi3
-- Setting from flags KernelSel4Arch: aarch32
-- Found seL4: /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel
-- Found GCC with prefix arm-none-eabi-
-- The C compiler identification is GNU 5.4.1
-- The CXX compiler identification is GNU 5.4.1
-- The ASM compiler identification is GNU
-- Found assembler: /usr/local/gcc-arm-none-eabi/bin/arm-none-eabi-gcc
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info - done
-- Check for working C compiler: /usr/local/gcc-arm-none-eabi/bin/arm-none-eabi-gcc - skipped
-- Detecting C compile features
-- Detecting C compile features - done
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler ABI info - done
-- Check for working CXX compiler: /usr/local/gcc-arm-none-eabi/bin/arm-none-eabi-g++ - skipped
-- Detecting CXX compile features
-- Detecting CXX compile features - done
-- Found elfloader-tool: /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/tools/seL4/elfloader-tool
-- /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/kernel/gen_headers/plat/machine/devices_gen.h is out of date. Regenerating from DTB...
Traceback (most recent call last):
  File "/home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel/tools/hardware_gen.py", line 15, in <module>
    from hardware.fdt import FdtParser
  File "/home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel/tools/hardware/fdt.py", line 8, in <module>
    import pyfdt.pyfdt
ModuleNotFoundError: No module named 'pyfdt'
CMake Error at /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel/config.cmake:197 (message):
  Failed to generate from DTB:
  /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/kernel/gen_headers/plat/machine/devices_gen.h
Call Stack (most recent call first):
```

好像要安装device-tree-compiler

[Install Device Tree Compiler on CentOS using the Snap Store | Snapcraft].可能遇到too early for operation, device not yet seeded or device model not acknowledged错误，见[centos 安装 snapd 报错: too early for operation, device not yet seeded or device model not acknowledged_程序猿在武汉-CSDN博客]。

要安装pyfdt

在python中安装包出现Retrying (Retry(total=4, connect=None, read=None, redirect=None, status=None)) lsf_007的博客-CSDN博客.

安装Jinja2

python - ImportError: No module named jinja2 - Stack Overflow。

module 'yaml' has no attribute 'FullLoader'错误：

[linux操作]module 'yaml' has no attribute 'FullLoader' Slientsake的博客-CSDN博客。

好像成功：

```
[liuqingtao@CentOS84x64-01 build-rpi]$ ../init-build.sh -DPLATFORM=rpi3 -DBAMBOO=TRUE -DAARCH32=TRUE
loading initial cache file /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/projects/sel4test/settings.cmake
-- Found GCC with prefix arm-none-eabi-
-- CPIO test cpio_reproducible_flag PASSED
-- Found musllibc: /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/projects/musllibc
-- Found util_libs: /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/projects/util_libs
-- Found seL4_libs: /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/projects/seL4_libs
-- Found sel4_projects_libs: /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/projects/sel4_projects_libs
-- Found sel4runtime: /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/projects/sel4runtime
-- Performing Test compiler_arch_test
-- Performing Test compiler_arch_test - Success
-- libmuslc architecture: 'arm' (from KernelSel4Arch 'aarch32')
-- Detecting cached version of: musllibc
-- Found Git: /usr/bin/git (found version "2.27.0")
--   Not found cache entry for musllibc - will build from source
-- Found Nanopb: /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/tools/nanopb
-- Configuring done
-- Generating done
-- Build files have been written to: /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi
```

ninja步骤

还报错，缺少库

```
[liuqingtao@CentOS84x64-01 build-rpi]$ ninja
[17/308] Generating from /home/liu...d/sel4_arch_shared_types/types.pbf
FAILED: libsel4/sel4_arch_include/aarch32/sel4/sel4_arch/types_gen.h
cd /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/libsel4 && python3 /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel/tools/bitfield_gen.py --environment libsel4 /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/libsel4/generated/sel4_arch_shared_types/types.pbf /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/libsel4/sel4_arch_include/aarch32/sel4/sel4_arch/types_gen.h
Traceback (most recent call last):
  File "/home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel/tools/bitfield_gen.py", line 24, in <module>
    import lex
  File "/home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel/tools/lex.py", line 39, in <module>
    from past.builtins import cmp
ModuleNotFoundError: No module named 'past'
[18/308] Generating from /home/liu.../shared_types_gen/shared_types.pbf
FAILED: libsel4/include/sel4/shared_types_gen.h
cd /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/libsel4 && python3 /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel/tools/bitfield_gen.py --environment libsel4 /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/libsel4/generated/shared_types_gen/shared_types.pbf /home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/build-rpi/libsel4/include/sel4/shared_types_gen.h
Traceback (most recent call last):
  File "/home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel/tools/bitfield_gen.py", line 24, in <module>
    import lex
  File "/home/liuqingtao/study/oscomp/seL4-12.1.0/sel4test/kernel/tools/lex.py", line 39, in <module>
    from past.builtins import cmp
ModuleNotFoundError: No module named 'past'
[28/308] Invoking muslc build system
ninja: build stopped: subcommand failed.
```

past库

Python中Import Error: no module named 'past'错误以及解决方法_皇族永不言弃-CSDN博客。

ModuleNotFoundError: No module named 'google'

python - ImportError: No module named 'google' - Stack Overflow。

from .proto import nanopb_pb2 ImportError: attempted relative import with no known parent package：

编译出错 ninja: build stopped: subcommand failed Android 源码编译锅ke24的专栏-CSDN博客 ninja:build stopped:subcommand。

build.ninja 修改？？？？

- 文件中的-Werror需要去掉，不然会严格将警告当做错误。
- 搜索 apps/sel4test-driver/sel4test-tests/CMakeFiles/sel4test-tests.dir/src/tests/domains.cxx.obj.d，在其下面的FLAGS中，加入-std=c++11。

换个思路，官方是低版本gcc编译的：

Linux 安装指定版本GCC方法*beyondLi71*的博客-*CSDN*博客安装低版本gcc。

Ubuntu用它了

官方依赖教程：Host Dependencies | seL4 docs。

用docker试试？Using Docker for seL4, Camkes, and L4v dependency management | seL4 docs。

ubuntu reboot 问题

Ubuntu 12.04 (Wubi) not starting - root.disk corrupted - Ask Ubuntu

升级ubuntu20了