KVM on Jetson TX2

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1 Install KVM on Jetson TX2

The Jetson TX2 does not natively support KVM. We need some modifications to Jetson TX2 operating system. In particular, we need

1.1 Recompile the kernel

First is to recompile the kernel and enable the hardware virtualization support in the kernel.

```
$ git  clone https://github.com/jetsonhacks/buildJetsonTX2Kernel
```

Go to the cloned directory, there are three executable files (*.sh*): *getKernel.sh*, *makeKernel.sh*, *copyImage.sh*. Run

```
$ ./getKernel.sh
```

This command will get the kernel sources from the website and let you select kernel configurations. Once you enter into the configuration selection, the following configurations need to be enabled.

```
Tegra Virtualization Support
Kernel−based Virtual Machine
```

There is also a small bug that needs to fixed in the kernel source code, i.e., in $include/linux/irqchip/arm-gic.h$

```
+#ifndef __ASSEMBLY__
enum domain_gic_pm_event {
MOD_DOMAIN_POWER_ON,
MOD_DOMAIN_POWER_OFF
};
−#ifndef __ASSEMBLY__
```

Then run (it will take 40 minutes)

```
$ ./makeKernel.sh
```

Finally run:

```
$ ./copyImage.sh
```

Finally reboot Jetson TX2. You will find that the KVM does not work properly. This is because KVM can not get the *irq* maintainance from device tree of Jetson TX2. Therefore you need to recompile the device tree of Jetson TX2.

1.2 Recompile device tree

First is to install device tree compiler using

```
$ sudo apt−get install device−tree−compiler
```

Then decompile *dtb* file to *dts* by

```
$ dtc −I dtb −O dts −o <name of dts you want>.dts /boot/tegra186−quill−p3310−1000−c03−00−base.dtb
```

Edit the decompiled dts file

```
sudo nano <name of dts file>.dts
```

Find the interrupt-controller device entry and edit it like the following

```
        interrupt−controller@2c001000 {
                compatible = "arm,cortex−a15−gic";
                #interrupt−cells = <3>;
                interrupt−controller;
                reg = <0x2c001000 0x1000>, //need two more entries
                      <0x2c002000 0x1000>,
                      <0x2c004000 0x2000>,
                      <0x2c006000 0x2000>;
                interrupts = <1 9 0xf04>; //directly add this line
        };
```

After modification, recompile dtb from the edited dts by

```
dtc −I dts −O dtb −o /boot/<name of dtb file>.dtb /boot/<name of dts file>.dts
```

The flush the device tree by

```
sudo dd if=/boot/modified_tegra186−quill−p3310−1000−c03−00−base.dtb of=/dev/mmcblk0p15
```

Then reboot the Jetson TX2, the hypervisor mode should be enabled successfully.

2 Create virtual machines on KVM

After installing KVM on Jetson TX2, we proceed to create and run virtual machines using KVM through following steps

2.1 Install necessary packages

```
$ sudo apt−get install qemu−kvm libvirt0 virt−manager bridge−utils
```

2.2 Configure bridge network interfaces (optional)

Change the Jetson TX2 host network interfaces to

```
auto wlan0
iface  wlan0 inet  dhcp

auto br0
iface  br0 inet  dhcp
        bridge_ports  wlan0
        bridge_stp  off
        bridge_maxwait 0
```

$Wifi$ is used here, if you are using ethernet, $wlan0$ shoule be $eth0$ according to the specific network interface.

2.3 Use virt-manager to install virtual machine

Virt-manager is an user-friendly GUI application to manage virtual machines (see Figure 1 as a reference.)
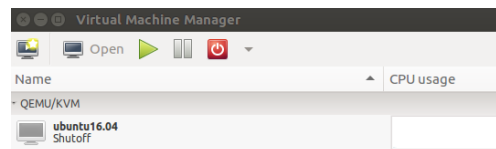
Figure 1: Virt-Manager

The install options of virtual machines are limited, you can only install virtual machines through iso file. Moreover, UEFI firmware is also required. Therefore, first is to install UEFI firmware, in ARM64, UEFI is OVMF. Get the $AAVMF\_CODE.fd$ from the following Github repository

```
https://github.com/BaoqianWang/VirtualizationOnJetsonTX2
```

Install the firmware by

```
$ mkdir /usr/share/AAVMF
$ cp AAVMF_CODE.fd /usr/share/AAVMF/AAVMF_CODE.fd
$ dd if=/dev/zero of=/usr/share/AAVMF/AAVMF−VARS.fd bs=16M count=1
```

Get the iso file also from

```
https://github.com/BaoqianWang/VirtualizationOnJetsonTX2
```

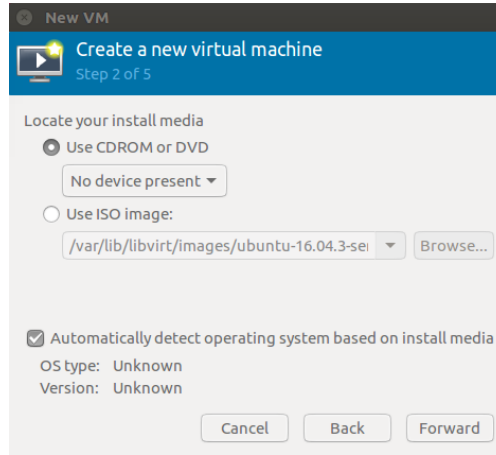Then install virtual machine through *iso* fie. (See Figure 2)

Figure 2: Install virtual machine through ISO file.

Then specify the CPU, memory and disk size for the virtual machine. (See Figure 3).

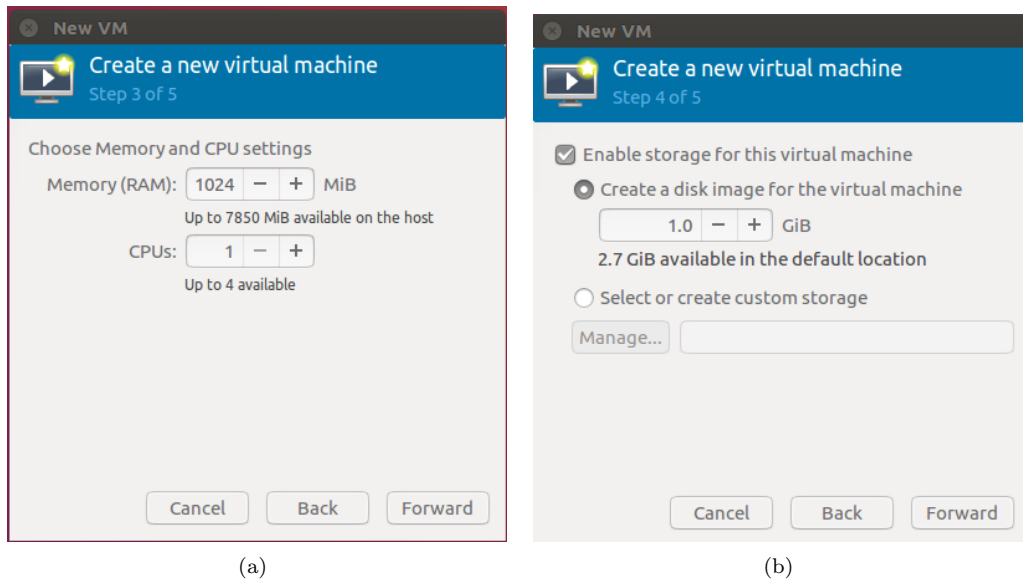(a)   (b)

Figure 3: Specify the CPU, memory and disk size for the virtual machine.

Before beginning installation, customize the installation configuration and select None in the firmware option. (See Figure 4)

Then begin installation. This will create VM but it does not boot successfully.

To fix it, from the Jetson TX2, run the following

```
$ sudo virsh edit <name of the virtual machine>
```
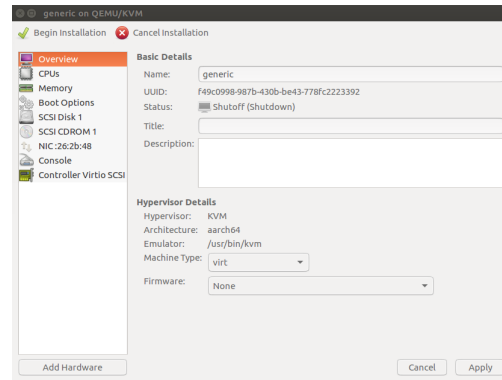
Then under the $< os >$ tag, add the following line

```
<loader readonly='yes' type=' rom >/share/AAVMF/AAVMF_CODE.fd</loader>
```

Then connect the virtual machine to the ISO image (see Figure 5)

4
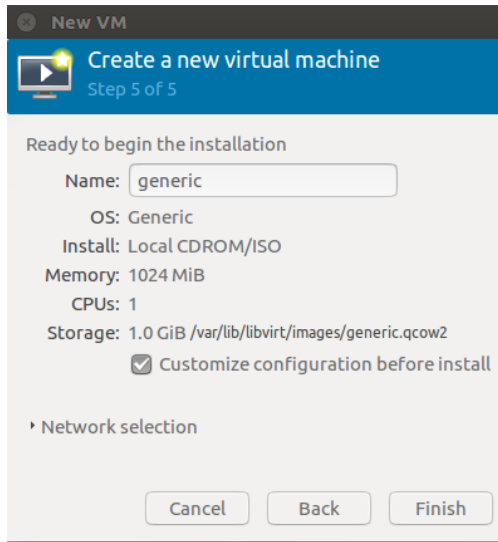
Figure 4: Customize the installation configuration and select None in the firmware option.
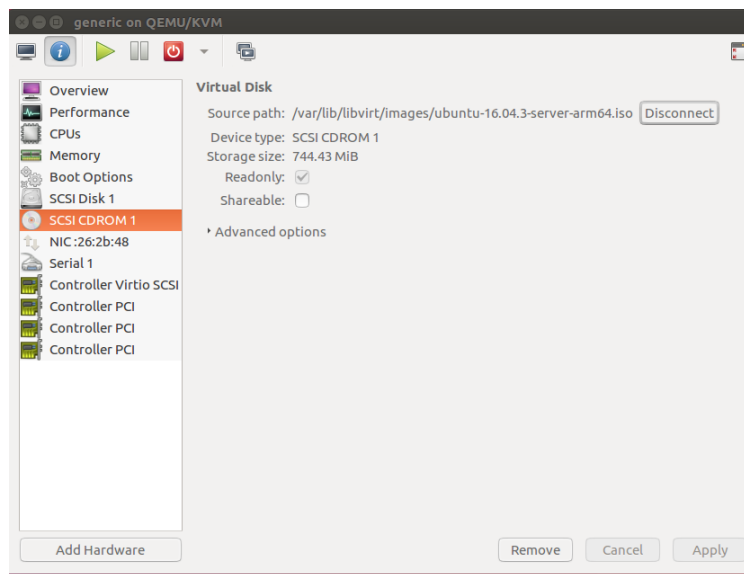

Figure 5: Connect ISO image to the virtual machine.

Then reboot the virtual machine, it should enter into the Ubuntu installation.(see Figure 6)

After finishing installation of operating system, you need to disconnect the CD-ROM drive in virt-manager. Then restart the virtual machine, it will enter into UEFI shell, run

```
$ FS0:
$ cd EFI/ubuntu
$ <name of file>.efi
```

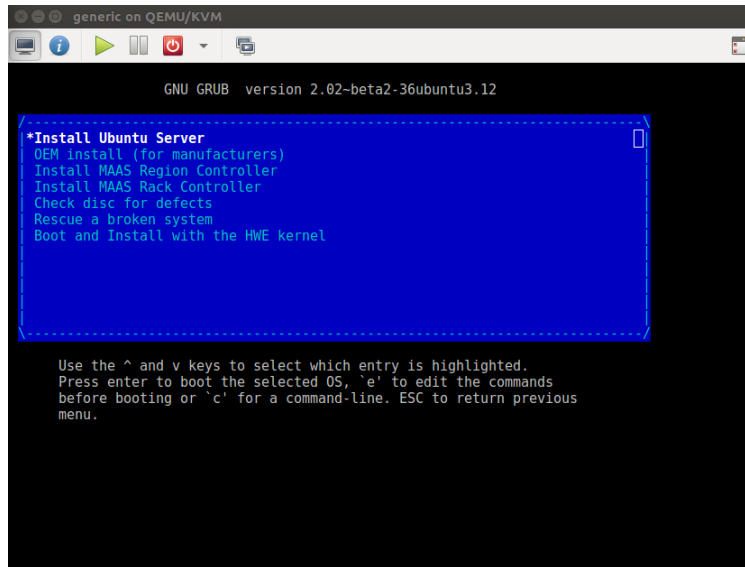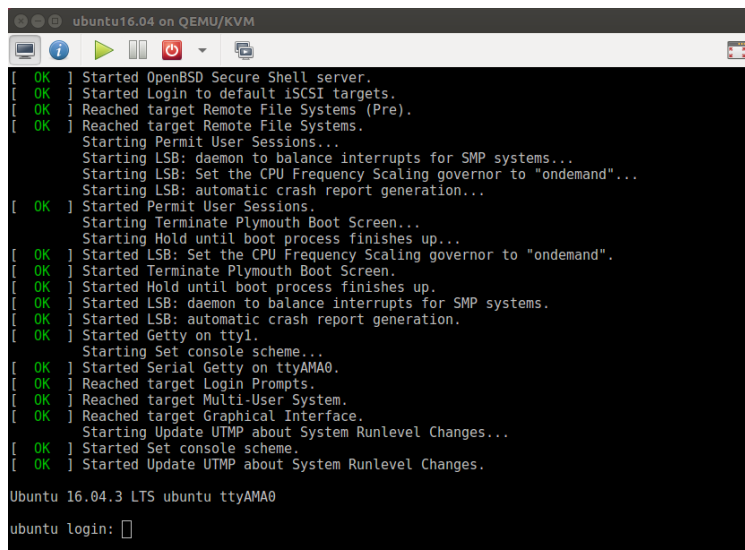Now you can run the Ubuntu operating system. (see Figure 7).

Figure 6: Installation of Ubuntu Server.

Figure 7: Running Ubuntu Server.