Cloud Computing Assignment 1

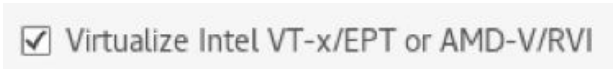
Build a virtual infrastructure and perform some virtualization features via IaaS

Outline

- Environment
- Install Qemu and KVM
- Create and Install a virtual machine
- Setup Bridged network with TAP interfaces
- Live migration
- Demo and report

Environment

- Linux server
- Privileged user (root or superuser)

- You can use VMware to build a linux server
- Need to enable “Virtualize Intel VT-x/EPT or AMD-V/RVI” in VMware “Processors” setting 

- We would use Ubuntu-16.04 to demonstrate this assignment, but you can use other Linux distributions.
- Ubuntu-16.04

Install Qemu and KVM

In Ubuntu 16.04

```
$ sudo apt-get install qemu-kvm
```

For other distributions, https://www.qemu.org/download/#linux

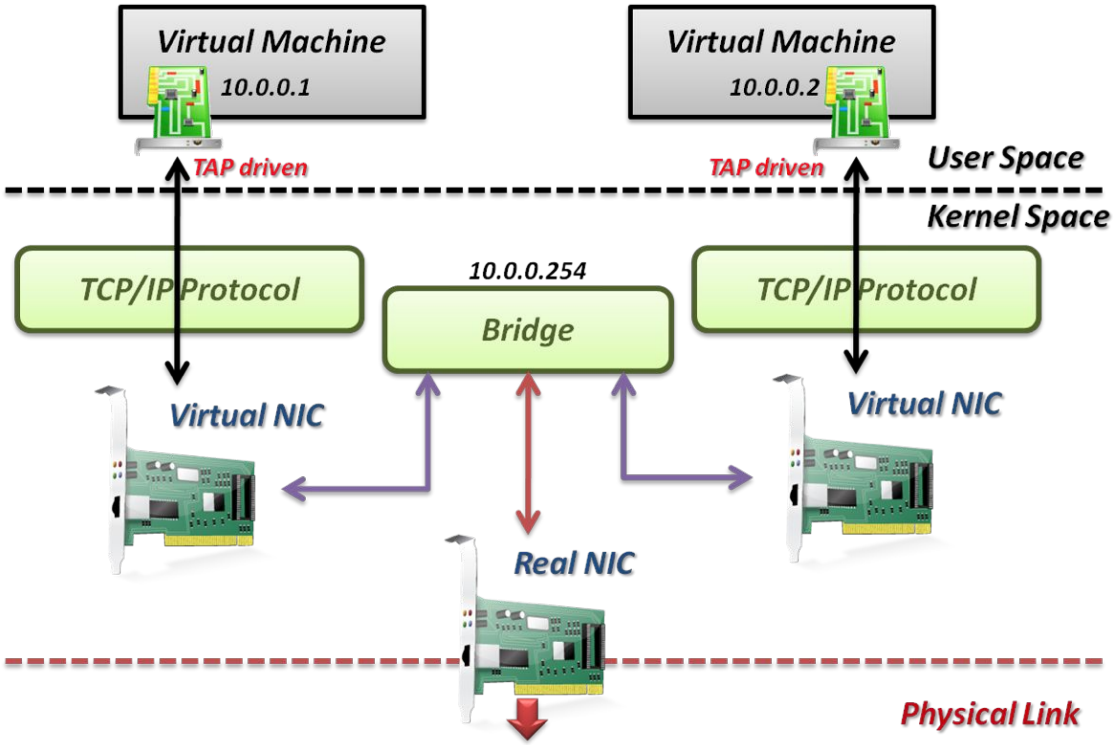
You can also build Qemu from source code.

Create and Install a virtual machine (VM)

```
$ qemu-img create -f raw ubuntu.img 10G
$ sudo qemu-system-x86_64 --enable-kvm \
-drive format=raw,file=ubuntu.img,if=virtio -m 2048 \
-net nic,model=virtio -net user \
-cdrom ubuntu-16.04.4-server-amd64.iso -vnc :0
```

Using any VNC viewer (ex: RealVNC, vncviewer) connect to (Your host IP):5900 (ex: 172.16.193.131:5900 or 127.0.0.1:5900), and complete the install process.

Setup Bridged network with TAP interfaces



Setup Bridged network with TAP interfaces

- On Host
- Install bridge-utils and OpenVPN for bridge and TAP

```
$ sudo apt-get install bridge-utils openvpn
```

Setup Bridged network with TAP interfaces

- On Host
- Modify /etc/network/interfaces to add a bridge interface

```
# The primary network interface
auto ens33
iface ens33 inet static
address 0.0.0.0

auto br0
iface br0 inet dhcp
bridge_ports ens33
bridge_maxwait 0

auto br0:0
iface br0:0 inet static
address 10.1.1.254
netmask 255.255.255.0
```

Setup Bridged network with TAP interfaces

- On Host
- Modify /etc/rc.local to set IP forwarding and NAT

```
echo "1" > /proc/sys/net/ipv4/ip_forward
###### iptables.rule ######
EIF="br0"
INNET="10.1.1.0/24"
iptables -t nat -A POSTROUTING -o $EIF -s $INNET -j MASQUERADE
exit 0
```

- Add execute permission

```
$ sudo chmod +x /etc/rc.local
```

- Reboot

```
$ sudo reboot
```

Setup Bridged network with TAP interfaces

- On Host
- Create a TAP interfaces and add it to bridge

```
$ sudo openvpn --mktun --dev tap0 --user `id -un`
$ sudo ifconfig tap0 promisc up
$ sudo brctl addif br0 tap0
$ sudo openvpn --mktun --dev tap1 --user `id -un`
$ sudo ifconfig tap1 promisc up
$ sudo brctl addif br0 tap1
```

Setup Bridged network with TAP interfaces

- Launch Qemu VM

```
$ sudo qemu-system-x86_64 --enable-kvm \
-drive format=raw,file=ubuntu.img,if=virtio -m 2048 \
-vnc :0 -redir tcp:10022::22
```

- Use VNCViewer and Install SSH server in VM

```
$ sudo apt-get install openssh-server
```

- Now you can SSH to VM from Host by port 10022

```
$ ssh localhost -p10022
```

Setup Bridged network with TAP interfaces

- Modify /etc/network/interfaces on VM

```
# The primary network interface
auto ens3
iface ens3 inet static
address 10.1.1.1
netmask 255.255.255.0
gateway 10.1.1.254
dns-nameserver 8.8.8.8
```

Setup Bridged network with TAP interfaces

- Shutdown and relaunch Qemu VM with the TAP device

```
$ sudo qemu-system-x86_64 --enable-kvm \
-drive format=raw,file=ubuntu.img,if=virtio -m 2048 \
-net tap,ifname=tap0,script=no,downscript=no \
-net nic,model=virtio,vlan=0,macaddr=ae:ae:00:00:00:50 \
-vnc :0
```

- Now you can SSH to VM from Host by IP

```
$ ssh 10.1.1.1
```

Live migration

- Launch VM1 with monitor

```
$ sudo qemu-system-x86_64 --enable-kvm \
-drive format=raw,file=ubuntu.img,if=virtio -m 2048 \
-net tap,ifname=tap0,script=no,downscript=no \
-net nic,model=virtio,vlan=0,macaddr=ae:ae:00:00:00:50 \
-vnc :0 -monitor telnet:127.0.0.1:5500,server,nowait
```

- SSH to VM1 and keep doing something on VM1
  - ex: *ping*, *sysbench*, or *iperf*.

Live migration

- Launch VM2 with migration parameters

```
$ sudo qemu-system-x86_64 --enable-kvm \
-drive format=raw,file=ubuntu.img,if=virtio -m 2048 \
-net tap,ifname=tap1,script=no,downscript=no \
-net nic,model=virtio,vlan=0,macaddr=ae:ae:00:00:00:50 \
-vnc :1 -incoming tcp:0:4400
```

Live migration

- VM1 is source, and VM2 is destination.
  - Now we would migrate the VM from source to destination
- Start the migration (use telent to enter Qemu monitor)

```
$ telnet localhost 5500
(qemu) migrate -d tcp:localhost:4400
```

- Check migration status

```
(qemu) info migrate
```

- Keep check migration status until you see `Migration status: completed`
  - Kill the process of VM1 (by ctrl+c or kill)
  - You would see your SSH connection is still alive and your work is still running

Demo and report (1/3)

- You have to give a demo to TA and show how to SSH to VM and perform the live migration. (30 poins)

Demo and report (2/3)

- You have to submit a report (pdf format) named HW1_{student_id}.pdf to iLMS. In your report, you must include following items:
  - A. Please simply explain how do you setup your VM (5 points)
  - B. Show the performance testing results by *sysbench* with and without “--enable-kvm” on VM, and Host; furthermore compare among them and explain the results (10 points)
  - C. Show the performance testing results by *iperf* with and without “virtio” on VM, and Host; furthermore compare among them and explain the results (10 points)
  - D. Show the performance measurements by *iperf* and *sysbench* during the live migration is progressing; furthermore, describe your observations. (10 points)

Demo and report (3/3)

- You have to submit a report (pdf format) named HW1_{student_id}.pdf to iLMS. In your report, you must include following items:
  - E. What is “live migration” and why we need it. (10 points)
  - F. Please describe how to maintain the network connection when the VM is being migrated. (10 points)
  - G. The latest version of QEMU introduced a new feature with fault tolerance, named COLO (http://wiki.qemu-project.org/Features/COLO). We don’t ask you to perform this feature in this assignment, but some questions you may answer:
    - What is fault-tolerance in cloud system and why we need it? (7.5 points)
    - What are the relationships between live migration and fault-tolerance? (7.5 points)

Deadline

Deadline: 4/18 23:59

If you have any question, asking through iLMS or email are welcome.