OMEC Gateways Tutorial

Great Software Laboratory Private Limited

6th Floor, Amar Arma Genesis, Baner Road,
Baner, Pune - 411045, India

www.gslab.com

info@gslab.com

CONTENTS

Introduction

This is quick guide to capture all the required configurations to deploy and launch Gateway tutorial working with il_trafficgen test tool.

Scope

Deployment will be considered for Combined SGW+PGW control plane(SPGWC), Combined SGW+PGW data plane(SPGWU) and traffic generator (il_trafficgen).

Terminologies

This section describes terminologies or abbreviations.

- CP - Control Plane Service/PDN Gateway node i.e. SPGWC
- DP - Data Plane Service/PDN Gateway node i.e. SPGWU
- SPGWC - Combined Serving and PDN Gateway Control plane function.
- SPGWU - Combined Serving and PDN Gateway User plane function.

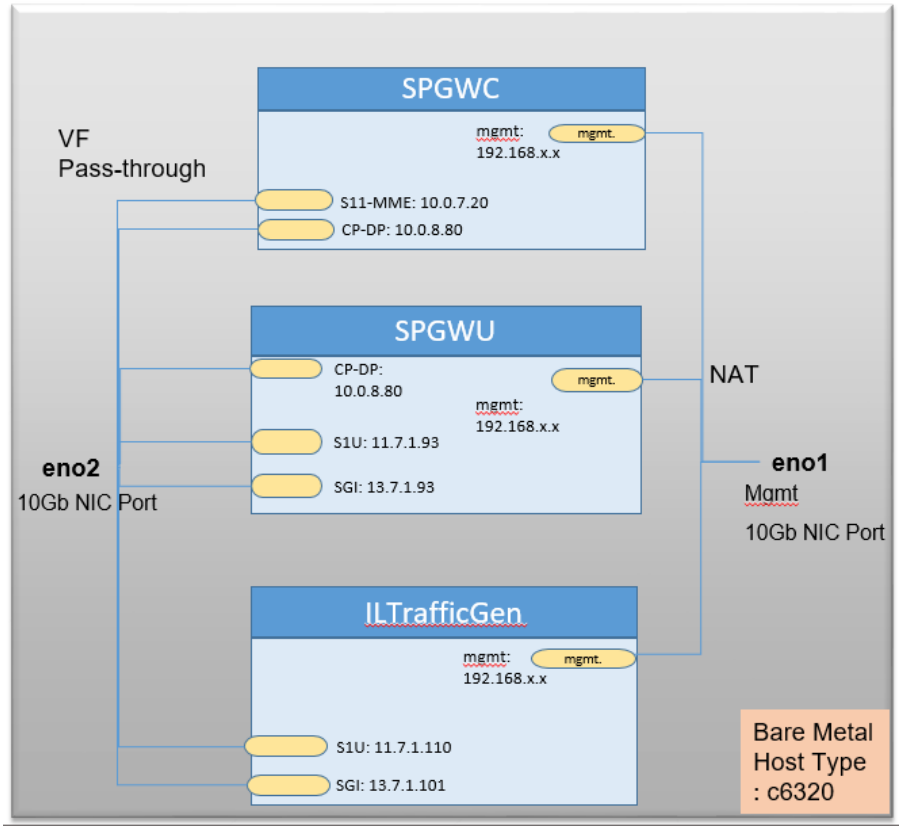
Deployment

In order to run this tutorial user needs cloudlab account.

Cloud Lab Profile

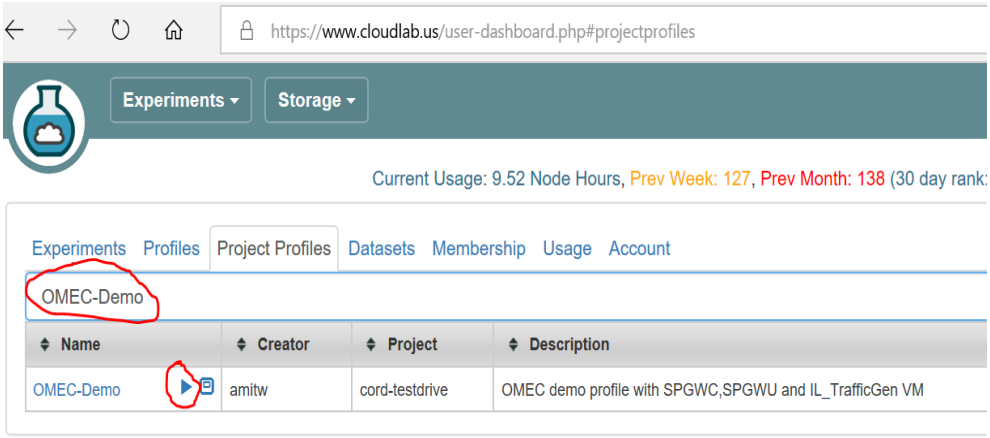
Cloud Lab URL: https://www.cloudlab.us/

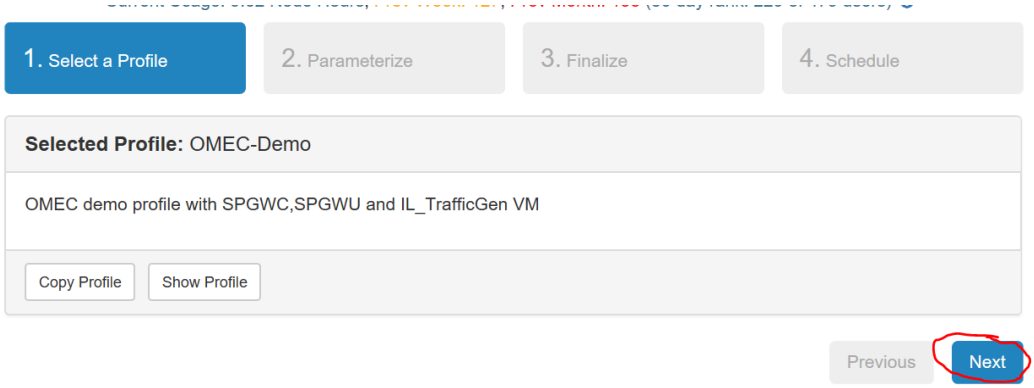
Sign up for an account and choose "Join Existing Project"; for "Project Name" enter `cord-testdrive`.



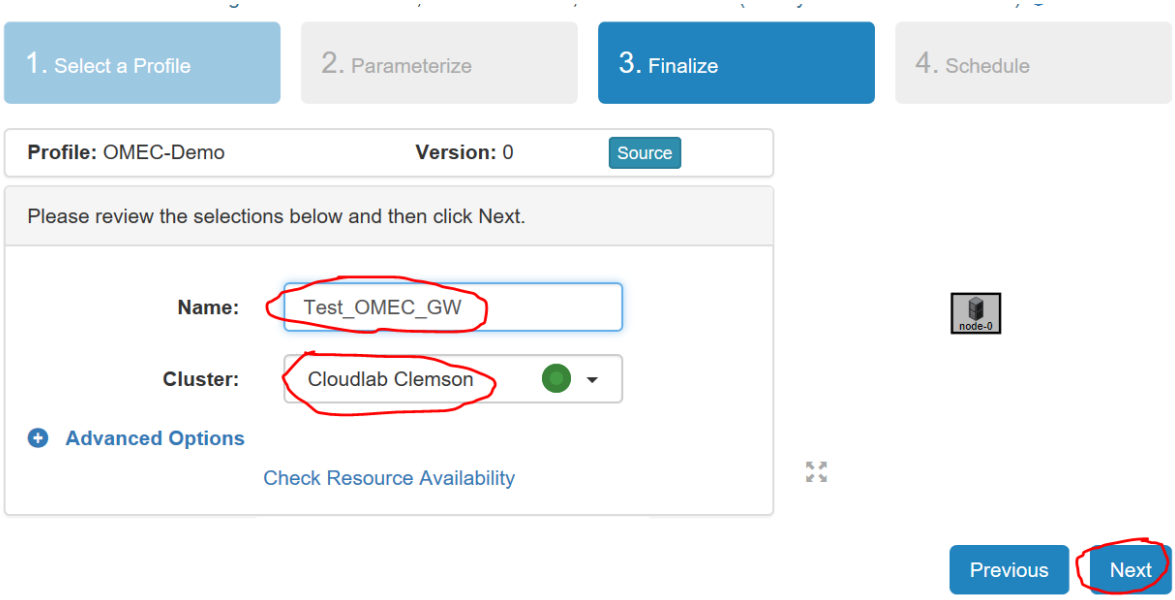
Following section will guide user to create OMEC-Demo instance on cloudlab where it has single Bare metal server with three VMS (SPGWC, SPGWU and ILTrafficGen) preinstalled and preconfigured.

1. Create Instance using OMEC-Demo profile
   Select Tab option “Project Profiles” and then search for the profile name “OMEC-Demo”
2. Instantiate the profile by clicking blue arrow against the profile.

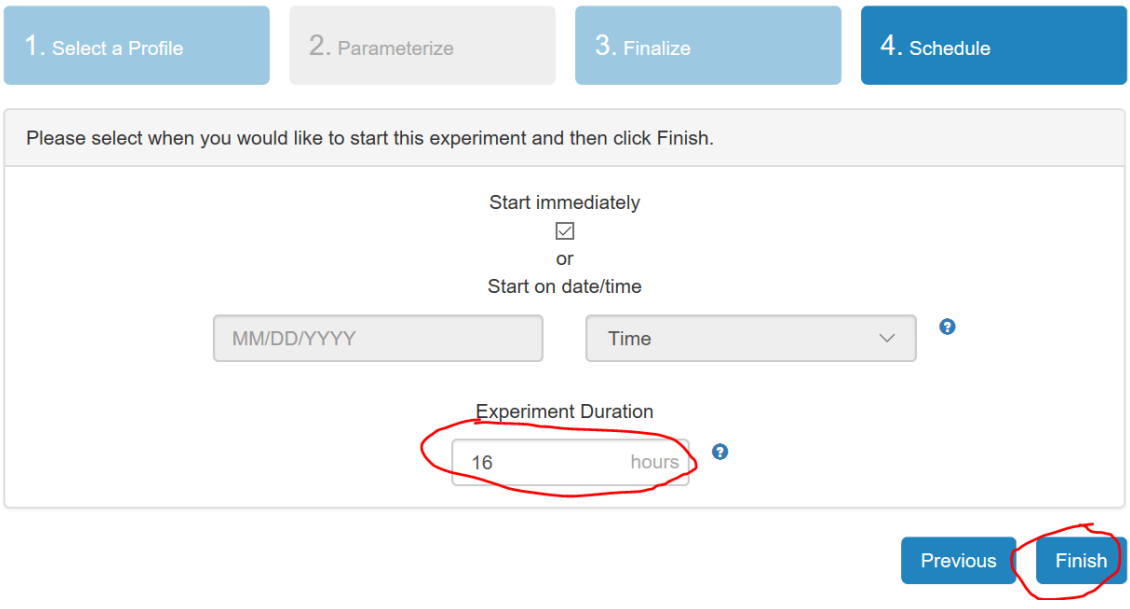




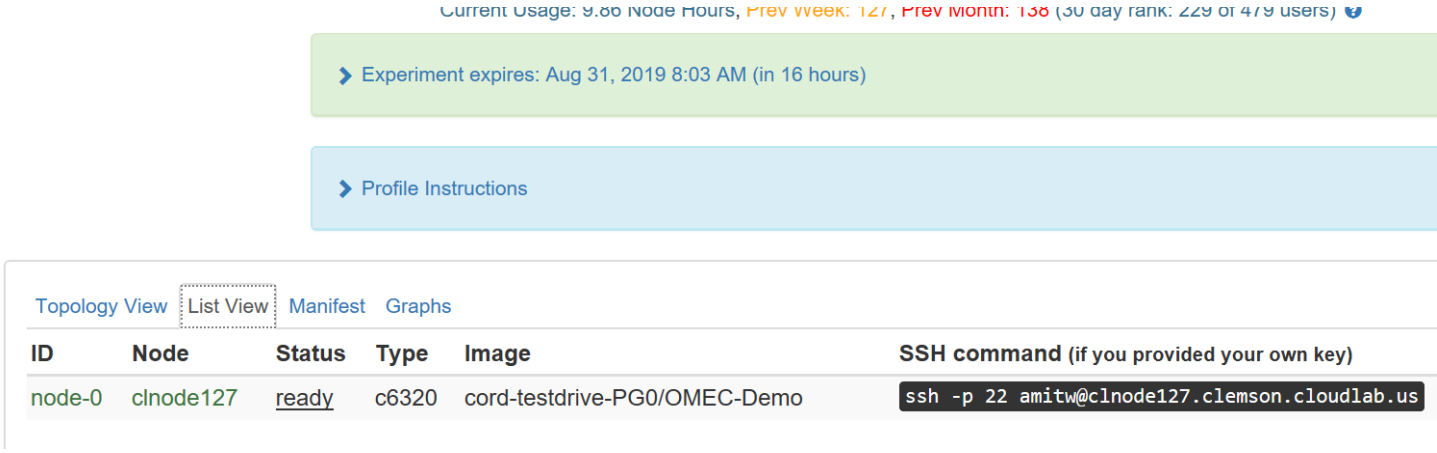
3. Click on “Next”



4. Give some unique name e.g. “TestOMECGW1” and select cluster “Cloudlab Clemson” and then click “Next”.



5. Experiment Duration 16hr is max and default you can change it. If u want to schedule the instance then you can select the date and time and then click “Finish”. **Deployment takes around 5-10mins.**



6. Once deployment finishes it will display the ssh information. Use that to login to instance using your user name and key setup with the account.
   Please note SSH is key based. User should generate SSH key and upload to user profile on cloudlab.

7. After ssh do, 'sudo su' and then follow the instruction to access the VMs.

Accessing VMs/SSH to VM

1. To check list of running vm on the host

```
virsh list
```

2. Get IP address of VM

```
cd /opt/deployment/scripts
./get_vm_ip.sh <vm_name>
```

3. Login to vm

```
cd /opt/deployment/scripts
./sshvm.sh ubuntu <vm_name>
```

4. Login to vm using ubuntu ssh key

```
ssh -i /home/ubuntu/.ssh/id_rsa ubuntu@<ip_address_of_vm>
```

Note: OMEC-Demo profile has prebuild and pre-configured components. If you want to manual install and configuration then follow the instruction from section Manual Build and Setup of each NGIC components. Otherwise jump directly to execution steps at to Running OMEC tutorial.

Manual Build and Setup of each NGIC components

This section assumes all the VMs are installed and networking is setup and validated

Combined GW (SAEGW mode)

SPGWC

Installation

1. Clone ngic-rtc repo under /opt/

```
git clone https://github.com/omec-project/ngic-rtc.git
```

2. Execute the install.sh script available in ngic-rtc directory. Install script will provide below mentioned options. Choose the options accordingly and install required items.

```
------------------------------------------------------------
 Step 1: Environment setup.
------------------------------------------------------------
[1] Check OS and network connection
[2] Configured Service - Collocated CP and DP
------------------------------------------------------------
 Step 2: Download and Install
------------------------------------------------------------
[3] Agree to download
[4] Download packages
[5] Download DPDK zip
[6] Install DPDK
[7] Download hyperscan
------------------------------------------------------------
Step 3: Build NGIC
------------------------------------------------------------
[8] Build NGIC
[9] Exit Script
Option Descriptions:
[1] This will check the OS version and network connectivity and
report any anomaly. If the system is behind a proxy, it will
ask for a proxy and update the required environment variables.
[2] Select services to build. You will be prompted to select
following options from sub-menu, and optionally edit the memory
size:
        1. CP Only
        2. DP Only
        3. Collocated CP and DP
[3] Select yes in this option to be able to download the
required packages.
[4] Actual download of the dependent packages like libpcap,
build essentials
    etc.
[5] Download dpdk as a zip file using this option.
[6] Build and set environment variables to use DPDK.
[7] Download hyperscan library. This option is displayed in
menu when
    'DP Only' or 'Collocated CP and DP' option is selected in
[2].
[8] Build controlplane and dataplane applications. This sets
the RTE_SDK environment variable and builds the applications.
```

Note for SGWC: use the following options in sequence

1) [3]
2) [4]
3) [5]
4) [6]
5) [2]->[1]->[no]
6) [8]

Configuration

1. Update **config/interface.cfg** file for the below parameters based on the interfaces configured on VM.

```
dp_comm_ip =  10.0.7.81 ← DP interface IP towards CP
dp_comm_port = 20
cp_comm_ip = 10.0.7.80 ← CP interface IP towards DP
cp_comm_port = 21
```

2. Update **config/cp_config.cfg** for the below parameters based on the configuration in this case it's running as SGWC

```
#SPGW_CFG:: SGWC=01; PGWC=02; SPGWC=03
SPGW_CFG=03
# Put MME IP here  MME_S11_IP
S11_MME_IP={{ MME_S11_IP }}
S11_SGW_IP=10.0.2.70       ←  S11 interface IP on CP
S1U_SGW_IP= 11.7.1.93      ← S1U interface IP on DP
MEMORY=1024
CORELIST="0-4"             ← core list needs 5 cores
```

Run

Run CP using the following:

```
ngic-rtc/cp/run.sh log
```

Note: If the any prompt complaining memory, type 'y' and press 'enter'

SPGWU

Installation

1. Clone ngic-rtc repo under /opt/

```
git clone https://github.com/omec-project/ngic-rtc.git
```

1. Execute the install.sh script available in ngic-rtc directory. Install script will provide below mentioned options. Choose the options accordingly and install required items.

```
-----------------------------------------------------------
 Step 1: Environment setup.
-----------------------------------------------------------
[1] Check OS and network connection
[2] Configured Service - Collocated CP and DP
-----------------------------------------------------------
 Step 2: Download and Install
-----------------------------------------------------------
[3] Agree to download
[4] Download packages
[5] Download DPDK zip
[6] Install DPDK
[7] Download hyperscan
-----------------------------------------------------------
Step 3: Build NGIC
```

```
------------------------------------------------------------
[8] Build NGIC
[9] Exit Script
Option Descriptions:
[1] This will check the OS version and network connectivity and
report any anomaly. If the system is behind a proxy, it will
ask for a proxy and update the required environment variables.
[2] Select services to build. You will be prompted to select
following options from sub-menu, and optionally edit the memory
size:
        1. CP Only
        2. DP Only
        3. Collocated CP and DP
[3] Select yes in this option to be able to download the
required packages.
[4] Actual download of the dependent packages like libpcap,
build essentials
    etc.
[5] Download dpdk as a zip file using this option.
[6] Build and set environment variables to use DPDK.
[7] Download hyperscan library. This option is displayed in
menu when
    'DP Only' or 'Collocated CP and DP' option is selected in
[2].
[8] Build controlplane and dataplane applications. This sets
the RTE_SDK environment variable and builds the applications.
```

Note for SGWC: use the following options in sequence (without SGX)

1) [3]
2) [4]
3) [5]
4) [6]
5) [7]
6) [2]->[2]->[no]

```
------------------
Service Selection.
------------------
1. Configure CP only
2. Configure DP only
3. Configure Collocated CP and DP

Please choose option : 2
Data Plane Setting
Do you want data-plane with Intel(R) SGX based CDR? no

Current DP memory size : 4096 (MB)
Do you want change the DP memory size[Recommended = 4096](y/n)? n
MEMORY (MB) :  4096
Number of pages :  2048
vm.nr_hugepages=2048
vm.nr_hugepages = 2048
hugetlbfs /dev/hugepages hugetlbfs rw,relatime 0 0

Press enter to continue ...
```

7) [8]

Configuration

1. Update **config/interface.cfg** file for the below parameters based on the interfaces configured on VM.

```
dp_comm_ip =  10.0.7.81 ← DP interface IP towards CP
dp_comm_port = 20
cp_comm_ip = 10.0.7.80 ← CP interface IP towards DP
cp_comm_port = 21
```

2. Update **config/dp_config.cfg** for the below parameters based on the configuration in this case it's running as SGWU

```
#SPGW_CFG:: SGWU=01; PGWU=02; SPGWU=03
SPGW_CFG=03
S1U_PORT=0000:00:05.0     ← PCI ID of the s1u interface
S1U_PORT=0000:00:06.0     ← PCI ID of the sgi interface
S1U_IP= 11.7.1.93          ←  IP address for the s1u interface
S1U_MAC=3e:bb:de:3e:28:48 ← MAC address of s1u interface
SGI_IP= 13.7.1.93           ←  IP address for the sgi interface
SGI_MAC=f6:ab:93:49:98:d7 ← MAC address of sgi interface
MEMORY=2048
CORE_LIST="0-3"           ← Core list needs 4 cores
```

Run

Before running DP ensure the S1U port is bind to DPDK (refer DPDK Binding section)

1. Run DP using the following:

```
cd /opt/ngic-rtc/dp/
./run.sh log
```

Note: If the any prompt complaining memory, type 'y' and press 'enter'

2. Open another terminal and run the KNI Scripts

```
cd /opt/ngic-rtc/kni-config
./kni-s1udevcfg.sh
./kni-sgidevcfg.sh
```

ILTraffic Gen

Installation

1. Clone il_trafficgen repo under /opt/

```
git clone https://github.com/omec-project/il_trafficgen.git
```

2. Execute the install.sh script available in il_trafficgen directory. Install script will provide below mentioned options. Choose the options accordingly and install required items.

```
------------------------------------------------------------
 Step 1: Environment setup.
------------------------------------------------------------
```

```
[1] Check OS and network connection

------------------------------------------------------------
 Step 2: Download and Install
------------------------------------------------------------
[2] Agree to download
[3] Upgrade Ubuntu 16.04 LTS [OPTIONAL]
[4] Download packages
[5] Setup Huge Pages
[6] Download DPDK submodule
[7] Install DPDK

------------------------------------------------------------
 Step 3: Build IL_TRAFFICGEN
------------------------------------------------------------
[8] Build IL_TRAFFICGEN

[9] Exit Script
```

Configuration

1. Update user_input.cfg file

```
$cd /opt/il_trafficgen/pktgen/autotest/
$ vim user_input.cfg

# Il_trafficgen Generator host IP
gen_host_ip="127.0.0.1" <= IP ADDR OF IL-NPERF MGMT INTERFACE

# Il_trafficgen Generator port number
gen_host_port=5344

# Il_trafficgen Responder host IP
resp_host_ip="127.0.0.1" <= IP ADDR OF IL-NPERF MGMT INTERFACE

# Il_trafficgen Responder port number
resp_host_port=5345

# S1U port
s1u_port="0000:00:04.0"

# SGI port
sgi_port="0000:00:05.0"

# il_trafficgen: generator S1U interface src mac address
p0_src_mac="46:71:87:00:ab:58" <= MAC ID OF IL-NPERF S1U
INTERFACE

# System Under Test: ngic/vnf_portfwd S1U dst mac address
p0_dst_mac="4e:26:94:10:b2:52"   <= MAC ID OF DP S1U INTERFACE

# il_trafficgen: responder SGi interface src mac address
p1_src_mac="56:6c:fd:3c:3d:6a" <= MAC ID OF IL-NPERF SGI
INTERFACE

# System Under Test: ngic/vnf_portfwd SGIdst mac address
p1_dst_mac="aa:5d:38:f7:e2:1a"   <= MAC ID OF DP SGI INTERFACE
```

2. Configure CP for simulating control sessions
    a. Edit the "/opt/ngic-rtc/config/simu_cp.cfg"

```
[0]
S1U_SGW_IP=11.7.1.93            ←  S1U interface IP on DP
ENODEB_IP_START = 11.7.1.101    ← eNB IP start sync with iltraffic
UE_IP_START = 16.0.0.1
UE_IP_START_RANGE = 16.0.0.0
AS_IP_START = 13.7.1.110        ← AS IP start sync with iltraffic
MAX_UE_SESS = 5000           ← Max UE sessions  sync with iltraffic
TPS = 1000
BREAK_DURATION = 60
DEFAULT_BEARER = 5
ng4t_max_ue_ran = 500000
ng4t_max_enb_ran = 80
```

    b. Enable flags for "DSIMU_CP" and rebuild CP

```
$ cd /opt/ngic-rtc/cp/
$ vim Makefile
# Un-comment below line to read fake cp config.
CFLAGS += -DSIMU_CP
```

    Re-build CP using install.sh script.

    c. On DP VM Enable static ARP (default dynamic ARP) as follows:

```
$ cd /opt/ngic-rtc/dp/
$ vim Makefile
# Un-comment below line to enable STATIC ARP
#CFLAGS += -DSTATIC_ARP
```

    Re-build DP using install.sh script.

    d. Edit the "static_arp.cfg" file which is available under 'config' directory. Update the ipaddr range of SGI and S1U interface and mac addresses of SGI and S1U interfaces on il-traffic-gen(IL-NPERF) on machine

```
$ vim /opt/ngic-rtc/config/static-arp.cfg

[sgi]
13.8.1.110 13.8.1.141 = 86:6f:43:2f:44:16
[s1u]
11.8.1.101 11.8.1.180 = 9e:45:1d:9c:c1:d6
```

Running OMEC Demo

Demo

1. Complete DPDK binding on DP as mentioned in DPDK binding section.
2. Start the DP service on SPGWU VM.

```
$ /opt/ngic-rtc/dp
$./run.sh
```

3. Start CP Service no SPGWC VM

```
$ /opt/ngic-rtc/cp
$./run.sh
```

Wait for CP to establish session on DP wait for the following message on the CP console

```
        STATS ::

*************************
MAX_NUM_CS     : 5000
MAX_NUM_MB     : 5000
NUM_CS_SEND    : 5000
NUM_MB_SEND    : 5000
NUM_CS_FAILED  : 0
NUM_MB_FAILED  : 0
*************************

************ DP Configured successfully ************
```

1. Complete DPDK binding on IL-NPERF(il_trafficgen) machine as mentioned in DPDK binding section.
2. Open two SSH windows to IL-NPERF instance.
3. In fist SSH window of IL-NPERF start the il-trafficgen generator on **IL-NPERF** machine using below command. once it is successfully started then proceed next step for start il-trafficgen receiver.

```
$cd /opt/il_trafficgen/pktgen
# Start generator in one screen
$ ./il_nperf.sh –g

# Wait for generator to start and then start receiver in another
#screen
```

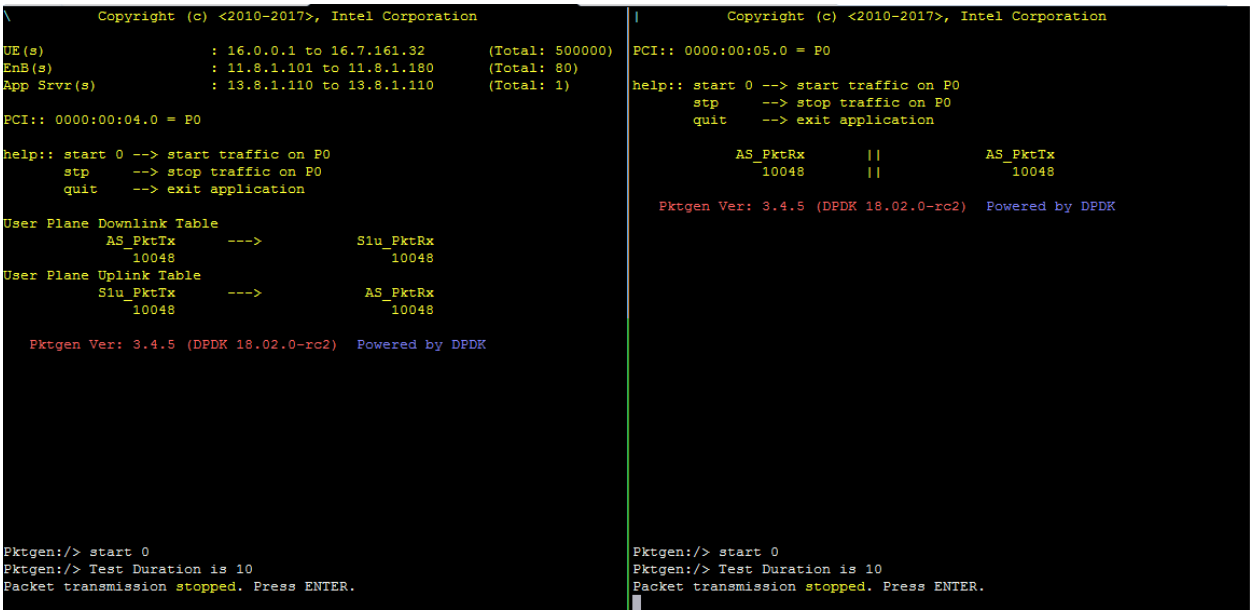
4. In second SSH window of IL-NPERF start the il-trafficgen generator on IL-NPERF machine using below command.

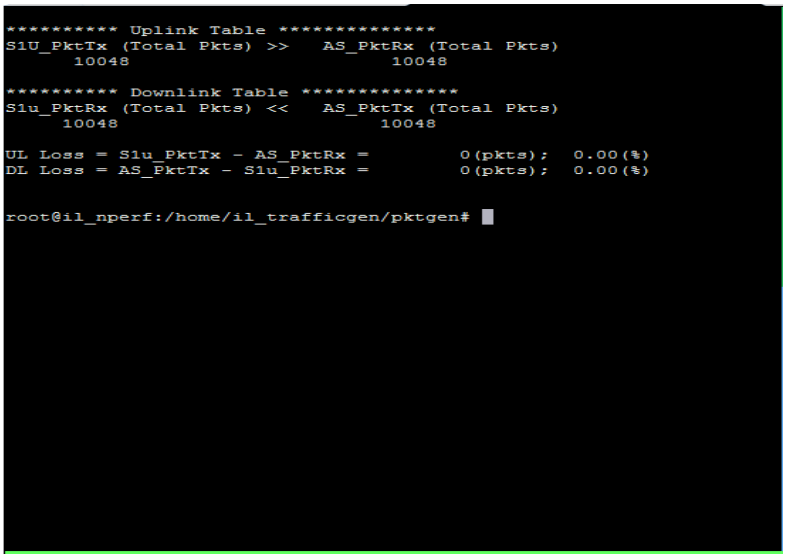
```
$cd /opt/il_trafficgen/pktgen
$ ./il_nperf.sh –r
```

5. To start traffic flow type start 0 on both generator and receiver prompt and press enter.
   Note: Do not try to start generator and receiver both simultaneously.

6. Once test completes press “quit” on both IL-NPERF consoles to see the traffic results.

Sample O/P Stats on IL-NPERF instance





DPDK Binding

Bind the S1u/Sgi port to DPDK drivers on SPGWU instance.

1. Command to get PCI address is:

```
root@spgwu:/opt/ngic-rtc/dpdk/usertools# lshw -c network -businfo
Bus info          Device      Class          Description
========================================================
pci@0000:00:03.0  ens3        network        Virtio network device
pci@0000:00:04.0  ens4        network        Virtio network device
pci@0000:00:08.0  ens5        network        82599ES 10-Gigabit SFI/SFP+
Network Connection
pci@0000:00:09.0  ens6        network        82599ES 10-Gigabit SFI/SFP+
Network Connection
...
```

2. Bind the port using the PCI id

```
cd /opt/ngic-rtc/dpdk/usertools/
./dpdk-devbind.py -b igb_uio 00:08.0
```

3. Lists ports

```
root@spgwu:/opt/ngic-rtc/dpdk/usertools# ./dpdk-devbind.py --status

Network devices using DPDK-compatible driver
============================================
0000:00:08.0 '82599ES 10-Gigabit SFI/SFP+ Network Connection 10fb'
drv=igb_uio unused=ixgbe

Network devices using kernel driver
===================================
0000:00:03.0 'Virtio network device 1000' if=ens3 drv=virtio-pci
unused=igb_uio *Active*
0000:00:04.0 'Virtio network device 1000' if=ens4 drv=virtio-pci
unused=igb_uio *Active*
0000:00:09.0 '82599ES 10-Gigabit SFI/SFP+ Network Connection 10fb'
if=ens6 drv= ixgbe unused=igb_uio
…
```

Recovery steps in case of reboot/shutdown

Step to perform on the Host in case of host reboot

1) Insert following command on host server.

```
modprobe vfio-pci
```

2) Identify the physical interface on which the VFs were configured and the number of VFs

Following command will give you interface name.
e.g.

```
$ cat /opt/deployment/terraform/c3povm_defs.cfg | grep CTRL_PFDEV
CTRL_PFDEV=ens786f1
```

Following command will give you cound of the VFs

```
$ cat /opt/deployment/terraform/c3povm_defs.cfg | grep NUM_CTRL_VF
NUM_CTRL_VF=17
```

3) Create virtual network function using following command.

```
echo 17 > /sys/class/net/ens786f1/device/sriov_numvfs
```

4) Up the NIC

```
ifconfig ens786f1 up
```

5) Start VM on host using virsh command.

```
 virsh start <VM name>
```

Steps to perform on DP VM after rebooting of VM/Host.

Following step need to perform on the DP (SGWU/PGWU/SPGWU) VM after reboot.

1) Login to particular VM from host using following command.

```
cd opt/deployment/script
./sshvm.sh ubuntu <VM name>
```

2) Load DPDK drivers

```
cd /opt/ngic-rtc/dpdk/usertools/
./dpdk-setup.sh

Select the following options and then exit

Options : 14  #set environment
          17  #insert igb_uio module
          19  #insert kni module
```

3) Bind the S1u/Sgi port to DPDK drivers (refer DPDK Binding Section)