R3 - Test Documentation
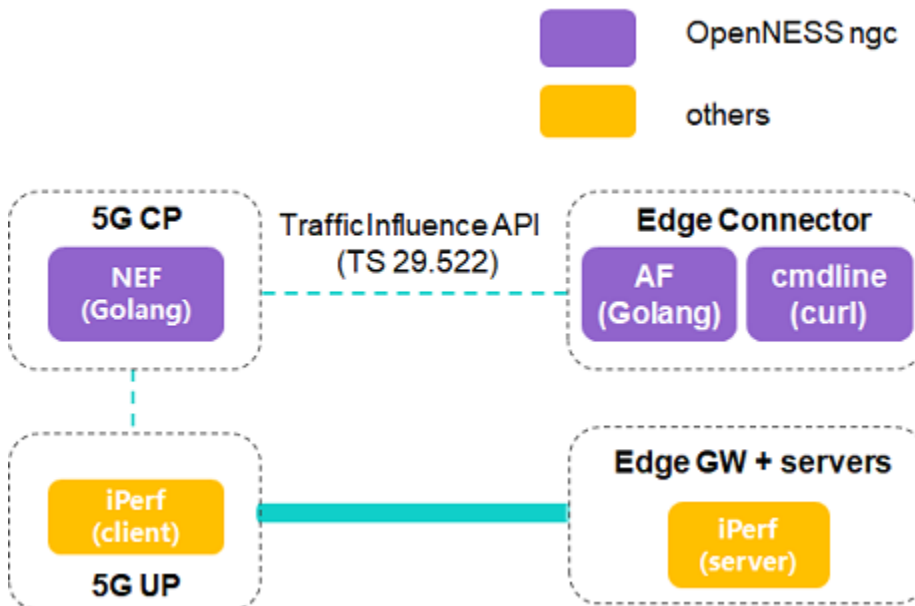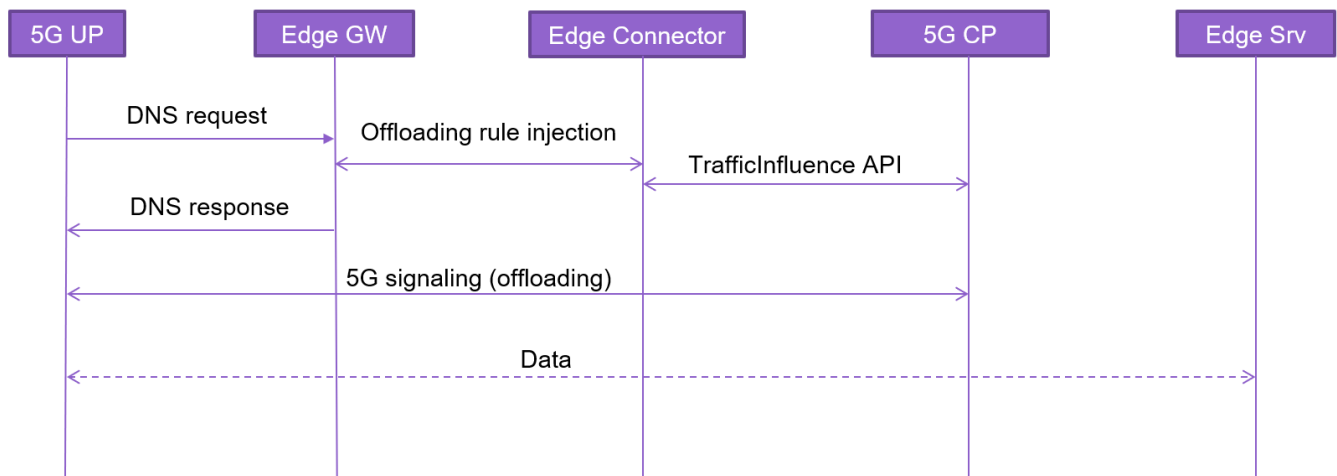
Test-Env Setup

End-to-end test with the 5GC emulator

To validate the BP, a 5GC emulator is provided, which consists of a 5G CP and UP.

- The 5G CP is based on the Network Exposure Function (NEF) implemented by openNESS ngc
- The 5G UP is an iPerf instance running in the client mode, controller by the 5G CP

Offloading call flow

The offloading call flow is as follows.

1. A UE (not shown in the figure) sends a DNS request via the 5G user plane, which is detected by the Local DNS (LDNS) at the Edge GW.
2. A new offloading rule is injected to the Edge Connector by the Edge GW.
3. AF function hosted on the Edge Connector invokes the TrafficInfluence API, offered by the 5G CP.
4. A DNS response is composed and sent by the LDNS, which includes an IP pointing to an Edge server.
5. 5G CP configures the 5G UP with standardized 5G signaling related to offloading.
6. Traffic from the UE is offloaded to the Edge server.

Setup guide

- Step 1, deploy edge GW and on-board iPerf (server) following the steps described in Installation Documentation.
- Step 2, run ngc/start.sh to launch the 5G CP (NEF), Edge GW+server and AF. A DNS request will be sent hereafter.
- Step 3, run ngc/test/Post.sh to start traffic offloading or ngc/test/Delete.sh to stop offloading.

Unit Test

Enter test directory:

- cd ./5g-mec-cloud-gaming

Execute the versify.sh script to setup the test environment:

versify.sh script first installs Golang and ginkgothen installs docker and docker-compose.

The test commands for the three submodules are as follows:

- make -C 5GCEmulator/ngc build && make -C 5GCEmulator/ngc test-unit-nef
- make -C edgenode networkedge
- make -C edgecontroller build-dnscli && make -C edgecontroller test-dnscli

Test results

End-to-end test

- Non-offloading case

The 5GC prints "No data offloaded..." when offloading is not enabled.

- Offloading case

The 5GC prints "Offloading in progress", while the Edge GW prints the mount of data it receives in realtime.

```
^Cyangf@fengfyang-LC0:~/Documents/5GCEmulator/ngc$ iperf -u -s -i 1
------------------------------------------------------------
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size:  208 KByte (default)
------------------------------------------------------------
[  3] local 127.0.0.1 port 5001 connected with 127.0.0.1 port 46324
[ ID] Interval       Transfer     Bandwidth        Jitter   Lost/Total Datagrams
[  3]  0.0- 1.0 sec   129 KBytes  1.06 Mbits/sec   0.004 ms    0/   90 (0%)
[  3]  1.0- 2.0 sec   128 KBytes  1.05 Mbits/sec   0.001 ms    0/   89 (0%)
[  3]  2.0- 3.0 sec   128 KBytes  1.05 Mbits/sec   0.002 ms    0/   89 (0%)
[  3]  3.0- 4.0 sec   128 KBytes  1.05 Mbits/sec   0.001 ms    0/   89 (0%)
[  3]  0.0- 4.0 sec   514 KBytes  1.05 Mbits/sec   0.001 ms    0/  358 (0%)
[  4] local 127.0.0.1 port 5001 connected with 127.0.0.1 port 49316
[  4]  0.0- 1.0 sec   129 KBytes  1.06 Mbits/sec   0.001 ms    0/   90 (0%)
[  4]  1.0- 2.0 sec   128 KBytes  1.05 Mbits/sec   0.003 ms    0/   89 (0%)
[  4]  2.0- 3.0 sec   128 KBytes  1.05 Mbits/sec   0.006 ms    0/   89 (0%)
[  4]  3.0- 4.0 sec   128 KBytes  1.05 Mbits/sec   0.001 ms    0/   89 (0%)
[  4]  0.0- 4.0 sec   514 KBytes  1.05 Mbits/sec   0.001 ms    0/  358 (0%)
[  3] local 127.0.0.1 port 5001 connected with 127.0.0.1 port 44311
[  3]  0.0- 1.0 sec   129 KBytes  1.06 Mbits/sec   0.001 ms    0/   90 (0%)
[  3]  1.0- 2.0 sec   128 KBytes  1.05 Mbits/sec   0.001 ms    0/   89 (0%)
[  3]  2.0- 3.0 sec   128 KBytes  1.05 Mbits/sec   0.001 ms    0/   89 (0%)
[  3]  3.0- 4.0 sec   128 KBytes  1.05 Mbits/sec   0.001 ms    0/   89 (0%)
[  3]  0.0- 4.0 sec   514 KBytes  1.05 Mbits/sec   0.001 ms    0/  358 (0%)
[  4] local 127.0.0.1 port 5001 connected with 127.0.0.1 port 42806
[  4]  0.0- 1.0 sec   129 KBytes  1.06 Mbits/sec   0.002 ms    0/   90 (0%)
[  4]  1.0- 2.0 sec   128 KBytes  1.05 Mbits/sec   0.001 ms    0/   89 (0%)
[  4]  2.0- 3.0 sec   128 KBytes  1.05 Mbits/sec   0.002 ms    0/   89 (0%)
[  4]  3.0- 4.0 sec   128 KBytes  1.05 Mbits/sec   0.005 ms    0/   89 (0%)
[  4]  0.0- 4.0 sec   514 KBytes  1.05 Mbits/sec   0.005 ms    0/  358 (0%)
```

```
<134>Mar   2 13:14:15 nef[4652]: [NEF] HTTP Request Received :HTTP/2.0
<134>Mar   2 13:14:15 nef[4652]: [NEF] ===================================================
<134>Mar   2 13:14:15 nef[4652]: [NEF]   Method : POST
<134>Mar   2 13:14:15 nef[4652]: [NEF]   URL PATH : /3gpp-traffic-influence/v1/1/subscriptions
<134>Mar   2 13:14:15 nef[4652]: [NEF]   Route Name : CreateTrafficInfluenceSubscription
<134>Mar   2 13:14:15 nef[4652]: [NEF] ===================================================
<134>Mar   2 13:14:15 nef[4652]: [NEF] HTTP Request Handling -- STARTS
<134>Mar   2 13:14:15 nef[4652]: [NEF]   AFID  : 1
<131>Mar   2 13:14:15 nef[4652]: [NEF] NO AF PRESENT CREATE AF
<134>Mar   2 13:14:15 nef[4652]: [NEF] PCFs PolicyAuthorizationCreate Entered
<134>Mar   2 13:14:15 nef[4652]: [NEF] PCFs Policy Authorization DB size : 0
<134>Mar   2 13:14:15 nef[4652]: [NEF] PCFs Policy Authorization AppSessionId created: 8081
<134>Mar   2 13:14:15 nef[4652]: [NEF] PCFs PolicyAuthorizationCreate [CorrId,NotifUrl,DnaiChg
<134>Mar   2 13:14:15 nef[4652]: [NEF] PCFs PolicyAuthorizationCreate Exited successfully with
<134>Mar   2 13:14:15 nef[4652]: [NEF] PCF Policy Authorization Create Success. Response Code:
<134>Mar   2 13:14:15 nef[4652]: [NEF]   NEW AF Subscription added 11111
<134>Mar   2 13:14:15 nef[4652]: [NEF] https://localhost:8060/3gpp-traffic-influence/v1/1/subs
<134>Mar   2 13:14:15 nef[4652]: [NEF] CreateTrafficInfluenceSubscription responses => 201
<134>Mar   2 13:14:15 nef[4652]: [NEF] AF count 1
<134>Mar   2 13:14:15 nef[4652]: [NEF]   AF ID : 1, Sub Registered Count 1
<134>Mar   2 13:14:15 nef[4652]: [NEF]     SubId : 11111, ServiceId:
<134>Mar   2 13:14:15 nef[4652]: [NEF] HTTP Request Handling -- ENDS. Time Taken: 387.002µs
<134>Mar   2 13:14:15 af[4643]: [ngc-af] Deleted transaction ID 1
Offloading in progress...
Offloading in progress...
Offloading in progress...
Offloading in progress...
Offloading in progress...
Offloading in progress...
Offloading in progress...
Offloading in progress...
Offloading in progress...
Offloading in progress...
```

Unit Test

- 5GCEmulator

```
------------------------------
NefServer NefServer init
  Will init NefServer - No HTTP endpoints
  /home/gerrit/5g-mec-cloud-gaming/5GCEmulator/ngc/pkg/nef/nef_server_test.go:33
<3>Jun  8 12:52:55 nef.test[4805]: [NEF] Failed to load NEF configuration: open noconfig: no such file or directory
.
Ran 27 of 27 Specs in 8.097 seconds
SUCCESS! -- 27 Passed | 0 Failed | 0 Pending | 0 Skipped
PASS
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] ******************** NGC NEF CONFIGURATION ******************
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] APIRoot: localhost
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] LocationPrefix: /3gpp-traffic-influence/v1/
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] UpfNotificationResUriPath:/3gpp-traffic-influence/v1/notification/upf
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] UserAgent:NEF-OPENNESS-1912
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] ------------------------- NEF SERVER ---------------------
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] EndPoint(HTTP):
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] EndPoint(HTTP2):
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] ServerCert(HTTP2):
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] ServerKey(HTTP2):
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] AFClientCert(HTTP2):
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] ********************************************************
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] PCF Stub Client created with initial session id: 1847
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] UDR Stub Client created
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] NEF Location URL Prefix :http://localhost/3gpp-traffic-influence/v1/
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] SMF UPF Notification URL :http://localhost/3gpp-traffic-influence/v1/notification/upf
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] HTTP Server not configured
<6>Jun  8 12:52:55 nef.test[4805]: [NEF] HTTP 2 Server not configured
<3>Jun  8 12:52:55 nef.test[4805]: [NEF] HTTP Servers are not configured
coverage: 71.1% of statements

Ginkgo ran 1 suite in 36.760164264s
Test Suite Passed
make: 离开目录"/home/gerrit/5g-mec-cloud-gaming/5GCEmulator/ngc"
[root@127 5g-mec-cloud-gaming]# █
```

- EdgeNode

```
Step 9/15 : RUN echo '%sudo ALL=(ALL) NOPASSWD:ALL' >> /etc/sudoers
 ---> Using cache
 ---> d3666b70a917
Step 10/15 : RUN echo 'Set disable_coredump false' >> /etc/sudo.conf
 ---> Using cache
 ---> 8cf8b5bdc0ff
Step 11/15 : USER $username
 ---> Using cache
 ---> 4fb34038f995
Step 12/15 : WORKDIR $user_dir
 ---> Using cache
 ---> da4de25f7dfa
Step 13/15 : COPY ./edgednssvr ./
 ---> ea822a827fce
Step 14/15 : ENTRYPOINT ["sudo", "./edgednssvr"]
 ---> Running in 7a43029600d8
Removing intermediate container 7a43029600d8
 ---> 5441ebe3b7a2
Step 15/15 : CMD ["-port=53", "-fwdr=8.8.8.8"]
 ---> Running in e84bd8018bbe
Removing intermediate container e84bd8018bbe
 ---> a5fec2d50f6a
Successfully built a5fec2d50f6a
Successfully tagged edgednssvr:1.0
VER=1.0 docker-compose build syslog-ng
WARNING: The OVN_NB_DB variable is not set. Defaulting to a blank string.
WARNING: The NTS_MEM_MB_S0 variable is not set. Defaulting to a blank string.
WARNING: The NTS_MEM_MB_S1 variable is not set. Defaulting to a blank string.
WARNING: The OVS_BRIDGE_NAME variable is not set. Defaulting to a blank string.
WARNING: The OVSE variable is not set. Defaulting to a blank string.
WARNING: The REMOTE_SYSLOG_IP variable is not set. Defaulting to a blank string.
syslog-ng uses an image, skipping
make: 离开目录"/home/gerrit/5g-mec-cloud-gaming/edgenode"
```

- EdgeController

```
..............................
CLI test when DNS CLI DelA is called With folder path instead of file
  Should trigger an error
  /home/gerrit/5g-mec-cloud-gaming/edgecontroller/edgednscli/cli_test.go:345
del failure: Failed to read JSON file /tmp: Failed to read file /tmp: read /tmp: is a directory•
..............................
CLI test when DNS CLI DelA is called Correct del, empty record_type field
  Should pass
  /home/gerrit/5g-mec-cloud-gaming/edgecontroller/edgednscli/cli_test.go:243
RecordType not provided, setting "A" as defaultConnecting to EdgeDNS server(localhost:14204)[Test Server] DeleteAuthoritative: [A
d authoritative host: [A, baz.bar.foo.com.]•
..............................
CLI test when DNS CLI DelA is called Wrong record_type
  Should fail
  /home/gerrit/5g-mec-cloud-gaming/edgecontroller/edgednscli/cli_test.go:313
del failure: RecordType of HostRecordSet is not valid[incorrect_type_passed]. Please provide 'None' or 'A' or ... in JSON file•
..............................
CLI test when DNS CLI DelA is called With non existing file
  Should trigger an error
  /home/gerrit/5g-mec-cloud-gaming/edgecontroller/edgednscli/cli_test.go:333
del failure: Failed to read JSON file /some/not/existing/file: Failed to find file /some/not/existing/file: stat /some/not/existin
..............................
CLI test when DNS CLI DelA is called Correct del, without record_type field
  Should pass
  /home/gerrit/5g-mec-cloud-gaming/edgecontroller/edgednscli/cli_test.go:266
Connecting to EdgeDNS server(localhost:14204)[Test Server] DeleteAuthoritative: [A baz.bar.foo.com.]Successfully deleted authorita
Ran 15 of 15 Specs in 4.061 seconds
SUCCESS! -- 15 Passed | 0 Failed | 0 Pending | 0 Skipped
PASS

Ginkgo ran 1 suite in 22.368337811s
Test Suite Passed
make: 离开目录"/home/gerrit/5g-mec-cloud-gaming/edgecontroller"
[root@127 5g-mec-cloud-gaming]#
```

CI/CD logs

Pushed to the Nexus server.