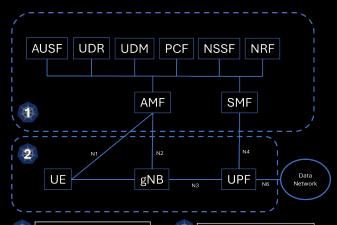
Deploying free5GC in a Multi-Cluster Environment (towards5gs-helm)



D.	CONTROL PLANE				
	Node	CPUs	RAM (MB)		
	kmaster	2	2048		
	knode01	1	1024		
	knode02	1	1024		

USER PLANE					
Node	CPUs	RAM (MB)			
upmaster	2	2048			
upnode01	1	1024			
upnode02	1	1024			

Network attachment definitions

		masterIf/GW					
Reference point	Туре	UERANSIM	AMF	SMF	UPF		
n2	MACVLAN	enp0s8/ 10.100.50.254	enp0s8/ 10.100.50.254				
n3	MACVLAN	enp0s8/ 10.100.50.238			enp0s8/ 10.100.50.238		
n4	MACVLAN			enp0s8/ 10.100.50.246	enp0s8/ 10.100.50.246		
n6	MACVLAN				enp0s3/ 10.0.2.2		

Cluster 1. Control Plane

```
vagrant@kmaster:~/towards5gs-helm/charts/free5gc/charts$ kubectl cluster-info dump | grep -m 1 cluster-cidr
```

vagrant@kmaster:-/towards5gs-helino/carts/fearts/ kubectl cluster-info dump | grep -m 1 service-cluster-ip-range

-vagrant@kmaster:~/towards5gs-helm/charts/fr							
NAME STATUS ROLES AGE	VERSION I	ITERNAL-IP	EXTERNAL-IP	OS-IMAGE	KERNEL-VERSION	CONTAINER-RUNTIME	
kmaster Ready control-plane 29d	v1.29.0 1	92.168.56.11		Ubuntu 20.04.6 LTS	5.4.0-170-generic	containerd://1.7.11	
		92.168.56.21		Ubuntu 20.04.6 LTS	5.4.0-170-generic	containerd://1.7.11	
				Ubuntu 20.04.6 LTS	5.4.0-170-generic	containerd://1.7.11	
vagrant@kmaster:~/towards5gs-helm/charts/free5gc/charts\$ kubectl get pods -o wide -n free5gc							
NAME		ATUS RESTART		NODE	NOMINATED NODE	READINESS GATES	
amf-free5gc-amf-amf-6fd8d684f9-k94bq		nning 0		244.1.19 knode01			
ausf-free5gc-ausf-ausf-7cf6c77b6f-jpt2d		nning 0		244.1.18 knode01			
mongodb-0		nning 0		244.1.16 knode01			
nrf-free5gc-nrf-nrf-7947c959ff-lncrs		nning 0		244.1.15 knode01			
nssf-freeSgc-nssf-nssf-7bbcf599f5-hnggx		nning 0		244.2.224 knode02			
pcf-free5gc-pcf-pcf-6d79cb66fd-xlwbr		nning 0		244.2.225 knode02			
smf-free5gc-smf-smf-f4fc5b68d-65rjq		nning 0		244.2.226 knode02			
udm-free5gc-udm-udm-597949df6f-p6hnc		nning 0		244.1.17 knode01			
udr-free5gc-udr-udr-6c77776c7b-6nwrn		nning 0		244.2.223 knode02			
webui-free5gc-webui-webui-9b59d9f58-b6wn4	1/1 Rui	nning 0	10n 10.	244.1.20 knode01			

vagrant@kmaster:~/towards5gs-helm/charts/free5gc/charts\$ kubectl top nodes

kmaster 269m 13% 1064Mi 56% kmode01 69m 6% 495Mi 57% kmode02 42m 4% 462Mi 53%

Cluster 2. User Plane

```
vagrant@upmaster:~/towards5gs-helm/charts$ kubectl cluster-info dump | grep -m 1 service-cluster-ip-range
vagrant@upmaster:~/towards5gs-helm/charts$ kubectl get nodes -o wide
NAME
                                   AGE
                                                   INTERNAL-IP
                                                                    EXTERNAL-IP
                                                                                 OS-IMAGE
                                                                                                       KERNEL-VERSION
                                                                                                                          CONTAINER-RUNTIME
                                                                                  Ubuntu 20.04.6 LTS
                                                                                                      5.4.0-170-generic
                                                                                                                          containerd://1.7.12
upmaster
          Ready
upnode01
          Ready
                                                                                  Ubuntu 20.04.6 LTS
                                                                                                     5.4.0-170-generic
upnode02
          Ready
                                                                                 Ubuntu 20.04.6 LTS
                                                                                                      5.4.0-170-generic
                 /towards5gs-helm/charts$ kubectl get pods -n free5gc -o wide
                                      READY STATUS RESTARTS
                                                                                                    NOMINATED NODE
                                                                                                                    READINESS GATES
ueransim-onb-5766f8759-k45f6
                                                                   2n8s
ueransim-ue-f9f5f56fb-hdgzf
                                              Running 0
                                                                                         upnode02
upf-free5gc-upf-upf-84b5c8d575-qgj5t
                                              Running 6
            ster:~/towards5gs-helm/charts$ kubectl top nodes
NAME
          CPU(cores)
                              MEMORY(bytes) MEMORYS
          267n
                                              469
```

upnode01 23m

upnode02

405M

46%

49%

N2 Interface Up (from gNB)

```
$ info
name: UERANSIM-onb-208-93-1
nci: 16
plmn: 208/93
nssai:
 - sst: 0x01
   sd: 0x010203
ngap-ip: 10.100.50.250
gtp-ip: 10.100.50.236
paging-drx: v128
ignore-sctp-id: true
$ status
is-ngap-up: true
$ amf-list
- id: 2
$ amf-info 2
id: 2
name: AMF
address: 10.100.50.249:38412
state: CONNECTED
capacity: 255
association:
 rx-num: 3
 tx-num: 5
served-quami:
 - guami:
    plmn: 208/93
    region-id: 202
    set-id: 1016
    pointer: 0
   backup-amf:
served-plmn:
 - plmn: 208/93
    - sst: 0x01
      sd: 0x010203
    - sst: 0x01
```

N4 Interface Up (from SMF)

```
free5GC version: v3.3.0
        build time: 2023-06-20T08:00:26Z
        commit hash:
                            8eb6843b
        commit time:
                           2023-05-31T04:43:19Z
go version: go1.17.8 linux/amd64
2024-02-01T23:44:21.274790025Z [INFO][SMF][CFG] Read config from [../config/smfcfg.yaml]
2024-02-01T23:44:21.276196005Z [INFO][SMF][CFG] Read config from [../config/uerouting.vaml]
2024-02-01T23:44:21.276553201Z [INFO][SMF][Main] Log enable is set to [true] 2024-02-01T23:44:21.276550571Z [INFO][SMF][Main] Log level is set to [info]
2024-02-01T23:44:21.276563120Z [INFO][SMF][Main] Report Caller is set to [false]
2024-02-01T23:44:21.276570714Z [INFO][SMF][CTX] smfconfig Info: Version[1.0.7] Description[SMF initial local configuration]
2024-02-01T23:44:21.276598919Z [INF0][SMF]
2024-02-01T23:44:21.276627153Z [INF0][SMF]
                                              || CTX| Endpoints: [10.100.50.233
                                              [Init] Server started
2024-02-01T23:44:21.290933621Z [INF0][SMF][Init] SMF Registration to NRF {17c44c97-3ee2-48b7-affe-27b8bb47cbff SMF REGISTERE
000544500 <nil> <nil> <nil> <nil> <nil> <nil> <nil> inil> false 0xc00051f098 false false []}
2024-02-01T23:44:21.291129638Z [INFO][SMF][PFCP] Listen on 10.100.50.244:8805
2024-02-01T23:44:21.291187389Z [INF0][SMF][Main] Sending PFCP Association Request to UPF[10.100.50.241]
```

2024-02-01T23:44:21.292989379Z [INFO][SMF][Main] Received PFCP Association Setup Accepted Response from UPF[10.100.50.241]

vagrant@kmaster:~/towards5gs-helm/charts/free5gc/charts\$ k logs -n free5gc smf-free5gc-smf-f4fc5b68d-r9z2h

Defaulted container "smf" out of: smf, wait-nrf (init)
2024-02-01T23:44:21.274743626Z [INFO][SMF][Main] SMF version:

vagrant@kmaster:~/towards5gs-helm/charts/free5gc/charts\$

Successful ping from UE to DN

vagrant@upmaster:~/towards5gs-helm/charts\$ k exec -it -n free5gc ueransim-ue-f9f5f56fb-mctfw -- bash

64 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=0 ttt=17 time=27.4 as 64 bytes from bogd5866 in-f4.1610, net (142.251.135.164); cemp_seq=0 ttt=17 time=21.8 as 64 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=0 ttt=17 time=31.8 as 64 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=2 ttt=17 time=30 as 64 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=2 ttt=17 time=30 as 64 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=30 as 64 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=30 as 64 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=17 time=31.6 as 65 bytes from bogd5866 in-f4.16100, net (142.251.135.164); cemp_seq=3 ttt=1

```
root@ueransim-ue-f9f5f56fb-mctfw:/ueransim/build# ip a
1: lo: <LOOPBACK,UP,LOWER UP> mtu 65536 qdisc noqueue state UNKNOWN group default glen 1000
     link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
     inet 127.0.0.1/8 scope host lo
         valid lft forever preferred lft forever
     inet6 :: 1/128 scope host
         valid lft forever preferred lft forever
2: eth9@if8: <BROADCAST.MULTICAST.UP.LOWER UP> mtu 1450 gdisc nogueue state UP group default
     link/ether 56:06:98:fe:89:64 brd ff:ff:ff:ff:ff:ff link-netnsid 0
     inet 10.234.2.16/24 brd 10.234.2.255 scope global eth0
         valid lft forever preferred lft forever
     inet6 fe80::5406:98ff:fefe:8964/64 scope link
         valid lft forever preferred lft forever
3: uesimtung: <POINTOPOINT, PROMISC, NOTRAILERS, UP, LOWER UP> mtu 1400 gdisc fg codel state UNKNOWN group default glen 500
     inet 10.1.0.1/32 scope global uesimtun0
         valid lft forever preferred lft forever
     inet6 fe80::9160:9331:44d4:d3df/64 scope link stable-privacy
         valid lft forever preferred lft forever
root@ueransim-ue-f9f5f56fb-mctfw:/ueransim/build# ping -I www.google.com
ping: usage error: Destination address required
root@ueransim-ue-f9f5f56fb-mctfw:/ueransim/build# ping -I uesimtun0 www.google.com
PING www.google.com (142.251.135.164) from 10.1.0.1 uesimtun0: 56(84) bytes of data
64 bytes from bog03s06-in-f4.1e100.net (142.251.135.164); icmp_seq=1 ttl=117 time=75.1 ms
64 bytes from bog03s06-in-f4.1e100.net (142.251.135.164); icmp_seq=2 ttl=117 time=13.9 ms
64 bytes from bog03s06-in-f4.1e100.net (142.251.135.164); icmp_seq=3 ttl=117 time=31.3 ms
64 bytes from bog03s06-in-f4.1e100.net (142.251.135.164): icmp_seq=4 ttl=117 time=136 ms
64 bytes from bog03s06-in-f4.1e100.net (142.251.135.164): icmp_seq=5 ttl=117 time=41.1 ms
64 bytes from bog03s06-in-f4.1e100.net (142.251.135.164): icmp_seq=6 ttl=117 time=13.6 ms
64 bytes from bog03s06-in-f4.le100.net (142.251.135.164): icmp_seq=7 ttl=117 time=84.6 ms
64 bytes from bog03s06-in-f4.le100.net (142.251.135.164): icmp_seq=8 ttl=117 time=45.9 ms
```