Analysis on Dual Stack Support of Service Enablement Platform

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Abstract – *A cellular network or mobile network is a communication network where the last link is wireless. The network is distributed over land areas called called "cells", each served by at least one fixed-location transceiver, but more normally, three cell sites or base transceiver stations. Multi-access edge computing (MEC), formerly mobile edge computing, is an ETSI-defined network architecture concept that enables capabilities and an IT service environment at the edge of the cellular network. This environment is characterized by ultra-low latency and high bandwidth as well as real-time access to radio network information that can be leveraged by applications. Using the Robot framework automation tool the automation of MEC for its various xapps is done written in python programming language. For the manual testing the platform of putty , Kubernetes , Mobaxterm is used which makes it easier. The basic idea behind MEC is that by running applications and performing related processing tasks closer to the cellular customer, network congestion is reduced and applications perform better.*

Key Words**: *Mobile Networks, Multi-access edge computing, Edge computing, Kubernetes, Service Enablement Platform.***

1.INTRODUCTION

A mobile network also called as cellular network is an emerging technology wherein the communication occurs wirelessly. The land areas called as "cells" are divided in which the network is distributed. In each cell there are different components like base transceiver, receiver, amplifier, power supply unit . The base station helps cells with transmission of data, voice signal and other types of content. Each cell is provided with unique frequencies from its neighbouring cells which avoides the interference and improves the quality of services provided. The most commonly used communication equipment is mobile phone in which it is a portable telephone which can be used to receive or make calls with the hep of a base station. In order to transfer signals to and from mobile phone radio waves are used.Machine 2 Machine (M2M) communication is a network of connected devices or objects with amazing intelligence and sensing capabilities often designed to perform certain tasks with little or no human interventions. M2M communication has permeated every sphere of human endeavour with its unlimited range of applications. The power LTE-A consumption patterns of the main elements in the BS, employ various M2M Communication techniques to reduce the power consumption, reduce the operational cost, Power consumption and improve efficiency of the BS[1]-[2].In last four decades the cellular networks has grown tremendously. The cellular network started with 1G where 'G' implies generation. It has grown from 1G-4G. And now finally working towards 5G. The advantages and disadvantages of different generation networks from 1G-5G in mobile network wireless communication are studied[3]-[4].The small cells such as microcell, picocell, femtocell, metrocell which are used in different indoor environment which provides improved cellular coverage, capacity in Enterprises/Homes/Metropolitan and rural areas. The advantages of cells in a heterogeneous cellular network, the spectrum allocation, denser deployment of base stations and interference management are studied. The different issues such as off-loading of users from a macro to small cells etc, potentials of superimposing small Base Station with traditional macro cell BS and user association are studied[5]-[8].The Generation networks is an indirect adjustment in the idea of the speed, frequency, technology, latency, data capacity etc. Each generation has different capacities, some standards, new features and new techniques which makes each generation distinct from each other. The 1G network is used for voice calls. The 2G network is a digital technology and it supports messaging through texts. The 3G mobile technology includes higher data transmission rate, increased capacity. The 4G is a extension of 3G with fixed internet to help wireless mobile internet which overcomes the limitaions of 3G[9]. A power consumption model of microcell and macrocell base stations is studied. As per the assumptions made the power consumption of macrocell is about 4.4 times more than microcell base station. A microcell base station is less energy-efficient because of its lower coverage range than microcell base station. Above all this, microcell station is still used as they provide same coverage with a lower total power consumption than with a network where only macrocell base stations are used[10].

1.1. 4G ARCHITECTURE

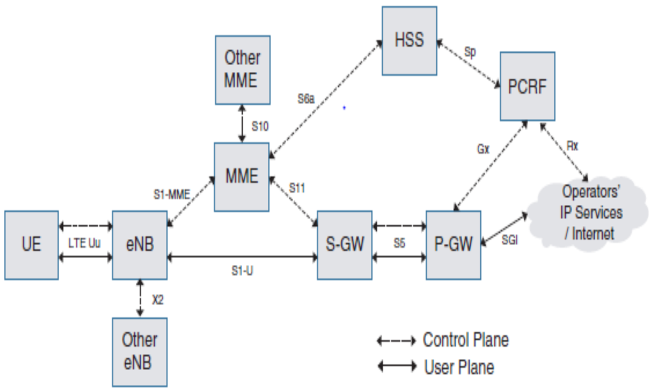

Fig -1: 4G-LTE Architecture Block Diagram

LTE network reference model consisting of LTE entities (UE and eNB) and EPC entities (S-GW, P-GW, MME, HSS, PCRF). A PCRF is an internal or external IP domain of the operator that a UE wants to communicate with, and provides the UE with services such as the Internet or IP Multimedia Subsystem (IMS). EPC includes an MME (mobility management entity), an S-GW and an P-GW. They are responsible for different functionalities during the call or registration process. EPC and E-UTRAN interconnects with the S1 interface. The S1 interface supports amany-to-many relation between MMEs, S-GWs, and eNBs. MME connects to E-UTRAN by means of an S1 interface. This interface is referred to as S1-C or S1-MME. When a UE attaches to an LTE network, UE-specific logical S1-MME connections are established. This bearer, known as an EPS bearer, is used to exchange UE specific signaling messages needed between UE and EPC. Each UE is then assigned a unique pair of eNB and MME identifications during S1-MME control connection. The identifications are used by MME to send the UE-specific S1 control messages and by E-UTRAN to send the messages to MME.

1.2. MULTI-ACCESS EDGE COMPUTING

Multi-Access Edge Computing used in Edge and data centers are seen, which is depoyed in order to reduce the latency and mobile resource demands at the edge instead of core network. MEC is the edge computing which moves the traffic and services from a centralized cloud to the edge of the network which is closer to the customer. Instead of sending data to a central cloud for processing, the network edge analyzes, processes, and stores the data. It provides ultra-low latency , proximity and also reduced cloud data storage and transport costs. Service enablement platform is the integration of both MEC and RIC wherein from SEP the programmable RAN is easily accessible.

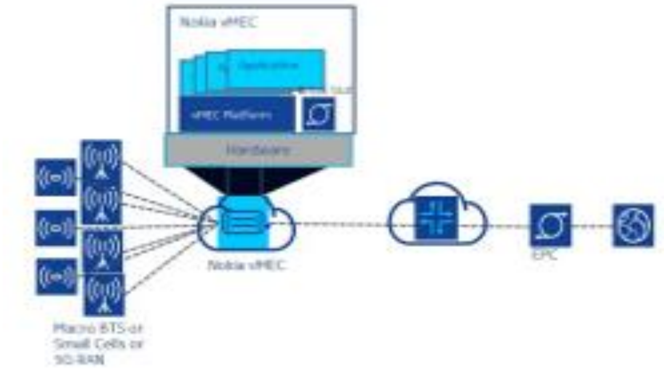

Fig -2: MEC Block Diagram

1.3. SERVICE ENABLEMENT PLATFORM

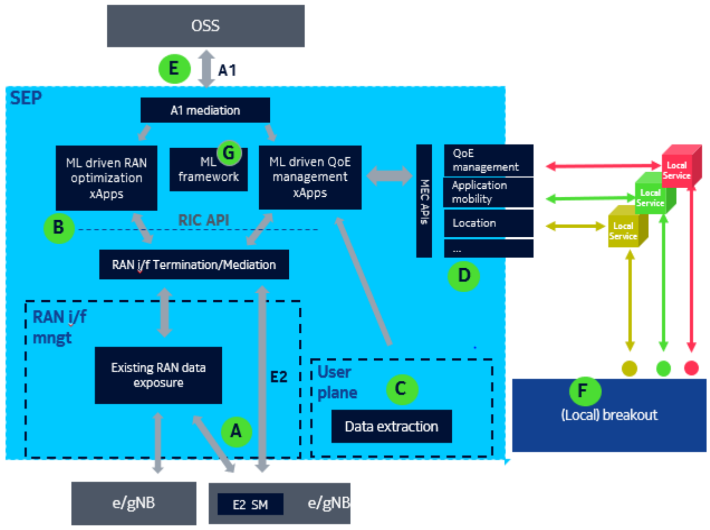

Fig -3: SEP Architecture

A. Support for existing RAN interfaces as well as native E2.
B. RIC API provides a set of RAN information and control capabilities for xApps to consume.
C. User plane data extracted for end user identity mapping and QoE analysis.
D. MEC APIs for service interaction.
E. OSS layer provides SEP with service level policies over A1 interface; These policies guide the actions in the SEP.
F. Local breakout as part of SEP or outside of SEP (e.g. SGW-LBO or UPF for 5G SA).
G. ML inference services.

1.4. KUBERNETES

Kubernetes, otherwise called K8s, is open-source engineering for the mechanization of containerized application organization, scale and the board. Initially created by Google, the Cloud Native Computing Foundation right now oversees it. It looks to give a "stage for computerizing sending, scaling, and tasks of use compartments across groups of hosts"

Different Features of Kubernetes are,

- Secret and Configuration management.
- Batch Execution.
- Horizontal scaling.
- IPV4/IPV6 Dual stack.

Dual stack IPv4/IPv6 allows both IPv4 and IPv6 addresses to be allocated to Pods and Facilities. Allowing dual-stack IPv4/IPv6 networking for your Kubernetes cluster, the cluster can accept both IPv4 and IPv6 addresses being allocated simultaneously.

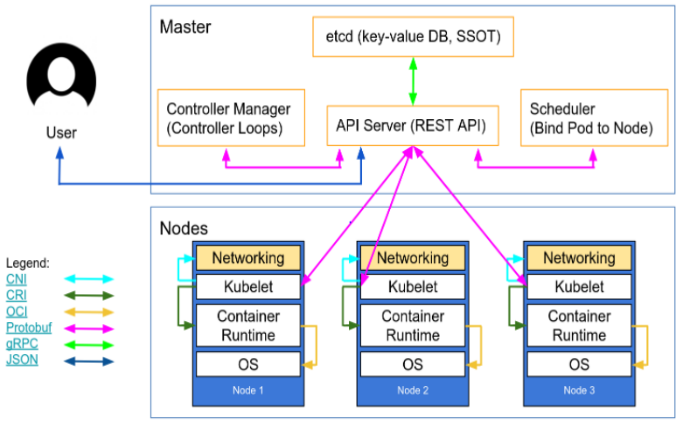

Fig -4: Kubernetes Architecture

1.5. DUAL STACK OF SEP PLATFORM

Fig -5: Service Enablement Platform

Dual stack implies that gadgets can run IPv4 and IPv6 in equal. It permits hosts to all the while arrive at IPv4 and

IPv6 content, accordingly offering a truly adaptable conjunction methodology. Nokia vMEC implements European Telecommunications Standards Institute (ETSI) Multiaccess Edge Computing (MEC) standards. The Nokia vMEC solution offers the vMEC Platform for hosting applications at the edge and supports independent software vendors (ISV) to develop and test their MEC applications. Nokia vMEC can be added to the existing RAN anywhere in the topology. The vMEC Platform enables the operator to deploy and undeploy various applications. The exposure to real-time information (like location) provides the operator additional value. The content services and applications are contextualized to offer a personalized experience.

1.5. COMPARSION BETWEEN CLOUD AND EDGE COMPUTING

Edge Computing is regarded as ideal for operations with extreme latency concerns. Thus, medium scale companies that have budget limitations can use edge computing to save financial resources. Edge Computing requires a robust security plan including advanced authentication methods and proactively tackling attacks.

Cloud Computing is more suitable for projects and organizations which deal with massive data storage. Actual programming is better suited in clouds as they are generally made for one target platform and uses one programing language. It requires less of a robust security plan.

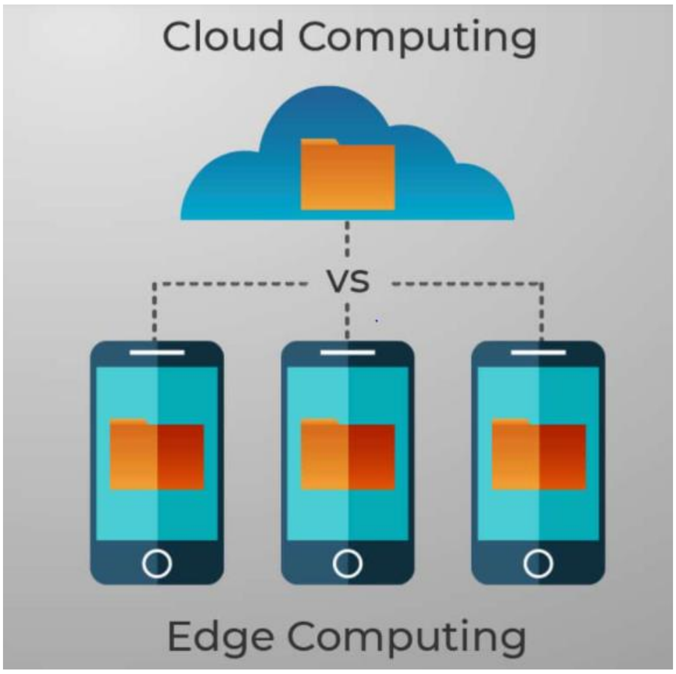

Fig -6: Difference between Edge and cloud Computing

2. DESIGN

Fig -7: Block Diagram

1. Yaml file is configured.

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-deployment
  labels:
    app: nginx
spec:
  replicas: 3
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
      - name: nginx
        image: nginx:1.14.2
        ports:
        - containerPort: 80
```

Fig -8: Yaml File

2. Creating the deployment using yaml file

For the deployment-MEC , RAN and EPC pods are brought up using the yaml file.

Kubectl apply –f ngnix-deployment.yaml

3. To check if the deployment is created

Kubectl get deployments

4. To add the ip's and vlan tagging.

ip link show ens1f0 | grep -i <ip>
ip link set ens1f0 vf <vf> vlan <vlan>
ip link set ens1f0 vf <vf> trust on

5. Configuring the lua files.

```
NAME                                      READY   STATUS    RESTARTS   AGE
config-manager-0                          2/2     Running   0          8d
goon-mqtt-app-7d6ff50d98-2d56q            1/1     Running   0          8d
goon2-mqtt-app-goon-mqtt-575977ff88-bk84h 1/1     Running   0          8d
mec-cuplane-service-0                     3/3     Running   0          8d
rnis-service-8596bc746c-95hnl             1/1     Running   0          8d
```

Fig -8: Deployment of Pods in K8s Multinode Cluster

3. MEC-XAPP FEATURE

The XAPP testcase is simulated for both IPV4/V6 support.
1. Start necessary logs on EPC and RAN
2. Start RAN and EPC sim, load respective config files.
3. Attach UE and verify the attach is successful.
4. Verify UETable context and Tunnel Table context on S1 Packet Broker
5. Check S1 Packet Broker is publishing Establish message and validate all below given parameters.
Message topic – UE Establish Message.

```
+ KEYWORD BuiltIn. Should Contain ${AttachOut}, UE performed EPS_ATTACH
+ KEYWORD BuiltIn. Comment Getting UE IDs for the UEs attached
```

Fig -10: UE Attach

4. RESULTS

```
RNIS_FT_CTR_011 :: As an operator, RNIS of S1 Packet Broker to pub... | PASS |
------------------------------------------------------------------------------
Sa.Testcases.TS 3 RNIS                                                | PASS |
1 critical test, 1 passed, 0 failed
1 test total, 1 passed, 0 failed
==============================================================================
Sa.Testcases                                                          | PASS |
1 critical test, 1 passed, 0 failed
1 test total, 1 passed, 0 failed
==============================================================================
Sa                                                                    | PASS |
1 critical test, 1 passed, 0 failed
1 test total, 1 passed, 0 failed
==============================================================================
```

Fig -10: Robot container Results

The testcase for the above mentioned requirements of RNIS-XAPP for both IPV4 and IPV6 is tested manually and then automated in robot framework and run in robot container and is passed.

5. CONCLUSIONS

Multi-Access Edge Computing (MEC) helps in computing of the traffic and services at the edge of the network instead of sending all data to a cloud for processing. Robot Framework is one of the best and well know open source test automation tools for software testing. The concepts regarding Mobile networks , 4G Architecture , MEC , SEP , RAN Platforms are understood. The MEC XPPS – RNIS is tested manually and automated using robotframework for IPV4 and multimode cluster after the container deployment of MEC pod, EPCSIM, RANSIM. For manual testing purpose, Kubernates open source platform is used in which EPC, MEC, RAN pods are deployed. Also the different components in the macrocell base station is studied which will be designed and implemented in the future work.

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REFERENCES

[1] Swati Yadav and Sugandha singh , "Development of Mobile Wireless Technologies (1G to 5G)" , International journal of computer science and mobile computing(IJCSMC), vol 7,(5) ,2018 ,pp. 94-100.

[2] A.A. Amin, M.S. Islam, A.A.M. Masud and M.N.H. Khan, "Design and performance analysis of 1.8 Ghz low noise amplifier for wireless receiver applications," in Indonesian Journal of Electrical Engineering and Computer Science (IJEECS), Vol. 6,(3),2016, pp. 656-662.

[3] C. C. Hsu and J. M. Chang, "Spectrum-Energy Efficiency Optimization for Downlink LTE-A for Heterogeneous Networks," IEEE Transactions on Mobile Computing, Vol. 16 ,(5), 2017, pp. 1449-1461.

[4] A. Zabri, M.K.A. Rahim, F. Zubir, N.M. Nadzir, and H.A. Majid, "Video monitoring application using wireless sensor nodes with various external antenna," in Indonesian Journal of Electrical Engineering and Computer Science (IJEECS), Vol. 6,(1),2017, pp. 148-154.

[5] M. Toufique, H. Jiang and A. R. Hadi, "Duty cycling stratagems for network permanency in wireless sensor network", in Indonesian Journal of Electrical Engineering and Computer Science (IJEECS), Vol. 3,(3), 2016, pp. 534-539.

[6] Neelu, "A STUDY ON NOKIA", International Research Journal of Commerce , Arts and Science (CASIRJ), vol. 5, (6), 2014 ,pp.2319 –9202.

[7] X. Zhang, Y. Zhang, R. Yu, W. Wang and M. Guizani, "Enhancing Spectral Efficiency for LTE-Advanced Heterogeneous Networks: Users Social Pattern Perspective," in IEEE Wireless Communications, Vol. 21,(2), 2014 ,pp. 10-17.

[8] A. K. Jagannatham, "Principles of Modern Wireless Communication Systems: Theory and Practice", McGraw Hill Education (India) Private Limited, New Delhi, pp. 60-63.

[9] C. Desset et al., "Flexible power modelling of LTE base stations", IEEE Wireless Communications and Networking Conference, Shanghai, 2012, pp. 2858-2862. W. Vereecken et al., "Power Consumption in Telecommunication Networks: Overview and Reduction