Multi-Access EDGE Computing (MEC): A Mainstay of 5G

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Abstract: **The proliferation of Internet of Things (IoT) and the success of rich cloud services have pushed the horizon of a new computing paradigm, edge computing, which calls for processing the data at the edge of the network. Edge computing has the potential to address the concerns of response time requirement, battery life constraint, bandwidth cost saving, as well as data safety and privacy.**

Multi-access edge computing (MEC) is an emerging ecosystem, which aims at converging telecommunication and IT services, providing a cloud computing platform at the edge of the radio access network. MEC offers storage and computational resources at the edge, reducing latency for mobile end users and utilizing more efficiently the mobile backhaul and core networks. This paper introduces a survey on MEC and focuses on the fundamental key enabling technologies. This paper will review Multi-access edge computing in context to 5G. In addition, this paper analyzes the MEC reference architecture along with its pros and cons.

Keywords: MEC, LTE, IoT, ETSI, 3GPP.

I. INTRODUCTION

Edge computing is a method of optimizing cloud computing systems by performing data processing at the edge of the network, near the source of the data[1]. This reduces the communications bandwidth needed between sensors and the central data center by performing analytics and knowledge generation at or near the source of the data. This approach requires leveraging resources that may not be continuously connected to a network such as laptops, smartphones, tablets and sensors.[2] Edge computing covers a wide range of technologies including wireless sensor networks, mobile data acquisition, mobile signature analysis, cooperative distributed peer-to-peer ad hoc networking and processing also classifiable as local cloud/fog computing and grid/mesh computing, dew computing,[3] mobile edge computing,[4][5] cloudlet, distributed data storage and retrieval, autonomic self-healing networks, remote cloud services, augmented reality, and more.[6]

Multi-Access Edge Computing (MEC) is an open platform which integrates the core capabilities of network, computing, storage and application at the network edge close to people, things or data sources. The platform provides edge intelligence services to meet the key requirements of industry digitization in various aspects such as agile connection, real-time service, data optimization, application intelligence, security and privacy protection. In 3GPP R15, based on the service-oriented architecture, 5G protocol module can be called according to service requirements and provide technical standards for constructing edge network. As a result, the MEC can be flexibly deployed in wireless access cloud, edge cloud or converged cloud in different scenarios based on demands. MEC can provide mobile operators with the following values:

- To reduce the utilization of the core network and backbone transmission network and effectively improve the utilization rate of the operator network through local offload of high-bandwidth services such as 4K/8K and Virtual reality and augmented reality (VR/AR);
- The operator network will effectively support future latency-sensitive services (such as the Internet of Vehicles and remote control) and services requiring high computing and processing capabilities (such as video monitoring and analysis) by descending the content and computing capability, so as to help operators transform from connection pipe to information-based service enablement platform;
- As an edge cloud computing environment and network capability open platform, MEC will lay a foundation for operators to construct the network edge ecology.

II. MEC NETWORKING ARCHITECTURE OF LTE NETWORK

In today's LTE network, a MEC server has two forms:

1) built-in: integrated with the base station as an enhancement function through upgrading software or an add-in board card;

2) external form, deployed behind the base station or gateway as stand-alone equipment.

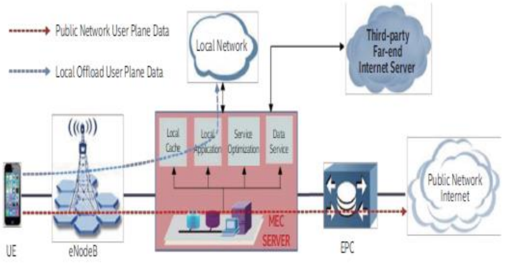

Figure 1: Diagram of MEC End-to-end Networking Architecture in LTE Network

Figure 1 shows the typical MEC end-to-end networking architecture. The MEC server is located between the base station and core network and implements service offload through parsing S1 messages. There are usually multiple transmission rings between the base station and core network: access ring, convergence ring, and core ring. The MEC server is deployed in a proper position within the network according to the requirements of service type, processing capability, network planning, etc.

The MEC server can run on a physical platform or virtualized platform to provide such functions as local cache, local data service and service optimization. It can also carry local applications. The offload rules of these services are preconfigured for the MEC offload module. When the user plane receives a service data message, MEC parses the feature field of the message (for example, IP quintet) and matches it with the preconfigured offload rules. If the rules are matched, the service flow will be led to the corresponding local application or service, as shown by the blue line in Figure 1. In addition, MEC performs a transparent parsing for S1 signalling, which does not affect the signaling process between the base station and core network. For service flows that do not belong to the MEC local service, the MEC transparently transfers the service message received to the core network.

III. MEC BENEFITS ANALYSIS

In edge computing we want to put the computing at the proximity of data sources. This have several benefits compared to traditional cloud-based computing paradigm. Here we use several early results from the community to demonstrate the potential benefits. Researchers built a proof-of-concept platform to run face recognition application in [7], and the response time is reduced from 900 to 169 ms by moving computation from cloud to the edge. Ha et al. [8] used cloudlets to offload computing tasks for wearable cognitive assistance, and the result shows that the improvement of response time is between 80 and 200ms. Moreover, the energy consumption could also be reduced by 30%–40% by cloudlet offloading. clonecloud in [9] combine partitioning, migration with merging, and on-demand instantiation of partitioning between mobile and the cloud, and their prototype could reduce 20× running time and energy for tested applications.

IV. PROBLEM ANALYSIS OF MEC DEPLOYMENT

ETSI defines the function of MEC standards, while the definition of concrete implementation is incomplete. There was no standard interface established with the 3GPP elements in the network and the commercial deployments are faced with the following challenges:

- Billing: At present, there is no complete traffic billing scheme in the existing network application, further research and evaluation need to be done for statistics and report of local traffic through MEC, the newly-added node at the core network side (or P-GW upgrade) is responsible for the scheme of generating the CDR and reporting to BOSS system;
- Security: The security of the MEC platform is a prerequisite for the deployment of third party applications, and further research needs to cover physical port isolation, logic port isolation, firewall security control and access control;
- Lawful intercept: Providing the listening and monitoring function at the user level should be considered when deploying MEC;
- Mobility management: There is no well-validated mobility scheme, and the continuity of service (between MEC servers) needs to be ensured in the handover scenarios

V. CONCLUSION

For more than a decade, the innovation of mobile technology has continuously boosted the development of the mobile industry. Compared to 4G, 5G has become the primary productivity of the society and is about to implement industry-wide digitization. On the basis of improving the user experience of mobile Internet services, 5G will further satisfy the massive requirements of IoT applications and deeply integrate with such industries as the Internet of Vehicles, industrial control, telemedicine and energy, so as to implement the “Internet of Everything” in a real sense.[10]

In the 5G era, the applications of MEC will extend to such fields as transportation system, intelligent driving, real-time tactile control and Augmented Reality to become the key enabler for the digital transformation of operators. This will bring about a transformation of the network from access pipeline to information-based service enablement platform. The development of the MEC industry standards and the deployment of general virtualization platforms will provide a new network ecosystem and value chain.

REFERENCES

[1] G. L., Pedro; M., Alberto; E., Dick; D., Anwitaman; H., Teruo; I., Adriana; B., Marinho; F., Pascal; R., Etienne (2015-09-30). "Edge-centric Computing: Vision and Challenges". ACM SIGCOMM Computer Communication Review. 45 (5): 37–42.

[2] G., Mohamed Medhat; S., Frederic; G., Joao Bártolo (2014). Pocket Data Mining - Big Data on Small Devices (1 ed.). Springer International Publishing. ISBN 978-3-319-02710-4.

[3] S., Karolj; D., Davor; A., Enis; S., Ivan; S., Zorislav (2015). "Scalable Distributed Computing Hierarchy: Cloud, Fog and Dew Computing". Open Journal of Cloud Computing (OJCC). RonPub. 2 (1): 16–24. ISSN 2199-1987. Retrieved 1 March 2016.

[4] "Mobile-Edge-Computing White Paper" . ETSI.
[5] A., Arif; Ahmed, Ejaz. A Survey on Mobile Edge Computing. India: 10th IEEE International Conference on Intelligent Systems and Control(ISCO'16), India.
[6] Edge Computing - Pacific Northwest National Laboratory
[7] S. Yi, Z. Hao, Z. Qin, and Q. Li, "Fog computing: Platform and applications," in Proc. 3rd IEEE Workshop Hot Topics Web Syst. Technol. (HotWeb), Washington, DC, USA, 2015, pp. 73–78.
[8] K. Ha et al., "Towards wearable cognitive assistance," in Proc. 12th Annu. Int. Conf. Mobile Syst. Appl. Services, Bretton Woods, NH, USA, 2014, pp. 68–81.
[9] B.-G. Chun, S. Ihm, P. Maniatis, M. Naik, and A. Patti, "CloneCloud: Elastic execution between mobile device and cloud," in Proc. 6th Conf. Comput. Syst., Salzburg, Austria, 2011, pp. 301–314.
[10] China Unicom Edge Computing Technology White Paper