Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 11, Issue 4, December 2020: 2032-2036

Problem Analysis of Multi-access Edge computing (MEC) in 5G

Jatinder Kaur

Asst. Prof., GSSDGS Khalsa College, Patiala, Punjab. jkkcp17@gmail.com

Abstract

The The popularity of rich cloud services and the spread of the Internet of Things (IoT) 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. Mobile edge computing (MEC), a key technology in the emerging fifth generation (5G) network, can optimise mobile resources by hosting compute-intensive applications, processing large data before sending it to the cloud, providing cloud computing capabilities within the radio access network (RAN) in close proximity to mobile users, and providing context-aware services using RAN information.

MEC (multi-access edge computing) is a new ecosystem aimed at bringing together telecommunications and information technology services by providing a cloud computing platform at the edge of radio access network. MEC provides storage and processing resources at the edge, reducing latency for mobile end users and allowing mobile backhaul and core networks to be used more efficiently. 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, VR/AR, 3GPP.

1. Introduction

Edge computing is a method of optimising cloud computing systems by processing data at the network's edge, close to the data source [1]. Engineers realised that the same mechanism that reinforces a data communications network can also reinforce a data processing network, and therefore edge computing became part of the 5G Wireless requirement. By performing analytics and knowledge generation at or near the source of the data, this reduces the amount of bandwidth required between sensors and the central data centre. This method requires the use of resources that aren't always linked to the internet, such as laptops, cellphones, tablets, and sensors. [2] Wireless sensor networks, mobile data acquisition, mobile signature analysis, cooperative distributed peer-to-peer ad hoc networking and processing, sometimes known as local cloud/fog computing, , dew computing,[3], grid/mesh computing, mobile edge computing,[4][5] cloudlet, distributed data storage and retrieval, autonomic self-healing networks, remote cloud services, augmented reality, and more[6] are all examples of edge computing.

MEC (Multi-Access Edge Computing) is an open platform that combines network, computing, storage, and application capabilities at the network edge, close to people, things, and data sources. The platform offers edge intelligence services to address industrial digitization's main requirements in areas including agile connectivity, real-time service, data optimization, and application intelligence. 5G protocol modules can be called according to service requirements and provide technical guidelines for establishing edge networks in 3GPP R15, which is based on the service-oriented architecture. As a result, the MEC can be implemented in a variety of situations, including wireless access cloud, edge cloud, and converged cloud, depending on need. MEC can deliver the following values to mobile operators:

- 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);
- By descending the content and computing capability, the operator network will effectively support future latency-sensitive services (such as the Internet of Vehicles and remote control) as well as services requiring high computing and processing capabilities (such as video monitoring and analysis), allowing operators to transform from connection pipe to information-based service enablement platform.
- MEC will offer a framework for operators to build the network edge ecosystem as an edge cloud computing environment and open platform for network capability.

2. MEC Networking Architecture of 5G and LTE Network

A MEC server can take one of two types in today's LTE network:

1) External form, placed behind the base station or gateway as stand-alone equipment;

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

The MEC server sits between the base station and the core network, and it uses S1 communications to implement service offload. Between the base station and the core network, there are normally three transmission rings: access, convergence, and core. The MEC server is placed in the appropriate network location based on the service type and processing capability needs. The 5G architecture offers a variety of options for integrating MEC into the network. Furthermore, MEC implementation is adaptable. As a result, it may be used in a variety of 5G network settings. Infrastructure, applications/services, network latency, and bandwidth are all issues to consider.

- MEC and transmission node (potentially with UPF) are co-located.
- MEC and UPF (User Plane Function) can be co-located with the BS (Base Station)
- MEC and UPF co-located with the network aggregation point
- MEC is housed in the same building as the network's main services.

The MEC server, which provides features like local caching, local data service, and service optimization, can run on a real or virtualized platform. It can also run apps on a local level. The MEC offload module is preconfigured with these services' offload rules. MEC parses the feature field of a service data message when it arrives at the user plane (for example, IP quintet) and matches it with the preconfigured offload rules. The service flow will be sent to the corresponding local application or service if the rules match. MEC also provides transparent parsing for S1 signalling, which has no impact on the signalling process between the base station and the 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.

3. 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.

- It provides customers with new network services. As a result, it allows service providers to enhance revenue by utilising a variety of use cases.
- Service providers can roll out new services for end users without having to change their existing 5G network architecture.
- Applications run in local environment which improves performance and user experience due to lower latencies.
- Researchers created a proof-of-concept architecture to run a facial recognition programme in [7], and by relocating processing from the cloud to the edge, the response time was reduced from 900 to 169 milliseconds. Ha et al. [8] used cloudlets to offload computational duties for wearable cognitive aid, and the results demonstrate that response times improved by 80 to 200 milliseconds.
- Customers can get services based on their location to OTT ("Over the Top") applications[11].
- It provides protection for Internet of Things (IoT) services.
- It provides a distributed infrastructure and improves application and network service reliability.
- It provides an environment for enterprise clients to manage local policies.
- 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.
- It lowers operational costs by obviating the need for costly data centres.
- It minimises the requirement for cloud data storage while also lowering transportation expenses.
- It minimises network congestion and conserves network bandwidth.

4. Problem Analysis of MEC Deployment

ETSI(European Telecommunications Standards Institute**)** 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:

- Reliability and mobility: Densification is critical component of the upcoming 5G network, and it is anticipated that combining MEC and network densification would yield huge potential benefits. Managing mobility and assuming reliability in such contexts can be difficult.
- Billing: There is currently no complete traffic billing scheme in the existing network application; additional research and evaluation is required for statistics and reporting 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 the BOSS system;
- Distributed resource management: Because MEC servers' calculation power is often limited, resource allocation is one of the major roadblocks to MEC's success in executing compute-intensive and latency-critical applications. Resource allocation optimization can be multi-objective and vary depending on the situation[12].
- 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
- Network integration and application portability: MEC can be positioned in many places within the RAN depending on the underlying technology and technical and business requirements (e.g., WLAN and E-UTRA). As a result, another major problem is integrating MEC into the underlying network architecture and current interfaces in order to enable new services at the edge of mobile networks and improve overall network performance[13].
- 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

5. Conclusion

MEC is a revolutionary computing paradigm that enables the deployment of compute-intensive and latency-critical applications on resource-constrained end devices in a RAN. 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]

Non orthogonal multiple access, wireless power transmission and energy harvesting, unmanned aerial vehicles, the Internet of Things, ultra-dense networks, and machine learning are leading-edge technologies and tools of the emerging 5G network. MEC's applications will expand in the 5G era to include transportation systems, intelligent driving, real-time tactile control, and Augmented Reality, making it a vital enabler for operators' digital transformation. The network will be transformed from an access pipeline to an information-based service enablement platform as a result of this. A new network ecosystem and value chain will emerge as a result of the development of MEC industry standards and the deployment of general virtualization platforms. This paper covers both fundamentals of MEC, architecture and state-of-the-art research works on “MEC in LTE and 5G. In addition, it has benefit analysis and problem domains. This paper can help the readers to deeply understand the fundamentals of MEC and the state-of-the-art of MEC in 5G and select interesting MEC problems for their research.

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.
3. "Mobile-Edge-Computing White Paper" . ETSI.
4. A., Arif; Ahmed, Ejaz. A Survey on Mobile Edge Computing. India: 10th IEEE International Conference on Intelligent Systems and Control(ISCO’16), India.
5. Edge Computing - Pacific Northwest National Laboratory
6. 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.
7. 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.
8. 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.
9. China Unicom Edge Computing Technology White Paper
10. 5G MEC Multi Access Edge Computing | Advantages of MEC in 5G (rfwireless-world.com)
11. (PDF) A Survey of Multi-Access Edge Computing in 5G and Beyond: Fundamentals, Technology Integration, and State-of-the-Art (researchgate.net)
12. Q.-V. Pham, T. L. Anh, N. H. Tran, B. J. Park, and C. S. Hong, “Decentralized computation offloading and resource allocation for mobile-edge computing: A matching game approach,” IEEE Access, vol. 6, pp. 75 868–75 885, Nov. 2018.