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# Real Time Use cases of Mobile Edge Computing and Challenges in a Nutshell

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**ABSTRACT:** Mobile Edge Computing is an emerging technology which provides IT and cloud services within the close proximity of mobile users. Regular telecom network operators perform traffic control flow (forwarding and filtering of packets), but in Mobile Edge Computing, cloud servers are deployed in each base location. Industry investment and research interest in edge computing, in which computing and storage nodes are placed at the Internet's edge in close proximity to mobile devices or sensors, have grown dramatically in recent years. This emerging technology promises to deliver highly responsive cloud services for mobile computing, scalability and privacy-policy enforcement for the Internet of Things, and the ability to mask transient cloud outages. Therefore, network operator has a great responsibility in serving mobile users. Mobile Edge Computing platform reduces network latency by efficient computation and storage capacity at the edge network. It also enables content providers and application developers to serve context-aware services (such as collaborative computing) by using real time radio access network information. IOT and Mobile devices perform computation offloading for compute intensive applications, such as image processing, mobile gaming, to leverage the Mobile Edge Computing services. In this paper, some of the promising real time Mobile Edge Computing application scenarios are discussed. Later on, a state-of-the-art research effort on Mobile Edge Computing domain is presented. The paper also presents taxonomy of Mobile Edge Computing, describing key attributes. Finally, open research challenges in successful deployment of Mobile Edge Computing are identified and discussed.

**KEYWORDS:** Mobile Edge Computing, Computation Offloading, Collaborative Computing

## I. INTRODUCTION

Multi-access Edge Computing (MEC) formerly known as mobile edge computing It is a type of edge computing that extends the capabilities of cloud computing by bringing it to the edge of the network. MEC was borne out of the ETSI (European Telecommunications Standards Institute) initiative that originally focused on placing edge nodes on the mobile network, but it has now expanded to include the fixed (or eventually converged) network. Whereas traditional cloud computing occurs on remote servers that are situated far from the user and device, MEC allows processes to take place in base stations, central offices, and other aggregation points on the network.

By shifting the load of cloud computing to individual local servers, MEC helps reduce congestion on mobile networks and decrease latency, enhancing the quality of experience (QoE) for end users. Recently, Mobile devices (such as Mobile Phone, Smart Phone, Tablet etc.) are emerging as an important tool for learning, entertainment, social networking, updating news and businesses (E. Ahmed A. G., 2015). However, due to resource constraints of mobile devices (processing power, battery lifetime, storage capacity) mobile users do not get the same satisfaction compare to desktop (H. T. Dinh, 2013). After the evolution of mobile cloud computing, many cloud computing services such as m-health-care (Chen, 2010), m-learning (Shen, 2014), m-gaming (J. Wu, 2015) and m-governance (Shaji, 2014) are directly accessible from the mobile devices (E. Ahmed A. G., 201). This also implicates the high network load, and growing demand of network bandwidth since data have to be transmitted and received to and from mobile devices and cloud data centers. It is estimated that demand of bandwidth is expected to be doubled each year.

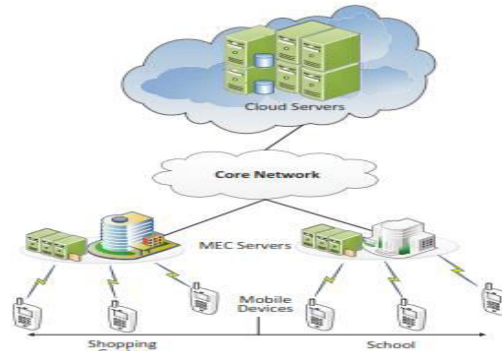


Figure 1. Mobile Edge Computing Novel Engineering

Mobile Edge Computing offers constant RAN data (like organization load, client's area) to the application engineers and substance designers. These ongoing organization data are utilized to give setting mindful administrations to the mobile endorsers, consequently advancing client's fulfillment and improving Quality-of-Experience (QoE). Mobile Edge Computing stage builds the edge duty and permits calculation and administrations to be facilitated at the edge, which decreases the organization inactivity and data transmission utilization of the endorsers. Organization administrators can permit the radio organization edge to be taken care of by outsider accomplices, this will permit to quickly send new applications and edge administrations to the mobile supporters, undertakings. There are three essential segments in the design of Mobile Edge Computing novel engineering as shown in Figure 1. Edge gadgets incorporate all sort of gadgets (both mobile telephones and IoT gadgets) associated with the organization. Edge cloud is the less creative cloud conveyed in every one of the mobile base station. Edge Cloud have the obligation of customary organization traffic control (both sending and filtering) and having different mobile edge applications (edge medical services, shrewd following and so forth.) and public cloud is the cloud foundation facilitated in the Internet.

## II. LITERATURE RIEW

**2.1 History:** The underlying foundations of edge computing reach back to the last part of the 1990s, when Akamai presented content conveyance organizations (CDNs) to quicken web execution. A CDN utilizes hubs at the edge near clients to prefetch and reserve web content. These edge hubs can likewise play out some substance customization, for example, including area significant promoting. CDNs are particularly important for video content, in light of the fact that the data transmission investment funds from storing can be significant. Edge computing sums up and expands the CDN idea by utilizing cloud computing foundation. As with CDNs, the proximity of cloudlets to end clients is urgent. Notwithstanding, rather than being restricted to storing web content, a cloudlet can run self-assertive code similarly as in cloud computing. This code is regularly typified in a virtual machine (VM) or a lighter-weight acknowledgment could be actualized with adequate execution on an asset restricted mobile gadget by offloading calculation to a close by worker.

Cloud computing's development during the 2000s prompted the cloud turning into the clearest foundation to use from a mobile gadget. Today, Apple's Siri and Google's discourse acknowledgment administrations both offload calculation to the cloud. Sadly, combination suggests huge normal detachment between a mobile gadget and its ideal cloud datacenter. Ang Li and his partners revealed that the normal full circle time from 260 worldwide vantage focuses to their ideal Amazon Elastic Compute Cloud (EC2) occurrences is 74 ms. To this must be included the inactivity of a remote first jump. Regarding jitter, the difference intrinsic in a multihop network must be incorporated for developing applications, for example, increased reality (AR).

## 2.2 WHY PROXIMITY MATTERS

As the investigation of new applications and use cases for both mobile computing and the IoT (L. Atzori, 2010), the ideals of proximity are getting progressively evident. In the physical world, the significance of proximity has never been in question. The familiar maxim about the three top determinants of land esteem being "area, area, and area" catches this perception well. In the digital world, the consistent availability offered by the Internet has hushed us into a misguided feeling of negligence for physical proximity. Since legitimate organization proximity is completely described by low idleness, low jitter, and high transmission capacity, the inquiry "How close is truly close enough?"



can't be replied in the theoretical. It is reliant on components, for example, the systems administration advancements utilized, network conflict, application qualities, and client capacity to bear poor intuitive reaction.

Physical proximity influences start to finish idleness, monetarily feasible transfer speed, foundation of trust, and survivability. With adequate exertion and asset venture, the absence of proximity can be incompletely concealed. For instance, an immediate fiber association can accomplish low idleness and high data transmission between inaccessible focuses. Notwithstanding, there are cutoff points to this methodology. The speed of light is an undeniable physical cutoff on dormancy. The need to utilize a multihop organizing technique to cover an enormous geographic region with many passageways forces a financial breaking point on both dormancy and transmission capacity. Each jump presents lining and steering delay, just as cradle swell. The proximity of cloudlets helps in any event four unmistakable ways namely Highly responsive cloud administrations, Scalability, Privacy-strategy implementation and Masking cloud blackouts.

### III. MOBILE EDGE COMPUTING BUSINESS ANALYSIS

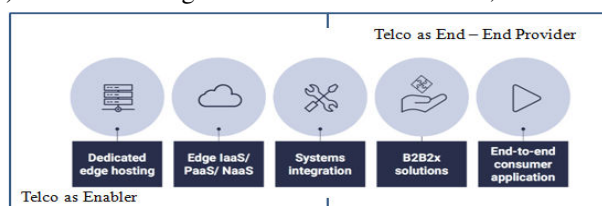
MEC is viewed as to a greater extent a medium-term opportunity (2-3 years) for Telecom Company (telcos), as it will take effort for application designers to exploit the adequate framework which is yet to be conveyed – the world guide underneath shows that dominant part of telcos have just barely begun to turn out MEC locales. In terms of the actual market size for MEC, although there are some discrepancies (upper/lower bounds) on projections across multiple sources, the general trend is that the global MEC market will experience significant growth in the next few years. This growth will be primarily driven by telcos rolling out MEC infrastructure starting from 2020, as well as the deployment of MEC applications across various industries. **Analysts disagree on the forecasted size of the MEC market is shown in figure 2.**



Figure 2. Analysts disagree on the forecasted size of the MEC market

#### 3.1 Mobile Edge Computing Telecom Company Business Models

MEC is a tool for improving the performance of existing applications, such as content delivery or caching, but it is also turning into a key enabler for new applications. MEC will drive new revenue-generating (5G) use cases and could potentially also improve efficiencies for telcos in delivering highly distributed throughput content use cases. Therefore, MEC can yield benefits for both customers and telcos. Although the MEC market is still at an early stage, telcos should not wait for it to mature before trying to tap into emerging commercial opportunities as shown in figure 3. With strong competition looming, they should explore what could be viable business models to support many potential MEC use cases (M. Beck, 2014). The Below Figure 3 is Dedicated Use case,



### IV. USE CASES AND APPLICATIONS OF MOBILE EDGE COMPUTING

Associated/self-governing vehicle capacities: For the situation of self-ruling vehicles, MEC can be used to share data on street foundation, the situation of people on foot/different vehicles/creatures and climate conditions legitimately to

the vehicles, rather than having to interface with focal cloud workers. Joining MEC with AI/ML will permit self-sufficient vehicles to know about their encompassing circumstances continuously. The low inertness that MEC gives is basic to self-governing vehicles to work securely, as vehicles can't bear to trust that data will be prepared in the cloud (M. Satyanarayanan, 2009)

Undertaking Mixed Reality (MR), Augmented Reality (AR) and Virtual Reality (VR) applications MEC in AR/VR can uphold telecommuters direct upkeep and fix assignments in the field. A MEC arrangement would give an overlay of rich data identified with a specific resource they are fixing on the field power laborer's showcase on a headset or mobile gadgets. Today, 3D models are too substantial to even consider rendering on the end-gadgets and is impossible in the cloud, as the inertness is excessively high. MEC permits handling of information and possible delivering of 3D models off the gadget, which permits advanced twin models to be increased on the perspective on the laborer, just as empower a far off master to comment on the picture/video being transferred from the headset or mobile gadgets continuously (Amazon(AWS), 2020).

Another endeavor MR application empowered by MEC is multi-client cooperation for design, building and development groups. It permits continuous cooperation by delivering models that the group will be dealing with mutually in the edge cloud. This diminishes inactivity, especially as these 3D plans are regularly gigantic records. MEC organization likewise permits simple sharing among different partners, through a conveyed network (E. Ahmed A. A., 2015).

Cloud gaming and multiplayer gaming MEC would move the serious register/designs handling from a devoted gaming console, or a server farm as cloud gaming develops, to the edge of the organization. Gamers would approach a similar nature of game from a more slender customer, anyplace inside the organization's inclusion. For gaming studios and engineers, since MEC gives outrageous low dormancy, cloud gaming turns into a reasonable method of giving a more extensive crowd admittance to very good quality gaming encounters and possibly another pay stream when joined with another membership model (Microsoft Azure, 2020).

Constant automotive location There is expanding requirement for arrangements that recognize when an automotive has entered a protected, geo-fenced zone and to trigger important cautions/activities as characterized by the security groups that deal with the site. Air terminals, as observed by the Gatwick Airport drone occurrence in the UK in 2018, detainment facilities and medical clinics could be essential adopters of this innovation, since they should have the option to react to dangers quickly, which is made conceivable through MEC. Utilizing MEC would decrease inertness for distinguishing an unfamiliar automaton and planning its way decide if it's moving toward a prohibition zone. MEC keeps information from the automaton closer to its source, decreasing the time taken to respond when there is a penetrate or a security danger.

## V. MOBILE EDGE COMPUTING RESEARCH CHALLENGES

Mobile Edge Computing is still in earliest stages state. There are numerous difficulties to defeat in this field. The open examination challenges in Mobile Edge Computing like Protocol, Portability Management, Evaluating Model, Versatility and Security are issues will give an impression thought for scientist to defeat the difficult issues.

**Standard Protocol:** Normalization is a cycle to bring an open domain for scientists and enterprises to work in a solitary concurred stage. Mobile Edge Computing is an ongoing innovation that has not been executed appropriately. Thus, a normalized open condition is should have been made for Mobile Edge Computing that will permit consistent and proficiently incorporation of customary applications over the Mobile Edge Computing stages. The standard stage will likewise quicken the fast improvement of mobile edge applications over the business, and eventually expanding the market size. Standard conventions are needed to actualize standard qualities of Mobile Edge Computing, for example, setting mindful data, offloading situation. When the standard conventions are accessible, specialists and academician can improve the convention subsequent to executing or displaying in the genuine stage.

**Portability Management:** It is one of the explanations behind incessant detachment of connection among gadgets and edge network in Mobile Edge Computing stage. At the point when the gadget is in moving state, administration nature of the application is debased because of changing properties of organization boundaries, for example, delay, transmission capacity, jitter and so forth. One of the difficult issues in Mobile Edge Computing is actualizing a

versatility the executives strategy with which client can get to edge application with no separation. Versatility the executives procedure should deal with both even and vertical portability.

**Evaluating Model:** Client versatility is basic in Mobile Edge Computing where the organization is heterogeneous. Proper estimating model ought to be made if the client admittance to edge administrations from meandering base station. Estimating model ought to be dynamic dependent on the organization boundaries of the entrance advancements, for example, inactivity, meeting restoration delay, jitter, data transfer capacity accessibility, and nature of security.

**Versatility:** Its property guarantees the accessibility of the administration paying little mind to the quantity of customer gadgets in the edge organization. In the ordinary situation, the greater part of the gadgets doesn't get to edge application all the while. Lately, the quantity of the edge gadgets, (for example, mobile gadgets, IoT gadgets and so on.) are developing and if tremendous number of gadgets access a molecule administration all the while, this will embroil network bottleneck and eventually the administration may intrude. The edge worker ought to guarantee adaptability of the administration by applying load adjusting system, Server bunches.

**Security:** It is one of the difficult issues in Mobile Edge Computing stage where applications are facilitated at the edge organization. As opposed to customary computing, application engineers have no function in testing the security strategies authorized by the radio organization. Before the application is facilitated in mobile edge worker, following security challenges must be settled. The application facilitated at the edge worker ought to validate a client getting to the application assets whether the one it professes to be. Mobile edge worker must ensure applications and information store at the edge worker from interruption. Then again, mobile gadget needs to validate the edge application getting to from the edge worker. Finally, Mobile Edge Computing stage must give confirmation of information trustworthiness.

**Commercialization:** It is unclear which telco edge use cases will deliver significant value to telcos and their customers. Telcos need to identify a segment in value chain where they want to play in, based on their existing capabilities and propositions.

**Operationalisation:** Different parts of telco organization perceive edge computing in a different manner, for both internal/external use cases as well as wider efforts related to NFV and 5G. Some telcos are using edge capabilities internally as a way of supporting 5G rollouts, while others perceive it as a by-product of 5G, for which distributed compute needs to be deployed anyway.

### 1. The future of mobile edge computing

Mobile edge computing is still a nascent market. Its association with 5G and telcos' unique ability to support mobility, combined with significant longer-term potential size of the applications (AR/VR, drone control etc) make MEC of strategic interest to Telcos.

In order to capture future growth opportunities in MEC, telcos must build propositions in more than one area, where synergy will help drive an incremental benefit. This could be done through working with real customers across edge domains and identifying common requirements across use case domains, and also collaborating with customers to focus on defining business models. Moreover, there are some key questions that telcos should ask themselves to enhance the benefits of MEC:

- What are the telcos existing areas of strength, and can MEC help augment these?
- How can telcos align my chosen business model with my existing customer base and network infrastructure?
- How many use cases can my MEC infrastructure support?
- How easily can telcos implement a given business model?
- What is appetite for risk in telcos?

## VI. CONCLUSION AND FUTURE ENHANCMENTS

Mobile Edge Computing brings computation and storage capacity of traditional core network within the range of the radio of access network. In this new architecture, traditional base station not only perform traffic control, but also deploy less resourceful edge server/cloud to provide context-aware services towards mobile subscribers within the close proximity. The primary objective of Mobile Edge Computing is to pro- vide application and services with less latency and minimum bandwidth.

Edge computing clearly offers many benefits. At the same time, it also faces many technical and nontechnical challenges. On the technical side, there are many unknowns pertaining to the software mechanisms and algorithms needed for the collective control and sharing of cloudlets in distributed computing. There are also substantial hurdles in managing dispersed cloudlet infrastructure. As mentioned earlier, one of cloud computing's driving forces is the lower management cost of centralized infrastructure. The dispersion inherent in edge computing raises the complexity of management considerably. Developing innovative technical solutions to reduce this complexity is a research priority for edge computing. Another important area of study will be the development of mechanisms to compensate for the weaker perimeter security of cloudlets, relative to cloud datacenters. The development of tamper-resistant and tamper-evident enclosures, remote surveillance, and Trusted Platform Module-based attestation are all important paths that could contribute to alleviating this problem.

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