White Paper

Mobile Edge Computing – A Gateway to 5G Era

Sponsored by: Huawei Technologies

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IDC OPINION

Mobile network operators (MNOs) continue to face pressure on their core revenue streams, even as the thirst for mobile data including mobile video services is on the rise. For a sustainable growth pattern, MNOs are seeking to metamorphose into digital lifestyle enablers, mainly by looking for opportunities to either acquire, partner with or build new solutions. As discussed in the document titled *Frictionless Mobile Internet Ecosystem – A Reality?* (IDC #251506, September 2014), IDC is of the opinion that MNOs need to actively consider the applicability of the four pillars of emerging computing platform termed as "3rd Platform" that covers the areas of mobility, cloud, big data/analytics and social. Furthermore:

- Cloud based technologies such as Network Function Virtualization (NFV) and Software Defined Networking (SDN), Mobile Edge Computing (MEC) along with big data and Analytics will usher in an era of sophisticated service offerings that are relevant and reliable in nature.

- The new and upcoming ICT team within a telecom operator has the opportunity to lead and accelerate innovation by changing its legacy "support-based" approach to that of a change driver one that constantly searches for business value from ICT solutions. It must be noted though, this opportunity becomes a challenge due to clear risks of internal and external disintermediation.

- From a 5G narrative perspective, ICT convergence is akin to a strong foundation for a network infrastructure that will be not only be cost efficient due to cloud enabled technologies, but also technologically flexible enough to serve a diverse set of adjacent industry verticals such as automotive, industrial Internet, healthcare, insurance etc.

SITUATION OVERVIEW

Industry Trends

2016 has been a transitional year for the entire telecom industry, as every other eco system partner has spent considerable amount of time discussing a number of ground changing technologies like Virtualization, Cloud, IoT, 5G and others over the last one year. Telecom operators are entering a new era of convergence and digital transformation, with dramatic change in the communications industry - disrupting established value chains and business models. 2017 will see a lot of operators moving on from conceptualizing to implementation stage for the technology enablers that will be a key to operator's transformation from being a communication service provider to becoming a digital service provider.

Telecom operators are entering a new era of convergence and digital transformation, with dramatic change in the communications industry – disrupting established value chains and business models. The next few years will see a lot of operators moving on from conceptualizing to actual implementation stage for the technology enablers that will be a key to operator's transformation from being a communication service provider to becoming a digital service provider. IDC estimates, the industry capital expenditure in this process, will see an upraise starting with FY 2016-17 with US$321 billion or 1.4% growth over FY 2015-16. The spending from thereafter is only to increase till FY 2020 with a CAGR of 3% and a cumulative spending of more than US $ 1.7 trillion.

FIGURE 1

IDC Worldwide Total Telecom CapEx Forecast 2015-2020
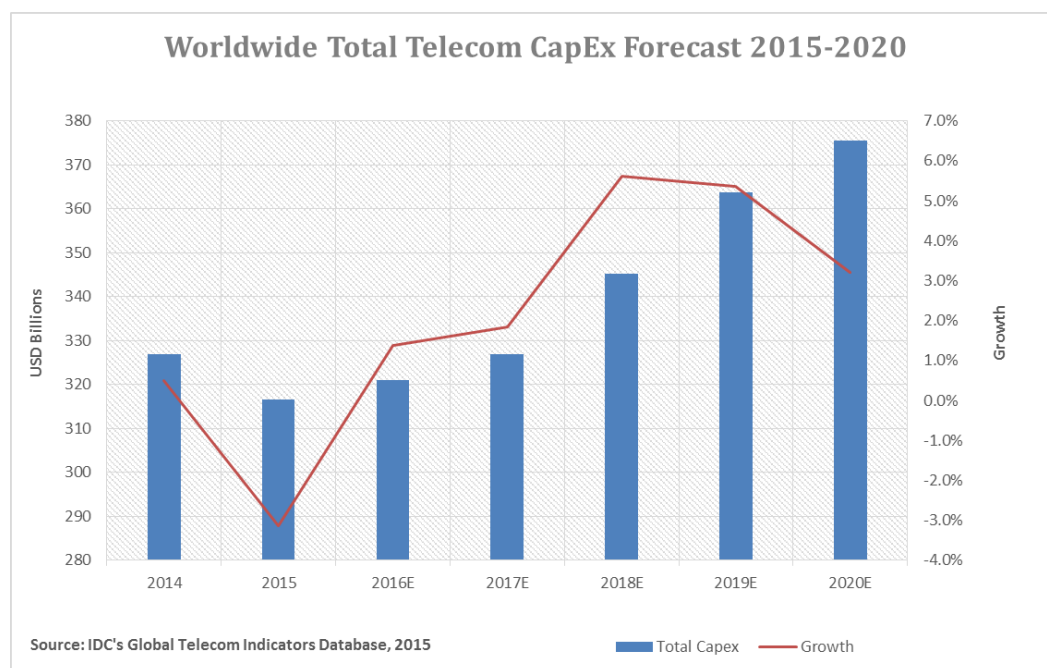
Source: IDC Capital Expenditure Report, 2015–2020. Doc # US41401116 – June 2016

Software Defined Networking (SDN) and Network Function Virtualization (NFV) are the two major disruptive technology innovations that are shaping the "New Telecom Industry" and will transform all key aspects of networks and operations. These technologies will be the key enablers of next generation networking enabling the service providers a homogenous cloud-based infrastructure, transforming their operations by optimizing operating expenditure and on the other hand increasing operator's service agility. SDN/NFV based networks will have the ability of 'Self Healing' and 'Automation across domains' while big data analytics will play a pivotal role in future networks and marketing operations.

Network Utilization — A Major Concern

Mobile network generations transitioning from 1G to 2G to 3G to 4G have brought a quantum jump in the ability to massively scale networks that can deliver services in a reliable, secure and, most importantly, cost-efficient way. In addition, this transition has brought along a change in the mindset of MNOs to open the network assets and explore new business models. That said, it must be noted that network utilization rates remain at less than 50% of its capacity and ability to support new services. The low utilization of network assets on one hand and the enormous amount of investment dollars on the other has forced the mobile industry stakeholders take a hard look at what should be the approach for next-generation (5G) network strategy.

When it comes to the mobile Internet ecosystem, digital media has exponentially grown in prominence. The digital media ecosystem is dominated mainly by MNOs, digital broadcasters, ecommerce players, developers, social media players, OEMs, OTTs, content aggregators, and content delivery networks. The sector is evolving rapidly; partnerships and revised business models are a key feature of the ecosystem. MNOs are increasingly challenged to reinvent themselves so as to stay relevant to not just content providers but, most importantly, the consumers who now have multiple choices to accessing information when they want, where they want. A number of MNOs are exploring, if not already, to refine or sometimes create new business units that will focus on how to take advantage of the new revenue opportunities brought about by ICT convergence.

Newer Use Cases Challenging Today's Networks

Virtual Reality (VR) and Augmented Reality (AR) are technologies that attempt to either replace a person's existing reality with a digital one or augment a person's surroundings with digital information. While VR will start faster, the AR market has the potential to grow dramatically larger and to drive much larger revenue for participating companies over time. VR/AR applications require very low latency, near real time response times that make it very hard for the current mobile networks to efficiently serve the service needs. Mobile networks will need to redesign their current 4G and plan for the 5G era to handle such low latency requirements.

Internet of Things (IoT) based use cases especially in vehicle to vehicle (V2V and V2X) industry will be highly dependent on the mobile network infrastructure capabilities of low latency, real time communication. Some of the requirements of connected vehicles include alerting the driver of obstacles on the road or alert the dealership that maintenance is needed, as well as environmental monitoring and detection, which utilizes assets such as meteorological, chemical, and biological sensors to detect and respond to emergency situations such as the presence of harmful substances in the air.

Mobile Operators — Uniquely Positioned

Information and Communication Technology (ICT) convergence captures the underlying sentiment of capital expenditure by telecom network operators. Against a backdrop of stagnant or reduced revenue growth, dynamic user behavior, increasing product and operational complexity, operators worldwide are increasingly challenged by the need to both innovate and leverage existing infrastructure and knowledge in their network transformation efforts. IDC asserts that as part of the ICT convergence narrative, forward thinking operators must take a pragmatic approach to transforming network architecture, leveraging current assets, overhauling legacy skills based workforce to a workforce adept at handling not just the typical telecom technologies, but more importantly adept at technologies such as network virtualization, software defined networks, big data analytics that are here to stay.

MNOs should realize that their networks are uniquely positioned to act as the lynchpin for emerging industry verticals especially at crossover points between these verticals, which is where new innovation is taking place. As a digital lifestyle enabler, it will be imperative that MNOs look to adopting a new set of strategies that could very well be considered as conflicting with the traditional telecommunications business model. In this fast-paced age of a digital customer, failing often and failing fast will likely be a key to MNO's survival.

Vendors in such a fast-paced mobile Internet ecosystem, will have to step up their solution portfolio so as to be the trusted partner to a MNO. New ways to leverage current CAPEX investment with a minimal impact on OPEX costs, ability to foster new business models, ability to quickly turn around with proof-of-concepts, and most importantly facilitate a fast time to market of new features, will be key attributes that a MNO will seek in a vendor solution.

In addition, when it comes to traffic in today's LTE network, the biggest challenge will be the unpredictable behavior of a subscriber as to when and where the subscriber will avail which service. MNOs would like to take this opportunity to be the trusted partner for the subscriber, claiming to offer a pervasive coverage of the network, so that the subscriber can avail of any subscribed service from anywhere in the network. The unpredictable behavior of the subscriber introduces the need for vendor solutions to be context aware, location aware, and policy aware so that the right content can be delivered to the right subscriber at the right time and right place toward the right QoE. Given the high customer acquisition costs and customer retention costs, MNOs are looking to traffic steering technologies to ensure high levels of customer retention.

Traditionally, service delivery mechanisms have resorted to static methodologies wherein all traffic is directed toward a specific port that will be the focal point for all value-added services platforms. With the growing requirement of delivering content in a relevant fashion, traffic steering is becoming a critical make/break factor. Mobile operators are now exploring solutions wherein the traffic steering function can be moved away from the router and transformed more into a specific traffic steering function that can be virtualized and instantiated as needed.

Mobile Edge Computing: Key Features and Concepts

Mobile Edge Computing (MEC) looks to move computational abilities from the Internet data centers in a mobile network all the way to the radio access network (RAN) edge. By way of such a location shift of compute function, MEC aims to reduce latency, enable efficient traffic steering, open up services to adjacent industry verticals that could now deliver their mission critical applications over the mobile network. Typically, Mobile Edge Computing is characterized by:

- **On-Premises**: The Edge is local, meaning that it can run isolated from the rest of the network, while having access to local resources. This becomes particularly important for Machine-to-Machine scenarios, for example when dealing with security or safety systems that need high levels of resilience.

- **Proximity:** Being close to the source of information, Edge Computing is particularly useful to capture key information for analytics and big data. Edge computing may also have direct access to the devices, which can easily be leveraged by business specific applications.

- **Lower latency**: As Edge services run close to end devices it considerably reduces latency. This can be utilized to react faster, to improve user experience, or to minimize congestion in other parts of the network.

- **Location awareness**: When a Network Edge is part of a wireless network, whether it is Wi-Fi or Cellular, a local service can leverage low-level signaling information to determine the location of each connected device. This gives birth to an entire family of business-oriented use cases, including Location Based Services, Analytics, and many more.

- **Network context information**: Real-time network data (such as radio conditions, network statistics, etc.) can be used by applications and services to offer context-related services that can differentiate the mobile broadband experience and be monetized. New applications can be developed (which will benefit from this real-time network data) to connect mobile subscribers with local points-of-interest, businesses and events.

Mobile Edge Computing — Key Enabling Steps

The figure 2 below illustrates how Mobile Edge Computing is transforming three key areas of the mobile packet core.

FIGURE 2

Mobile Edge Computing Transforming 3 Areas of Mobile Packet Core
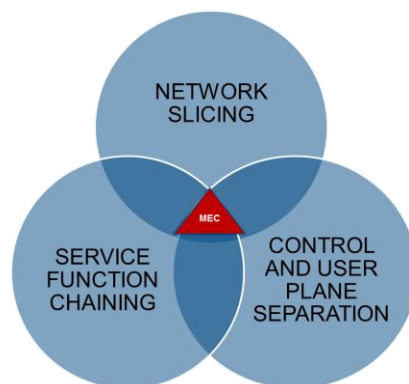
Source: IDC Capital Expenditure Report, 2015–2020. Doc # US41401116 – June 2016

1. **Cloudification of Mobile Packet Core:** As MNOs and NEPs increasingly work toward keeping pace by introducing virtualization techniques into various parts of the network, building cloud applications rather than porting applications to the cloud will gain importance, especially in the context of specific trends that need to be kept in mind for a successful NFV deployment.

2. **Central Office Modernization:** MEC opens doors to a whole new way of thinking about legacy central offices that are currently existing within a mobile network. The control plane and user plane separation allows mobile operators to redesign and redefine the role of a truly next generation central office.

3. **Local Breakouts driven by data plane requirement:** The data plane needs to handle flow forwarding, flow tracking, and bandwidth requirements not just at the level of a switch or router but also at the level of a network. With video traffic consistently flooding the data plane, latency has gained significant importance when it comes to quality of experience. Local breakout architectures will be crucial in addressing video metrics such as round trip times, MOS scores. Furthermore, critical functions such as policy, charging, rating for local breakout traffic will be important to consider.

4. **Control plane requirement:** Servers will have to host multiple virtual network functions that are critical for a mobile network but at the same time manage and orchestrate services in a complex maze of firewalls, load balancers, VPN gateways, and so forth. The control plane that needs to maintain traffic steering and policy rules for quality of service will not have to additionally handle a mix of virtualized and non-virtualized environments. Does this indicate the need and possibility of an NFV controller in addition to an existing SDN controller?

5. **NFV-aware applications:** What will be the impact of NFV on current applications? Should NFV-aware applications be optimization oriented? What are the monetization opportunities for MNOs using NFV-aware applications? Applications can no longer operate in a walled garden approach, rather they will have to be redefined to work in an ecosystem that is extremely quick to adapt to network behavioral changes, consumer usage patterns, and new device adoptions.

## HUAWEI MOBILE EDGE COMPUTING SOLUTION

Huawei MEC@CloudEdge is a 5G-oriented solution for constructing edge cloud for carriers.

The MEC@CloudEdge solution is based on Huawei CloudEdge platform and provides the following functions:

- Can be deployed by sharing common servers with third-party apps.
- Supports gateway user-plane processing and LBO to achieve service localization.
- Can integrate and manage third-party apps and supports content awareness and orchestration of service flows for service scalability and experience improvement.
- Supports network capability opening for carriers' service innovation.
- Supports modularized deployment of the control plane, user plane, enable plane, and management plane.

FIGURE 3

Huawei Mobile Edge Computing Architecture
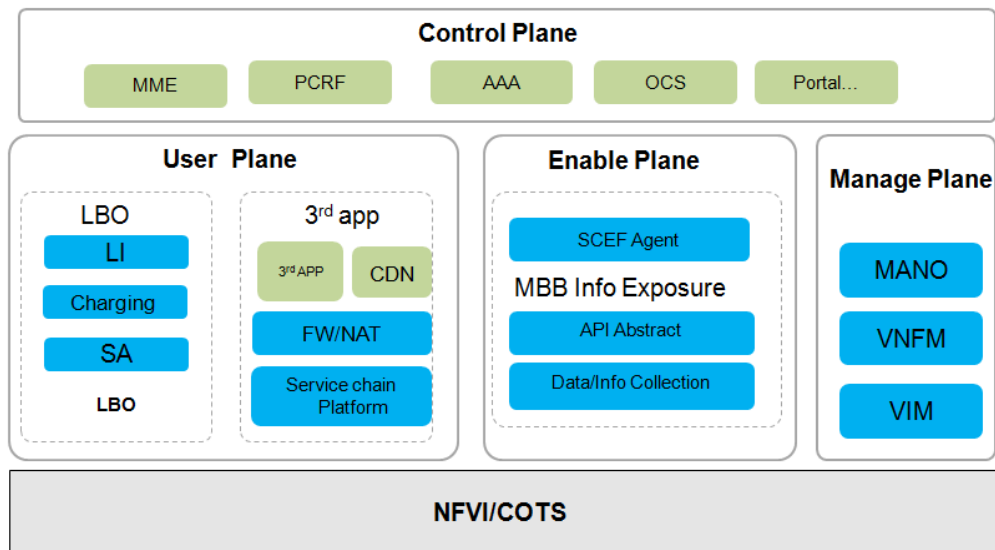
Source: Huawei, 2016

FUTURE OUTLOOK

MEC brings the promise of not only rapid deployment of new services for subscribers and enterprises alike, but also the possibility of adding new revenue streams from innovative services delivered closest to the user, with best possible quality of experience (QoE). However to realize this vision, there are several key areas of development that need to be in place:

- MNOs have to rethink the roles of CTO and CIO given the tight overlap of MEC architecture between the RAN-EPC domain and the IT domain. People, processes and infrastructure needs to account for such overlap, and MNOs should proactively work on upgrading skill sets across its workforce.

- CTO-CIO in a MNO as a combined entity should clearly define the rules of engagement with content providers, content creators, content management, big data analytics providers.

- CMOs and Sales within the MNOs will have to take concrete steps in identifying new business models. This entails engagement not just with the traditional mobile advertising sector, OTT players and Internet companies but also verticals such as insurance, banking, healthcare, life sciences, transportation and such.

- Vendors have to arm themselves either on their own or via partnerships, with a broad solution portfolio that not only addresses architecture needs and operational needs, but also address the need to be a trusted partner in the MEC experimentation journey. Developing a successful MEC technology and business model will require separate strategies within the MNO business to accelerate development and implement over time.

A 3rd Platform Perspective to Mobile Edge Computing

The adoption of one or more 3rd Platform technologies – mobility, cloud, big data and analytics, and social business – will be key in enabling mobile network operators, network equipment vendors, enterprise verticals, and content providers, to achieve long-term success.

Mobility

Mobile data traffic including high-quality, rich media services delivered on the mobile network is increasingly replacing the traditional voice and SMS services. It would serve well for the MNO to clearly define its road map for a mobile broadband network while transitioning its legacy 2G and 3G network to a smarter 4G/LTE network.

Cloud

Mobile networks of today already provide a concept often termed as network as a service (NaaS) that arguably could be seen as an equivalent of infrastructure as a service (IaaS). Mobile networks, if designed correctly, can support a business model that potentially offers storage, compute, power, bandwidth, platform, and software as a service that will be critical to steering of mobile network data traffic.

Big Data and Analytics

Optimization based on richer set of data sets from multiple network elements and, more importantly, intelligent network elements will make it possible to reduce the amount of time it takes to decide steering traffic on a real-time basis. MNOs have to leverage big data and the analytics therein to serve internal departments as well as external enterprise verticals.

Social Technologies

Social technology and its related business models have to take into account social activity by individual subscribers, enterprise subscribers, and a hybrid set of users who are individuals as well as enterprise subscribers with the same mobile operator. Identifying such segments is critical to track the net promoter score (NPS) that is often seen as the health of the mobile operator's brand value.

CHALLENGES/OPPORTUNITIES

MEC is an emerging technology and the resulting environment will be equally new from the perspective of a network planning team within a MNO. As with any new technology or architectural environment, MEC comes with its share of challenges that could very well be seen as opportunities for vendors to step up with flexible, reliable and scalable solution offerings. Some of the key challenges and relevant opportunities include:

- MEC architecture seeks to integrate content providers transparently with the existing 3GPP based network infrastructure. This kind of integration will require a close coordination with the CTO office of a MNO who technically owns the network, and the CMO office in a MNO organization who potentially could own the business relations with the content providers and adjacent industry verticals.

- MEC architecture further brings the challenges of security especially from the traditional IT based applications that will now need access to the network that is usually shielded by extreme security mechanisms. The challenge will be for the CTO and CIO of a MNO to now work together and create a mutually beneficial MEC architecture. This almost instantly opens up opportunities for vendors that are able to address the security needs of both CTO and CIO in a MNO organization.
- MEC architectures will also now need to include factors such as policy based performance rules, enforcement of traffic patterns in the network across different geographies, ensuring resilient behavior in the MEC server layouts as they seek to deliver right content to the right subscriber at the right time.

In order to deliver the promise of moving compute power closer to the radio edge, MEC architecture introduced three management layers that will be new to the existing network operations team. These layers address the need to manage the hosted infrastructure, manage application platform and finally manage the actual software applications resident on these hosted platforms. A typical network operations team in the MNO organization will know have to augment skill sets to manage these new management layers. This challenge opens up opportunities for vendors with professional services to quickly deploy resources on the ground to get these new management layers up and running quickly.

The year 2017 will be very critical for these technologies, since most of the operators are still not very sure about the return on investment related to virtualization of operator's network. The investments in SDN/NFV will gather momentum in FY 2017 and FY 2018 due to a widespread adoption of these technologies among the Tier 1 and Tier 2 operators mostly from North America, Western Europe, China and other mature economies in the Asia Pacific. This growth will be followed by a moderate level of investment in 2019 and 2020 as more number of tier 2 operators in the Asia pacific and Middle East region will join the SDN/NFV bandwagon in order to build efficient networks eventually optimizing user experience.

IDC expects the widespread adoption of 5G services in the beginning of FY 2020 even though global service providers like AT&T, Verizon, Telefonica and Deutsche Telekom are expected to launch 5G services by the end of 2018 or first half of 2019. These operators have already announced 5G trials and are working in collaboration with the likes of Ericsson, Huawei and Nokia. The actual realization of their capital expenditure will occur only from the year 2018 onwards.

CONCLUSION

Figure 4 illustrates three areas of impact from Mobile Edge Computing technologies in a mobile Internet ecosystem:

FIGURE 4

Impact of Mobile Edge Computing on Mobile Internet Ecosystem
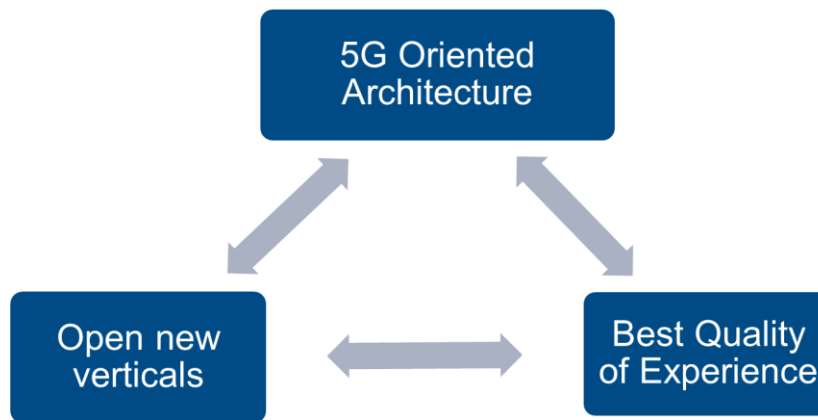
Source: IDC Capital Expen

Mobile edge computing offerings come in several forms as discussed in the previous sections. However, with any new technology framework in the mobile Internet ecosystem, it is of paramount importance that NEPs and MNOs take the high road when standardizing specifications for network traffic steering in 3GPP releases. In addition, IDC provides MNOs and NEPs the following actions to consider:

- Compile exhaustive list of use cases where Mobile Edge Computing will not just help network quality of experience but also provide new avenues for monetization. This activity includes long-term road map that takes into account network capacity projects, business partnership preferences, and what-if scenarios.

- Mobile Internet ecosystem is quickly approaching a tipping point, where product features and functions are not always enough to satisfy and retain subscribers. Ensure that Mobile Edge Computing is not done in isolation by network architecture groups. Rather, it should be an exercise across sales, marketing, operations, and customer care departments with a direct involvement from C-suite leadership.

- Realize and acknowledge that defining network optimization parameters that are key to Mobile Edge Computing is not a "one time event". Data content traffic is influenced by unpredictable factors as diverse as societal events, subscriber lifestyle, technical failures, business imperatives, and so forth. MNOs proactively have to regularly revisit optimization parameters for a particular part of the network or the entire network.

About IDC

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