5G networks use-cases in 4G networks

5G Networks offering superior performance are just around the corner! Wait! Are applications that maximize the benefits of these networks ready?

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Introduction

Mobile phone technologies have grown tremendously in the last few decades to almost a $ 335 billion market (2017) with an estimated 4.8 billion users (2017). Of these Android and iPhones contributed to a sale of about 1.46 billion units in 2017 alone. The mobile networks (2G, 3G and of late 4G), successively improving in speed and size, catalyzed this proliferation.

Growing by leaps and bounds, the mobile network evolved from the initial stages into 4G technologies enabling much faster network speeds than 3G networks. The advent of 4G technologies in this decade overcame the drawbacks of 3G technology in terms of speed and performance, enabling 4G networks to handle high volume data flow such as those required by high quality video streaming.

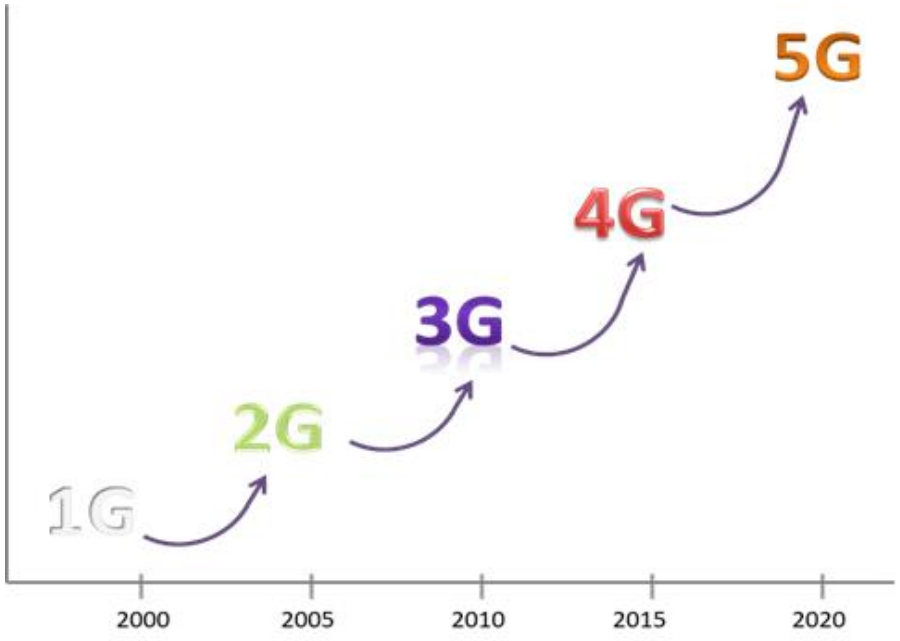
(Source: Adobe)

Expectation is that 5G technology will outperform 4G networks in many ways with faster speeds, reduced latency and larger bandwidth. With the upcoming introduction of 5G networks, several serious questions are being raised. How will 5G technology work with older devices? What are the cost implications of 5G compatible devices? In general, how is it possible to leverage 5G network advantages at optimal costs?

Revolution in cellular network

Although mobile phone technology has existed for almost 75 years, mobile phones were not used commercially until cellular networks were available on a large scale in the 1990's. Mobile phones have become synonymous with cellular phones since they require cellular networks.

The world has witnessed unprecedented progress in the successive generations of network types such as 2G, 3G and 4G. The phones became ***smarter*** with capabilities such as user identification, SMS (Short message service or "IM"), WiFi connections, and Mobile apps that match or exceed PC applications with almost continuous connectivity. But typically, with each stage, some of the older devices would not connect to the newer networks.



While 5G networks promise greater network speeds, reduced latency and increased bandwidth than 4G networks, the new applications may not be obvious but the existing applications must continue to work. To make the best use of 5G technologies, it is essential to understand and apply the 4G use-cases on 5G networks.

Defining 5G network technology and services

There are some facts and figures available to indicate the potential of 5G networks. Like 4G networks, 5G is based on the IEEE 802.11ac standard of broadband technology, and it is not yet clear if any new standards will be defined.

Key points related to 5G networks:

- Theoretically, 5G technologies (1000 to 10,000 MBPS) could be several times faster compared to 4G networks (100 MBPS), and bring the additional advantage of increased bandwidth.

- Initially, 5G networks may be costlier and they may only work on newer devices that are able to make best use of these performance levels. Devices that support 5G will work fine, but the movement from older technologies (3G or 4G) may not be easy.
- Although 5G networks will probably initially cover Smart devices, IoT connectivity is also likely to become a large-scale reality.
- The Next Generation Mobile Networks (NGMN) Alliance defines the objective of 5G networks to be "enable a fully mobile end-to-end connected society with empowerment of value creation for customers and partners by catering to existing and new business cases with business models sustained and improvised across generations".
- The above points indicate that the 5G-era is not just a direct movement of the Radio Access Network (RAN) to something better, but also needs to be supported by and enable edge computing for mobile devices (non-5G devices initially and every device in the long run). Mobile Edge Computing (MEC) is an important technology and an architectural concept that provides virtualized service environment and cloud-computing capabilities at the edge of mobile networks and is evolving to be Multi-Access Edge Computing (new definition of MEC) that includes support for wired and wireless devices.

5G networks will be faster but must leverage Edge computing to be fully effective. MEC or native mobility technology has been in existence for some time, but never before has its relevance been felt as significantly as now. MEC architectures will not only provide a demonstration of 5G networked applications, but will also provide many other insights to help prove in the network business case, including infrastructure requirements, the TCO (Total Cost of Ownership) and the ROI (Return on Investment) for the network.

5G application use-cases and benefits

5G application use-cases will be centered around 5G services combined with MEC (Mobile Edge Computing), and will tap into their combined strengths. These two aspects will drive applications working in real time, leveraging large bandwidth, over the mobile networks. Applications are limitless and influencing virtually every aspect of daily life! The use-cases of the applications will be enabled by the characteristics and benefits of 5G networks and the MEC. Some of these use-cases already exist on 4G networks, but will be more compelling with 5G networks.

- **Long Term Evolution (LTE):** This telecom standard for high speed wireless communication networks for mobile devices, data terminals and the emerging IoT, has enabled high speed

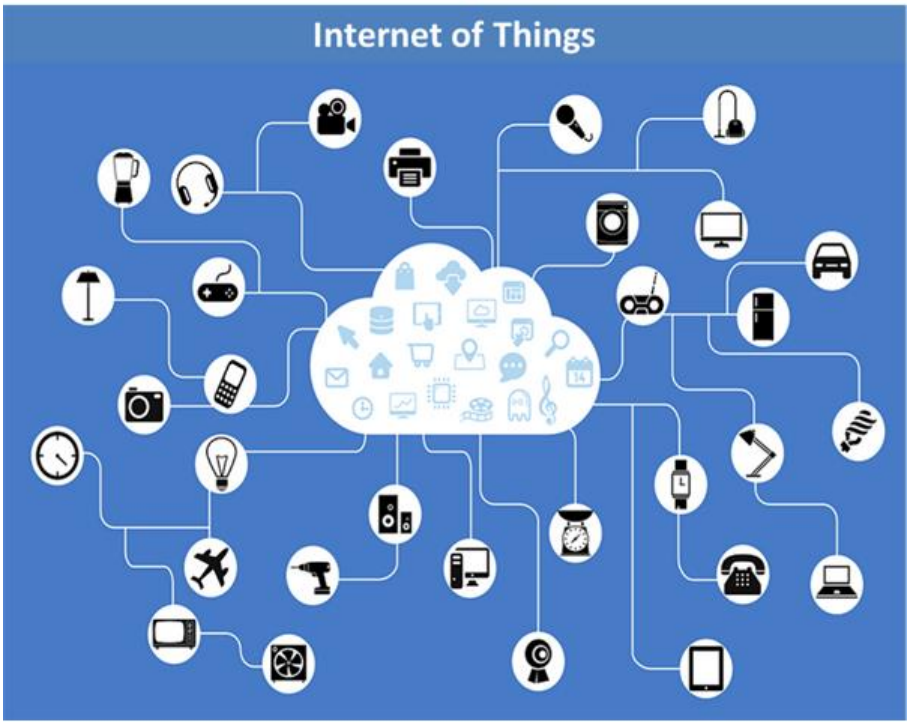
networks such as 4G and 4G+. LTE continues to define higher performance levels to be achieved by networks like 5G. Subscribers are impacted in many ways. Some of the foreseen applications are:

- **Voice over LTE (VoLTE)**: On 5G networks, VoLTE could provide high quality, distributed, real-time voice calls across locations. Speech signal processing could see new frontiers with this high-speed technology.
- **Video over LTE (ViLTE)**: High speed videos could become a reality over 5G networks providing real-time video communications with multiple people at multiple locations.
- **Wider Subscription ranges:** Superior quality of services, higher speeds and larger bandwidths on 5G networks will enable service providers to offer wider range of services and tariffs.

- **Enabling Enterprise class Applications:** Superior connectivity and high network speeds, combined with several advancements in Smartphone features and the architectural features of Edge computing, will make it not just possible, but compelling to move to 5G.
  - **Many domains and applications:** Numerous applications in support of key enterprise capabilities, such as supply chain and transportation, retail, healthcare, manufacturing, emergency services, can be improved using MEC combined with 5G network capabilities. Mobile devices like Smartphones can now be enabled with MEC architecture and the superior capabilities of 5G networks (combined with other technological advancements such as IoT). Highlighted use-cases:
    - **Supply Chain and Transportation**: Location driven applications can improve the ability of transporters to track and manage their vehicles closer to real time. Warehouses can be managed better and more effectively by combining technologies like IoT (RFID and similar devices) to track and move products, packages and consignments faster and easier.

- **Healthcare**: Mobile health and telemedicine become a reality with the apps taking the patients closer to their doctors in real time.
- **Emergency Services:** First-Responders such as fire, police and medical emergency teams will be able to provide improved services utilizing real time applications with enterprise-class connectivity brought in by Edge computing.
- **Manufacturing**: The deployment and implementation of large scale IoT services across locations becomes a reality with 5G and MEC enabled IT services.

- **Internet of Things (IoT):** IoT as a concept, innovation and technology becomes a reality with the advent of 5G network and MEC technologies. IoT in its full implementation provides the potential to connect every digital entity with all other entities by gathering signals and making every device interconnect with the others.



(Source: Pixabay.com)

So far the internet consists of digital devices such as PCs or similar devices, PDA devices, Smartphones and, on the high end, some servers. With appropriate security considerations this could be extended to all possible devices, sensors, actuators, signal generators, timekeepers, cameras, and many other devices. The possibilities from such connections are incredible, revolutionizing communication and control in every aspect of life - industry, office, business or personal life! The number and types of

devices are so large that MEC is no longer called Mobile Edge Computing, but in some references known as Multi-access Edge Computing!

- **5G Ultra Low Latency (URLLC) and Ultra High Definition (UHD) combined with MEC:** For network technologies used today (including 4G), a problem has been significant latency levels which negatively impact the user experience. Moreover, high definition pictures require greater data throughput. 5G promises to address these two problems enabling video and visual quality and clarity to reach unprecedented levels. But these capabilities need MEC architectures in order to realize these improved service and quality levels.
    - **Augmented and Virtual Reality:** Autonomous driving, drone management, virtual and merged reality, and location-based services are some of the experience-based applications that, so far, are confined to labs and closed confines of drive rooms. Now these applications can be delivered to people on-the-move. Immersive Reality is another aspect of virtual reality applications that enable real-time, multi-location communication amongst users spread out geographically utilizing a virtual world.
    - **Content over the internet:** Broadcasters can consume user-generated media content by acquiring media from different locations to be used in production. Compared to the time and cost of moving the whole team, this method may provide a faster and more economical alternative.
    - **Wide Variety of UHD content:** Users can have available a wide variety of high quality content for various devices such as Smartphones, PDA devices, Goggles and others. This advancement requires dynamic adaptability of configurations that will play different media according to types of devices and accesses.

Architecting 5G benefits at 4G network

In order to be more efficient, cost effective and sustainable, 5G networks must make use of network function virtualization (NFV) and software defined networking (SDN) deployed in the MEC architecture.

- ***Meeting Performance Goals*:** It is only possible to meet the performance goals set by NGMN alliance by adopting large-scale edge computing (particularly adopting MEC architecture). 5G networks must be capable of edge processing closer to the edge of the network, requiring MEC environments and applications that will extend the mobile/multi-access network to many other devices. 5G devices may be exciting to have but may not fit current budgets. The 5G network

architecture must make use of infrastructure that is virtualized and programmable to reduce the deployment efforts and infrastructure costs. This goal will be achieved with the combined 5G and MEC architectures.

- ***Illustration of total cost of ownership*:** To ensure successful adoption of 5G networks, it is necessary to demonstrate reasonable costs of ownership. Movement from 4G networks to 5G networks is not expected by the NGMN alliance to be a total change; it is expected to be an adaptive change. Moving to Edge computing via standards like MEC must be undertaken to demonstrate the applications and benefits of adopting 5G on a large scale. Importantly, 5G adds the speed and the MEC architecture, when planned and executed well, adds the scale. Making all this feasible requires the total cost of ownership to be well understood in order to help organizations make decisions in their respective cases.
- ***Improved customer experience*:** Success must be evidenced by improved customer experience in terms of increased speeds, better coverage and lower latency levels; the movement to 5G must truly deliver the expected gains. Aspects like better connectivity, improved service levels, and high-quality media will add up to improved user experiences.

"5G-ification" of 4G use-cases

The benefits that can be achieved with the 5G networks can be demonstrated by implementing MEC architecture in selected 4G use-cases. By providing LTE coverage with implementation of MEC environment, it should be possible to demonstrate the cost and value in moving to 5G networks, and to identify additional opportunities and create roadmaps for them. Where it is possible to deploy and implement MEC environment, particularly in the case of enterprise class applications, it may also be possible to deliver additional value. This would be achieved by using a 4G network for access and the MEC architecture for enhanced computing capability.

Conclusion

5G networks with enhanced wireless access and MEC (Multi-access edge computing) will support current applications with enhanced performance and enable new applications that require higher bandwidth and lower latency across all devices. To identify the key opportunities for improved ROI, early deployments of MEC can be used to improve the value of 4G applications. The MEC architecture will play a pivotal role in evolving current and future networks and helping them to achieve networks of tomorrow.