5G and the future

The telecom industry is abuzz with talk of the much-anticipated revolution – 5G. The "5G is here" shout-out at the Mobile World Congress, 2019 has been very enthusiastic. At the event that had nearly 100,000 attendees and 2,400 companies, industry innovators like Huawei, Samsung, Xiaomi and ZTE showcased new 5G-ready devices, Qualcomm, Intel talked new chipsets, network innovators like Ericsson and Nokia spoke the future of network architectures, virtualization, etc.

What is 5G? Is it worth the hype?

What is clear now is that 5G is not just the next 'G' after 4G. The change from 3G to 4G was one of degree (higher speeds essentially), but the change from 4G to 5G is much more than just that– 5G is not just faster 4G, it changes a few other things which, in combination, can transform industries and lifestyles significantly:

- **It is faster:** 5G is set to be significantly faster than earlier networks. Based on some early trials and prototypes, it is touted to be 100x faster than existing 4G networks. This means you could download a full HD, full-length movie in under a second!

- **Lower latency:** Speed is not everything. The time it takes a packet to go from the device to the network and back is defined as latency; it is another key parameter that affects usability of a network. 5G will bring latency as low as 1 millisecond, from the 40-50 millisecond baseline of existing 4G networks.

- **Greater network density:** 5G is expected to support up to 1 million connected devices per kilometer compared to around 2,000 connected devices per kilometer with 4G. This not only enables more users, but also lays the groundwork for IoT at a massive scale.

- **Reliability:** 5G networks are expected to ensure greater reliability than 4G networks, especially with regards to throughput, latency or packet loss issues which enable use-cases that need highly reliable connectivity like connected-cars or remote health.

- **Flexibility through slicing:** 5G will not be the same for everyone. It will be tailored to purpose – through network slicing – which basically allows multiple virtual networks, similar to MPLS/VPN, with different characteristics to operate on the same physical infrastructure. This means network slices with only the functions necessary to support a certain customer or use-case can be deployed.
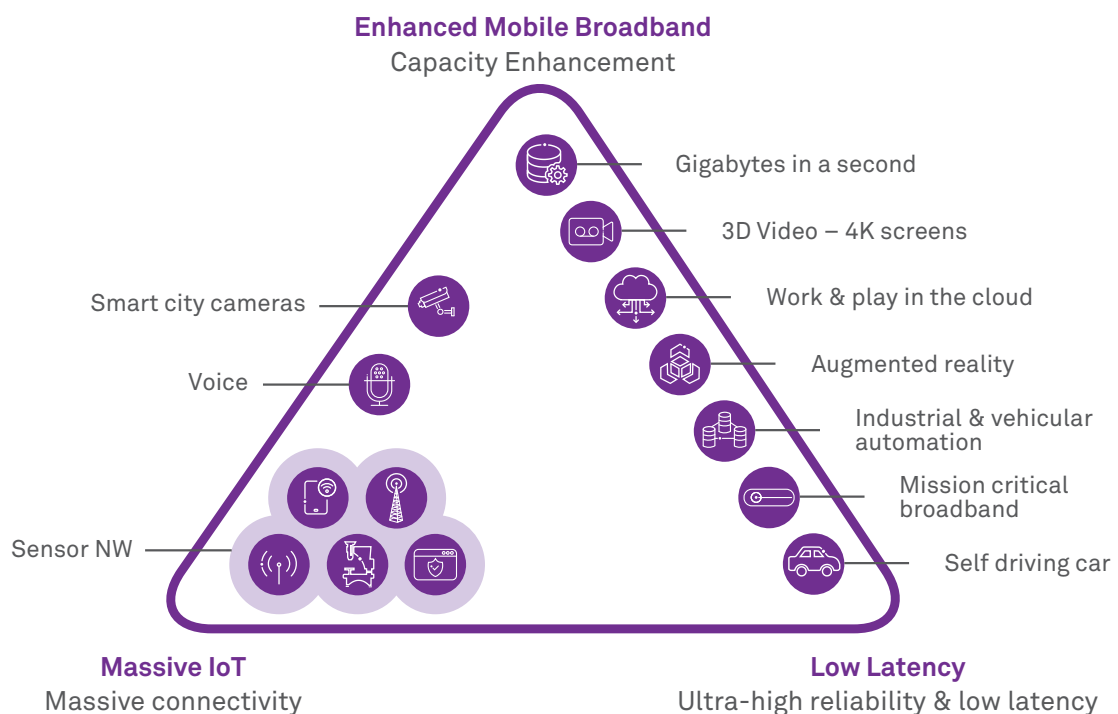
While these benefits, technologically speaking, sound like a significant step forward– what does this mean to the consumer and everyday life?

Let us remember the last telecom revolution – the smartphone revolution - putting a smartphone in the palm of every world citizen changed life significantly. It made information universally and perennially available. It created content consumerism and heralded the change of business models of several businesses and digital transformations to a degree (think Uber, Airbnb, Netflix and the burning need of every business to have an iOS/Android app). To put things in context, the next revolution – 5G – has the potential to be more dramatic than the last one. And our audacity in saying this comes from the fact that 5G will enable 3 fundamental technology use-cases which have a large set of applications and implications to consumer life and the industrial sectors:

- **Enhanced Mobile Broadband (eMBB):** It is one of three primary dimensions of 5G New Radio defined by the 3GPP as part of its SMARTER (Study on New Services and Markets Technology Enablers) project. eMBB enables peak data rates of 10-20 Gbps, provides 10,000 times more traffic than the current generation (4G). This enables use-cases like high fidelity video streaming (4K) and VR content. Another important aspect of eMBB is that it supports high-mobility speeds of 500kmph which can enable high-speed connectivity is cars and planes.

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Enhanced Mobile Broadband
Capacity Enhancement

- Gigabytes in a second
- 3D Video – 4K screens
- Work & play in the cloud
- Augmented reality
- Industrial & vehicular automation
- Mission critical broadband
- Self driving car

Smart city cameras
Voice
Sensor NW

Massive IoT
Massive connectivity

Low Latency
Ultra-high reliability & low latency

- **URLLC** – Ultra-reliable Low Latency Connectivity, the second key dimension defined by 3GPP, enables considerably reduced latencies in comparison to 4G and reduced error rates (in terms of packet loss). URLLC is aimed to enable use cases that are highly latency-sensitive like remote surgeries, connected-self-driving-cars and industrial automation which requires sub-millisecond latencies and error rates lower than 1 packet loss in 105 packets. URLLC essentially promises instantaneous data availability for applications.

- **mMTC** – Massive Machine Type Communications provides narrow band internet access for a large number of devices (like sensors and monitors) that transmit low amounts of data sporadically. mMTC with 5G can supercharge IoT and make it take flight as it can support very high device densities – up to 1 million devices in a square kilometer. This can enable some ambitious use cases like smart-cities, industrial automation and supply chain IoT.

These three dimensions of 5G, viz. high speed, high density and low latency, will bring significant changes to our homes, how we work, how we get to work, how we play and our healthcare.

The future of work

5G, most conservatively, will make collaboration more reliable – the improvements to connectivity speeds and latency will make applications like video conferencing, messaging and cloud collaboration more effective. But to take things further, 5G will enable the creation of expanded conference rooms with high-fidelity video conferencing, combining connected objects, AI and extended reality (XR = AR & VR). Companies like Cisco are invested in re-inventing their video conferencing solutions to what Rowan Trollope VP of Cisco's IoT department describes as "restoring the technology used by the Jedi council in Star Wars", where each participant has a holographic display in his field of view with personalized information. Products such as Microsoft's HoloLens (XR) enable visually rich virtual rooms that can help remote participants collaborate in the same virtual room already but these technologies will really take flight with 5G. At the most audacious level, 5G can potentially end the concept of an office space with hyper-collaboration capabilities from anywhere.

The future of home

The first thing we will notice about the home of the future is probably the absence of a standalone home broadband network – why use a 100mbps broadband when your cellular data speed is 10gbps with 5G? Some of the simpler problems that 5G might solve for connected homes is the use of a consistent standard for enabling connected device communications. Currently, there is an invisible spaghetti of standards for connected home devices to connect to the internet. For example, Philips Hue light connects through Zigbee to home Wi-Fi routers and August Smart Lock uses Bluetooth to connect the lock to a separate August Connect Wi-Fi bridge device. 5G can create consistency and a standard for these connections. Beyond that, the real power of IoT will be unleashed within homes with 5G – utility devices, like washing machines, refrigerators, ovens, etc., will all be controlled on a single platform/device that can be further amplified with gesture-based controls for everything. Powerful use cases like connected kitchens will become a reality – a kitchen where your oven can connect to the device with the recipe or one where your refrigerator takes stock of what foods are available and suggests recipes and reduce wastes. Security will also take center stage with our homes getting the ability to recognize us and larger security networks (with the police for example) will be established to monitor and react.

The future of transportation

The promise of 5G's low latency, high speed and high-density connections have been heralded as the enabler for autonomous transportation for some time, and there is a lot of concentrated research and trials in this one area alone. In Sweden, for example, a company called Einride has commissioned an all-electric autonomous truck in partnership with Ericsson and has had some great results. A fleet of such trucks are orchestrated and coordinated by an intelligent routing system resulting in higher efficiencies and battery life, thus, enabling efficient logistics

that also reduces carbon footprint significantly. Einride's concept at the scale of the entire logistics industry can revolutionize non-passenger transportation. Connected vehicles with 5G, at large, have the potential to radically change transportation and traffic management systems with improved device density and always on connectivity that can provide visibility into the movement of people and traffic, and help solve routing and traffic planning for seamless transportation. V2I (vehicle-to-infra) communications can enable the transportation infrastructure to respond to vehicular traffic (traffic signals can become dynamically responsive) and V2V communication can enable further intelligence for dynamic routing and safety. V2V and V2I together create a good foundation for autonomous vehicles as the constant availability of actionable intelligence makes the autonomy and decision-making more reliable.

The future of play

Video gaming has, slowly and steadily, become a key use case for communication services in general. The statistics tell the story – video gaming as a concept has 66% penetration in the US. PUBG (PlayerUnknown's Battlegrounds) has around 30 million active users a day. For a start, 5G will make multiplayer experiences more seamless with low-latency and faster data transfer. But that's just scratching the surface. 5G-fueled VR will enable richly detailed virtual game spaces that are occupiable by a large number of users. Truly responsive AR can create context-aware game objects super-imposed in the real world – imagine Pokemon GO where the Pokemon understand our real-world context. While XR will revolutionize the game-world and gaming, that's not all. We all watched in awe while Google demonstrated Stadia – its "game-stream" service a few months back. Cloud-gaming or virtualized-gaming services abstract the computing power necessary to run a game away from the user-device and basically stream the game to the device (not much unlike

Netflix streaming non-interactive content to our tablets which can help in the explosion of the user-bases for games) and basically any device with good connectivity then becomes a game-console. And this is 5G's sweet spot — it can empower and scale these services with its improved data speeds, low latency and edge computing capabilities.

The future of heath

Ericsson predicts a USD 76 billion revenue potential from the future transformation of healthcare with 5G. Wearables, medical sensors and a massive internet of 'medical things' will enable the transformation from hospital care to home care for preventative, routine and post-operative care. 5G will enable doctors to provide remote home care by ensuring that mission-critical communication always reaches on time (low latency) and is not lost (high reliability). This will not only mean that the general citizenry is a lot more health aware in the future but the availability of huge amounts of data from these devices will also bring AI and predictive health analysis into full steam. The availability of highly reliable and fast communication will also enable remote surgeries. Remote-controlled robotics with extremely low latency connections augmented with VR and AR capabilities has led to the first successful remote surgery test on an animal in China in January this year. XR presents a further set of possibilities like remote assistance for surgeries or care, trainings for doctors and surgeons, remote consultations, etc. — all of which are only realizable with reliable, high-speed communication.

The future of energy

The ecosystem of energy transmission and distribution has obvious benefits with information availability. 5G arrives at a time where it is perfectly poised to take smart-grids to the next level in their evolution. It can enable rapid response to the dynamics not only in energy demand but also in renewable energy production, as energy generation from renewable sources will be more dynamic than traditional sources. 5G availability will also clear the fog around last-mile energy consumption/metering — the current state-of-the-art already provides information about high/medium voltage branches but dynamic awareness of the low energy/last-mile branches needs improvement - a 5G enabled internet-of-everything could bring in the necessary visibility here. 5G will also bring benefits to smart-grid use cases like supervisory monitoring, self-healing smart-grid networks and dynamic energy re-routing. The potential of 5G is not strictly restricted to the smart-grid alone. Project VirtuWind, for example, aims to demonstrate a SDN/NFV based ecosystem as a control network for wind farms — information availability and reliability with sensors for critical equipment has the potential to ease and increase the safety of operating a wind-farm. 5G will also help solar energy generation by providing access to real-time intelligence to optimize energy generation and consumption.

While this is not a complete set of all 5G enabled use cases, these are the prime ways in which we see 5G having a pervasive impact on everyday lives of consumers. The industrial transformation that 5G will bring is much broader and will have its own impact on our lifestyles as well. The question to ask then is 'when?' — as the industry experts continue to iron out details on challenges like small-cell requirement (5G uses millimeter frequencies which need a higher density of relay cells), regulatory requirements in some countries and cities, spectrum allocation and sale. As device manufacturers are still piloting and bringing in the first set of 5G-ready devices, some operators have promised 5G availability in some parts of the US. However, for the world at large, the answer for now is 'progress is being made every day'

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Padman Kumar is a Management and IT consulting leader who partners with Telecom organizations on their digital transformation journeys. With more than 21 years of international consulting experience, Padman leads Wipro's communications consulting practice in the areas of business transformation, digital transformation, network modernization, M&A integration, cost & productivity optimization, etc. that drive tangible and measurable value to clients.

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