

Whitepaper

Impact Study on 5G over Infrastructure and opportunities offering in 5G and Future Applications

Shivakumar Bagenal Thippeswamy(s.thippeswamy@accenture.com)

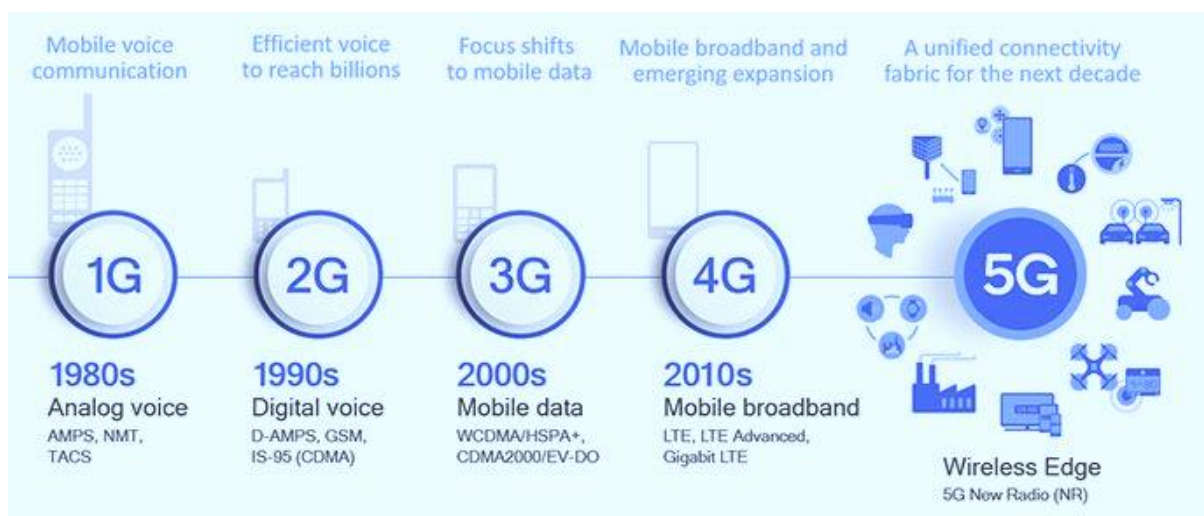
ACCENTURE SOLUTIONS PVT LTD ,Bengaluru

Abstract: - With the evolution of 5G Technology there is positive impact on all Industrial sections like carriers, OEMs, Network Service providers, Chip manufacturing Industry, AI and ML, Device Manufacturing Industry and Real Estate. Normally when there is a shift in a technology it will not be a sudden swift and there will be gradual change and impact. Since this decade is decade of convergence of technology it will be difficult to demark and precisely assess the impact as all electronic devices are interconnected and the internet chain is immersive. Here we try to focus and list down the factors and components which plays a major role in impacting Real Estate management on migration to 5G

Keywords: - Real Estate Management (REM), carriers, tower, cells, capital expenditure, 4G, 5G

I. Introduction: -

Before we talk about the 5G and migration and its objectives we need to know the evolution of communication technology which has been bounded by 3GPP norms. 5G Evolution has taken its own time to evolve and the offerings in different era in below diagram



As the above pic describes data is more prominent factor which is consistently playing a vital role in last 3 generations,

- i. Data Traffic is on huge impact since the smartphone users are generating million bytes of data and that need to be handled without any data loss or latency
- ii. Second most prominent factor which is common across generation is Existing Tower Infrastructure which has been continuing across generations

It can be noted that 5G will aim to provide 20times the peak data rate (speed), 10 times lower latency (responsiveness) and 3 times more spectral efficiency than 4G LTE

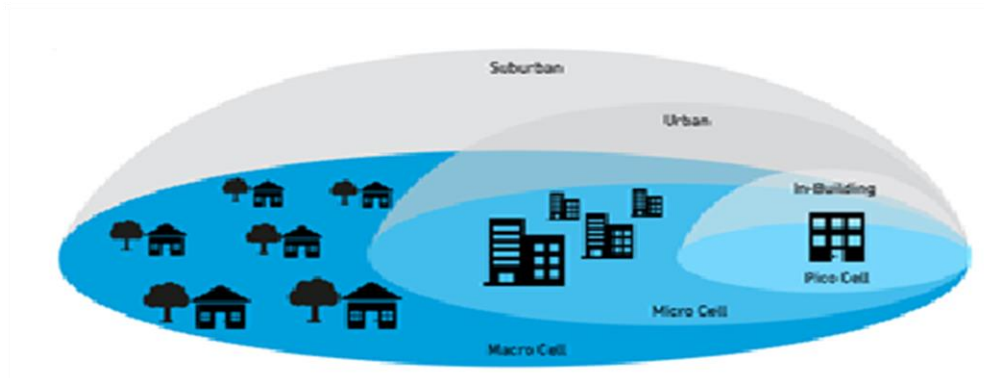
Data which is predominately ruling current generation emerging technologies like Big Data, IoT, AI and ML is playing a big role to satisfy customer needs. 4G migration to 5G offers fast, more

bandwidth and better connectivity which need to utilize in right extent. Where existing tower infrastructure need to be utilized for migration and since 5G works with shorter wavelengths more antennas should be part of network which indirectly adds capital investment in Tower Infrastructure and Real Estate Management

II. 5G Design and components

5G Wireless infrastructure includes macro base stations, metro cells, outdoor and indoor distributed antenna systems (DAS), small cells together working in Heterogenous Network

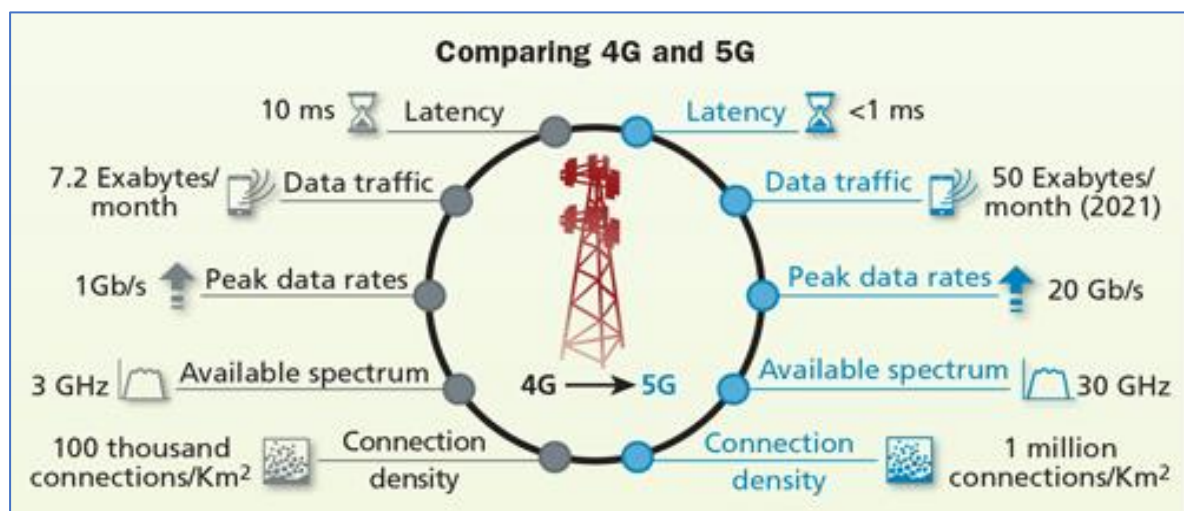
Below Pic will help us to understand about 5G Network architecture



III. 5G Offerings in comparison with 4G

Data in modern world which is primary fuel for Artificial Intelligence industry and is a big source of inspiration for new technology like Data mining, Big Data and Data Analytics. In 5G the data will be more precise, less latency, bidirectional and works on higher frequencies compare to 4G

4G networks use frequencies below 6 GHz, but 5G uses extremely high frequencies in the 30 GHz to 300 GHz range



So, both 4G and 5G networks work in unique radio frequencies as technology getting evolved more benefits is offered to users in connected devices (IoT), IIoT (Industrial IoT), Health and help in solving current Active problems like Traffic etc

Currently 4G tower supports 300 to 400m range supporting 48 incoming and outgoing calls or more simultaneously, so the challenge in 5G is to provide seamless data and network coverage across the landscape since 5G works within shorter wavelengths there is a need for more Cell towers

Optical fibre will be the biggest hope to provide high speed internet but still we may need Cell towers to cover the landscape, Due to increased cost in real estate, mobile tower management will be costlier than earlier years especially in fast growing cities.

Real Estate Management (REM) has more impact due to more space consumed by traditional towers and its accessories like Power backup Units, Watchmen Area, Storage house etc.

Recent improvement in technology has come up with new design tower where it takes very less space and easily installable compared to traditional tower installation as per the Field engineers it will take just a day to install cell tower and going live on same day.

As the technology is heading towards simplifying current hurdles time for tower installation is becoming less adopting new technologies and methods

IV. Salient Features in 5G

Massive MIMO

In LTE ,4G towers that fire data in all directions, potentially wasting both energy and power to beam radio waves at locations that aren't even requesting access to the internet i.e. broadcasting data for all recipients,4G base stations have dozen ports for antennas that handle all cellular traffic eight for transmitters and four for receivers At a time 5G base stations could send and receive signals for many users which increased the capacity of mobility networks by a factor of 22, This technology is MIMO (multiple input multiple output) Where as in 5G it uses shorter wavelengths, which means that antennas can be much smaller than existing antennas while still providing precise directional control.

Best Route Identification for Traffic

This Feature is must since 5G provides low latency in data transfer so more efficient data delivery route to a user need to be identified. It is also called Beamforming which supports massive MIMO, Millimetre waves may loss due to hills and objects and tend to weaken for longer distance travel due to maximum hops however Beamforming is very concentrated beam of data travelling only in one dedicated direction towards end user which supports Massive MIMO in great extent

Full Duplex Frequency communication

Bidirectional flow of data was not possible in traditional network since transmitters and receivers operating on same frequency need to take their turns to conclude communication while in 5G this can be achieved simultaneously and can operate on different frequencies

There were problems observed if speaker and mic are placed in a smartphone in specific design and fit but due to echo cancelling technology and emerging smartphone technologies will really help users to overcome these issue

Since one base station can utilize even more directional antennas, it means that 5G can support over 1,000 more devices per meter than what's supported by 4G.

What all of this means is that 5G networks, when they become widely available, will be able to beam ultrafast data to a lot more users, with high precision and little latency. However, most of these super-high frequencies work only if there's a clear, direct line-of-sight between the antenna and the device receiving the signal.

high frequencies are easily absorbed by humidity, rain, and other objects, meaning that they don't travel as far.

Since 5G uses shorter wavelengths it requires more antennas than existing antennas so that 5G can reach more receivers. This constrain opens a major outburst in Real Estate management (REM), Existing towers need to be upgraded and operators need to buy more lease/rented places for towers, but will this be huge impact on capital expenditure for 5G infrastructure

V. 5G Technology and Spectrum Requirements

- Radio Spectrum
- Core Networks
- Backhaul - Fibernization
- Fronthaul
- Spectrum for 5G

Radio Spectrum

- 5G delivers dense coverage, low latency and high bandwidth which 4G struggles to deliver.
- To Support applications like augmented reality, Virtual reality, Disaster alert, Autonomous driving densification of 4G radio access network is required
- Massive MIMO (multiple input and multiple output) scales up to thousands of antennae, increasing data rates, support beamforming for efficient power transmission

Core Networks

Network softwarization where the core network hardware and software has been separated

- **NFV** – replaces network functions on dedicated appliances – such as routers, load balancers, and firewalls, with virtualized instances running on commercial off-the-shelf hardware, reducing the cost of network changes and upgrades.
- Software Defined Networking (SDN) - allows the dynamic reconfiguration of network elements in real-time, enabling 5G networks to be controlled by software rather than hardware, improving network resilience, performance and quality of service.
- Network Slicing - permits a physical network to be separated into multiple virtual networks (logical segments) that can support different RANs or several types of

services for certain customer segments, greatly reducing network construction costs by using communication channels more efficiently

- C-RAN (Cloud based radio network) - is presented as a key disruptive technology, vital to the realization of 5G networks. It is a cloud-based radio network architecture that uses virtualization techniques combined with centralized processing units, replacing the distributed signal processing units at mobile base stations and reducing the cost of deploying dense mobile networks based on small cells

Backhaul

- Backhaul connects the radio network to core network
- Fibre is the suitable type of backhaul network capable of meeting high demands like high capacity, longevity and ability to support high capacity traffic
- Fibre covers cities which provides 5G but in suburban and rural areas users lag to benefit of 5G availability as the Fibernization is less
- High Altitude platform systems (HAPS) and satellite technology will deliver high data rates to complement fixed or terrestrial wireless backhaul

Fronthaul

- It's a link between radio frequency (RF) function and the remaining layer 1,2 and 3 (L1, L2 and L3)
- Latest bandwidth requirements in 5G makes it impractical to go with conventional Common Public Radio Interface (CPRI)

Spectrum for 5G

- Allocation and Identification of globally harmonised spectrum across a range of frequencies
- Frequencies above 24 and up to 86 GHz are the proposed range based on the recent studies and will be finalized in World Radiocommunication Conference (WRC)
- WRC has confirmed additional bands 24.25-27.5 GHz, 37-43.5 GHz, 45.5-47 GHz, 47.2-48.2 and 66-71 GHz for the deployment of 5G networks

VI. Solutions to Bring down Infrastructure cost

- Need to find a way to reutilize and upgrade existing towers to support 5G i.e. array of antennas
- Need to bring in more antennas and Macro cells so that the installation and operation management will be cost effective
- Acquisition or Agreements with Antenna suppliers will also make a tremendous impact in reducing the cost of Tower installation which widely opens an opportunity and reduces the cost of tower installation considerably in Antenna Business like Patents and other proprietary Items
- Building owners to make sure that their lease agreements with telecom companies spell out in precise detail the amount and type of equipment that is to be installed. Because of the rapid rate of technological change, companies may need to upgrade or increase the amount of equipment every few years hasn't been designed yet.

- Software defined infrastructure will be another option where few companies are exploring where the virtual container and data centre will be connected through the network enabling certain services and offers for both operators and enterprises
- Drone utilization for Physical Tower inspection during installation and maintenance and helps participants like Tower construction teams, tower owners and Network Operators to monitor and synchronize over the operation activities
- Network Virtualization

Network virtualization will be especially important for 5G network success as mobile network operators seek to find effective solutions to manage spectrum while reducing costs. Virtual networks will allow for tremendous network efficiencies and provide operators the ability to quickly deploy new services to their customers

- Rather supporting backward compatibility bring in all existing users and classify the users based on 4G and 5G so that infrastructure roadmap can be laydown accordingly This will drastically bring down maintenance cost for legacy users, operator can focus more on 4G/5G few countries have officially stopped supporting 2G.

VII. Recommendations before 5G Live

- Communication and touch points with Civil contractors and Real estate consultants will provide us overview of the Capital expenditure before Tower installation
- Training squad need to be prepared which helps to bring in required skill for 5G tower installation, operation and maintenance, it also helps in upskilling existing workers
- Floating antennas (air/water) which connects multiple existing towers need to be introduced to have 5G benefits, more research need to be done in this aspect
- Bring in nature friendly idea where operator can install cell devices over trees and encourage people to plant trees so that it will be benefited for Carrier as well as Environment
- Add sensors and collect the data periodically and analyse the data in micro level, Tower Analytics has scope for IoT, Artificial Intelligence and Machine learning
- Support existing and new applications, including web clients, mobile and tablets
- Easily Integrate devices and assets into backend enterprise systems
- Works with off the traditional work assignments Ideate and prototype and bring in solutions to marketplace in less time

VIII. Conclusion:

In this paper the recommendations will provide different ways to save capital expenditure on 5G Transformation. An attempt has been done to list down the major contributors for Capital Expenditure during 5G Tower Transformation. The considerations will help carrier to save expenditure on service and maintenance of towers in comparison with 4G. This paper will give overview and depth analysis on few key components adding cost for 5G transformation. It also emphasis the major engagements and agreements which give a key path to manage the high spike in Infrastructure. Infrastructure will be keen factor in next generation

offerings and service. It is difficult to assess the impact only on Infrastructure as the current world so convergent that the impact will be more inclusive and exclusive.

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