

Cost Analysis of 5th Generation Technology

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Abstract

In the global telecommunication manufacturing, the wireless telecommunication advertises is recognized as the wildest and the most dynamic growing sections over the past years. However, due to the science's improvement, the modern world started to shrink. Also, the human's technical requirements are enhancing over the time. Meanwhile, the new generations seem to be a merging of the existing technologies into a particular platform. However, as the internet generations started to be adapted and growth over the world and it can be used wherever the people go; so, Mobile access broadband is reality. 5G systems are the hottest topic to many researchers, although 4G systems are being deployed. Now a day, 5G is not being officially used yet by any company or calibration bodies as WiMAX Forum, ITU-R or 3GPP. Our main focus in this paper is to analyze the cost of both 4G and 5G and how the people can feel the progress with 5G but less price than 4G.

Keywords- 5G, 4G, Wireless, Mobile communication, Networks, Cost, Marketing.

I. Introduction

When Marconi verified the capability of radio to provide constant contacts in 1897 in English Channel; that significantly affected the ability of wireless communication between the people [1, 2]. Since that time, people have taken up and developed various wireless communication methods over the world. The industry of wireless communication has been remarkably grown over the last two decades [1]. In addition, the main contributory factors in this consideration become the miniaturization techniques such as new large scale incorporation, digital switching methods, ...etc.

However, as the life changed; we started to not be able to live without science which makes it much easier and

comfortable as the life requirements are increased. However, the modern life started to be dense due to the development of the technologies; as well as the industry of telecommunications has been changed for the same reason.

Hence, Wi-Fi (IEEE 802.11 wireless networks), WiMAX (IEEE 802.16 wireless and mobile networks), 3G mobile networks (UMTS, cdma2000), LTE (Long Term Evolution), 4th generation technology and sensor networks are the most mass deployed mobile and wireless communication now a day [3]. However, circuit switching is going to be extinct over the time although some mobile workstations include diversity of interfaces such as GSM. Switching systems, radio access, bandwidth, data rates can differentiate these technologies [4]. The difference can be noticeable in these techniques {1G, 2G, 2.5G and 3G... etc}.

5th Generation Mobile Technology (5G technology) is a packet switched wireless system. It has been created to cover wide area and high throughput results for on move communication [3, 4]. Moreover, cell phones that use this technology can be working within an extreme high bandwidth. Beam Division Multiple Access (BDMA) and Code Division Multiple Access (CDMA) are used for 5G technology [5]. In order to provide higher than 1Gbps at low mobility and greater than 100Mbps at high mobility, 5G technology uses millimeter wireless.

5G technology is considered as the most influential technology due to its advanced features [3]. However, these huge set of features in one small device may not considered as an incredible thing; more features and high efficiency are provided to the users by 5G technology. Mobile phone's users can obtain broadband internet connection of their 5G technology just by hooking their devices with tables or laptops. In addition, it provides higher data rates, the optimal Quality of Service (QoS) and bidirectional enormous bandwidth [6]. All-IP standard is being used for all mobile and wireless networks, where via internet protocol all the data is going to be transmitted on

the network layer [7]. To renovate the 100+ years of inheritance network transportation into a homogeneous and simplified network with a single general communication for all services, the All-IP Network (AIPN) is used in 5G technology [8]. Hence, in order to apply AIPN for implementing 5G technology, Master Core system is required. 5G-IU technologies, All IP Platform, Parallel Multimode (PMM), Cloud Computing and Nanotechnology are united by 5G Master Cores. Each one of these technologies has its own effect on current wireless and mobile networks which compose them hooked on 5G.

II. Wireless and Mobile Technologies Progression

In this section, bandwidth, radio access, switching schemes and data rates are considered for evaluating wireless and mobile systems from 1G to 4G advanced.

A. First-Generation Technology (1G)

In early of 1980's for voice service, 1G technology was found. Meanwhile, frequency modulation technique for radio transmission was used at that time since the most systems were analog. The capacity of channel was 30 KHz within frequency division multiple access technique (FDMA) with 824-894 MHz bandwidth [9]. Advance Mobile Phone Service (AMPS) was the main provider for that.

B. Second Generation Technology (2G)

Later in the 1990's, the 2nd generation technique was emerged. By that time, the transportable communication systems started to be digital systems; where it is still being used over parts of the sphere. 2G technology offers two services which are e-mail and SMS beside the improvement of voice communication. Code division multiple access (CDMA) and time division multiple access (TDMA) are the two digital modulation methods that were used in this generation [10]; with 850 to 1900 MHz bandwidth. In addition, eight channels were used per carrier in GSM technology in this generation. The rate of gross data is 22.8 kbps where the net rate is 13 kbps during 4.6ms frame and a full rate channel. The tree of this generation is 2G, 2.5G and 2.75G [11].

C. Third Generation Technology (3G)

High rapidity mobile accesses with Internet Protocol (IP)-based services were united by services of 3G technology [3]. Email, wireless web base access, video and multimedia services were the offered features in 3G technology. In order to allow all the wireless devices such computer, cell

phones ... etc sharing the same connection within the same network, the 3G W-CDMA air border set has been intended wide world [3, 12]. Up to 2Mbps data rate was offered in this generation within 5MHz channel per carrier, however, mobility/velocity or efficiency of the spectrum can decide. Although a high data rate has been offered in this generation, the averment can have an influence on that rate.

However, the bandwidth is 1.8 to 2.5 GHz [13]. Data rate in urban outside is 384 Kbps, 144 kbps in urban outside and dependency and 2Mbps in interior and low variety outdoor [14].

D. Fourth Generation Technology (4G)

4G technology is considered the deployment of 3G and 2G technologies; although the standardizing LTE Advanced is 3GPP which is deemed the 4G's future. The secure and comprehensive IP based is the accessible feature by 4G which is able to improve any existing network. The voice, data and streamed multimedia is offered to users anytime/anywhere under this solution with higher data rate. QoS is common requirement by the provided services in 4G technology. Most the applications were urbanized to be used in 4G such as video chat, HDTV substance, wireless broadband access, Multimedia Messaging Service (MMS) and Digital Video Broadcasting (DVB).

E. LTE advanced Technology

LTE advanced (LTE release 10) is considered to be the accurate 4G technology. The previous releases are integrated as incorporated components of LTE release 10 that offer a more simple backwards compatibility and sustain of inheritance terminals [15]; where permitted the major obligation specification for LTE advanced which are: wider than 70 MHz in DL and 40 MHz in UL for broadcast bandwidth, data rate of Peak Uplink is 500 Mbps, efficiency downlink of Peak spectrum is 30 bps/Hz and Uplink is 15 bps/Hz, data rate of Peak Downlink is 1 Gbs, the standard of the throughput is three times superior than in LTE where at cell edge; it is two times higher, no difference in mobility, Spectrum efficiency is three times higher, and exposure is supposed to be used in restricted areas/micro cell surroundings with up to 1 km Inter Site Distance.

III. FIFTH GENERATION TECHNOLOGY (5G) AND THE SYSTEM ARCHITECTURE

5G Technology is a name which was announced to indicate the significant upcoming step in mobile and wireless communication after the previous serial 1G, 2G, 3G, 4G, LTE advanced. However, 5G technology is not deployed yet and whereas it faces some challenges. According to

many researches, there will be no standard's implementation for 5G technology before 2020 [16].

5G promises to increase the aptitude to 1,000 fold and slightest 100 billion devices connected. It provides a low latency which allows the ability of individual experience to reach a 10 GB/s. The deployed existing technologies and a new Radio Access Technology (RAT) have a big influence on 5G radio access's structure.

The improvement of wireless network (Breakthroughs) which will be needed in 5G technology, will affect the growth of the social and economic in varies ways [17]. Zero distance connectivity will be provided by 5G technologies between connected devices as well as the people.

2G, 3G, 4G LTE as well as radio interface technologies (RITs) will be included in the multi-layered 5G architecture as showing in Figure 1. Digital video broadcasting (DVB), wireless local access network (WLAN), mobile satellite system, and wireless personal access network (WPAN) may be covered with 5G structure. Small cells such as femto, macro and pico can cover multi tiers. It would be simple and easy to deploy and operate such network in order to reduce OPEX and CAPEX.

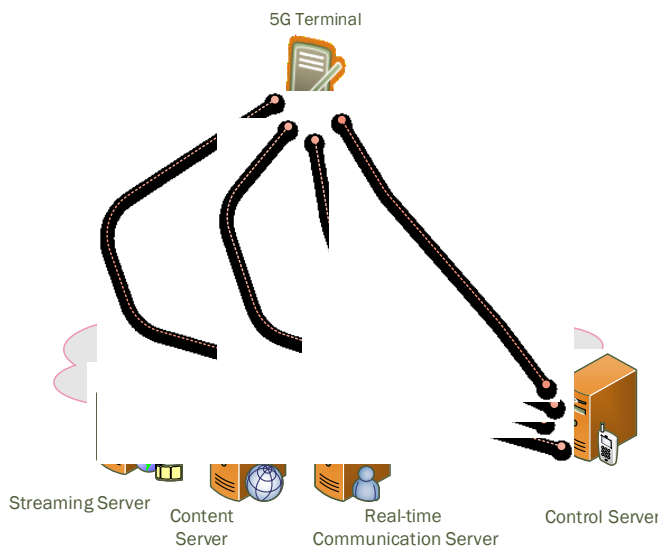


Figure1: Architecture of 5G Technology [6]

A. 5G Technology's Key Terms:

5 G technology will enjoy several advanced features including:

1. It is called "real wireless world" because it is almost free limitations.

2. HD TV quality for TV programs and it offers multimedia Newspapers feature.
3. Faster data transmission.
4. It considered as World Wide Wireless Web (www).
5. Almost no access limitation.
6. Wearable devices.
7. One incorporated universal standard.
8. IPv6 for assigning IPs based on the position and connected network [16].
9. With 5G technology, the devices will be connected to every wireless access equipment at same time (persistent networks) and faultlessly move among them [18]. These access technologies can be any one of previous existing technologies.
10. It provides high elevation stratospheric platform rank systems.
11. Dynamic radio reserve executive which called (smartradio) allows sharing the same band by varies radio technologies that are by finding idle band; then, adapting the broadcast system based on the current technologies supplies.

In addition, all doable applications will be provided by 5G technology within one device. Also, current communication infrastructures are communicating. Fast internet will be offered for upgradable software in downloading services. The main focus in 5G technology will be the user terminal's improvement in order to communicate with multiple wireless technologies simultaneously. Moreover, the eventual choice among diverse wireless and mobile access network suppliers will be made by the terminals.

B. Super Core Architecture:

Figure 2 shows the transformation from existing classification of a wireless communication network to the super core classification. It displays also the difference between them in hierarchy; the common core concept combines all subscriber traffic in one point where the existing one is shaped in categorized way (BSC/RNC). After then the components are channeled to gateways using flat IP design can allow the traffic to be transmitted from main station to broadcasting posterns with fewer loads on the shared point. A public ALL IP platform will be deployed after the change occurs from bequest ones such as: ATM and TDM to IPs. IP platform is the main key for 5G super core architecture where all the existing operators can be combined to one super capable core. That produces a single infrastructure for wireless networks. All the

communicating densities and charges which are considered as main faced problem by network operators will be excluded in the new concept. Moreover, Super Core concept can provide less delay by dropping down the number of terminals.

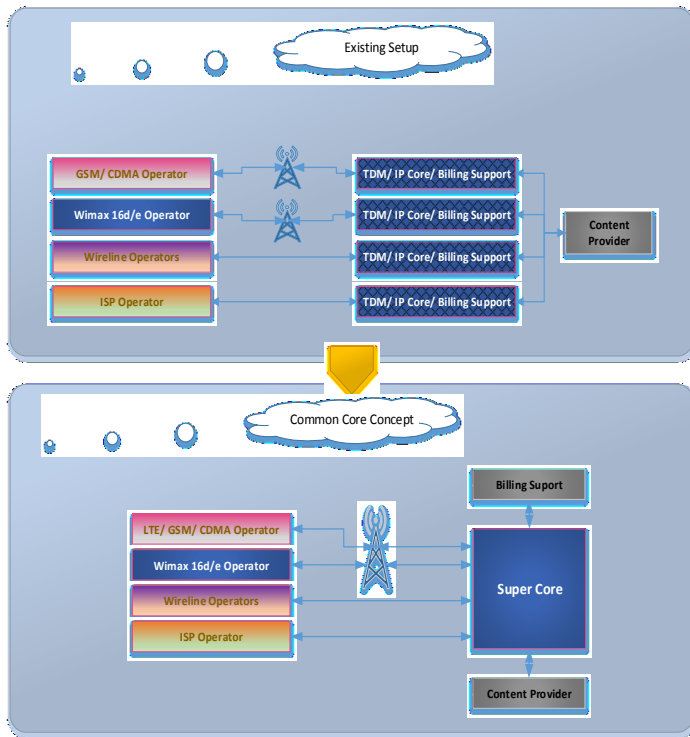


Figure 2: Transformation to Super Core Architecture [1]

C. 5G Mobile Phone Scheme:



Figure3: Design of 5G mobile phone [16]

The upcoming smart applications such as Multimedia Messaging Service (MMS), wireless broadband access, HDTV contented, video dialog, Digital Video Propagation (DVB) and mobile TV, data and voice services ... etc are going to be used in 5G mobile phone design in order to

accommodate the set of rate supplies and Quality of Services [3, 6]. The expected design of 5G mobile phone is shown in Figure 3; in other words, VoIP, sensors, TV, radio, mobile office, cameras, entertainment, mobile management, GPS are going to be available on your mobile phone by 2020 with faster internet and higher QoS [16]. In addition, 5G is defined based on the end user's demand to provide seamless interconnection of all wireless heterogeneous networks with more bits/Hz of bandwidth and suitable Radio Frequency exposure.

D. Future and Challenges of 5G Technology:

In order to have all the platforms available anytime, anywhere to be used, we need a technology which can provide omnipresent computing; that what make 5G technology as one of the hot topics since 5G is all about that. Hence, this requires creating a standard of all engineering practices to touch this improvement. Also, most of the new bright sensors will have a big effect on our daily life [1]; whereas we will be able to do such things:

1. One bill will include all the services that you used despite which system or application you accessed.
2. Your next doctor appointment will be sent as well as your medication can be send via MMS.
3. You can secure your house by using such connected cameras with secured internet in order to view it on your device.
4. You will receive an SMS from your smart care in case someone tries to theft it.

It can be more than above points with more effort. However, this future can be achieved if we can surpass the following challenges:

1. We need one standard that incorporates all engineering practices; whereas most of their have their own standard. However, efficient and time consuming technique will be required for this incorporation.
2. A common structural design for communicating a variety of engineering practices is required to build a universal platform to standardize information sharing and the interconnectivity concerns.

IV. Cost of 5G versus Cost of 4G

Most customers of mobile companies are complaining about their high bills of data services, although the carriers keep cutting the price of provided megabyte of data down by 50 percent each year. It started to be 1 cent to 3cents per megabyte of data, where it was 46 cents by the end of 2008

[23]. This reduction could not help reducing the subscribers' bills due to the increment of average data consumption frequently. Moving to 5G technology can solve the problem which will allow the end users to have all incredible tools with high data services which can reach to 50 GB per user within one universal device. Also, 5G can allow the user to download 3D movie on his/her mobile in six seconds instead of six minutes as 4G does. That can make a huge difference for the users and higher efficiency in the service. Table 1 shows the basic comparison between 4G and 5G technologies over the most important principles which can be considered.

Technology	4G Technology	5G Technology
Data Bandwidth	2Mbps to 1Gbps	1Gbps and Higher
Frequency Band	2 - 8 GHz [20]	3-300GHz [20],[21]
Principles	All access union containing: MC-CDMA , OFMDA, Network-LMPS [22]	CDMA and BDMA
Technology	Incorporated IP And seamless combination of broadband LAN/WAN/ PAN as well as WLAN [22]	Incorporated IP and seamless amalgamation of broadband, LAN/WAN/PAN/ WLAN [22] and tools for 5G new deployment
Service	Dynamic information access, HD streaming , wear-able devices; global roaming;	Dynamic information access, HD streaming , wear-able devices; any request of users; upcoming all technologies; global roaming efficiently;
Multiple Access	CDMA	CDMA & BDMA
Core Network	All IP Network	Flatter IP Network & 5G Network Interfacing(5G-NI)
Classification	Digital Broad band, Packet data, All IP	Digital Broadband, Packet data All IP, Very high throughput
Hand off	Horizontal & Vertical	Horizontal & Vertical
Start from	2010 [19]	2015 or later [19]

Table1: Basic Comparison of 4G and 5G Technologies [3]

In USA, there are two options for data plans either which is attached to your Smartphone or which can be connected with several ones (that is separated from your device subscription). The big mobile network's contributors in USA are AT&T, Verizon T-mobile and Sprint whereas each company offers different plans with different rates. It is remarkable that four of them provide an inexpensive text and voice messaging packages but various rates on data management. According to Tristan Louis in his article [24] end users would end paying on average "\$11.19 per Gigabyte on AT&T, \$10.79 on Verizon, \$16.72 on Sprint, and \$13.34 on T-mobile;" for 4G LTE technology. Table2 down shows us the actual data plan prices for each company based on Louis' analysis. Voice and text messages prices are excluded.

Bandwidth (Gb)	Actual Data Plans' Prices			
	AT&T	Verizon	Sprint	T-mobile
.5				\$20
1				
2				
2.5				\$30
3			\$34.99	
4	\$30	\$30		
4.5				\$40
6	\$40	\$40	\$49.99	
6.5				\$50
8		\$50		
8.5				\$60
10	\$60	\$60		
10.5				\$70
12		\$70	\$79.99	
14		\$80		
15	\$90			
16		\$90		
18		\$100		
20	\$110	\$110		
30	\$185	\$185		
40	\$260	\$260		
50	\$335	\$335		
Over allotted bandwidth	Extra \$15 per Gb	Extra \$15 per Gb	Extra \$51.20 per Gb	Not available (Moving to EDGE)

Table 2: Analysis of 4G LTE Prices for Data Planes[24]

Our main aim in this paper is to discuss and analyze how can the customer enjoy the features of 5G technology with less than or similar price to today. In order to achieve that point and maintain x1000 traffic detonation, the rate per bit will need to be reduced. Since the basic communication services of the Internet can be provided freely worldwide with IMT, the cost of global roaming can be reduced too.

We will need to reduce the bit rate to (1/1000) of today's level in order to receive x1000 of data capacity with same cost as today's.

Based on the above assumption, Table3 shows the estimated prices for 4G LTE per Gigabyte by the time when 5G would be launched. Although the prices for 5G will be similar to what we have today but the features which will be provided by 5G worth more.

Bandwidth (Gb)	Estimated Prices per Gigabyte for 4G LTE Compared to 5G			
	AT&T	Verizon	Sprint	T-mobile
.5	0.06	0.06	0.06998	0.04
1	0.03	0.03	0.03499	0.03
2	0.015	0.015	0.0175	0.015
2.5	0.012	0.012	0.014	0.012
3	0.01	0.01	0.01166	0.01333
4	0.0075	0.0075	0.0125	0.01
4.5	0.00889	0.00889	0.01111	0.00889
6	0.00667	0.00667	0.01	0.0075
6.5	0.00706	0.00706	0.01231	0.00769
8	0.0075	0.00625	0.01	0.0075
8.5	0.00706	0.00706	0.00941	0.00706
10	0.006	0.006	0.008	0.007
10.5	0.00857	0.00667	0.00762	0.00666
12	0.0075	0.00583	0.00667	Not Available
14	0.00643	0.00571		
15	0.006	0.006		
16	0.00688	0.00563	Not Available	
18	0.00611	0.00556		
20	0.0055	0.0055		
30	0.00617	0.00617		
40	0.0065	0.0065		
50	0.0067	0.0067		

Table 3: Analysis of 4G LTE Estimated Prices for Data Planes by the Time of 5G's Establishment

IV. CONCLUSION

By 2020 or before, the view of the internet services will totally be changed; starting from the high persistent speed to the tools that will be provided beside. The connectivity view is moving from one aspect which realms of P2P

(People to People) or (People to Machine) P2M to (machine to machine) M2M; where the communications options are open between those machines. So, you find the fridge is able to search online on the cooking requirements for the frozen objects that were removed and notify the stove with those requirements. In offices, you may find the equipments are monitoring each other and advice if anything goes wrong. 3D movie can be downloaded on your Smartphone in 6 seconds instead of 6 minutes.

All the above incredible technologies can be brought with 5G; however, 5G will be built as multi layered of existing technologies and deployed ones. This makes its structure easy and simple to deploy and operate. This technology can be offered with a similar cost as today's cost if the mobile companies can reduce the cost of today's level to 1/1000 per bit.

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