

5G in India

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Abstract—5G (Fifth generation) stands for the next major phase of mobile telecommunications standards beyond the current 4G/IMT-Advanced standards. As the expectation of the public increases with the advancement of the technology comes into picture, the services that can be obtained using the telecom networks have widened. Applications such as High-speed internet, Internet of Things, critical communications etc. the telecom network needs to support high data rate, low latency, reliability etc.

5G has speeds further what the present 4G can provide. From generation 1G to 2.5G and from 3G to 5G this world of telecommunication has seen a number of advancement along with improved performance with every passing day from IMT 2020, there are several requirements from the users and network side, which has to be supported in 5G to support the use cases. To fulfill the requirement, several technologies are being considered in 5G.

Key Words: 5G, Advancement, Requirement, Latency

I. INTRODUCTION

After every 10 years, new mobile generation has come since the first 1G (generation) system which came in 1982. After 10 years, the next generation which was introduced is 2G in 1992 and the first 3G system introduced in 2001. 4G system was introduced in 2012. The development of GSM that is 2G and CDMA i.e. 3G were officially done about 10 year after all the R&D projects where done.

We have observed remarkable growth of cellular communication over the radio. With ever- increasing subscriber base and limited radio resource, providing quality telecom services became difficult. These issues led mobile service providers to research into technologies and improve the quality of service and be able to support more users in their systems. Wireless communication networks have become much more pervasive than anyone could have imagined when the cellular concept was first deployed in 1960's and 1970's. Mobile cellular subscribers are increasing by more than 40% per year. Therefore Cellular communication has been continuously evolving into newer forms. Radio technologies have evidenced a rapid and multidirectional evolution with the launch of the analogue cellular systems in 1980s.

[1] Thereafter, digital wireless communication systems are consistently on a mission to fulfill the growing need of human beings (1G to 4G, or now 5G).

1G: 1G is the 1st generation. It is simply used to make phone calls; this is all it was able to do.

2G: The second generation provided customers with the facility of voice calling and text messaging. 2G networks are digital.

3G: This technology sets the standard for most of the wireless networks. Third generation allowed the use of internet on the mobile phone, while also enabling picture-sharing and Bluetooth Connectivity.

4G: It offers first true internet broadband data transmission rates. Its data transmission rates are 10 times faster than 3G technology.

5G: 5G will be the network for millions of devices and not just for the smart phone. It promises to enable fast (and secure) connectivity between devices other than smart phones, such as sensors, vehicles, robots, and drones. It will have data speed up to 1 to 10 Gbps. [1]

S.N	Mobile Technology in India	Frequency bands in India	Operators
1	GSM(2G)	900 MHz, 1800 MHz	Airtel, Idea-Vodafone, BSNL
2	CDMA	850 MHz	Reliance, BSNL, Tata
3	WCDMA(3G)	2100 MHz, 900 MHz	Airtel, Idea-Vodafone
4	WiMAX	2300 MHz	BSNL
5	4G LTE	1800 MHz	Airtel, Idea-Vodafone, Jio
		850 MHz	Jio
		2300 MHz	Airtel, Idea-Vodafone, Jio
		2500 MHz	BSNL, Idea-Vodafone

Figure 1: Different frequency bands in India

5G SPECIFICATIONS

PARAMETER	SUGGESTED PERFORMANCE
1. Network capacity	10,000 times capacity of current network.
2. Peak data rate	10Gbps
3. Cell edge data rate	100 Mbps
4. latency	<1 ms

Table 2: 5G wireless performances

- 1-10Gbps connections to deadline points in the field (i.e. not theoretical maximum)
- 1 millisecond end-to-end round trip delay - latency
- 1000 x bandwidth per unit area
- 10-100 x number of connected devices
- Perception of 99.999% availability
- Perception of 100% coverage
- 90% decrease in network energy usage

Why spectrum for 5G not purchased in India yet?

Due to extremely high price and several other factors, there is a delay to implement 5G in India which is the reason why spectrum for 5G is not yet purchased in India. With price of Rs 492 crore for 1 MHz, operators figured out that it is not a viable proposition, keeping the debt and international prices in mind. The Telecom Regulatory Authority of India (TRAI) marked the spectrum in 3,400-3,600 MHz band for 5G, and suggested that the radio waves will be allocated in blocks of 20 MHz. Therefore, to purchase 100 MHz of airwaves, an operator will be supposed to pay around Rs 50,000 crore. The telecom industry is loaded with a compound debt of Rs 7.5 lakh crore and is also undergoing a financial pressure due to the competition with Jio, the only telecom company earning profits. [2] The remaining two private companies- Airtel and Vodafone Idea- are also facing the combined Adjusted Gross Revenue (AGR) dues of around Rs 89,000 crore which they are suppose to pay in less than three months. Hence, it is currently too much problematic for the telecom industry to purchase 5G spectrum.

5G in India Vs World

5G require completely new infrastructure in India, that is setting new transmission lines, etc which required high cost. On the other side the developed country like America is progressing their 5G infrastructure by using space cloning, Which gives low infrastructure cost and high efficiency. In India 5g is taking time because of high spectrum cost, expensive infrastructure for transmission of 5g signal.

The Department of Telecommunications (DoT) has identified 35 MHz of spectrum in the 700MHz frequency band, and 300 MHz of spectrum in the midrange band of 3.3GHz to 3.6GHz. However, of the 35 MHz of spectrum in the low-frequency (sub-1GHz) band, Indian Railways has demanded 10 MHz, leaving only 25 MHz for telecom operators. [3] Even the 300 MHz of spectrum from the midrange band is not completely available for telecom operator in this band, the space and defense departments have staked claim to 25 MHz and 100 MHz units, respectively, leaving only 175 MHz of spectrum for telecom operators, which will result into high congestion of signal between multiple users.

Challenges to 5G technology in India

First of all huge investment is required for setting 5G in India. High spectrum cost due to which many telecom operator are not willing to upgrade from 4G to 5G. High debts of telecom operator which is not clear till now according to survey Airtel has to pay 50000 crore rupees, Idea and Vodafone has to pay 40000 and Jio has to pay 25 crore.

Lack of innovation in India: 5G plays major role in IOT that's why many companies is eager towards 5G but due to lack of innovation in India the company or organization is not interested in developing 5G. [4]

Security is also a major issue in 5G. The frequency of 5G might be harmful for humans and animals, so this is also a challenge for implementing 5G technology.

Is Current Infrastructure sufficient for 5G in India?

There are more than 13,000 smart phone model available in India but only 50-60 high end smart phone is 5G compatible which is also of high cost. 5G required more than 2,50,000 cell tower which will be small in size and mounted on traffic signals, lamppost, rooftop. The traditional tower can also be used in 5g but with certain improvement so that it will be compatible with 5G spectrum. [5]

Issues to be overcome before 5G Implementation

- **Hoaxing and Jamming hoaxing:** Hoaxing and Jamming Hoaxing is a fake GPS signal that is been sent out, in which the GPS receiver consider that the signals arrive from the satellites and computes the wrong coordinates. Such wrong computations can lead to more criminal activities and increase the crime rate. Jamming occurs when a transmitter sending out signals at the same frequency shifts a GPS signal.
- **Encryption of data:** If a GPS receiver will communicate with the main transmitter then the communication link between those two is easy to break and the consumer may use the encrypted data.
- Interception of private communications.
- There is more likely to be security issue such as stealing bank account, stealing private data
- Phishing attacks, stealing bank account details and other secured information, are more likely.
- Since all the network operators and service providers would share a common core network infrastructure, compromise of a single operator will lead to the collapse of the entire network infrastructure, if not carefully guided.

Expected Environmental issues due to 5G

The environmental issues in 5G arises due to frequency range that is between 30GHZ to 300GHZ at which 5G is supposed to work. EMF studies and published their results in peer-reviewed journals that show adverse biological and health effects caused through EMF sources developed by humans. We can organize types of radiation by their levels of power on the electromagnetic spectrum. Bigger wavelengths with lower frequency are less powerful, while smaller wavelengths at higher frequencies are more powerful. This spectrum is divided into two distinct categories: ionizing and non-ionizing. Ionizing, which includes ultraviolet rays, X-rays and gamma rays, are the harmful forms. [6] The energy from ionizing radiation can pull apart atoms, and it's known to break the chemical bonds in DNA, which can damage cells and cause cancer. This is why the FDA warns against having unnecessary X-rays. It's also why exposure to the sun can cause skin cancer.

India Vs China on 5G

Countries such as Australia, New Zealand, Japan and Taiwan besides the US are keeping Huawei out of 5G deployments, while others including France, the Netherlands, Russia and South Korea have allowed the Chinese equipment maker to participate. Major global equipment vendors in India include European companies Ericsson and Nokia, China’s Huawei and ZTE and South Korea’s Samsung. Vodafone Idea has applied to partner with Ericsson and Huawei for 5G trials, while Bharti Airtel has sought permission to conduct trials with Nokia, Huawei and Ericsson. Rival Reliance Jio Infocomm has applied for a pilot initiative with Samsung. [7] Vodafone Idea has applied to partner with Ericsson and Huawei for 5G trials, while Bharti Airtel has sought permission to conduct trials with Nokia, Huawei and Ericsson. Rival Reliance Jio Infocomm has applied for a pilot initiative with Samsung. India is now in dilemma whether 5g is to be used or not, but china is doing belt road initiative where it provides infrastructure development(5g is more focused) and investment in more than 70 Asian countries. Due to BRI India is taking service from china based company like Huawei and Zte. In India idea and Vodafone is against 5G they are saying that it is better to improve 4g because 4g has many functionality similar to 5G and instead of focusing on 5g these companies are doing modification in 4G.

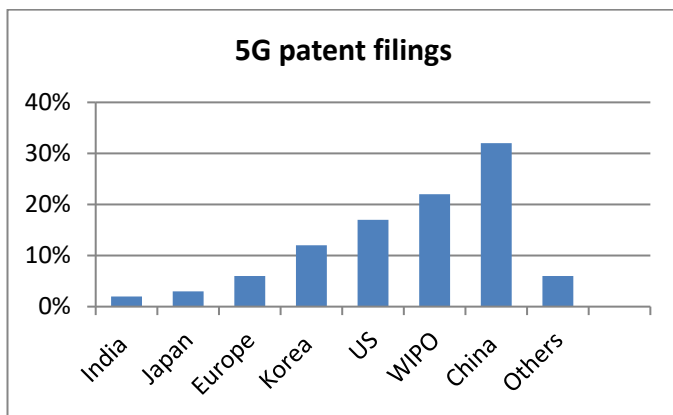


Figure 3: China leads in 5G patent filings

Applications of 5G:

- Smart Home
- Smart Cities
- Autonomous Driving
- High speed Mobile Network
- Healthcare and mission critical applications
- Internet of Things – Connecting everything

Is 5G really required in India?

Different countries are investing time, money and resources to bring in 5G technology as soon as possible which will result in advancement of technology, benefiting every sectors of the country. Though all sectors in India are making the optimum use of 4G technology also telecom industry are currently not capable of bringing in 5G technology due to ongoing debts. But, if India will not invest on 5G technology then it will lag behind as compared to other countries. As per the report and statistics, blocking Huawei from rolling out 5G may cause

\$4.7 bn loss to India by 2035. [8] China is also making 5G infrastructure development corridor with Pakistan. If there will be early development of 5g happen in Pakistan then it will politically affect India. For rural development we need intelligence hardware which will be built on the basis of 5G.

Why 5g is better than 4g?

In 4g, we can connect 10000 people per square kilometer but 5g will be able to connect more than 2 million people in one square kilometer. 5g can be responsible to make intelligence hardware which can be used in healthcare, robotics, defense etc. Most important feature that 5g can give is remote medical surgery which can be predominantly used in rural area and India has such issue from long time. Second reason china gives full data privacy to India if India will make 5g BRI with China.

India and their own take on 5G?

The government of India has take one step forward in 5G development by own self without taking further help from other companies, the project is named as "Indigenous 5G bed test". The some reputed organization are taking part into this program. These organizations are IIT DELHI, IIT MUMBAI, IIT Chennai, IIT Kanpur, IISC Bengaluru, CEWIT (Centre Of Excellence In Wireless Technology) and SAMEER (Society Of Applied Microwave Electronics Engineering and Research). [9] Jio is the only company giving proposal to government of India to implement 5G technology at mid of this year. Till now there is no 5G test done by Huawei in India.

ZTE is conduction pre-5G trials with Bharti Airte, Vodafone and Rjio	Will launch telecom products designed and customized for the local needs.
Expects India business to grow faster than its other global markets	Has tied up with BSNL to provide network support and 5G gear for future network needs.
Recently won a contract from state-run BSNL for network expansion in the north and east	Testing its 5G-ready products with Airtel and BSNL. India plans to roll out 5G services for consumers by 2022

Figure 5: India’s another step forward

Indian organizations and their step towards 5G?

Wipro has tied up with IIT Kharagpur to do research on 5g.the final outcome from this partnership will be: Wipro can use these technology to provide service to their costumer and IIT Khaaragpur get financial help and some expensive training and knowledge about these emerging technology via industry expert with the help of Wipro. [10] IIT Kanpur and TCS has joined hand for 5G research.IIT DELHI is doing research on 5G MIMO ...which will be implemented in next 4 years. It has 32 base stations which will be used to verify and test the algorithms.

Companies which are predominantly working on 5G?

- Nokia
- Cisco
- ZTe
- Huawei
- Qualcomm
- Samsung
- Databangteleco,
- AltioStar

Spectrum allocation dilemma in India?

Each government organization of India is demanding certain bands for their work by the result of that there is very less amount of spectrum is remaining for private organization in India which is blocking 5G to come into India early. [10] DoT has accepted the following spectrum for the given organization; 5G spectrum range lies between 3.3ghz to 3.6 Ghz.

ORGANISATION	SPECTRUM ALLOCATED
ISRO	3400-3425 MHz
DEFENCE SERVICE	3300-3400MHZ(NEARLY 100MHZ)
5G SERVICES(COMMERCIAL)	175 GHZ

Table 3: Allocated Spectrum for various use

II. CONCLUSION

5G will provide the elementary infrastructure for building smart cities, which will enhance the mobile network performance and capabilities to their maxima. Lot of improvements is done from 1G to 5G. 5G is expected to be released by the end of 2022. The government had initially stated that India could implement initial 5G roll outs by the end of 2021 and is expected to hold auctions for airwaves to facilitate the next generation technology by the end of fiscal year through March 2021. One of the most famous quotes said about 5G is: 5G is an emerging technology that hasn't really been defined yet.

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