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STANDING COMMITTEE ON INFORMATION TECHNOLOGY (2020-21)

SEVENTEENTH LOK SABHA

MINISTRY OF COMMUNICATIONS (DEPARTMENT OF TELECOMMUNICATIONS)

INDIA'S PREPAREDNESS FOR 5G

TWENTY- FIRST REPORT

LOK SABHA SECRETARIAT
NEW DELHI

February, 2021/Magha, 1942 (Saka)

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Presented to Lok Sabha on 08.02.2021

Laid in Rajya Sabha on 08.02.2021

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*Nominated to this Committee w.e.f. 15.10.2020 vide Bulletin Part-II dated 15.10.2020.

#Nominated to this Committee w.e.f. 28.12.2020 vide Bulletin Part-II dated 28.12.2020.

ABBREVIATIONS

3GPP	3rd Generation Partnership Project
5G	Fifth Generation
AR	Augmented Reality
BBNL Bharat	Broadband Network Limited
BIS	Bureau of Indian Standards
BRI	Broadband Readiness Index
CEWiT	Centre of Excellence in Wireless Technology
CMRTS	Captive Mobile Radio Trunking
CMSP	Cellular Mobile Service Provider
COAI	Cellular Operators Association of India
DoS	Department of Space
DoT	Department of Telecommunications
EMBB	Enhanced Mobile Broadband
EMS	Electronics Manufacturing Services
ER	Essential Requirements
EU	European Union
GHz	Gigahertz
HLF	High Level Forum
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICRIER)	Indian Council for Research on International Economic Relations
IDRBT	Institute for Development and Research in Banking Technology
IMC	Inter-Ministerial Committee
IMG	Inter-Ministerial Group
IoT	Internet of Things
ITU	International Telecommunications Union
LMLC	Low Mobility Large Cell
LSA	Licensed Service Area
MHz	Megahertz
MMTC	Massive Machine Type Communications
MoD	Ministry of Defence
M-SIPS	Modified Special Incentive Package Scheme
MTCTE	Mandatory Testing and Certification of Telecommunication Equipment
NCCS	National Centre for Communication Security
NDCP	National Digital Communication Policy
NPV	Net Present Value
OFC.	Optical Fiber Cable
PLI	Production Linked Incentive
PMP	Phased Manufacturing Programme
RAN	Radio Access Network
SMEs	Small and medium Enterprises
SPECS	Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors

TAIPA	Tower and Infrastructure Providers Association
TEC	Telecom Engineering Centre
TEMA	Telecom Equipment Manufacturers Association of India
TRAI	Telecom Regulatory Authority of India
TRDF	Telecom Research and Development Fund
TSDSI	Telecom Standards Development Society, India
TSP	Telecom Service Provider
UASL	Unified Access Service License
URLLC	Ultra-reliable and Low-Latency Communications
VR	Virtual Reality
WHO	World Health Organization

INTRODUCTION

I, the Chairperson, Standing Committee on Information Technology (2020-21), having been authorized by the Committee do present the Twenty-first Report on 'India's Preparedness for 5G' relating to the Ministry of Communications (Department of Telecommunications).

2. The Standing Committee on Information Technology (2019-20) selected this subject for detailed examination and report to the Parliament. The examination of the subject, however, could not be completed during the term of the Committee (2019-20). Keeping in view the importance of the subject and the need for wider consultation, the Standing Committee on Information Technology (2020-21) re-selected the subject for further examination and report.

3. The representatives of the Ministry of Communications (Department of Telecommunications) briefed the Committee on the subject on 11th August, 2020. The Committee heard the views of the industry bodies viz. Cellular Operators Association of India (COAI) and Telecom Equipment Manufacturers Association (TEMA) on 11th August, 2020. The Committee heard the views of the Telecom Service Providers (TSPs) viz. Reliance Jio Infocomm Limited, Vodafone Idea Limited and Bharti Airtel Limited on 27th October, 2020. The Committee took evidence of the representatives of the Department of Telecommunications and Telecom Regulatory Authority of India (TRAI) twice i.e. on 27th October, 2020 and 10th November, 2020. The Committee also received written submissions from Prof. Bhaskar Ramamurthi, Director, IIT, Madras and Prof. Abhay Karandikar, Director, IIT, Kanpur.

4. The Committee at their sitting held on 3rd February, 2021 considered and adopted the Report. The Committee wish to express their thanks to the representatives of the Department of Telecommunications (Ministry of Communications) and TRAI who tendered their evidence before the Committee and furnished valuable information. The Committee also wish to express their thanks to the representatives of COAI, TEMA, Reliance Jio Infocomm Limited, Vodafone Idea Limited and Bharti Airtel Limited for appearing before the Committee and furnishing

written information/views, which was of great help in the examination of the subject. The Committee further wish to express their sincere thanks to the two experts namely, Prof. Bhaskar Ramamurthi, Director, IIT, Madras and Prof. Abhay Karandikar, Director, IIT, Kanpur for providing valuable inputs on the subject.

5. The Committee also place on record their appreciation for the invaluable assistance rendered by the officials of Lok Sabha Secretariat attached to the Committee.

6. For facility of reference and convenience the Observations/Recommendations of the Committee have been printed in bold in Part-II of the Report.

New Delhi;
04 February, 2021
15 Magha, 1942 (Saka)

DR. SHASHI THAROOR,
Chairperson,
Standing Committee on
Information Technology.

Part-I
Narration Analysis

I. Introduction

India‘s history with wireless services began early. The first experimental wireless telegraphy links were demonstrated as early as 1902. A Department of Wireless Telegraph was created soon thereafter, and wireless telegraphy came into routine use in Calcutta at Diamond Harbour in 1908. However, widespread use of wireless technology had to wait for 90 more years. The first mobile phone service was launched in 1985 on a non-commercial basis, but it was only in 1995 that commercial service was started. The initial subscriber growth was modest, however new policy initiatives, beginning 2007, spurred rapid growth with the subscriber base reaching 560 million in 2009 and well over a billion by 2017. Early deployment of mobile networks was based on 2G technology, with 3G technology entering service in 2010 and 4G in 2016. All mobile services from 2G to 4G offered services based on increasingly advanced phones, with smart phones arriving about a decade ago.

2. 2G and the early 3G networks primarily offered voice services, but beginning with later 3G and now 4G technologies, the networks provide internet-based services like video, email, and social media. 4G technology has been a major inflexion in mobile technology with packet-switched data transmission and high-speed connectivity. The 5G technology‘s main benefits such as high speed, low latency, high connection density, greater reliability, and high energy savings are all conducive to enable Digital India use cases such as smart cities, smart manufacturing, smart agriculture, smart healthcare, to name a few.

II. 5G Technology: Next Generation of Mobile Communications

(i) Definition and Salient Features

3. The macro level requirements for 5G have been defined by the International Telecommunications Union (ITU) in its ‗IMT 2020‘ specification. The 3GPP (3rd Generation Partnership Project), an industry driven standardization body, that has undertaken the standardization of mobile technologies for the past 25 years, is currently in the process of developing standards for 5G networks based on the ITU

requirements. 5G is a new member of the vast global telecommunications ecosystem. The four major components of this ecosystem are Standards Development, Equipment Design and IP Development, Manufacturing and Service Provision. 5G standardization and deployment are at nascent stage and the technology is likely to reign the next decade or more considering its relevance across industry verticals. 5G will extend the use of wireless technologies, for the first time, across completely new sectors of the economy. 5G will enable both existing and new wireless service providers to develop novel business models to offer innovative applications to individuals and to different economic verticals from industrial, commercial, educational, healthcare, agricultural, financial and social sectors.

(ii) <u>Advantages of 5G vis-à-vis other technologies</u>

4. The Department of Telecommunications in a written note have explained the advantages of 5G over other technology like 4G as under:

> —4G was designed to provide the high speed internet facility. However, 5G has been designed to provide additional features which are not available in 4G. The 5G technology is capable of provisioning of diverse services in the intended three usage scenarios enhanced mobile broadband (eMBB), ultra-reliable and low-latency communications (URLLC), and massive machine type communications (mMTC) as well as support for features like network slicing, edge computing etc. 5G systems will outperform previous generation 4G systems. It is expected to support the following parameter values vis-à-vis 4G:

Sl. No.	Parameter	4G	5G
1.	User experienced data rate (Downlink - Megabits per second)	10	100
2.	Connection density (million connections per square kilometer)	0.1	1
3.	End-to-end latency (radio interface - milli seconds)	10	1 (For specific usage scenario of URLLC)
4.	Mobility in kilo meter per hour	350	500 (For specific usage scenario)

5.	Area Traffic Capacity (Megabits per second per square meter)	0.1	10

5G in future is expected to be revolutionary for data-driven industries, smart cities and smart manufacturing because it will be possible to have many more devices working, reliably, securely and uninterrupted in the same area. 5G public / private network may also be used in Industrial automation / smart manufacturing.

In essence, unlike 4G whose main focus was only on mobile broadband, 5G has been designed with a plethora of use cases for the next decade."

5. Providing further insights into the 5G technology, Director, IIT Kanpur has submitted as under:

—The Fifth Generation (5G) mobile communication technology is a paradigm shift in the field of communications as it not only enables human to human communications but machine to machine communications in a digitally connected world with a variety of use cases. There are three key use cases of 5G. One of them, of course, is mobile broadband with very high throughput up to 20 Gbps, also called ‗enhanced Mobile Broadband (eMBB)'. This will provide substantial increase in broadband throughput over that of 4G. The other two important use cases of 5G are ‗Ultra-high Reliable Low Latency (URLLC)' and ‗Massive Machine Type Communications (MMTC)'. These additional use cases result in a huge diversity of applications, which cannot be supported by previous generations of the mobile technology such as 4G. Significantly enhanced capabilities than those of 4G are possible in 5G. These are in terms of spectral efficiency, which can be as high as 30 bps/Hz, very low latency of less than a couple of milliseconds and very high-speed mobility support of up to 500 km/hour.

A key scenario for 5G technology is to support massive machine to machine communication (MMTC), or communication between appliances, devices or machines without intervention of human beings. While the earlier generations of telecom technology enabled human to human or human to machine communications, 5G would unleash massive machine to machine communication by connecting a large number of devices. These Internet of Things (IoT) applications will transform many sectors such as Transport, Agriculture, Healthcare, Power grid etc.

The ultra-low latency and reliable communication (URLLC) is another capability offered by 5G enabling newer applications such as vehicle to vehicle communication, remote robot assisted surgery, mission critical communication, augmented reality (AR), virtual reality (VR) etc. Some of these, for example, vehicle to vehicle communication, also called the V2X

communication, may not require high speed data access but needs extremely low latency or response time. Similarly, applications such as robotic surgeries require very low latency coupled with high reliability of communication. Some other applications like AR or VR may not only need high speed data access but low latency communication as well."

6. He further submitted that the applications enabled by URLLC, MMTC along with high speed connectivity or mobile broadband will bring a significant change in the communications landscape. As the world moves towards more and more digitalization, 5G will help create an 'all-pervasive digital world' where most of the appliances, equipment and gadgets will be connected. 5G technology will not only be used in telecom but in other sectors such as agriculture, healthcare, transport as well. While these developments are expected to transform the society, they also pose new challenges from cyber security and national strategic perspective.

7. As per TRAI, 5G is the latest iteration of cellular technology that will provide seamless coverage, high data rate, low latency, and highly reliable communications. It will increase energy efficiency, spectrum efficiency, network efficiency as well as efficiency of other systems. 5G will have use cases in many sectors such as health, smart cities, Industrial IoT and Industry 4.0, Emergency, disaster and public safety, Education, Transport etc.

8. In order to create an enabling environment for timely roll out of 5G in India, TRAI released a White Paper on 'Enabling 5G in India. This White Paper highlights the specifications of the 5G technology, discusses the potential use cases and architecture of 5G network, deliberates those areas that will require investment for 5G deployment, covers the spectrum requirement for 5G network for the deployment of 5G in India.

(iii) <u>Benefit and Relevance for India</u>

9. The relevance of 5G for India as contained in the Report "Making India 5G Ready' is as under:

> "5G Relevance to India 5G has been designed for global adoption with flexibility to support wide number of applications. Its adoption in India will involve many use cases adopted widely in the world, but also some unique applications to suit India's needs. 5G's value for India may be even higher than in advanced countries because of the lower levels of investments in physical infrastructure. 5G may offer "leapfrog' opportunities by providing "smart infrastructure' that offers lower cost and faster infrastructure delivery. A good example of this leap frog effect, in the past, was in telephony. India's telephone density till the late 1990s remained small due to high cost fixed line telephony. However, the arrival of mobile networks vastly reduced cost of service delivery and the country's telephone penetration went from less than 5% in 1995 to 95% by 2010, bringing striking benefits to the Indian economy.
>
> A more recent example of a leapfrog effect is ride sharing made possible by wireless internet access on 4G smart phones. Shared ride hailing services have transformed the infrastructure efficiencies in utilization of shared cars, autos and motor cycles. Though still early in its growth, vehicle sharing promises significant infrastructure value.
>
> 5G technologies will offer even more opportunities in infrastructure efficiencies. For example, 5G will enable "vehicle platooning', a technology that exploits 5G's low latency communication capability to pack vehicles into platoons with low inter-vehicle spacing despite travelling at high speeds. 5G will allow rapid coordination between the vehicles and keep the vehicles in the platoon safe. Platooning can double vehicle density in roads promoting efficient and safer use of the limited road infrastructure.
>
> In manufacturing,5G will enable use of robotics for precision manufacturing, particularly where humans cannot perform these functions safely or with the necessary precision. 5G can also enable better logistics to track goods from raw materials to product delivery and improved sharing of expensive design and manufacturing resources across the country.
>
> In agriculture, 5G can enable improvement in the entire value-chain, from precision farming, smart irrigation, improved soil and crop monitoring, to live stock management.
>
> In the energy sector, "smart grids' and "smart metering' can be efficiently supported enabling growth of alternate energy technologies. With the rise of renewable and storage technologies, low latency communications will be critical to manage these grids.

In health-care, 5G can enable more effective tele-medicine delivery, tele-control of surgical robotics and wireless monitoring of vital statistics.

With over 300 million in the Indian middle class living in urban areas, a variety of 5G business models for new services are likely to be successful. However, the economically weaker sections of the population will need special help to benefit from5G technologies. Clearly, it is this segment of population living in smaller towns and villages that require special attention from India‘s 5G initiatives.”

(iv) <u>Race for 5G Around the World</u>

10. As per TRAI, globally, 118 operators in 59 countries have deployed 5G network. 5G ecosystem is currently available in the following three bands:

Lower Band: 700 MHz band (Put to auction in 2016, remains unsold). [Globally 7 operators have deployed 5G in this band]

Mid Band: 3300-3600 MHz band (TRAI has recommended, yet to be auctioned). [Globally 82 operators have deployed 5G in this band]

mmWave Band: 26 GHz Band and 28 GHz band (Spectrum band yet to be declared in India). [Globally more than 8 operators have deployed 5G in this band]

11. As per GSA September, 2020 Report (https://gsacom.com/paper/5G-networks-member-report-september-2020/), over 100 commercial 5G networks are now launched worldwide. These networks are mainly in USA & Canada, UK (United Kingdom) and EU (European Union). As per information from GSM Association, 5G services has received major stride in Australia, Brazil, Canada, China, Finland, Germany, Italy, Japan, South Korea, New Zealand, Philippines, Qatar, Saudi Arabia, Singapore, South Africa, Spain, Switzerland, Taiwan, Thailand, United Arab Emirates, United Kingdom and USA.

12. Director, IIT Kanpur in his submission to the Committee stated as under:

~~-~~Globally, close to 100 commercial launches of 5G technology have taken place across different countries. As on date, the 5G network covers around 7% of the world population. It is expected to cover 20% of the world population by the year 2025.Major countries and geographies where 5G technology have already been launched are America – USA, Canada, Europe – UK and many countries under European Union such as Sweden,

Finland, Norway, Germany, Spain, Italy, Poland, Hungary etc., Asia Pacific – China, Japan, South Korea, Thailand, Australia, New Zealand, Philippines, Middle East – UAE, Oman, Saudi Arabia, Qatar, Kuwait, Bahrain and Africa – South Africa. Mostly, these are partial launches, i.e., 5G has been launched in parts of each of these countries. Countries in Asia Pacific like South Korea, Japan and China have witnessed sizeable growth in 5G deployments and possibly they are ahead of the curve. It appears that so far China has already deployed more than 5 lakh 5G base stations covering around 7-8% of their population."

13. The Committee enquired whether any effort has been made by the Department to study the experience gained by them. To this query, the Department have replied that DoT have planned for India specific use case trials through Licensed Telecom Service Providers. The Department have also informed the Committee that DoT have not signed any agreements specifically for cooperation in 5G technology with other countries. However, cooperation in 5G technology is one of areas of cooperation in the Memorandum of Understandings (MoUs) signed with Cambodia, Myanmar, South Korea and Vietnam in field of Communications.

14. The Department of Telecommunications have furnished the comparative chart for roll out of 2G, 3G, 4g and 5G as under:-

Technology	**2G**	**3G**	**4G**	**5G**
Global Deployment	1991	1998	2008	2019
Indian Deployment	1995	2008	2015	-

III. India's Preparedness for 5G Ecosystem

(i) DoT High Level Forum on 5G

15. 5G High Level Forum (HLF) was set up by the Government under Chairmanship of Secretary DoT, Secretary, MeitY and Secretary, Department of Science & Technology as Co–chairs with Members from Academia and Industry etc. in September 2017 to articulate the vision for 5G in India and to recommend policy initiatives and action plans to realize this vision. 5G HLF has given its report titled —Making India 5G Ready" to the Government in August 2018. The HLF has recommended that India should embrace opportunity by deploying 5G networks

early, effectively and pervasively as well as emerge as a significant innovator and technology supplier at the global level. For implementation of recommendations of HLF, DoT has constituted Expert Committee on Spectrum Policy, Regulatory policy, Education And Awareness Programme, Application and Use case Labs, Development of Application Layer Standards, Major Trials and Technology Demonstrations and Participation in International Standards. DoT along with MeitY, DST and other stakeholders is still working for the implementations of —Making India 5G Ready" recommendations.

16. On being asked about the level of preparedness for 5G, the Department have informed that so far following action have been taken for 5G deployment:

(i) Recommendations of HLF have been included in National Digital Communications Policy 2018.

(ii) National Broadband Mission has been set up.

(iii) Setting up of —End to End 5G Test Bed" with investment of Rs. 224 crores under IIT Madras led multi Academic/ Research institute consortium for testing of 5G products by startups/Small and medium Enterprises (SMEs).

(iv) Liberalised guidelines for experimental spectrum was issued on 23rd July 2019.

(v) First Use case lab at Institute for Development and Research in Banking Technology (IDRBT), Hyderabad has been set up in Banking and Financial sector.

(vi) 5G spectrum has been identified and being coordinated with concerned agencies.

(vii) Conferences are being supported for awareness on 5G and skill development.

17. The Department have further replied that they are prepared for trials of India specific Use cases. DoT have organized 5G Hackathon and have short listed 100 Use cases for further development. 30 out of 100, Use cases will be demonstrated along with TSPs to learn 5G Use cases and rollout challenges. The launch of 5G services is dependent of availability of network equipment and device ecosystem. 5G is expected to be launched in the year 2021-22.

18. However, during the course of deliberation, the industry body COAI informed the Committee that India has to do a lot of catching up so far as 5G deployment is concerned. Though the approach to 5G Policy requirements in India was already finalized in the 5G High Level Forum (5GHLF) Report released by DoT in August 2018, minimal on-ground actions/ implementation instructions have been issued so far. Action in areas such as identification of spectrum band, decision on spectrum policy etc. are still to be initiated. The 5G Trial applications were submitted by the TSPs in the month of January 2020, however, till date the guidelines for trials have not been made clear and there is no set date for commencement of these trials. Instructions for conduct of trials for 5G technologies need to be issued at the earliest.

19. Regarding the timeline for rolling out of 5G, Secretary, DoT, submitted during the sitting as under:

> —The 5G technology will initially ride on the 4G technology. It is not that one fine day 5G will come and replace all 4G. That is not so. The releases which are happening in 3GPP – release 8, 9, 10, 11, 12 like that – release 15 is what generally taken to be as 5G features. But different countries will adopt different parts of the features and what is more likely is that in the initial years, the core and radio access network which are two separate things - the core will be of 4G and the radio access network will be 5G. 5G has various applications. One of the most early applications which will be in large metros will be on Enhanced Mobile Broadband (EMBB) which will give users better mobile experience in terms of talking, download, and more reliability. What we are seeking is not just EMBB. It is important, but we think the real strength of this technology is in social use applications, in the field of health, education, agriculture, disaster management, public safety, traffic management, etc. So, this is going to be our focus because between 4G and 5G for faster speed I think user may not be able to distinguish. Sir, we do realize that it is a tough road ahead and we have to work to make sure that 5G in India comes in near future. Our own assessment would be regarding the specific time frame that somewhere by the end of 2021 and it is not that I am saying this based on any study which we have undertaken, but I am going by the logic that this will have to be preceded by auction of 5G. Right now, what we are going to have is auction for bands other than 3.3 to 3.6 but this band will also be auctioned somewhere in the next six months or so. After that, spectrum will be available. In parallel, various companies would be benefiting using 5G and would be making their investments. It will be rolled out not pan-India but in select areas first where the demand would justify the capex."

20. During the course of examination of the subject, the Committee came across numerous issues and challenges as submitted by various stakeholders and experts. These need to be addressed in war footing if the vision of 5G is to be achieved. The Committee will now deal these issues in detail.

IV. Spectrum Related Issues

(i) Availability of Spectrum for 5G

21. The Department have informed that they intend to make available 5G spectrum in various bands in line with global ecosystem. The Telecom Regulatory Authority of India (TRAI) had given their recommendation for the auction of spectrum in the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3400 MHz and 3400-3600 MHz bands on 01.08.2018 for providing mobile services. Digital Communications Commission has decided to hold auction of 3300-3600 MHz band separately. The opening up of the mmWave bands viz. 26 GHz etc. for IMT Services/5G is under deliberations.

22. Secretary, DoT, stated during evidence as under:

> —The bandwidth of 3,300 MHz. to 3,600 MHz. is not yet used in the 2G, 3G and 4G. It is envisaged to be used for 5G, but that does not mean that 5G will not use other spectrum bands. So, 5G would also come in 700 MHz., 800 MHz., 900 MHz. bands in the time to come. 5G would also be coming in what are called the millimeter wave bands, which are 24.25 GHz. to 27.5 GHz. Sir, that is also where the international ecosystem is coming up. Currently, the Digital Communications Commission has decided that the auction of 3,300 MHz. to 3,600 MHz. bands will be delinked from the other auctions. So, we are now preparing a Cabinet Note for auctions in other bands like 700 MHz., 800 MHz., 900 MHz., 1,800 MHz., and 3,300 MHz. to 3,600 MHz. bands will be considered separately. There is also an issue in this matter as part of the spectrum is being used by ISRO. So, that 25 MHz. has been taken away. There is also a band of about 100 MHz. between 3,300 MHz. to 3,400 MHz., which is to be used along with Defence. So, Defence has written now to us to allocate this entire band to them. We are in discussion with them because if we give this band to Defence, then what is available for 5G would just be about 175 MHz., which may not be sufficient for different vendors to actually give their services. We are holding discussions with them, and hopefully we will come with some solution on this issue."

23. As per COAI countries are identifying spectrum in sub-GHz, Mid band (3.5GHz) & mmWave bands for 5G deployment. India at present does not have sufficient spectrum earmarked for 5G in any of these bands as many other stakeholders are seeking spectrum in the 5G bands recommended by the 5GHLF as well as also being commercially deployed in other countries. To make India 5G ready at the earliest, Government needs to allocate at least the following spectrum per operator:

a. 3.5GHz : at least 100MHz per operator.
b. Mm Wave (26, 28, 37 GHz): at least 400MHz per operator.
c. Sub-GHz (600MHz & 700MHz): at least 2x10MHz per operator in each of these bands.
d. E-Band: at least 2x1GHz per operator.
e. V-Band: at least 1GHz per operator.

24. Bharti Airtel in a written submission to Committee have submitted as under:

> —In India, only the 3.5 GHz band (3.4-3.6 GHz) has been earmarked for 5G services, with just 175 MHz of spectrum being available for5G. In contrast, the sector needs a minimum of 300-500 MHz spectrum availability in this band. Apart from 3.5 GHz, other bands e.g. mmWave (26GHz) band and 600 MHz band, can be used for 5G services. However, the same is yet to be earmarked in India. India must consider the allocation of mmWave band (i.e. 26 GHz) for 5G and make it a part of the auction along with the 3.4-3.6 GHz band. For rural penetration, the spectrum in the 600 MHz band should be identified and earmarked for 5G."

25. A representative of a Telecom Service Provider (TSP) further submitted during evidence as under:

> —In India we are talking about only 175 MHz of spectrum that is right now having visibility for the 3.5 GHz spectrum, which means that every operator gets close to or less than 50 MHz spectrum, which is not sufficient. The second point is, the millimeter wave spectrum, which is the capacity spectrum, has yet to be identified. So, certainly there is need for getting the spectrum identified."

26. Explaining the impact of allocating less amount of spectrum, representative of a TSP during the sitting of the Committee stated as under:

> —On spectrum, our humble submission to the Committee is that there should be the right amount of spectrum at the right prices as per the global practices. For example, the famous 3.5GHz of spectrum which we call as sub-6 band in 5G, almost every operator across the globe has 100MHz of it. There are some exceptions with 80MHz of it but if we go lower than

80MHz, there are equipment on which we will spend billions of Dollars, I think, it would be a severe underutilisation of that. It is like buying a car and working it with one particular seat because the other three seats are not available. The equipment itself will be severely underutilised."

27. He had further commented as under:

> On an average, our 4G spectrum per operator is not more than one fourth of what any other operators across the globe has. That is not the only problem. The other problem is our footfall not only that we have 25 per cent of the spectrum, we have three and a half to four times people per sq. kms. So, you have four times more people and you have four times less spectrum which means the spectrum available to one person is 1/16. The number of customer is four to five times and that is again making the point that if we go the same way in 5G where everybody else is getting 100 MHz and we are getting 50 MHz and we have three or four times more customers, we will again be pegged at a much lower level saying that Indian customer will get four times less than what he is getting in US."

28. When the Secretary, DoT, was asked to clarify on the issue, he stated as under:

> Insofar as the spectrum availability is concerned, typically, we are talking of 5G spectrum as the band which is between 3.3 and 3.6 gigahertz. I had also flagged this issue last time. Of these 300 megahertz, which are available, 25 megahertz are required for certain satellite uses, which TRAI also said that we should give them with a suggestion that beyond the footprint of the use, the available spectrum -- even out of this 25-megahertz -- should be used wherever we can for our various experimental and trial purposes. Now, out of the balance 275 megahertz, about 100 megahertz -- between 3.3 and 3.4 gigahertz -- Defence is also wanting a part of it. So, we are having discussions with them. Two meetings have been held. A very positive response has come. I am sure this issue will be resolved. If this is deducted, then 175 megahertz are available to us. If this is added, then 275 megahertz are available. There are four players. Ideally, we should have about 300 megahertz. We are also trying to see if we can get a little more, that is, beyond 3.6. There we have a problem, because that is already committed for satellite usage. There is also millimetre wave, which has not yet gone to TRAI for recommendations. The auction, right now, is not thought of. No recommendation has come. There will be a consultation process. So, I would like to assure the hon. Committee that we will take a balanced view and a holistic view and see how best the interest of the industry, consumer and the public which is prime and supreme is balanced and then we will act accordingly."

29. Asked how the Department are addressing the issue of lack of spectrum, the Department have stated that they are deliberating with Department of Space (DoS) and the Ministry of Defence (MoD) for making sufficient spectrum available for 5G IMT services. Further DoT is working on sharing/ coexistence of spectrum uses in different spectrum bands including 3300-3600 MHz band and 24.25-27.5 GHz band.

(ii) <u>Spectrum Audit</u>

30. Licensed Service Area (LSA) is a concept to dynamically share a spectrum band, whenever and wherever it is unused by the incumbent users. Shared use of the spectrum is only allowed based on an individual authorization (i.e. licensed). All the Government agencies in India are assigned spectrum administratively. Spectrum audit will help in identification of unutilized or inefficiently utilized spectrum. After the identification, LSA can be used for optimal utilization of spectrum.

31. Asked as to whether any spectrum audit had been conducted in the county to suggest measures for efficient and best utilization of spectrum in India, TRAI stated that Spectrum is a scarce resource. Any amount of spectrum, if not put to use optimally and efficiently, results not only into financial loss to the Government, but also hinders economic and social development of the country. Spectrum allocation and spectrum management is done by DoT. Spectrum is also used by various Government agencies where its effective and efficient utilization needs to be measured. Therefore, spectrum audit is required to be done to detect under-utilization and to make effective and efficient utilization of this natural resource. Since 2015, TRAI in its various recommendations, has raised its concerns and has recommended to DoT that there is an urgent need for audit of all allocated spectrum both commercial as well as spectrum allocated to various PSUs / Government organizations. Government decision in the matter is awaited. Considering the importance of the spectrum audit, it should be done on priority basis by an independent agency regularly.

(iii) <u>High Spectrum Price in the Country</u>

32. COAI has submitted that TRAI earmarked spectrum in 3.3-3.6 GHz band for 5G. TRAI recommended the reserve price at INR 492 crore per MHz which is far higher than the auctioned spectrum price in other country. Minimum block of 20 MHz (Price for a block of 20 MHz will be Rs.9,840 crore). Minimum 80 MHz per TSP (Price will be INR 39,360 crores per operator).

33. Commenting on the present spectrum pricing policy, representative of TEMA during the sitting stated as under:

> —I believe that the policy of spectrum which we are holding in our country is of inverted structure. We expect raw material to be purchased at the highest price and the product should be rolled out at the minimum price which is absolutely inverted structure. I would like to say that when Government thinks about it, the ultimate idea should be to take it from the taxes, take it from the growth, not from the raw material."

34. Bharti Airtel submitted a comparative statement of the TRAI recommended Reserve Price in India vis-à-vis the auctioned discovered spectrum price in other countries in the 3.5 GHz band, both in absolute and relative terms as under:

Country	**Auction determined price (in Cr/MHz)**	**Spectrum Price in India is x times the price in other countries**		
		In Absolute Terms	**Basic Spectrum Price/Population/ GDP per capita**	**Basic Spectrum Price/Population/ ARPU**
Italy	182	3	2	1
UK	70	7	6	3
Australia	35	14	6	3
Spain	14	35	16	12
Austria	7	70	10	3
India	492	1	1	1

35. They have submitted that the recommended price of TRAI for India is exorbitantly higher and ranges from 3-70 times of the market-determined price of the spectrum in other countries in absolute terms and is 16 times of the price in the case of comparison in relative terms. Therefore, even if the price is compared after considering the Population and GDP per Capita / ARPU, the TRAI recommended reserve price in India is substantially higher than the auction determined price in other countries. Moreover, to roll out 5G, any TSP will require a minimum of 100 MHz spectrum in the 3.5 GHz band, which will cost around Rs. 50,000 Crores, even at TRAI recommended reserve price, thus making it too costly a proposition for the TSPs. Thus, to ensure the off-take of 5G services in India, the spectrum‘s pricing should be kept moderate. There is a need to strike a balance between the Government's expectation to generate revenue from the auction and growth of the sector and the overarching impact of 5G across the sectors. This is also critical since the monthly ARPU in India is under two dollars. India has one of the lowest ARPU in the world. While this can be seen as the telecom services are most affordable in India, below- cost pricing of services will only stifle the telecom sector and deprive the customers of good quality service and new technologies e.g., 5G. Hence, the necessary steps need to be taken to ensure adequate ARPU for the TSPs.

36. On the issue, representative of a TSP submitted as under:

> ~~I~~For one-fourth of the spectrum, there are four times more footfalls but then one-eighth the ARPU**.** That is another point. I think we should add to the equation. One-fourth, one-fourth and one-eighth is where the Indian telecom is right now.”

37. Asked as to whether any consultations have been held with the various Stakeholders before giving the recommendations on 5G spectrum pricing, the Department have stated that before giving its recommendations on "Auction of Spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3400 MHz and 3400-3600 MHz bands", which included 3300-3600 MHz band (globally adopted for 5G), TRAI has consulted with stakeholders and in this regard a consultation Paper was issued by TRAI on 28th August 2017 for the

comments of the stakeholders. The pricing methodology adopted by TRAI is given in the TRAI recommendation dated 1st August, 2018.

38. On pricing of spectrum, Secretary, DoT during the sitting stated as under:-

> "TRAI has given recommendations even for 3,300 MHz. to 3,600 MHz. This was considered and taken up in the Digital Communications Commission. It was referred back to TRAI, but they have reiterated the same prices and they have done very detailed analysis of it. All the telecom players do get an opportunity to give their viewpoints as TRAI has public consultation, etc. So, TRAI has given a very detailed report on this issue. The Digital Communications Commission has accepted what TRAI has said, but we have not yet finalised the prices because the prices are finalised by a Cabinet decision. We have not yet gone to the Cabinet, and prices have not been finalised."

39. Representative of TRAI has further stated as under:

> "If we compare a country which is equivalent to the size of a State in India and compare price of whole of India, I think, it is not an apple to apple comparison. But nevertheless, there are 7-8 well-defined international parameters. One has to judge the price based on those parameters…..I think a statement that the price of TRAI is very high requires some more in-depth deep dive so that we can reach to a conclusion."

40. On the reasons for high spectrum cost in the country, the Department submitted that the sector regulator, TRAI, have recommended the reserve price of spectrum in different bands including 3300-3600 MHz band (mid-band for 5G in industry parlance) after due considerations of all the aspects of it and due consultation with the stakeholders. Department's proposals for auction of spectrum in various bands including reserve price, after due consideration of TRAI recommendation, will be placed before the Cabinet, for a decision.

41. The Committee also enquired about the measures taken by the Department to help the telcos to ease the burden of high spectrum cost. The Department replied that pursuant to the recommendations of Inter-Ministerial Group (IMG) on "Stressed assets in Telecom Sector", Telecom Service Providers (TSPs) had been given a one-time opportunity to opt for higher number of installments (16) instead of the previously permitted 10 installments in respect of spectrum auction deferred payment, subject to the Net Present Value (NPV) being protected. Considering the

stress in the sector, the Government has given an option to the Telecom Service Providers (TSPs) to defer payment of the spectrum auction installments due for 2020-21 and 2021-22, either for one or both years. All the operational TSPs have generally opted for moratorium of 2 years. Deferment of spectrum auction installments will ease the cash outflow of the stressed TSPs and facilitate payment of statutory liabilities and interest on bank loans.

42. When asked whether the AGR issues will have any impact on the TSPs to bid for 5G, COAI have stated that apart from the AGR issue, there is a need to rationalize other levies and duties on the telecom sector so as to ease their financial burden. Key asks including providing soft loans against GST input line credit due to Operators, to address the immediate liquidity crunch as also reducing the SUC by 3% for all TSPs and reducing Licence Fee (USOF Contribution) from 8% to 3%. Exempt the levy of GST on payments to the government such as License Fees, SUC and Payment of Spectrum debt acquired in auctions. They also seek exemption of service tax on the amount of LF/SUC payable by telecom operators before implementation of GST, in compliance with the Hon'ble Supreme Court AGR Order. We believe that sector can be compensated from the USO Fund, which is estimated to be more than Rs. 51,500 crore, lying unutilised as on March 31, 2020. The industry can be provided the refund of the unutilized input tax credit immediately or be provided soft loans at MCLR rate, using the GST input credit as collateral.

(iv) <u>Spectrum for Industrial Use</u>

43. TEMA had submitted before the Committee that industry 4.0 is the main driver for 5G. Many countries around the world, be it the US, Germany, UK and Australia, all have allocated spectrum for the industrial development of 5G which is lacking in India. For example, in Germany, Mercedes is setting up a factory entirely based on 5G, famously known as _Factory 56' around the world, but the German Government has separately allocated the spectrum for that. In the same way, the US has done it and the UK has done it. Every country is setting apart spectrum and laying out policies for industrial growth of that country using 5G. In India,

unfortunately, we have a very double licensing system that for a factory to set up any system of its own, they have a two-year long process, first to get a license and then to get a spectrum which is really not very conducive to supplying the 5G equipment to the industries.

44. Asked to explain the term Industry 4.0, the Department have stated that Industry 4.0 is rooted in the concept of advanced manufacturing, also called Smart Manufacturing. Industry 4.0 based solutions enable better interoperability, more flexible industrial processes, and autonomous and intelligent manufacturing. Physical components of industrial production are being transformed into cyber physical systems by smart, digital networking, allowing for real-time management of production processes across great distances and products. DoT has not received any specific request/ demand for allocating spectrum for industry 4.0 uses.

45. On the present policy governing spectrum allocation for industrial uses in the country, the Department replied that currently, based on requests in this regard, industries are assigned spectrum, administratively, for their captive use in India.

46. TEMA has submitted that spectrum for industrial 4.0 uses be released immediately. TEMA has further stated regulators around the world have realised the importance of captive communications by their industries and enterprises and have been proactively working towards making the necessary spectrum resources available for their captive needs, keeping in view the importance of these users in nation building and economic growth. TEMA would request that DOT may take the lead and ask TRAI to conduct for a public consultation on spectrum needs and issues for captive users. TEMA also requests that a group be formed to work out policy for spectrum allocation and operation of 5G for 4.0 industrial uses.

47. Further elaborating on the issue, TEMA in a written note have submitted that Captive users of mobile wireless communications are industries, police, paramilitary, fire, forestry and mining, municipal corporations and public utilities as well as critical

infrastructure services projects such as railways, metros, airports, sea ports, refineries, highways, etc. They apply to WPC/DOT for three licenses- CMRTS (Captive Mobile Radio Trunking Services) License, spectrum license and import licenses. These projects are lifeline of the Country's economic development, Public safety, Industrial development and logistics and are critical to support Atam Nirbhar Bharat. The process of obtaining the necessary DOT/WPC approvals for such users typically takes between six months to two years. The main delay is in issue of a CMRTS license and also because of the sequential nature of the process where three separate licenses have to be taken from DOT one after the other rather than as single approval or as a parallel process.

48. Currently captive users like police, paramilitary, metros, airports, refineries, factories etc. have to take a CMRTS license before they can apply for a DOT spectrum license. These captive users only need wireless spectrum for their —captive" use only and no telecom service is being provided by them to the public or to anyone else. Thus, in principle, it appears there should be no need for a separate CMRTS license under Section 4 of the Indian telegraph act as these users do not provide any service to any customers and the wireless network is 100% used for internal communications and coordination purposes such as security, safety and logistics. In June 2018, the TRAI had recommended that DoT should do away with CMRTS license. TEMA requests that the CMRTS (Captive Mobile Radio Trunking) License may merged with the WPC spectrum license and that there needs to be a simplified process where the users directly apply for spectrum to WPC, instead of first going through an elaborate CMRTS licensing process with DoT and then applying for spectrum to WPC. This will cut down the process time substantially.

49. TEMA have further stated that it is critically important that radio spectrum for all captive users that share the primary mission to protect lives and property and help the Country to prosper is made available under a permanent administrative allocation process. Spectrum authorizations need to be based on relatively simple application policies that require only nominal administrative fees from the agencies and organization that require use of the spectrum for —private", non-commercial

communications networks. Consistent with the administrative policies of Countries around the world, the authorization process for private networks need be distinguished from the competitive bidding –spectrum auctions" that are commonly used to authorize commercial wireless networks that provide telecommunications services to the public at large on a for-profit basis.

V. 5G Test Bed, Use Case and 5G Field Trials

(i) Setting up of Indigenous 5G Test Bed

50. Keeping in view India's specific requirements and to take lead in 5G deployment, Department of Telecommunications (DoT) approved financial grant for the multi-institute collaborative project to set up "Indigenous 5G Test Bed' (Building an end to end 5G Test Bed) in India in March 2018 with total cost of Rs. 224.01 Crore. The test bed is expected to be ready by October, 2021. The eight collaborating institutes in the project are IIT (Indian Institute of Technology) Madras, IIT Delhi, IIT Hyderabad, IIT Bombay, IIT Kanpur, IISc Bangalore, Society for Applied Microwave Electronics Engineering & Research (SAMEER) and Centre of Excellence in Wireless Technology (CEWiT). The test bed is likely to enhance national capability in telecom technology, develop indigenous Intellectual Property (IP) and give fillip to Indian telecom manufacturers.

51. The main goals of "Indigenous 5G Test Bed' are to provide an open 5G test bed that can enable Indian academia and industry to validate their products, prototypes and algorithms and demonstrate various services, provide a test bed with complete access for research teams to work on new novel concepts/ideas holding potential for standardization in India and on global scale., make a test bed available for Indian operators to understand the working of 5G technologies along with security aspects and plan their future networks, provide the facilities of 5G networks for experimenting and demonstrating applications / use cases of importance to Indian society, and implement and demonstrate IoT based systems and services.

52. The test bed is planned to be realized in stages over 4 versions – version 0 (V0) to version 3 (V3). The initial two stages have been completed. The design of next version (V2) has started. Significant progress has been made by the Institutes in system hardware and algorithm design. It is anticipated that the third version (version 2) will be completed by March, 2021 and final version (version 3) by October, 2021. During 2020-21, Rs.45 crore have been allotted out of which Rs.3.1855 crore has been disbursed and utilized. It is expected that the balance fund shall be utilized within the stipulated time.

53. Due to the COVID-19 pandemic and subsequent lockdown and closure of the academic institutions, the work of hardware design, fabrication and testing was adversely affected. Although software development is on track, the testing and integration of the software with hardware requiring physical presence in the lab have been delayed. The test bed is likely to be set up by October 2021. Asked as to which other countries have successfully set up 5G test beds, the Department have informed the Committee that US, UK, European Union, Sweden, Finland, Thailand, China, Japan and South Korea are some of the countries which have announced the launch of 5G. The term —TestBed" is being used somewhat loosely in many of these, and they are better classified as ―field trials". Ready-for-market products of MNCs are being deployed in a limited manner to show-case 5G capabilities in these field trials. Only a select few of these Test Beds are meant for experimentation, validation of new ideas and products, and performance evaluation.

54. The Department further informed India's effort is unique with special focus on setting up a test bed that will be utilized by Academia, Industry, Telecom Operators and Start-ups to develop solutions and use cases which can be India-specific. Going forward, this will raise India's visibility in the Global Forums and Standardization bodies. Hence, a comparison between our test bed and others may not be possible.

55. Regarding the project, Director, IIT, Kanpur submitted that the ‗5G Testbed' project is focussed on developing IPRs in the country in the 5G technology space. The initiative is likely to lead to spin-offs that may be taken forward by telecom start-

ups and other industrial organizations for product development in the 5G domain. Some of the IPRs generated by this project can also be utilized for product development for the defence sector of the country. The ‗5GTestbed' should lead to further research and standardization activities under 3GPP and IEEE from India.

56. Director, IIT, Madras also expressed hope that technology spin-offs from this Test Bed will enable Indian industry and startups to enter the Indian and global markets for 5G telecom equipment, thus addressing a critical gap in our economic and national security.

57. On the progress of 5G Test Bed, Secretary, DoT during evidence stated as under:

> ―They have been progressing very well…..The timelines for completing this were September-October, 2020. In fact, we had a very big event, Indian Mobile Congress in October, 2020 and we thought that this the time we will formally have the Testbed absolutely ready. Then the technology would take another six months or so after that. But, due to Covid-19, all this has been delayed. Now what I am told is that a Testbed will be ready by March-April, 2021 and the technology which they are developing will take another six months or so after that…..The timelines could be compressed. But I think that they are progressing well."

(ii) <u>Setting up of 5G Use Case Labs</u>

58. DoT is working with different Ministries/Departments for setting up of India specific Use Case labs in Education, Health care, Agriculture, Public safety, FinTech etc. So far, Institute of Development and Research in Banking Technology (IDRBT), an Institute under RBI, in collaboration of Department of Financial Services has come forward for setting up of 5G Use case lab in Banking & Financial Services and Insurance (BFSI). DoT has approved this proposal for setting up of 5G Use Case Lab in Financial Sector at IDRBT with investment of Rs. 22.1 crore with Rs. 17.5 crore funding by DoT.

59. Considering that development of sufficient Use Case Labs is required for successful implementation of 5G. The Committee enquired what steps have been taken for setting up of India specific User Case Labs in other sectors. The

Department have replied that DoT is presently working with Food Safety and Standard Authority of India for setting up Use case lab in food safety certification and with Ministry of Health, AIIMS, Ministry of Housing and Urban Development for setting up of Use cases in respective domains.

60. COAI has submitted that 5G would have business case if there are applications for its use. Currently, there are no applications or use cases which are ready to promote business case & capex investment by operators. China has been working on the same since last two years and claim to have more than 100 use cases for 5G which have been built through initiatives from Government, Academia, Operators & Industry verticals. Coordinated Government actions are required for enabling digital transformation across sectors (Health, Transportation, Energy, Agriculture etc. as essential). A Digital Readiness Index to measure the same for each sector should be there to monitor progress as well as to enable development of India specific use cases.

61. On the plans of the Department to develop use cases in the country, the Department have stated that DoT has announced a ‗5G Hackathon' in association with MeitY, NITI Aayog, Start-up India, MSME, COAI, IITs/IIITs and other stakeholders on February 21, 2020. This Hackathon aims to shortlist ideas that can be converted into workable 5G products and solutions. In Phase 1 up to 30th April 2020, 1024 applications /entries have been received and we have been able to short list 100 Use case in 10 economic verticals.

62. With regard to the suggestion of COAI to prepare a Digital Readiness Index of different sectors to enable development of India specific use cases, the Department stated that the National Digital Communication Policy-2018 (NDCP) acknowledged the need for building a robust digital communications infrastructure leveraging existing assets of the broadcasting and power sector including collaborative models involving State, Local bodies and the Private sector. Accordingly, the NDCP envisaged the measurement of Broadband Readiness Index (BRI) of the States/UTs

in order to address RoW challenges and attract investments. The Broadband Readiness Index is similar to Digital Readiness Index for Telecom sector.

63. The framework on BRI parameters has been prepared based on the objectives of NDCP-2018 and inputs from the industry/expert. The Department of Telecom have entered into a Memorandum of Understanding (MoU) with Indian Council for Research on International Economic Relations (ICRIER), an autonomous, policy-oriented, not-for-profit, economic policy think tank, to develop Broadband Readiness Index for Indian States and Union Territories for the period 2019-2022. DoT is engaged with the State/UT Governments for the development of Broadband Readiness Index. The report for the first year, i.e. 2019-20 is under finalization.

64. Regarding poor development of 5G use cases in India and the suggestions to develop more use cases in the country, COAI submitted that coordinated Government actions are required for enabling digital transformation across sectors. There is a need for other industries to get together with the telecom industry at a common platform to discuss their requirements from 5G. Based on this, use cases will be developed. Many start ups will be able to participate in the development of use cases for 5G based services for various industry verticals. While India is consuming a very large amount of data per capita in various industry verticals. However, there is a need to convert the data produced into useful services through the development of use cases. The Digital Readiness Index of various sectors can be monitored by a cross sectoral entity for e.g. NITI Aayog. This will facilitate the monitoring of digital transformation in various sectors and thereby facilitate the development of use cases for development of digital services in the more digitised sectors. The combination of this with the India IT stack will help 5G based technologies build efficiencies in the various sectors and benefit the country.

(iii) 5G Field Trial and Experimental Spectrum for Field Trials

65. Government plans to allow 5G trials in limited area and for limited time to test potential 5G India specific Use cases based on enhanced Mobile Broadband(eMBB), Massive Machine Type Communications (mMTC) and Ultra Reliable Low Latency Communications (uRLLC) in isolation on non-commercial basis subject to strict safeguards. The participation in trials by any vendor is not linked to deployment of their equipment in Indian Network. Department of Telecommunications has received 16 Applications for 5G field trials using imported as well as indigenous technology. India has showcased 5G applications during India Mobile Congress 2019 and with these field trials, start-ups and SMEs can participate in this ecosystem. 5G trials are likely to be started in 2-3 months.

66. DoT have issued guidelines for assignment of spectrum for trials across all available spectrum bands on a nominal fee of Rs. 5,000. Indian entities involved in Research & Development (R&D), manufacturing, telecom operators and academia for the purpose of R&D and experimentation can get licence for a period of up to two years depending upon activity which is further renewable on case to case basis by the Government. One Experimental (Radiating) License for 5G Test Bed at IIT Delhi was issued on 20.04.2018 with 3-month validity. Guidelines for experimental spectrum has been issued. The Department have also stated that there are no major issue confronting trials in the country. An inter-ministerial Committee for monitoring and evaluation of 5G technology trials has been constituted under Member (Technology) in DoT.

67. COAI raised some key issues for bringing improvement in trial spectrum allocations for 5G. These include License for trial spectrum (3.5GHz, mmW, E-Band) should be for minimum one year, flexibility to conduct trial in any city/location within the circle as per allocated trial spectrum, single window clearance for the trial licenses, WPC license should be valid for any location change during the trial and should not need new application, no equipment/application vendor restriction for conducting Lab Trial, TSPs should have flexibility to conduct Lab trial for —like in

India" solution with minimum to no requirement of submitting document to WPC / DOT / Spectrum clearance, flexibility to select site locations & change locations during within the trial LSA, import duty waiver on 5G Trial equipment., etc.

68. COAI raised concern that the 5G Trial applications were submitted by the TSPs in the month of January 2020, however, till date the guidelines for trials have not been made clear and there is no set date for commencement of these trials. It is recommended that an early issue of orders for the conduct of these trials is issued. The issues listed above need to be resolved while issuance of final guidelines for conduct of trials.

69. Explaining the need for conducting 5G trial, representative of a TSP stated as under:

> —……we need to have these trials taking off very quickly. The industry as a whole, our industry body has participated as a part of the Government's 5G high-level committee which was set up a-year-and-a-half or two years back. Deliberations have taken place. We have made a request for trials to be given to us and we are more than happy to kind of go down that path because that will ensure that the true benefits are actually tried out because India use cases are extremely essential in order to derive the best benefits for 5G. And, therefore, we believe that for proper commercial 5G rollouts to take place, say, in 2022, we need to initiate the 5G trials now and start to build the ecosystem."

70. On the allocation of 5G spectrum for trials, representative of one of the TSPs have submitted as under:

> —Airtel and other TSPs have submitted their application for 5G trials; however, the 5G trial spectrum is awaited for almost a year. It is important that lab and field trials of 5G should be carried out extensively to test the factors e.g. interoperability of 5G smartphones with 5G infrastructure, testing of indigenous 5G infra based on Open RAN ecosystem with the commercial 5G handsets. The trial is also critical to ascertain the interoperability of 5G infra with the existing 4G networks, serving as an underlay network for 5G services."

71. 5G field trials will help stimulate local R&D eco system, help local TSPs better understand technology and business models for 5G, encourage OEMs to better target 5G applications for local needs, etc. When asked about status of 5G field trials

conducted so far, the Committee have been informed by the Department that 5G field trials have not yet been permitted.

VI. Issues Relating to Standards

(i) India's Contribution in Development of 5G Standards

72. As per ITU procedure, the requirement for IMT-2020 (Technical name for 5G) networks, devices and services are finalized by the ITU Radio Communication Sector (ITU-R) through consensus development by way of multiple meetings with Member States and other stakeholders. The current standards for 5G networks relate to 3GPP release 15 onwards.

73. To promote development of technology in India, the Government is working with academia, industry and start-ups for Innovation and R&D, generation of IPRs and their incorporation in 5G and related technologies' standards. DoT and Telecom Standards Development Society, India (TSDSI) in collaboration with the IITs have been successful in getting the Low Mobility Large Cell (LMLC) use case accepted by ITU as one of the 5G requirements for rural area. LMLC reflects the needs of rural India in which the distance between 2 base stations will increase up to 6 KM against 1.73 Km by other technology. This technology will be beneficial for India as well as other developing countries. The TSDSI has been established to enable Indian industry take lead in international standardization activities.. There are a few companies and institutions from India who are contributing on 3GPP and ITU and other international standard platforms in a limited way in telecom technologies.

74. On the special features of LMLC technology, the Department have informed that LMLC is part of the IMT-2020 requirements of ITU. This mainly looks at rural connectivity by placing base stations at Gram Panchayats and providing connectivity to the neighboring villages and farms. Similar rural connectivity issues exist in many developing countries where affordable rural broadband coverage is required. In fact, LMLC requirement was strongly supported by many African counties in ITU. The

Standard could be useful for deeper penetration in urban areas for other 5G applications.

75. When asked about the areas/technologies on which India is contributing to 5G standard, the Department have stated that contributions to 3GPP have been made in areas such as coverage enhancements, positioning, reduced capability of user equipment, New Radio Beyond 52.5 GHz operation, Flexible duplexing, Massive MIMO beamforming, OFDM Numerology and new waveforms, and NAVigation with Indian Constellation (NaVic) inclusion for geolocation support in addition to GPS etc. Department is encouraging setting up of test beds, incubation centers, start-ups, 5G applications & use cases, which will boost the development of new technologies, applications and standards. By increasing participation in International Standardization bodies, inclusion of Indian requirements in the International Standards can be ensured. This will also result in future ownership of Intellectual Property Rights (IPR), Standards Essential Patients (SEPs) etc. by India.

76. Director, IIT, Kanpur has submitted on the issue as under:

> ~~–~~Telecom Standard Development Society of India (TSDSI) was established in 2014 to contribute to the next generation telecom standards and drive the eco-system of intellectual property creation in India. TSDSI is an organizational partner of 3GPP and works closely with the global standards' body to reflect Indian requirements into International telecom standards. With the formation of TSDSI, the Indian research community has been able to channelize their research efforts towards standardization initiatives for 5G and beyond technologies and make contributions to various global standards. TSDSI, being an organizational partner of 3GPP, provides an opportunity for all Indian organizations to contribute to standardization activities for 5G and beyond technologies under 3GPP. As mentioned in the previous section, an important beginning has been made with TSDSI facilitating the LMLC contribution from India to ITU and 3GPP. More efforts can be made by the Indian research community to take their research contributions to 3GPP and other global standards development organizations such as IEEE through the forum offered by TSDSI.

77. Expressing the importance of addressing the digital communication needs of rural India, Director, IIT, Madras submitted as under:

> —The rural Indian, even more than the urban, needs wireless broadband connectivity in order to address basic needs. The pandemic has made this criticality even more stark. Since wireless/cellular broadband needs to be back-hauled primarily using optical fiber, the rural towers have to be located where the BharatNet fiber ends, i.e., at the approximately 2.5 lakh gram panchayats. From the towers at these locations, neighbouring villages numbering more than 3.5 lakh have to be provided wireless coverage. Roughly 33% of these villages are between 3--6 km away from the gram panchayats, the rest being within 3 km. Ensuring coverage to these villages at distances up to 6 km is therefore crucial if a large fraction of rural Indians is not to be left out of 5G as well.
>
> With Telecom Standards Development Society, India (TSDSI) in the lead and with the help of DOT, India for the first time took to ITU the requirement of Low Mobility Large Cell (LMLC), to provide rural cellular coverage up to a distance of 6 km and asked for this to be made a mandatory requirement of 5G (IMT-2020) technologies. Hitherto, only high-speed rural highway and railway coverage was a requirement in 2G, 3G and 4G. As expected we got a lot of support for LMLC from developing countries, but in the compromise hammered out at ITU, the mandatory coverage distance was reduced to 3 km. It is to be noted that there is nothing preventing 5G technology from exceeding this requirement.
>
> Enthused by this partial success in ITU, Indian academia, supported by MEITY through research grants, along with some startups and industry, submitted innovative and affordable technology enhancements to the standard being developed in 3GPP (which is the preponderant global wireless standardization forum in which TSDSI is an organisational partner). These enhancements ensure LMLC coverage up to 6 km as needed in India through minimal software changes in the equipment. However, due to the diverging interests of several companies represented in 3GPP, and possible concerns about Indian IPR, our enhanced LMLC coverage solution was not included in the 3GPP standard.
>
> Given the importance of 100% rural 5G broadband coverage to India, TSDSI has re- incorporated these LMLC enhancements into the 3GPP standard, in a fully inter- operable and compatible manner, and submitted an Indian "5Gi" enhanced standard to ITU for approval as a part of IMT-2020. The 5Gi standard is on the threshold of being approved — this represents the first time a global standard is emerging from India at ITU."

(ii) <u>Need for Harmonization of Indian Standards with Global Standards</u>

78. Need for enhanced rural coverage is one of the important aspects to cover rural and remote areas considering the size of the country and large capex/

investments required especially 5G cell site coverage is smaller compared to 4G as higher spectrum bands are used for 5G and higher the frequency higher the attenuation. IIT Madras and associate institutions have developed a variant to the 3GPP standard (Release 15) with the objective to enhance coverage in the existing standards and also offered technology solution to implement it. This is called TSDSI RIT and is self-evaluated by an Independent Evaluation Group and submitted to ITU. The standard compliant to the requirements of 5G technology, the TSDSI RIT along with the original 3GPP standard have been recommended by the ITU. Some of the other developing countries also supported the TSDSI RIT considering its relevance for enhanced rural coverage, which implies reduced capex costs to cover a certain defined area.

79. COAI while deposing before Committee have stated that it is important to have globally harmonized standards to allow interoperability and economies of scale. India should adopt globally harmonized 3GPP standards. If India adopts any standard other than 3GPP, it would disconnect India from globally harmonized standard, device & network ecosystem. This would severely impact 5G rollouts, its adoption in India and increase cost.

80. To a query of the Committee regarding whether India should adopt globally harmonized 3GPP standards and what steps have been by the Department in this regard, the Department have stated that India should adopt standards that are harmonized sufficiently with global standards to ensure inter-operability, roaming, and to derive ecosystem benefits such as economies of scale. However, it is possible to adopt carefully enhanced variants of the global standard that specifically provide some features of importance to India such as enhanced rural broadband coverage, without compromising on either inter-operability or economy of scale.

81. On whether India has adopted any standard other than 3GPP, the Department have replied that ITU standards are in final stages of approval for finalization. India has not adopted any standard for 5G services as yet.

82. Bharti Aitel has also submitted as under:

> –Current TSDSI RIT standards being proposed for 5G are not globally harmonized. The adoption of TSDSI RIT without global harmonization would make India an isolated island in the global 5G ecosystem. GSMA & GSA have raised concerns on the same with DOT. This would impact international roaming, incompatibility of global handset & infra with Indian network. Similar efforts in the past by other countries like China (TS-SCDMA, local 3G standards), Korea (WiBro — local 4G standards) etc. have been failures due to the lack of harmonization of these standards with the global ecosystem. The adoption of globally harmonized standards for 5G is more critical as SG services are not only for human communication but also impact the adoption of 5G in vertical industries.
>
> Gaps in the current TSDSI RIT specification would lead to a delay in adopting 5G services in India. It would increase the cost of 5G handset and services, which would impact the mass population, who will have to invest in a comparatively expensive handset (because of made ONLY for India as against Made in India).Thus, any standard needs to be globally harmonized to create an open ecosystem that allows the development of common smartphones/ infrastructure to drive down the cost of services. The local standards approach will deprive Indians of affordable 5G devices and applications apart from making the network and devices cost higher and also cause a delay in the roll-out of 5G. Therefore, we suggest that the timelines should be to lay down for resolution of gaps around Interoperability, Performance, Implementation, Alignment, and IPR in the proposed TSDSI RIT specifications."

83. COAI further submitted that even after submission of the inputs of the TSPs to TSDSI regarding technical errors, incompleteness, unimplementability aspects and non-testability issues in TSDSI documents, the same have not been incorporated in the TSDSI RIT. Issues related to interoperability of the proposed specification with global 3GPP specification still prevail and remain unaddressed. Performance gain of proposed specifications compared to 3GPP specifications have not established. Also, the 3GPP has identified that there is an overlap in the signalling messages of TSDSI, which will cause interoperability issues. The issue related to lack of interworking in the TSDSI RIT will lead to creating inefficient supply chain (limited for India market), thereby leading to higher cost of ownership of devices and services for end customers. It will also lead to restrictions in international roaming of 5G services between India & other countries, leading to significant revenue loss. It is important to have globally harmonized standards to

allow interoperability. If the standards are not harmonized, there will be compatibility issues with other standards, which will impact international roaming. Globally harmonized standards also allow economies of scale. The network and customer devices when developed for mass market will have economies of scale, however, if isolated devices are to be developed for niche market, the cost will definitely rise.

84. On the apprehensions raised by some TSPs, Director, IIT, Madras submitted as under:

> "Fears have been expressed that with this 5Gi standard, India will trap itself into a corner isolated from the global 5G ecosystem. This is wholly misplaced, as inter- operability and compatibility between the 3GPP 5G and the TSDSI 5Gi standards can easily be ensured, since the latter is merely an enhanced version of the former. Moreover, there will be no cost implications as equipment will support both standards through mere software selection and in a manner transparent to the user….xxxxx….xxxx…Instead of fretting about the largely imagined risks in adopting the 5Gi standard, such a move by the TSPs would establish the voice of rural Indian consumer, numbering more than half a billion, in a global body meant to serve their needs, and make India's presence felt for the first time. It is definitely not too much to ask for a couple of bits to enable India to serve the needs of her rural populace. Till date, 3GPP member- companies have not taken this request, hitherto made by Indian academia and some Indian industry members, seriously. Should 3GPP not heed even this reasonable request, we will still implement the 5Gi standard in an inter-operable and compatible manner with the 3GPP standard in India, so that we avoid the trap of being "stranded" or "forked" form the global technology roadmap. However, I believe that the voice of 1 billion-plus Indians cannot be so easily ignored."

85. Elaborating on the issue, Secretary, DoT, during the sitting stated as under:

> "The 3rd Generation Partnership Project, (3GPP) lays down standards which are adopted by ITU after consideration. Then, that is an international standard. So, it is not a standard which is specific for India. We are free to also adopt specific standards. But one particular issue which must have been flagged before the hon. Committee is with regard to the Low Mobility Large Cell (LMLC) that is, where the tower for the 5G will have a large coverage. Sir, that is good for India. It is good for rural areas also. It is good for many countries on the same footing. Interoperability is important. The equipment that is used should be able to operate in this standard also. We are looking into it. Right now, there is no decision as if this is being adopted. But yes, if it is an international standard, it is also applicable to us and we have been advocating that it should be done

through the TSDSI, which is the standards setting body and which also, incidentally, has private participation."

86. When asked about the difference between TSDSI RIT and LMLC, the Department have stated that LMLC is a rural test configuration and is part of the IMT-2020 requirements. TSDSI RIT has been approved by ITU SG5 and one of the standards which has successfully completed all evaluation steps for IMT 2020. This is hence qualified for commercial deployments. It is in final stage of approval by the 193 member states of ITU. TSDSI-RIT (5Gi) is a standard/technology specification approved by ITU which meets the IMT 2020 requirements (including LMLC) with enhanced performance for LMLC rural eMBB use case. The concern of the TSPs relate to TSDSI-RIT.

VII. Device Eco-system for 5G

(i) Affordable Handsets

87. India is a price sensitive market. Therefore, the success of 5G roll out will also greatly depend on the availability of affordable 5G devices. On the measures being envisaged to make affordable 5G handsets and devices, the Department have stated that the Government has approved Production Linked Incentive Scheme (PLI) for Large Scale Electronics Manufacturing which includes mobile phones also in which an incentive of 4% to 6% is proposed to be extended to eligible companies on incremental sales (over base year) of manufactured goods including mobile phones and specified electronic components for a period of five (5) years subsequent to the base year. There is another scheme, the Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS) which shall provide financial incentive of 25% on capital expenditure for the identified list of electronic goods that comprise downstream value chain of electronic products, i.e., electronic components, semiconductor/ display fabrication units, Assembly, Test, Marking and Packaging (ATMP) units, specialized sub-assemblies and capital goods for manufacture of aforesaid goods. The setting up of mobile manufacturing ecosystem including components will enable affordable handsets.

88. Expressing the need for affordable devices for 5G, representative of a TSP during the sitting of the Committee stated as under:

> I think, devices or smartphones will play a role. With regard to smartphones along with fixed wireless devices, we really are, I would say, enthralled by the Make in India incentives that have been given to the device or smartphone OEMs. But I think, similar ecosystem has to develop in 5G where we have to see how we can get the 5G smartphones and the devices less than Rs. 10,000 range. That will basically make the 5G thrive in India because that is exactly what happened with 4G, if I have to go back in three years' time. Actually, when the 4G smartphones were less than Rs. 5,000, that is when the whole adoption started in a big manner. So, I think, certainly, we have to make sure that the ecosystem for 5G smartphones and devices is ready and is given the right incentives to make sure that we are able to see the 5G adoption once the networks get rollout."

(ii) <u>Promotion of Domestic Manufacturing of Telecom Equipment</u>

89. Telecom service providers have done expansion in 4G infrastructure and hence import has increased. China is one of the leading suppliers of components, piece parts and also finished equipment including mobile phones. There are a number of multinational companies who have manufacturing facilities in China.

90. India has the second highest number of mobile subscribers in the world. The Committee enquired how much of telecom equipment requirement in the country is not through domestic production, the Department have replied that as per information obtained from MeitY, as a result of the implementation of Phased Manufacturing Programme (PMP) to substantially increase the domestic value addition of cellular mobile handsets manufacturing eco-system in India and support provided under Modified Special Incentive Package Scheme (M-SIPS), India rapidly started attracting investments in mobile manufacturing segment and significant manufacturing capacities have been set up in India during the past five years. Most of the major brands (both foreign and Indian) have either already set up their own manufacturing facilities or have sub-contracted manufacturing to Electronics Manufacturing Services (EMS) companies operating from India. India has emerged as the 2nd largest manufacturer of mobile phones in the world in volume terms.

During year 2018-19, there were import of finished telecom equipment worth more than 50, 000 crores and about Rs. 10, 000 crores worth of telecom products were manufactured within the country.

91. Asked as to whether the Department foresee any obstacles in getting adequate supply of equipment and technology for 5G, the Department stated that 5G technology is still in development phase and vendors are making their efforts for development of eco-system in phased manner. The Government have taken several initiatives under _AtmaNirbhar Bharat' and _Make in India' for promotion of domestic manufacturing of telecom equipment, such as Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS), PLI Scheme of MeitY to attract large investment in manufacturing of mobile phones and electronic components, imposition of basic Custom Duty notification of 36 telecom products and services under Public Procurement Order, 2017, etc.

92. The representatives of TEMA submitted before the Committee that an ecosystem needs to be developed for complete manufacturing rather than just assembly. India should be made a manufacturing destination for global companies and to develop Indian Champions. As an association of equipment manufacturers in the country, TEMA are of the view that assembly gives value addition of 5-20% whereas design led manufacturing gives much more value addition may be up to 50% or more. TEMA strongly believes that a design led domestic manufacturing is the backbone of country to have complete control on strategically important telecom networks. It is imperative that rather than just increasing manufacturing contribution to GDP by low value added assembly-led manufacturing, efforts and policies are required to be evolved on building a strong design led manufacturing with high value addition in hi-tech products in telecommunication for commercial as well as strategic communications purposes and others.

93. TEMA has also stated that TRAI in this behalf in its recommendations dated 3rd August, 2018 has recommended that for promoting research, innovation,

standardization, design, testing, certification and manufacturing indigenous telecom equipment, Telecom Research and Development Fund (TRDF), with initial corpus of Rs. 1000 Crore, should be created. They have further requested that Government may provide about Rs 1,000 Crores corpus to support Industry led R&D support to promote Indian companies who have requisite technological competence to develop and commercialize world-class products in the core technological areas. The Government may identify some of the frontrunners and aim to create at least two National Champions in each category.

94. Explaining the importance of R&D, representative of TEMA stated as under:

> "...xxx...We need something very, very fundamental and solid on the R&D part because R&D is very different from innovation. The innovation comes from start-up and then it becomes the commercial part of it. R&D is a sustainable long-term activity. Unless there is a real policy, economic thrust and support for R&D, thinking that we will start manufacturing really is a far-flung dream."

95. Further elaborating on the issue, TEMA stated that now the PPP MII policies are applicable to only Central Government and Central PSUs. This includes two PSU as telecom service providers, which has about 10% market share. The balance market share is with private Telecom service providers. Thus the PPP MII policy addresses about 10% of the market share of telecom service operators. We feel that India can become Atma Nirbhar with 100% access to market. Hence need for extension of PPP-MII to private telecom operators also. Likewise TEC, DOT technical specifications are at present followed by PSU telecom operators. Need to extend it to all public or private operators as also State Government/State PSUs. Detailed submissions hereunder.

(iii) <u>Development of Indigenous 5G Technology</u>

96. In the backdrop of Newspaper Reports that Reliance Jio has developed its own 5G technology using 100 per cent homegrown technologies and plans to offer it to other telecom companies, the Committee desired to know more details about the

indigenous 5G developed by Reliance Jio. On Reliance Jio's progress on indigenous 5G, Secretary, DoT, stated during evidence as under:

> "We have Jio which has announced recently publicly that they have the entire technology. We have sought details from them. They have also met us. We do not doubt them. We have not tested the technology as to how this is going to emerge. We have not examined it. But, given the track record, it must be workable, it must be good.……They have their own major research organisation also and they have also applied for trial in our 5G trials. Jio has also given an application for trial using their own technology. So, we will be able to see it also. I am not aware of whether specifically they have sought any testing in the 5G Testbed."

97. Also submitting on the development of 5G technology by domestic industry, Secretary, DoT, further stated as under:

> "In terms of technology, we have Jio who have said that they have got the technology. We have this 5G testbed, which is coming with the technology, and we are also encouraging CDoT to come up with the 5G technology. CDoT already has 4G technology not of a high level, and they are working on it. So, we have encouraged them and told them to now also work on 5G and come up with it. We are hopeful that they should do it in the year 2021.

98. On the status of ITI, the only telecom PSU to manufacture 5G equipment, the Department have stated that ITI has recently tied up with system integrators like Tech Mahindra, TCS etc. for 4G equipment. They are also discussing with couple of Indian companies with 4G upgradable to 5G solutions. ITI has the capabilities to take up manufacturing of Radio equipment for 4G/5G and has been discussing with Original Equipment Manufacturers to have transfer of technology to manufacture these products.

99. TEMA stated that Indian OEMs have proved time & again their expertise on technologies. Indian Prowess on Software is recognized world over. In recent times there is more of software in telecom equipment than hardware. Indian telecom equipment has already proved them in implementing many mission critical and national importance networks (Bharatnet, NFS, AFNET etc) based on domestically developed equipment. 5G standards are Open standards. Foreign OEMs has an edge in 2G, 3G & 4G because they monopolize the standards implementation with

IPRs in their name hence restricting others to develop it or make use of. However in the case of 5G, it‘s not the case. All components can be developed individually with no dependency on one component working over the other, as 5G use cases is not just covering Mobile Users but the plethora of applications. Many foreign companies like Nokia, Ericsson, Ciena, NEC etc. are OEMing Indian products which shows the quality of the product which India is manufacturing now. TEMA requests that for 5G domestic procurement should be made mandatory, so that Indian companies first have in country deployment base and then they enter world market.

100. Commenting on the issue, Director, IIT, Kanpur submitted as under:

> ~~C~~urrently, India has insignificant share of its own homegrown product or equipment manufacturing companies in the domain of mobile communication technology. We missed the 3G and the 4G bus earlier. However, due to the changed nature of network components and the architecture of 5G, it offers us an opportunity to develop products in India. One of the key design principles used by 5G networks is the `softwarization‘ of network components. Unlike specialized hardware elements in the earlier generations of mobile networks, a large number of equipment/network entities in the 5G network will be based on software running on commodity off-the-shelf hardware. Specialized chipsets and hardware elements may not be needed for most of the network entities in 5G network barring elements like Radio Frequency frontends and antenna sub-system. This provides an opportunity to Indian vendors (R&D and software vendors) to leapfrog and start developing 5G network equipment for deployments in India and across the world given our expertise in software.”

(iv) <u>Development of Open RAN in the Telecom Network</u>

101. As per the submission of Vodafone Idea Limited traditionally, telecom networks have followed the Single RAN model that consisted of defined standard interfaces with closed proprietary information and message exchanges between them and purpose-built hardware with all RAN components from the same telecom vendor. This has meant that the control to resolve many of the challenges that confront the Telecom service providers on a day to day basis lies with just that one telecom vendor who has designed the particular hardware/software, depending on where the problem lies, as in traditional RAN deployments, the software and

interfaces remain either proprietary or "closed" by the individual vendor and are often tied on the underlying hardware by the same vendor. Open RAN, on the other hand, is one where the interfaces and the software are open and there are no proprietary interfaces and can be executed on non-proprietary hardware. "Open RAN" is a movement to define and build 2G, 3G, 4G and 5G RAN solutions based on a general purpose, vendor neutral hardware and software defined technology with open interfaces between all the components.

102. Vodafone further submitted that cost savings, competition, choice and security are some of the key advantages of Open RAN. Typically, RAN network constitutes about (60-70%) costs of whole CAPEX spend of a telecom operator, and hence the most important cost factor to focus upon. It is expected that Open RAN would offer around one-third savings over the traditional gears. In cost sensitive market like India, Open RAN promises to offer a substantial saving to the telecom operators while maintaining the performance requirements and KPIs for the consumers.

103. Accelerating Open RAN deployments and the development of a global Open RAN ecosystem can advance key strategic objectives of the Indian Government viz. Make In India; Connected India and Building Atma Nirbhar Bharat. Government should provide financial incentives to operators that transit a portion of their network to Open RAN and Government should invest in and encourage private sector investment in areas where India has comparative advantage, such as software development. The Government should seek to establish Open RAN Centres of Excellence (CoEs) at Indian Institutes of Technology, leveraging and enhancing their international reputation.

VIII. Infrastructure & RoW Policy Issues

(i) Fiberisation and RoW Policy Issues

104. COAI has submitted that Uniform RoW policy across states has Critical role in the operationalization of 5G networks. Making available existing and new municipal infrastructure (for e.g. street furniture/ open spaces etc.) for site densification (small

cell deployments/ telecom infrastructure installation). Fiberization is next key foundation for 5G readiness. India lacks fiberized sites and there needs to be strong govt. push to build at least 50% sites on fiber. Tracker at circle level would be useful in this regard with target to achieve 50% of sites in each circle on fiber. Free RoW for this will be a great contributor in the national interest of providing 5G access to the entire nation.

105. Explaining the need for streamlining the RoW policy, representative of a TSP stated as under:

> "Since it is a high bandwidth capability on the network side, 5G would definitely demand the reach of the optical fibre to each and every tower or point of emissions from where the 5G radio waves are emitted. Now, this will need a significant change in the way the policy, the subsequent implementation and the execution of right of way are handled in the country. Today, there are multiple agencies right from State Governments to municipalities to RWAs which have very clear entry barrier for anybody else like us to lay fibre while we call it essential services like electricity and water. I think our ability to reach out to the customer the way we want as far as our plan is concerned is seriously hampered by delays, exorbitant costs and non-uniform ways of operating this and this could be the single largest delay in expansion of the 5G network in length and breadth of the country. The second infrastructure related issue which I would like to highlight is the permission for putting up towers and polls. Unlike 4G, 5G will be much more densified a network. It will go much closer to the customer because of the bandwidth, the kind of services and the industry support it would need. In that scenario, it would be very, very critical for us to go ahead and deploy towers, polls and sites what the world calls the 'street furniture', not only the classical towers or telco towers. To go there, we would again need a single window clearance, which means if I need to cover this room, I would need to put a sense of emission either here or in some place near which can cover it in the right way."

106. On the present policy governing RoW for setting up of towers and laying of fiber in the country, the Department have stated that The Indian Telegraph Right of Way Rules, 2016 (IT RoW Rules, 2016), notified in the Gazette of India Extraordinary on the 15th November, 2016, govern the RoW for setting up of towers and laying of fiber in the country. The uniform RoW policy is very critical for operationalisation 5G as it would help TSPs/ISPs/Telecom in creating and expanding telecom infrastructure [for 5G) across India. Ultimately it would support

citizens and enterprises by fulfilling the information and communication needs through the establishment of a ubiquitous, resilient, secure, accessible and affordable telecom Infrastructure, necessary for 5G operations.

107. Asked about the challenges in providing RoW across all States/UTs, the Department submitted the following:

a) Delay in issuing permissions due to lack of Online Single window clearance system.

b) Lack of clarity regarding documents required for submission of application for RoW permission.

c) Multiple Policies with multiple levies of charges and procedures by many States/UTs.

d) Lack of availability of Government Land & Buildings for installation of Mobile Towers as procedure for same is not included by many States/UTs in their existing policies. —

108. Regarding meeting the fiber requirement for complete roll out of 5G, the Department further stated that the requirement of towers and fiberization is subject to rollout plans of 5G. In the initial spell, 5G is envisaged to be rolled out in high density and high data consumption hotspots in mid band and in subsequent phases, the other applications will be rollout progressively considering the infrastructure costs in rolling out 5G and business demand.

109. The IT RoW Rules, 2016 provide uniform rates for granting RoW permission by the States/UTs. So far 16 States/UTs have aligned their RoW Policies/Rules with the Indian Telegraph Right of Way Rules, 2016.Various Seminars, Regional Workshops, Meetings are being held from time to time with the States/UTs including the stakeholders for reviewing the implementation of IT RoW Rules, 2016. Requests have been/are being made to Chief Ministers and Chief Secretaries of the remaining States/UTs from time to time for aligning their RoW Rules/Policies with the IT RoW Rules, 2016. As envisaged in the NDCP 2018, DoT has initiated to measure a set of parameters across states to assess Broadband Readiness Index with the objective to address the challenges in building infrastructure and attract investments in digital

infra. The DoT's 2016 RoW guidelines adoption, approval period, Power supply to cell sites, Fiberization are some of the parameters in the index that are important. The objective is to monitor and measure the performance to enhance the competitive spirit among states and build collaboration with states to mitigate the challenges in infrastructure rollout.

110. On the issue of RoW policy and need for adoption of uniform policy, representative of TRAI stated as under:

> —Sir, Right-of-Way is very, very important if we want to increase fiberization. Our percentage of fiberization is very low. We have made very detailed recommendations and DoT also has written to MOHUDA. But we think that a time-bound schedule should be prepared. May be, if required, we should work with States to amend the laws on Municipality Acts or the Municipal Corporation Act and the Panchayat Act in which specific provisions should be made. Today, what is happening? Different cities and different towns are charging different kinds of rates. In many cases, the rates are prohibitive. It is because of that also the cable operators, even the TSPs find it very difficult. That is one thing. Secondly, giving a time-bound permission is another problem. It is almost difficult for an operator to get the permission in time. That is also increasing cost and overruns. So, these are two things where we are of the view that we should concentrate on Right-of-Way. We are also going to work with the State Governments on this. We are preparing a White Paper on it…..xxxxx….xxxxx….. On right-of-way, I just want to add one thing. If we have to improve the quality of service, modification of building bylaws is also very much required….We have taken up this issue with Ministry of Housing and Urban Affairs. But a lot of work has to be done on that on topmost priority basis; otherwise the quality of telecom service will not be up to the mark and we will not be able to give proper coverage particularly for the 5G."

(ii) <u>Requirement of Small Cells</u>

111. As large numbers of small cells are required to be deployed, in order to reduce the approval time and administrative burden of local authorities, batch processing for group of small cells will play a crucial role. Also, for making deployment of huge number of small cells economically viable, administrative fee for getting approvals/clearances needs reconsideration. Though comprehensive RoW rules 2016 have been declared, necessary steps need to be taken to follow up with

the state governments for getting RoW rules 2016 implemented properly. Moreover, keeping with the requirements of small cell deployment, suitable amendment in the RoW rules will be beneficial.

112. The Committee asked pending amendment in the RoW Rules, whether any stopgap arrangements are being put in place to set up small cell or the proposal for amendment of RoW Rules is under process. TRAI in a written reply stated that the service providers and Infrastructure Providers (IP-1s) need to construct and establish small cell facilities in the public Right of Way. Timely approval process for RoW permissions is required for ensuring faster rollout of 5G connectivity, wherein approximately 1000 Base Station cells per square kilometer are required. For rolling out 5G small cells, providers could utilize the existing electricity poles, streetlight poles or utility poles. Moreover, a 5G cell needs to be connected through a fiberized backhaul. This again requires RoW permissions for laying underground as well as aerial Optical Fiber Cable (OFC). The facilitation of OFC, towers and poles installation through the RoW Rules enables the operators to faster rollout 5G services. Mitigating the present challenges of RoW permissions in the country will expedite infrastructure rollout and make India 5G ready. In view of the above, TRAI is reviewing whether the RoW Rules 2016 have effectively addressed the issues in grant of RoW permissions on time at reasonable prices in nondiscriminatory manner? Accordingly, TRAI has raised various RoW issues for seeking inputs from stakeholders in the recent consultation paper on —Roadmap to Promote Broadband Connectivity and Enhanced Broadband speed". The consultation with the stakeholders is under progress. After the conclusion of the consultation process, TRAI may issue suitable recommendations to the Government for addressing the issues relating to RoW permissions, if any. Further, as a stop gap arrangement, the alternate of OFC backhaul for small cells could be wireless backhaul connectivity. The E and V spectrum bands are considered optimum for providing high speed wireless backhaul connectivity. For this purpose, TRAI has already given its recommendations to the Government for assignment of E and V band spectrum to the service providers.

(iii) Sharing of Infrastructure

113. Infrastructure sharing provides a healthier competitive environment for the telecom market. It also improves economies of scale, avoiding duplication of networks where unnecessary. The increase of infrastructure sharing in the telecom business has allowed for a more efficient pace of expansion and innovation, for example, a faster roll-out of next generation networks and services have been made possible due to sharing of active and passive infrastructure. 5G would require densification of network, thus necessitates to further ease out the sharing of infrastructure. Presently, Infrastructure Providers Category-I (IP-I) are permitted to deploy and share passive infrastructure such as Dark fiber, Right of Way, Duct space, and Towers on lease/rent out/sale basis to the licensees of telecom services on mutually agreed terms and conditions. In the year 2009, the scope of IP-I registration was enhanced to cover the active infrastructure limited to antenna, feeder cable, Node B, Radio Access Network (RAN), and transmission system for and on behalf of Unified Access Service License (UASL)/Cellular Mobile Service Provider (CMSP) licensees. However, IP-I providers are not permitted to own and share active infrastructure, i.e., these elements should be owned by the TSPs.

114. Stressing the need for sharing of fibre, representative of a TSP during the sitting stated as under:

> ~~5~~G rollouts typically have been in countries which are already having more than 90 per cent fibre rollouts. If you look at China, they have 90 per cent of their sites already fiberized. Similarly, if you look at Japan, they have the similar situation. If you look at US, even if it is a widespread market, they have a very good fibre penetration up to each and every site. So, I think, this is very very important that we should have a fibre infrastructure enrichment that should happen which basically would entail permissions to be given within a particular timeframe, or I would say, single window, very clear timeframe for a permission, as well as Government incentivizing the right of way by creating a free right of way and creating fibre as a national asset where we all can pool in our fibre asset and make it available on a sharing basis. I think, sharing the resources right now is very very critical and hence, what we recommend and request is that we should have fibre sharing policy well-defined wherein all the fibre, right from PSUs to TSPs, operators like ourselves and others should share the fibre and make it usable so that we

can let our 5 lakh towers to be lit by fibre. The fiber sharing and using the fiber as a national asset has not been the case till now along with the right of way in terms of its cost and in times that it will be very very critical."

115. Elaborating further on the issue, the representative of Bharti Airtel stated as under:

> "The connectivity of the BTSs through the fiber is another requirement for the roll-out of 5G services. However, India remains highly under-fiberized, providing connectivity to less than 30% of mobile towers and 7% of our homes. The major bottlenecks for low fiber penetration in India have been the difficulties, delays, and costs associated with obtaining Right of Way (RoW) permissions from various state/local authorities.Fiber needs to be accorded with the status of essential national infrastructure, and TSPs should be supported with zero RoW cost with single window clearance so that they can fiberize their BTSs. Sharing of fiber infrastructure across Govt. and private players should be made mandatory, and a pricing model for such sharing need to be adopted."

116. TRAI have informed that they have given their recommendations on "Enhancement of Scope of Infrastructure Providers Category-I (IP-I)' to the Government on 13.03.2020. TRAI has recommended to expand the scope of the IP-I providers, and permit them to own, establish, maintain, and work all such infrastructure items, equipment, and systems which are required for establishing Wireline Access Network, Radio Access Network (RAN), and Transmission Links. The recommendations are under consideration in DoT. Once implemented, this would increase sharing of common active sharable infrastructure established by IP-I providers resulting in efficient utilization of resources.

117. To a query on their plan to meet the fibre requirement of TSPs for 5G services, TRAI in a written reply stated that fiberisation is the key focus area for the industry. The National Broadband Mission launched in December 2019, to achieve the NDCP goal of 'Broadband for All', highlights fiberisation of towers, to increase by around two and half times the current number of fiberized telecom towers in the country. As per the latest data available with TRAI, approximately 30 percent of the total base stations are connected through OFC. It is right that BharatNet will be able

to meet the demand of the Telecom Service Providers for optical fibre connectivity in the rural and remote areas. As per the latest status available on the website of Bharat Broadband Network Limited (BBNL), as on 6th Nov 2020, 4.7 lakh km length of OFC is laid for 1,59,901 Gram Panchayats (GP), out of which 1,47,368 GPs are made service ready (on fibre & satellite). This network can accelerate 5G penetration across rural India. However, BharatNet has its own set of challenges during implementation. TRAI has issued its recommendations to the Government for expeditious rollout and efficient utilization of BharatNet. The same are under implementation in some of the areas. Further, TRAI has already taken steps to increase fiberisation through recent consultation paper on —Roadmap to Promote Broadband Connectivity and Enhanced Broadband speed", illustrating the current footprint status, existing bottlenecks, and opportunities to increase fibre penetration. As the Government is aiming to increase fibre footprint to 5 million-kilometer route and increase fiberized towers to 60% by 2022, TRAI would furnish its recommendations on fiberisation soon.

IX. Use of E and V Bands for Backhaul Spectrum

118. As per TRAI fibre-based backhaul is still in its infancy in India. There is inadequacy in terms of optic fibre cable density both in urban and rural areas and a special focus for its densification in a time bound manner is essential for 5G deployments. While providing the inputs to the Government for the National Telecom Policy in February 2018, the Authority has recommended a number of strategies for increasing fiber penetration in the country. Most of those strategies have got reflected in the National Digital Communication Policy (NDCP) 2018. The Government should focus on implementation and execution of the NDCP 2018 policy strategies as a critical attribute to drive the development of the whole telecom ecosystem in the right direction. If done timely, the policy will provide the impetus, the required thrust, and augur to be extremely positive for 5G launch in India.

119. The spectrum in E Band and V band will provide high capacity backhaul links for mobile networks and is very important specially for deployment 5G network.E-

band was established in the US over 10 years ago. Since then, E-band has grown steadily. E-band is now open in more than 85 countries and the most common regulation for E-band assignment is link-by-link coordination. Over 70 countries across the world including US, UK, Korea, Japan, Australia, Sweden, South Africa among others, have already opened up the 60 GHz (V band) for delicensed usage.

120. Regarding the status of E&V backhaul spectrum, the representative of TRAI submitted during evidence as under:

> "TRAI has recommended giving the E band and V band for backhaul and band, for some portion, as a hotspot and Wi-Fi…… We have already made the recommendation. There are conflicts of interests. One is that the TSPs want that E band should be auctioned but Internet Service Providers and other people are of the opinion that it should not be."

121. Asked about auctioning of E&V band which will not only address fibre requirement but also generate revenue, the Department have replied that the issue of allotment of Microwave Backhaul spectrum to the TSPs, which also include E&V Bands, is part of the ongoing process of finalisation of —Policy for Normative and Transparent Assignment /Authorisation of Spectrum" as well as the TRAI recommendation dated 29 August 2014.

122. Representative of a TSP stated during the sitting as under:

> —Another thing which we always say is that just like fiber is there on the ground, we have the opportunity of using airwaves to reach just like wireline reaches to places. We could use wireless technology to reach people faster. Same thing is true about the ability to use E&V band, the recommendation which has been made by TRAI and DOT in the past, however, it has not been allocated. As an industry body, we have requested that if a quick auction of that can be done along with the spectrum auction that takes place, then it is almost like providing fiber in the air. The ability for us, therefore, to make this figure of 30 per cent go up to 90 per cent becomes that much higher because you are literally having airwave-based fiber so to say."

123. On the issue of delicensing, he further stated as under:

> "There are a lot of other people who are saying that it should be delicensed. Delicense is a problem. In the name of Wi-Fi, people are talking about delicensing. I will just mention one thing. In the last 18 months, 550 MHz has been delicensed. The question to ask is, has it led to proliferation of Wi-Fi? The answer is no. The Wi-Fi that has been put by one-way operators like three of us or it has been done by the common service centers of the Government of India."

124. Bharti Airtel in their submission have stated that with explosive growth of wireless data services across the globe with advent of technologies like LTE, this high capacity spectrum band has been found to be very useful for backhaul transmissions. Many fibre rich countries like Japan and South Korea, among others, are using E&V band for backhaul transmission networks. As backhaul spectrum, it can be used as high capacity focused, point-to-point "pencil beam" links allowing a much higher reuse of the same frequency in a given area & make it suitable for last mile deployments in urban areas. As 5G will enhance the access network's bandwidth and capacity, a higher capacity backhaul spectrum is required. E&V Band can revolutionize 5G and high speed wired broadband. Therefore, an enabling policy for the E&V band as a backhaul needs to be finalized at the earliest.

X. Security Related Issues in 5G Scenario

125. Increased risk of hacking of data is one of the immediate concerns of 5G. In this background the Committee desired to know about the data security related preparedness. To this, the Department stated that the data including voice that goes through the network is protected considering the fact the network protocols reliably take care of potential scenarios. Further several applications say banking transactions etc., are protected end to end with specific application specific encryption keys. However, as 5G is a bouquet of technologies, is considered to work across platforms, devices, radio technologies, threat perception may be higher considering the fact that rollouts have just begun and issues are still being studied. The 3GPP standards do take care of network level protections as may be necessary.

126. Further, enhancing security protection and addressing vulnerabilities is a continuing process with equal responsibility on device makers, network gear makers and application developers as well.

127. To tackle the cyber security related concerns emerging due to introduction of 5G, the Department have stated that the Telecom service in India is provided by the Telecom Service Provider (TSP) after obtaining license from DoT. For ensuring security of Telecom networks the TSP has to abide by the 'Security Conditions' specified in chapter 6 of the license agreement. These —Security Conditions" are technology agnostic and are equally applicable to 5G services. Further, DoT has notified Indian Telegraph (Amendment) Rules 2017 enabling Mandatory Testing and Certification of Telecommunication Equipment (MTCTE), which prescribes that any telegraph which is used or capable of being used with any telegraph established, maintained or worked under the licence granted by the Central Government in accordance with the provisions of section 4 of the Indian Telegraph Act, 1885, shall have to undergo prior mandatory testing and certification in respect of parameters as determined by the telegraph authority from time to time. Telecom Engineering Centre(TEC) has been designated as the Telegraph Authority for the purpose of administration of MTCTE procedure and Surveillance Procedure, and for formulation of Essential Requirements (ER) under MTCTE. One of the important parameters of ER against which the testing and certification shall be carried out is the Security Requirement. The National Centre for Communication Security (NCCS), DoT Bengaluru has been entrusted with the responsibility of drafting the same which shall be called Indian Telecom Security Assurance Requirement (ITSAR). Thus, any Original Equipment Manufacturer (OEM)/ importer/ dealer who wishes to sell or import any telecom equipment in India, shall have to obtain Certificate from Telecommunication Engineering Centre (TEC), DoT and mark or affix the equipment with appropriate Certification label.

128. It is also to mention that the "Personal Data Protection Bill, 2019" has already been introduced in the Parliament on 11th December 2019. Once the PDP Bill is finally approved the directions related to Telecom Sector will be implemented accordingly.

129. The Committee have also been informed that mandatory testing and certification in respect of "Security requirements" is planned to be implemented through a scheme titled "Communication Security Certification Scheme" (ComSeC). National Centre for Communication Security (NCCS) is responsible for implementation of this scheme. The objectives of ComSec are:

- To develop country specific security standards, processes and test specifications.
- To develop security testing and certification eco-system.
- To ensure Telecom network elements meet security assurance requirements.
- To ensure compliance of regulatory requirements pertaining to security testing.
- Security requirements are framed by NCCS, for each Telecom product as per the country requirements by following an open, consultative and transparent process.

130. On the issue of security, representative of a TSP submitted before the Committee as under:

> "We need to very clearly be cognitive of the fact that unlike 4G where the telecom was just a connectivity part of the whole network and we were building roads. From 5G onwards, it will become much more intrusive in our business operations like the applications, the digitisation, e-governance, smart city, all the cameras in a city, the data centres, the device and the chipset in the devices. Now, the more open and more densified this whole network plain gets, the more vulnerable this becomes to threats. The threats are simple. It is a very good term – STRIDE. It talks about the fundamental threats, this is true in any scenario. 'S' stands for Spoofing, 'T' stands for Tampering, 'R' stands for Repudiation which means the ownership and authenticity of the data itself, 'I' is for information disclosure, 'D' is for denial of service making the network unavailable when it is needed more and 'E' is for what they call as escalation of privileges which means that if I am not allowed to access this particular data and somehow I manipulate my privileges to elevate them to get it, all of them will cut across all the nine items in which we build our

network – the hardware which is the physics of the network, the software which is the whole brain of the network and finally the data itself like customer data and the application data. Now, the mitigation strategy to the STRIDE is complying flawlessly with the right standards ensuring that the IPR is either our own which could be the best thing, which is what we are trying, or is validated in such a foolproof way that there is absolutely no backdoor or hacking kind of scenario which comes up. Unless we understand this in its full glory, I think we will be kind of catching up with the nuances that will hit us post the network goes live or post the industries or the Government start riding on this network. It would be a delay if that happens on the post facto basis."

131. In this regard, the representative of a TSP submitted during evidence as under:

> ~~S~~ir, we do have cloud service providers like Amazon and Google. We are having edge networks in India as well. So, what is important is that all the critical services should be hosted more from India as compared to being hosted outside, and the user data and the user information should be secured within the Indian territories. That, I think, is our recommendation and request.

(i) <u>Threat from Imported Telecom Equipment</u>

132. There is a growing reluctance by a number of countries globally to allow Chinese telecommunications giant Huawei to roll out 5G services in their territories. The US has already banned Huawei over concerns of security. When asked about the stand of the Department on the above issue, the Department have informed that they are having close watch on 5G development around the world and would take appropriate decision after evaluating all the pros and cons on 5G ecosystem including social, economic and security considerations.

133. Secretary, DoT stated during the evidence as under:

> ~~S~~ir, DoT has not specifically banned any company. However, we have issued orders based on a representation from our local manufacturers that if there is any country which is preventing our vendors from supplying there, then our PSUs will also not buy from any such country. This order was issued about four or five months back, but no country is named here. So, if there is any such case, then the PSU will have to then not buy from such a country."

XI. Other Issues

(i) Need for Investment

134. TRAI in their White Paper on ‗Enabling 5G in India' had given reference to the report on ―5G: The catalyst to Digital Revolution in India" by Deloitte, where it has been mentioned that while the investment for 5G would grow incrementally as advancements on existing 4G/LTE technology, with 5G spectrum and network densification needs, it is anticipated that industry might require an additional investment of USD 60-70 billion to seamlessly implement 5G networks. Ernst & Young has also estimated that India would have to invest USD 60-70 billion for 5G.

135. When asked to furnish their comment on the above observation, TRAI have stated that it is a fact that substantial amount of investment would be required to roll out 5G services in India. The service providers have to envisage various business cases and the revenue models for commercial success of the 5G network roll out. Service providers should also consider various methods to minimize the cost of deployment. One of the methods is the Infrastructure sharing which is the key for success of 5G.Infrastructure sharing provides a healthier competitive environment for the telecom market. It also improves economies of scale, avoiding duplication of networks where unnecessary. The sharing of towers and equipment also translates into sharing of expertise between telecom companies, and an overall reduction in Capex and Opex costs. Presently, Infrastructure Providers Category-I (IP-I) are permitted to deploy and share passive infrastructure only such as Dark fiber, Right of Way, Duct space, and Towers. TRAI has given its recommendations on 13th March 2020 on ‗Enhancement of Scope of Infrastructure Providers Category-I (IP-I)' vide which TRAI has recommended to expand the scope of the IP-I providers, and permit them to own, establish, maintain, and work all such infrastructure items, equipment, and systems which are required for establishing Wireline Access Network, Radio Access Network (RAN), and Transmission Links. The recommendations are under consideration in DoT. Once the recommendations are implemented, there will be increased sharing of common active sharable infrastructure established by IP-I

providers resulting in efficient utilization of resources and reduction in cost for the TSPs.

136. On the requirement of Government support, representative of a TSP stated as under:

> "The next thing I would like to mention is around the investment required to make this whole thing work. Everybody would acknowledge that there is stress in this sector at this moment. As an industry, all of us individually and as a body, have written to TRAI to also intervene in setting low prices. We understand that in the recent past, the aviation sector has got floor and ceiling, Rs.4000 for a ticket at a minimum and Rs. 10,000 at a maximum. We are balancing out in a difficult situation like this in the consumer's interest and in the industry's interest. We submit that for some time to come, it is very important that price stability is there and the floor pricing would be a great way to ensure that the industry which is supposed to cough up about a hundred billion dollars for 5G investment over the next few years is able to become more robust and therefore contribute not just to the exchequer, because that would be useful by way of revenue share that we give to the Government, but also would become cashflow-rich to handle that. The related area there is National Digital Communications Policy 2018 approved by the Parliament and the Government which talks about reducing the levies and duties. Should that be done quickly, it will again put more money in the hands of the industry to invest faster, and therefore, capitalize the whole 5G movement."

137. Bharti Airtel also submitted as under:

> "5G services launched globally are being offered at the same price levels as 4G services and mostly used for offloading 4G networks and building capabilities to offer FWA services that were not scalable on 4G networks. Given the high level of 4G network usage in the Indian market, 5G would be used mainly for decongesting 4G networks. Hence, it would not increase operators' revenues unless there is price correction in existing 4G & fixed broadband services. However, the adoption of 5G requires massive investments. Therefore, as stated above, it is critical to ensure the telecom sector's viability and sustainability by taking necessary steps such as rationalization of regulatory levies, tariff floor on a temporary basis, etc."

(ii) <u>Availability of Reliable Power Supply</u>

138. Availability of the reliable grid power has also been cited as one of the largest bottlenecks in upgrading the network. According to Tower and Infrastructure

Providers Association (TAIPA), about 35% towers in the country are connected to reliable power supply on Pan India basis. As regards rural areas, on an average, power supply is available for 10-12 hrs. Since telecom services are to be maintained on 24x7 basis, the short fall in the power supply is supplemented through alternate power sources like DG sets, renewable energy solutions and high efficiency battery deployment. Therefore, there is a need to augment grid power supply availability in rural areas for greening of telecom; so that the shortfall in power availability could be met only through deployment of high efficiency battery banks.

139. The cross-sectoral use cases would require coordinated efforts in managing the 5G ecosystem with cross sectoral involvement. For cross-sectoral cases of M2M/ IoT, in order to bring M2M industry concerns and regulatory bottlenecks, DoT has proactively formed M2M Apex Body, M2M Review Committee and M2M Consultative Committee. Domain experts from every vertical which has been considered as potential M2M/IoT market has to get together to address the concerns and also be in advisory role to the policies making bodies of the government. Consultative Committee has been constituted incorporating representatives from Standardizing bodies such as Bureau of Indian Standards (BIS) and Telecom Standards Development Society of India (TSDSI) and sectoral industry representative bodies to bring M2M industry concerns and regulatory bottlenecks to the notice of Apex body. Also, in order to support implementation of actionable points evolved from National Telecom M2M Roadmap, M2M Review Committee has been formed under DoT. The scope of the existing committees can be expanded or broadened for inclusion of all the 5G use cases.

(iii) <u>5G to BSNL and MTNL</u>

140. Cabinet in its meeting held on 23.10.2019 approved the administrative allotment of spectrum to BSNL/MTNL for 4G services through capital infusion. The funds for 4G spectrum has been allocated in FY 2020-21. BSNL had floated a tender on 23.03.2020 for 4G Mobile Network in North, East, West & South Zones of BSNL and Delhi & Mumbai LSA of MTNL on turnkey basis for procurement of 50,000 e-

Node B's of BSNL and 7,000 e-Node B's of MTNL. However, due to some policy issues, that tender has been cancelled and fresh tender will be floated compliant with PMI provisions to give preferential treatment to domestic vendors as per Government of India guidelines. In so far as sourcing of technology and participation of suppliers from different countries is concerned, Government instructions/decisions including provision of the General Financial Rules 2017 (i.e. Rule 144(xi)) and Department of Expenditure order dated 23.07.2020 will be followed.

141. The Government in its decision dated 23.10.2019 decided that BSNL/MTNL will be allotted spectrum for 4G services administratively and funding of the spectrum cost through capital infusion by the Government. BSNL/MTNL has not yet requested for allocation of 5G spectrum.

142. Highlighting the importance of domestic players, TEMA submitted as under:

> —The domestic industry has made huge competence and requisite expertise in the mobile technology domain to compete with foreign OEMs. Domestic players have successfully supplied and managed O&M of more than 2000 sites in BSNL, under LWE areas in 2G technology. Domestic players have also successfully developed the 4G network products and done the POC in BSNL network. We would also like to bring your attention to the DOT's interactions with the domestic industry on their readiness of 4G LTE products for the BSNL/MTNL requirements.
>
> Many Indian Companies have participated and have even showcased their competence in respective areas. We strongly believe the domestic industry should be promoted for design & development of indigenous 4G technologies, such handholding will also help develop domestic ecosystem for 5G technologies also."

143. During evidence, the representatives of TEMA submitted as under:

> —Today, I was to talk about the Indian manufacturing. TEMA appreciates domestic manufacturing. We want Indian manufacturing and at the same time, it is our duty to ensure that the guys who give us order for Indian manufactured goods survive. So, who is giving us orders for Indian manufactured goods are only PSUs, BSNL, MTNL. Now, as per the Government policy, we are being able to supply IDDM and Make in India goods to Indian companies. BSNL, which is of a strategic importance is allowing Make in India, IDDM products to be sold to it. We would wish that BSNL survives and therefore, the policy should be that 30 per cent goods

should be made IDDM with preference to Make in India policy, meeting all those conditions and to ensure that Indian products which they will buy, will be approved on a fast track basis because the policy which is being considered will take 3-4 years for BSNL to roll out 4G. But that will delay the competitiveness of BSNL and that could also be a death knell to BSNL. So, we would wish that 30 per cent is given to IDDM and all that but the pricing which is given is higher because technological development cost initially is higher, therefore, there is a difference in cost and the Government should support to that level. But the 70 per cent, initially, at least, in the next one year could go to others or Make in India products, which do not have Indian-owned technology at present so that the supplies to BSNL can happen and they can roll out the 4G network in the next few months. The domestic companies are putting up our manufacturing plants and technology together. C-DoT, ITI, Sterlite, even Paramount, we are all working towards consortium approach in having a complete Indian made technology. The process is that it will go to different levels of testing, namely, first, second and third, and then only it will be rolling out on a commercial scale. If BSNL dies in the process, then at that time, we will have nobody to again buy our product and we will be lost in the woods. So, that is our hope and claim. We want to survive but we also want our customer to survive."

(iv) <u>Coordinated Efforts across Sectors for 5G Eco-system</u>

144. The cross-sectoral use cases would require coordinated efforts in managing the 5G ecosystem with cross sectoral involvement. For cross-sectoral cases of M2M/ IoT, in order to bring M2M industry concerns and regulatory bottlenecks, DoT has proactively formed M2M Apex Body, M2M Review Committee and M2M Consultative Committee. Domain experts from every vertical which has been considered as potential M2M/IoT market has to get together to address the concerns and also be in advisory role to the policies making bodies of the government. Consultative Committee has been constituted incorporating representatives from Standardizing bodies such as Bureau of Indian Standards (BIS) and Telecom Standards Development Society of India (TSDSI) and sectoral industry representative bodies to bring M2M industry concerns and regulatory bottlenecks to the notice of Apex body. Also, in order to support implementation of actionable points evolved from National Telecom M2M Roadmap, M2M Review Committee has been formed under DoT. The scope of the existing committees can be expanded or broadened for inclusion of all the 5G use cases.

145. The Committee desired to know whether TRAI has conducted any study to understand the best international practices and identify as adopted by other countries. The Committee also enquired as to whether the present body formed by DoT will be adequate to deal with all issues concerning cross-sectoral use cases including 5G. To the above queries, TRAI have replied that it is important to develop India specific use cases across different verticals for utilizing the 5G ecosystem. DoT has taken initiative for development of use cases through setting up of test beds and labs in this regard. For standardization in M2M and IoT segment, TSDSI and Telecommunication engineering Centre (TEC) have carried out the transposition of international standards for use in India. Further, subsequent to formation of M2M Apex Body, a 5G High Level Forum (5G HLF) was set up by the Government in September 2017 to articulate the vision for 5G in India and to recommend policy initiatives & action plans to realize this vision. The 5G HLF released a report in August 2018 titled —Making India 5G ready" suggesting measures in the area of Spectrum Policy, Regulatory Policy, Education and Awareness Promotion Program, Application & Use Case Labs, Development of Application Layer Standards, Major Trials and Technology Demonstration and Participation in International Standards. The Steering Committee formed by 5G HLF created seven Task Forces, each with a Chair and one of these task forces was for —Application and Use Case Labs". Regarding applications and use cases it has been mentioned in the report. Since 5G will support many applications, deeper and faster deployment in India can greatly benefit from the setting up of Applications and Use Case Labs. These labs will provide multiple functions – interoperability testing for new applications, fostering innovation in 5G use cases, and promote entrepreneurship to develop locally tailored solutions. The 5G HLF has recommended that the Applications and Use Case Labs be set up within different economic verticals in a phased manner. Accordingly, DoT has taken initiative in setting up of the Test Beds and labs for use cases involving the key academic institutions.

(v) 5G and Health Concerns

146. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) issues guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz) which cover many applications such as 5G technologies, WiFi, Bluetooth, mobile phones, and base stations. Department of Telecommunications has adopted stricter norms for safety from Electric and Magnetic Fields (EMF) emission from mobile towers in India which has been fixed to be 10 times more stringent than the safe limits prescribed by International Commission on Non-Ionizing Radiation Protection (ICNIRP) and recommended by World Health Organisation. Further, Government of India has taken adequate steps to ensure that Telecommunications Service Providers strictly adhere to these prescribed norms.

147. The Department have informed the Committee that with regard to impact of Electromagnetic Field (EMF) emissions from mobile towers on health, it is intimated that World Health Organization (WHO) has referred to approximately 25,000 articles published around the world over past 30 years, and based on an in-depth review of scientific literature, has stated, —Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals." WHO has concluded - —current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields. WHO has recommended that National authorities should adopt international standards to protect their citizens against adverse levels of RF fields and referred to the international Exposure Guidelines developed by the International Commission on Non-ionizing Radiation Protection (ICNIRP). The main conclusion from the WHO review is that EMF exposure below the limits recommended in the ICNIRP international guidelines do not appear to have any known consequence on health.

148. In the year 2008, DoT adopted the ICNIRP guidelines that are recommended by WHO for basic restriction levels of electromagnetic emission from mobile towers. Further, based on media reports and public concerns an Inter-Ministerial Committee

(IMC) consisting of officers from DoT, Indian Council of Medical Research (Ministry of Health), Department of Biotechnology and Ministry of Environment and Forest was constituted on 24.08.2010 to examine the effect of EMF Radiation from base stations and mobile phones. The Inter-Ministerial Committee (IMC) in its report, has examined the environmental and health related concerns and has indicated that most of the laboratory studies were unable to find a direct link between exposure to radio frequency radiation and health; and the scientific studies as yet have not been able to confirm a cause and effect relationship between radio frequency radiation and health. The effect of emission from cell phone towers on human health is not known yet with certainty.

149. Based on the recommendations by Inter-Ministerial Committee (IMC), norms for exposure limit for the Radio Frequency Field (Base Station Emissions) have been made further stringent and reduced to 1/10th of the existing limits prescribed by ICNIRP. These limits were further reviewed in 2014, based on recommendation of a committee that was setup at the behest of High Court Allahabad, Lucknow bench. The Committee in their report submitted in 2014, has, inter-alia, noted that —there are no conclusive evidence to establish any causal link between the effect of EMF radiation from BTS with biological effects described in cell models, animals or humans, and any possible resulting health effects." After due consideration of the human health concerns on account of EMF radiation being raised in public and the Report of the Committee, the Government has decided, in February 2014, that the present prescribed precautionary EMF safe exposure limits are adequate and need no further change at this stage. In February, 2020, the WHO, in Q&A session on **"5G mobile networks and health"** again clarified that —To date, and after much research performed, no adverse health effect has been causally linked with exposure to wireless technologies.

150. The Committee also enquired from the Department whether some Governments are halting 5G until their health authorities have reviewed the impacts to environmental and human health. The Department in a written reply have stated

that no such information/report regarding halting 5G by some Governments until their health authorities have reviewed the impacts to environmental and human health, has come to their notice. Further, DoT is regularly monitoring the global development in this regard. However, it is reiterated that EMF radiations from a mobile tower, irrespective of technology being used, which are below the safe limits prescribed by ICNIRP and recommended by WHO, have no convincing scientific evidence of causing adverse health effects.

151. Clarifying on the issue, Secretary, DoT, during the sitting stated as under:

> —..xxxx…different literature available world over including WHO clearly say that this is unfounded and there is no basis to say that radiation from the 5G will be harmful to the people."

152. Representative of a TSP during the sitting also stated as under:

> In fact, Indian standards are one-tenth of the global standards. We have actually gone and put the emission standards which is one-tenth of the global standards, and, therefore, there is no issue at all. As industry, we work with the Government and we have made sure 100 per cent of our towers are visible to anybody. We have a portal called Tarang Sanchar, which anybody can go and see what is the emission taking place from any tower in their neighbourhood. Further, by paying this small amount of Rs.5000, they can actually have the DoT to go and do a test and give them a certified test report."

Part-II
Observations/Recommendations

1. The Committee note that 5G is a new member of the vast global communications eco system. The four components of this eco-system are standards development, equipment design and IP development, manufacturing and service provision. 5G standardization and deployment are at a nascent stage and the technology is considered likely to reign the next decade or more considering its relevance across industry verticals. 5G will extend the use of technologies across new sectors of economy. It will enable service providers to develop novel business models to offer innovative applications in different economic verticals from industrial, commercial, educational, healthcare, agricultural, financial and social sectors. Several countries across the globe have already taken a foray into 5G technology.

2. The Committee note that an Inter-Ministerial High Level Forum for 5G India 2020 was constituted in September, 2017 to articulate the vision for 5G in India and to recommend policy initiatives and action plans to realize this vision. This Committee submitted its Report titled _Making India 5G Ready' in August, 2018. Based on the Report, the Government is creating an enabling framework for development of 5G services in India. The 5G services are expected to be introduced gradually and advance to a full range of services as ecosystem and demand for services grows. As per the above Report 5G is the next generation of cellular communications technology with evolutionary and revolutionary services that can have a deep impact on India. 5G can unleash new economic opportunities and societal benefits giving it the potential for being a transformational force for Indian society. It can help the country leapfrog the traditional barriers to development as well as advance the _Digital India' Mission. The cumulative economic impact of 5G on India can reach one trillion USD by 2035. The Committee note that the 3GPP (3rd Generation Partnership Project), an industry driven standardization body that has undertaken the standardization of mobile technologies for the past 25 years, is

currently in the process of developing standards for 5G networks based on the ITU requirements. The Committee have been informed that the Fifth Generation (5G) mobile communication technology is a paradigm shift in the field of communications as it not only enables human to human communications but machine to machine communication in a digitally connected world with a variety of use cases.

However, there are apprehensions that India is set to miss the '5G bus' due to lack of preparedness, spectrum issues, inadequate use-case development, uncertainty around sale of radio waves for 5G, etc. The Committee find that inadequate availability of spectrum, high spectrum prices, poor development of use cases, low status of fiberization, non-uniform RoW issues, deficient backhaul capacity, etc. are some of the factors coming in the way of rolling out of 5G services in India. Considering the immense benefits of 5G for a country like India, the Committee took up the subject 'India's preparedness for 5G' for detailed examination. During the course of examination of the subject, the Committee heard the views of the representatives of the Ministry of Communications (Department of Telecommunications) and Telecom Regulatory Authority of India (TRAI). The Committee also heard the views of the representatives of the Cellular Operators Association of India (COAI), Telecom Equipment Manufacturers Association of India (TEMA) and representatives of three Telecom Service Providers viz., Reliance Jio Infocom Limited, Vodafone Idea Limited and Bharti Airtel Limited. The Committee examined the subject in the light of the views expressed by the above stakeholders and written documents/information furnished by DoT, TRAI, COAI, TEMA and TSPs. The Committee also received inputs from the professors of IITs involved in 5G Test bed development. All the issues relevant to the subject have been dealt with in the succeeding paragraphs.

5G Deployment Around the World vis.-à-vis. Position in India

3. The Committee have been informed by TRAI that globally 118 operators in 59 countries have deployed 5G network. Currently, the 5G network covers around 7 per cent of the world population. It is expected that 20 per cent of the world population will be covered by the year 2025. Major countries where 5G technology have been launched are USA, Canada, UK and European Union, Asia pacific countries like China, Japan, South Korea, Thailand, Australia, New Zealand and Philippine etc. In Middle East, UAE, Oman, Saudi Arabia, Qatar, Kuwait, Bahrain have also launched 5G. In Africa, 5G has been launched in South Africa. Mostly, 5G has been launched partially in these countries. Countries in Asia Pacific like South Korea, Japan and China have witnessed sizeable growth in 5G developments and possibly they are ahead of the curve. The Committee are given to understand that so far China has already developed more than 5 lakh 5G base stations covering around 7-8 per cent of their population. Regarding status of deployment of 5G in India, the Department have informed that 5G High Level Forum has given its report titled 'Making India 5G Ready' to the Government in August, 2018. 5G Hackathon had been organized and the Department have shortlisted 100 use cases for further development. 30 out of 100 use cases will be demonstrated along with TSPs to learn 5G use cases and roll out challenges. However, Cellular Operators Association of India (COAI) has informed the Committee that even though the report of the 5G HLF has been released by the Department of Telecommunications in August, 2018 minimal implementation instructions have been issued so far. Spectrum issues which are at the heart of 5G are yet to be resolved. The TSPs, have submitted that spectrum bands for 5G are yet to be identified and made available to them. The current reserve price of spectrum is one of the highest in the world, which needs to be rationalized taking into account per capita income and reserve price benchmarks of other countries, 5G trial applications have been submitted by the TSPs in the month of January, 2020, however, till date the guidelines for trials have not been made clear and there is no set date for commencement of these trials. When

asked about the timeline for the rollout of 5G, the Secretary, DoT informed the Committee during its hearings that in India 5G technology will initially ride on 4G technology. In the initial years, the core will be 4G and the radio access network will be 5G. First it will not be rolled out pan India, but in selected areas where the demand would justify the Capex. The Committee have been informed that by the end of calendar year 2021 or beginning of 2022, there will be some roll out in India in some specific uses, because 4G should continue in India for at least another 5-6 years.

From the foregoing, the Committee are inclined to conclude that sufficient preparatory work has not been undertaken for launching of 5G services in India. As such, India has not moved beyond the modest beginning stage as compared to other countries in the world. The Committee's concern about this observation is enhanced by the fact that while 2G was deployed globally in 1991, it was deployed in India only in 1995; 3G was deployed globally in 1998 but deployed in India ten years later, i.e. in 2008. Similarly, 4G services were launched in India 7 years after their global launching in 2008. This reflects very poorly on our planning and execution. Now when many countries are swiftly moving towards 5G technology, India is likely to witness its deployment only by the end of 2021 or early part of 2022, that too partially. So it is very likely that after missing the 2G, 3G and 4G bus, India is going to miss on 5G opportunities, unless time-bound action is taken in core areas where Governmental intervention is required. It is disappointing to note that the Department have hardly learnt from the past delays as the vision for 5G which was reflected in the constitution of the HLF and Expert Committees has not been transformed into action on the ground is not reflected in the policies formulated by the Government. The Committee trust that the Government will take expeditious action on the pending recommendations of TRAI. The Government are yet to take action on many of the recommendations of TRAI on issues which have direct bearing on 5G deployment (outlined in subsequent pages).

While expressing their displeasure over the laid back approach, the Committee recommend that the Department review all their policies relating to 5G, identify the areas which need concerted action and fast track their action so that a conducive eco-system for 5G deployment is developed soon and India is not left behind the race for 5G. The Committee desire that the Department should conduct a thorough study of the experience gained by other countries in successfully rolling out 5G for better understanding the complexities involved in the process. The Committee further desire that the Department apprise them of the reasons for delay and explain why India has not been able to catch up and keep pace with comparable countries in rolling out 5G services. The Committee may be kept informed of the progress made as well as hurdles that in the Government's view impede such progress.

<u>Allocation of Spectrum for 5G</u>

4. The Committee note that International Telecommunication Union (ITU) has identified two broad spectrum ranges for 5G, the frequency range-I and frequency range-II. Frequency range-I extends from 410 MHz to 7125 MHz and multiple frequency bands have been identified for 5G in this large range. Frequency range-II is the millimeter wave band lying between 24.25 GHz and 52.6 GHz. Around 40 countries in the world have completed allocation of 5G spectrum. So far as allocation of spectrum for 5G in India is concerned, the Committee note that TRAI on 01.08.2018 had given their recommendation for the auction of spectrum, in the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3400 MHz and 3400-3600 MHz bands for providing mobile services. However, it is disturbing to note that even after the lapse of more than 2 years since TRAI gave their recommendations for auctioning of spectrum, including 3300 MHz to 3600 MHz in the prime band for 5G, the auction of spectrum in this band is yet to be done by the Department. The Department while deposing before the Committee had informed that they are still in the process of preparing a Cabinet Note for auction of bands like 700 MHz, 800 MHz, 900 MHz, 1800 MHz etc. excluding 3300-3600 MHz bands as the Digital Communications Commission has decided to hold auction of 3300-

3600 MHz band separately. The bandwidth of 3300 MHz to 3600 MHz is currently not used for 2G, 3G and 4G. It is envisaged to be used for 5G. The Committee have also been informed that 5G will come in other bands like 700 MHz, 800 MHz, 900 MHz bands in times to come and also in millimeter wave spectrum which are 224.2G GHz to 275 GHz. As this Report is being finalized, the Committee have come to know from media reports that auctions for the above bands except 3300 MHz to 3600 MHz are slated to be held in March, 2021. The coveted 5G spectrum has been kept out of the offer. The Department had informed the Committee that 3300 MHz to 3600 MHz band will also be auctioned sometime in the next six months or so. The Committee fail to understand as to how the TSPs are going to move towards 5G technology without spectrum, the lifeline for 5G, being allocated. No wonder the TSPs and the industry body COAI were in unison in their demand for –right spectrum at right price" as the key for 5G rollout and pleaded for release of spectrum at the earliest.

The Committee, while deploring the Department's unconscionably long delay in auctioning of spectrum, recommend that spectrum auction including auctioning of 3300 MHz to 3600 MHz be conducted at the earliest. The Department have assured the Committee that 3300 MHz to 3600 MHz is going to be auctioned in the next 6 months or so. While urging the Department to take necessary steps so that auction of spectrum takes place early, the Committee also desire that the process of spectrum allocation must be guided by constitutional provisions and the doctrines of equality and larger public good. They, therefore, trust that the Department will take all the appropriate steps for the successful auctioning of the spectrum so as to avoid any litigation or controversy which may further impede the process of 5G launching.

<u>Availability of Adequate Spectrum</u>

5. The Committee note that the 5G ecosystem is currently available in three bands, lower band, Mid Band 3300 MHz to 3600 MHz and millimeter wave band (26 GHz and 28 GHz) for 5G deployment. Globally seven operators have

deployed 5G in lower band, 82 operators have deployed in mid band and more than 8 operators have deployed in mmWave band. However, India at present does not have sufficient spectrum earmarked for 5G in any of these bands. Department of Space and Defence are seeking spectrum in the bands identified for 5G. The Committee have been informed by COAI that to make India 5G ready at the earliest, the Government need to allocate at least 100 MHz per operator in 3.5 GHz, at least 400 MHz per operator in mmWave (26,28,37 GHz) and at least 2x10 MHz per operator in each of these bands in Sub-GHz (600 MHz & 700 MHz). This is without taking into consideration the requirement of the operators in E&V band. In 3.5 GHz, which is basically the mainstream spectrum for 5G, almost every operator across the globe has 100 MHz. However, in case of India out of 300 MHz, 25 MHz are required for satellite uses. About 100 MHz between 3.3 and 3.4 GHz has been demanded by Defence. If this is deducted, only 175 MHz is available. The Committee note that the Department are deliberating with Department of Space (DoS) and the Ministry of Defence (MoD) for making sufficient spectrum available for 5G IMT services. The Department have stated that they have received very positive response and expressed the hope that the issue will be resolved. With regard to mmWave spectrum, the same is yet to be earmarked in India. The average 4G spectrum per operator in India is around one-fourth of the global average. According to submission made by one of the TSPs, we have four times more people and four times less spectrum which means that spectrum available to one person is 1/16th of the global average.

The Committee are fully aware of the extreme shortage of spectrum in the country. Availability of 175 MHz only in 3300 MHz to 3600 MHz band will mean that approximately 50 MHz or so spectrum per operator could be allocated, which is far below the global average. The Committee note that not allocating right amount of spectrum will not only deprive the customers of good quality of services but also lead to severe under utilization of investment made as the equipment installed cannot be optimally utilized. The Committee are of the view that the issue of allocating the right amount of spectrum as

demanded by the industry needs to be addressed by the Department if India is to have the real benefits of 5G. In this regard, the Committee recommend that the Department need to have fruitful deliberation with Department of Space and Ministry of Defence and an understanding must be reached at the earliest for identification of adequate spectrum for 5G services. The Department should also expedite the implementation of OFC based network for Defence services. Efforts should be made to earmark and allocate mmWave band for 5G in consultation with TRAI.

Audit of Spectrum

6. The Committee note that TRAI as back as 2015 have recommended that there is an urgent need for audit of all allocated spectrum both commercial as well as spectrum allocated to various PSUs/Government organizations. However, Government's decision in the matter is still awaited. The Committee are of the view that audit of spectrum is essential for detecting under utilization of this precious natural resource and also to assess the adequacy and operating effectiveness on management control framework in order to make its utilization more efficient. It is deplorable that the Department have neglected such an important recommendation of TRAI, which is both future-oriented and has serious implications for technological advancements. The Committee would like the Department to explain as to why spectrum audit as recommended by TRAI has still not been carried out so far by DoT and come out with specific reasons/compulsions which has forced the Department not to undertake such an exercise. The Committee desire that early decision on spectrum audit may be taken on a priority basis and the findings of the audit may be shared with the Committee.

Issues Relating to High Spectrum Price in the Country

7. COAI has informed the Committee that TRAI had recommended Rs.492 crore per MHz as reserved price for spectrum in 3300 MHz to 3600 MHz for 5G which is far higher than the auctioned spectrum price in other countries. Comparison of unit pricing of 5G spectrum with other countries indicates that

it is 07 times costlier than UK, 14 times costlier than Australia, 35 times costlier than Spain and 70 times costlier than Austria. Bharti Aritel has informed the Committee that the price recommended by TRAI is exorbitantly high and ranges from 3-70 times of the market determined price of the spectrum in other countries in absolute terms and is 16 times of the price in relative terms. They are of the view that there is a need to strike a balance between the Government's expectation to generate revenue from the auction and growth of the sector and the overarching impact of 5G across the sectors. Commenting on the issue, representative of TEMA stated that the policy of spectrum in the country is of inverted structure. Raw material is expected to be purchased at highest price and the product at minimum price which is absolutely unviable. Having noted the unanimous view of industry associations and Telecom Service Providers that spectrum price in India is exorbitantly high and that there is a need to review the spectrum price by taking into consideration factors, such as per capita and ARPU in the country, the Committee sought the views of TRAI on spectrum price. TRAI, to the surprise of Committee, have informed that if comparison is made in terms of population and geographical size, India's spectrum price is one of the lowest. The Committee note, however, that 5G is not intended to be rolled out everywhere in the country, nor extend to the entire population, for some years. TRAI further stated that there are well-defined parameters and if we compare all these parameters India's price is very moderate. The Committee are also given to understand that TRAI have given the reserve price of the spectrum after due consideration of all the aspects and due consultation with the stakeholders. The Department have informed the Committee that proposals for auction of spectrum in various bands including reserve price, after due consideration of TRAI recommendation will be placed before the Cabinet for a decision.

The Committee further note that in order to ease the burden of high spectrum cost, TSPs had been given a one-time opportunity to opt for a higher number of installments (16) instead of the previously permitted 10 installments

in respect of spectrum auction deferred payment, subject to the Net Present Value (NPV) being protected. The Committee have also been informed that considering the stress in the sector, the Government have given an option to the TSPs to defer payment of the spectrum auction installments due for 2020-21 and 2021-22, either for one or both years. The Committee have been informed that all the operational TSPs have generally opted for moratorium of 2 years and deferment of spectrum auction installments will ease the cash outflow of the stressed TSPs and facilitate payment of statutory liabilities and interest in bank loans. Their industry body COAI, on the other hand, have stated that there is a need to rationalize other levies and duties on the telecom sector so as to ease their financial burden, such as providing soft loans against GST input line credit due to operator, reducing spectrum usage charge by 3 per cent for all TSPs and license fees from 8 to 3 per cent, soft loans at MCLR rate using the GST input credit as collateral etc.

Going by the merits of the submissions from both sides, the Committee find that there are fundamental differences between the versions of TSPs and TRAI on fixing of spectrum price in the country and there is a need to review the spectrum pricing policy in the country. The divergent views given by the two sides also implies that there is a need to revisit the nuances of spectrum pricing in other countries and adopt the best practices. The Committee are of the view that telecom is the backbone of many important sectors of economy. Both DoT and TRAI which are at the forefront of telecom revolution in the country need to pay adequate attention to the concerns expressed by the TSPs and industry associations. Considering the stress in the sector and that the 5G ecosystem is yet to be developed, keeping such a huge reserve price for 3.3 GHz to 3.6 GHz will undoubtedly have an adverse impact on the ability of the TSPs to fully rollout 5G in the country. At this rate, price for a block of 20 MHz will be Rs.9,840 crore and minimum price for 80 MHz per TSP will be Rs.39,360 crore. In this, the Committee are of the view that long-term consumer benefit should be the guiding principle and not short term revenue maximization. TRAI need to take the TSPs on board as it is they who are

contributing to the growth of the sector. The concerns expressed by TSPs and COAI cannot be ignored but merit attention. Factors such as per capita income and ARPU should also be taken into consideration. The Committee recommend that the issue of high spectrum prices is looked into and DoT/TRAI should come out with a convincing spectrum pricing policy that is sustainable, affordable and acceptable to all, focusing on consumer interest and socio economic goals of our country. The Committee also recommend that the concerns raised by COAI for rationalization of levies and duties on the telecom sector should also be given time bound consideration by the Government, so that financial burden neither acts as a deterrent for TSPs in their move towards 5G nor places an unsustainable burden on the Indian customers.

Spectrum for Industrial Use

8. TEMA have submitted that apart from Enhanced Mobile Broadband (EMBB), Industry 4.0 is the main driver for 5G. Industry 4.0. is mooted in the concept of advanced manufacturing, also called Smart Manufacturing. Industry 4.0 based solutions enable better interoperability, more flexible industrial processes, and autonomous and intelligent manufacturing. Many countries in the world like USA, Germany, UK and Australia have allocated 5G spectrum for industrial development. For example, in Germany, Mercedes is setting up a factory entirely based on 5G, termed as _Factory 56'. Many countries are setting aside spectrum and laying out policies for industrial growth using 5G. Not only industry, captive users of mobile wireless communications are industries, police, paramilitary, fire, forest and mining, municipal corporations and public utilities as well as critical infrastructure services like Railways, Metros, Airports, Sea Ports, Refineries, Highways, etc. As per the present policy of licensing, TEMA have stated that they have to apply to WPC/DoT for three licenses – Captive Mobile Radio Trunking Services (CMRTS) License, Spectrum License and import License which usually takes six months to two years. They have further informed the Committee that since these captive users only need wireless spectrum for their _captive' use only, it

appears that there should be no need for a separate CMRTS license. TEMA have requested that TRAI may be requested to conduct a public consultation on spectrum needs and issues for captive users. TEMA have also stated that a group be formed to work out policy for spectrum allocation and spectrum of 5G for 4.0 industrial uses.

The Committee feel that Industry 4.0 will be one of the main drivers of 5G in days to come. However, the present licensing policy is not conducive to the growth of Industry 4.0. The manufacturing industry's choice and decision to come to India is heavily dependent on how quickly the Government of India can go ahead and allocate spectrum for 5G-driven industry. The issues relating to licensing and allocation of spectrum for Industry 4.0 need to be properly streamlined to attract the manufacturing industry to set up their base here and also to reap the full benefits of 5G in industry. In this regard, the Committee desire the Department to look into the above suggestion given by TEMA and also to explore all possible issues needed for the success of Industry 4.0, so that spectrum can be allocated and proper policies are laid down for industrial growth of the country using 5G. The Committee would like DoT/TRAI to take the views of stakeholders on board in the matter.

<u>Setting up of Indigenous 5G Test Bed</u>

9. The Committee note that the Department of Telecommunications had approved financial grant for multi-institute collaborative project to set up 'Indigenous 5G Test Bed' for building end-to-end 5G Test Bed in India in March, 2018 with total cost of Rs.224.01 crore. The Test Bed was expected to be ready by October, 2020. However, due to the Covid-19 pandemic, the work of hardware design, fabrication and testing was adversely affected. The test bed is likely to be set up by October, 2021. The Committee have been informed that the indigenous test bed is completely home-grown and it is first of its kind, wherein eight leading academic and research institutes have come together to build the test bed with Government support. The eight collaborative institutions are IIT (Indian Institute of Technology) Madras, IIT

Delhi, IIT Hyderabad, IIT Bombay, IIT Kanpur, IISc Bangalore, Society for Applied Microwave Electronics Engineering & Research (SAMEER) and Centre of Excellence in Wireless Technology (CEWiT). India's effort is unique with special focus on setting up a Test Bed that will be utilized by academic, industry, telecom operators and startups to develop solutions and use cases which can be India specific. The Test Bed is going to raise India's visibility in the global forums and standardization bodies. The Committee also note that '5G Test Bed' project is focused on developing IPRs in the country in 5G technology. Some of the IPRs generated by this project can also be utilized for product development for the Defence sector of the country. It is expected that technology spin-offs from this Test Bed will enable Indian industry and startups to enter the Indian and global markets for 5G telecom equipment, thus addressing a critical gap in our economic and security prospects. The Department have informed the Committee that the Test Bed is not a commercial project, only what is reasonable or affordable will be charged. The Department also foresee a lot of private sector participation for testing.

The Committee are happy to note that the 5G test bed project which is a good example of harnessing the talents and capabilities in the country is progressing well and is going to be ready for operation by October, 2021. The Committee hope that the balance fund of Rs. 45 crore allocated for the project will be utilized fully and project becomes operational as per schedule. It is indeed encouraging to note that some of the best Institutes in the country are making collaborative efforts to develop end-to-end and open Test Bed for 5G. While appreciating the efforts put in for 5G test bed as a right step for promotion of indigenous technology, startups, Indian innovators, the Committee desire that more such collaborative efforts are encouraged in future too by involving more and more Institutes/Industry verticals. The Committee recommend that efforts should be made to get the Test Bed ready and operational as per schedule and the Department must ensure that the deadline is not further extended. The Committee may be kept apprised of the progress of the project and its technological spin-offs.

Setting up of 5G Use Case Labs

10. As per the submission made by COAI, China has been working on use case labs for last two years and claim to have more than 100 use cases for 5G which have been built through initiatives from Government, academia, operators and industry verticals. On the contrary, India does not have any applications or Use Cases which are ready to promote business case and capex investment by operators. Coordinated Government actions are required for enabling digital transformation across sectors. A Digital Readiness Index to measure the same for each sector should be there to monitor progress as well as to enable development of India specific Use Cases. The Committee are given to understand that the Department are working with different Ministries/Departments for setting up of India specific Use Case in education, healthcare, agriculture, public safety, fintech, etc. So far, Institute of Development and Research in Banking Technology (IDRT), an institute under RBI, in collaboration of Department of Financial Services, has come forward for setting up of 5G use case lab in Banking and Financial Services and Insurance (BFSI). The Department are also presently working with Food Safety and Standard Authority of India for setting up of use case lab in food safety certification and Ministry of Health, AIIMS, Ministry of Housing and Urban Development for setting up of use cases in respective domains. To develop more use cases, the Department have organized 5G Hackathon and have shortlisted 100 use cases for further development. Out of these, 30 Use Cases wil be demonstrated along with TSPs to learn 5G use cases and roll out challenges. On the suggestions of COAI for development of Digital Readiness Index, the Department have stated that Broadband Readiness Index is similar to Digital Readiness Index for Telecom sector. The framework on BRI parameters has been prepared based on the objectives of NDCP-2018 and inputs from the industry/expert. The BRI is envisaged to create robust and high quality digital communications infrastructure, attract investments in creating next generation digital communication infrastructure, simplification of compliance and procedures and create a collaborative institutional

mechanism between Centre, States and Local Bodies. An MoU has been entered with Indian Council for Research on Institutional Economic Relations (ICRIER) to develop Broadband Readiness Index for Indian States and Union Territories for the period 2019-2022. The Committee also note that the Department are engaged with the States/UT Governments for the development of BRI and the report for the year 2019-20 is under finalization. COAI has further submitted that India is consuming a very large amount of data per capita in various industry verticals and there is a need to convert the data produced into useful services through the development of Use Cases. The Digital Readiness Index of various sectors can be monitored by a cross sectoral entity, such as NITI Ayog. This will facilitate the monitoring of digital transformation in various sectors and thereby facilitate the development of Use Cases for development of digital services in the most digitalized sectors.

The Committee note with concern that even though Use Cases have been developed around the world, in India no sufficient use cases have been developed so far for successful implementation of 5G in India. The present status indicates that India is far behind countries like China in term of development of 5G. This will undoubtedly have an adverse impact on rolling out of 5G considering that development of sufficient Use Case labs is required for successful implementation of 5G. The Committee recommend the Department to focus on development of Use Cases by providing suitable incentives and support and Use Case labs which are currently under development should be expedited. The Department need to involve more Government Ministries/Departments, start ups/MSMEs, academia, telecom service providers, industries, etc. for development of Use Cases for 5G in the country with adequate funding and hand holding, wherever required. Considering the fact that coordinated Government actions are required for enabling digital transformation across sectors like health, transportation, energy, agriculture, etc. the Committee desire that the Department may consider assigning cross sectoral entity like NITI Ayog to monitor Digital Readiness Index of various sectors so as to facilitate the development of use

cases for development of digital services in the more digitalized sectors. The Committee also recommend that the Broadband Readiness Index Report for the year 2019-20, which is under preparation should also be finalized at the earliest.

Experimental Spectrum Policy and Conduct of 5G Trial

11. The Committee have been informed by the Department that the Government have allowed all applications for 5G trials, in limited areas and for a limited time, to test potential 5G India specific use cases based on enhanced Mobile Broadband (eMBB), Massive Machine Type Communications (MMTC) and Ulrtra Reliable Low Latency Communications (URLLC) in isolation on non-commercial basis subject to strict safeguards. The Department have received 16 applications for 5G trials, using imported as well as indigenous technologies. 5G trials were likely to be started in 2-3 months. DoT have issued guidelines for assignment of spectrum for trials across all available spectrum bands on a nominal fee of Rs.5000. Guidelines for experimental spectrum has also been issued. An Inter-Ministerial Committee has been constituted under Member (Technology) in the Department of Telecommunications for monitoring and evaluation of 5G technology trials. With regard to Indian entities/TSPs that have been issued experimental license, the Department have informed that so far one experimental (radiating) license for 5G Test Bed at IIT, Delhi has been issued on 20.04.2018 with 3 months validity and 5G field trials have not yet been permitted. Though the Department submitted that there are no major issues confronting trials in the country, industry body COAI flagged a number of issues relating to trial spectrum. These include, license for trial spectrum should be for minimum one year, flexibility to conduct trial in any city/location within the circle as per allocated trial spectrum, singe window clearance for the trial license, no equipment/application vendor restriction for conducting lab trial, import duty waiver in 5G trial equipment, etc. TSPs also echoed the same sentiment during evidence that for proper commercial 5G roll outs to take place by 2022,

there is an urgent need to initiate the trials now and start to build the ecosystem. COAI brought out the concern that though TSPs submitted the applications of 5G trial in January, 2020, till date the guidelines for trials have not been made clear and there is no set date for commencement of these trials. Bharti Airtel specifically emphasized that the lab and field trials of 5G should be carried out extensively to test factors, such as interoperability, testing of indigenous 5G infra based an Open RAN ecosystem with the commercial 5G handsets. The trial is also critical to ascertain the interoperability of 5G infra with the existing 4G networks, serving as an underlay network for 5G services.

Notwithstanding the submission of TSPs, and the industry body, it is really disturbing to note that 5G trials have not yet been permitted. This is in complete contradiction to what the Department had informed the Committee during examination of Demands for Grants (2020-21) in the month of February, 2020 that Government have allowed all applications for 5G trials in limited area and for limited time to test potential 5G India specific use cases. The Department have also issued only one experimental (Radiating) license to IIT Delhi for 5G Test Bed in April, 2018 with 3 months validity. The Committee wonder why spectrum for 5G trial has still not been allowed when the Department have categorically stated that there are no major issues confronting trials in the country. Considering that TSPs have submitted their applications for 5G trials in the month of January, 2020, the Committee would like to know the reasons for the delay in issuing spectrum for 5G trials to TSPs. The Committee feel that 5G trials are an essential prerequisite for building the 5G ecosystem and the Department need to take the issues of experimental spectrum and early conduct of 5G trials more seriously. Any further delay will only have an adverse impact on building an ecosystem for 5G in the country and will further delay the launching of 5G services. The Committee recommend that the guidelines relating to experimental spectrum are streamlined and implemented in letter and spirit. The concerns raised by COAI for bringing in improvements in 5G trials may also be looked into by the

Department. The Committee anticipate the number of field trials in the 5G spectrum to accelerate in the coming days.

India's Contribution in Developing 5G Standards

12. The Committee note that the Department and Telecom Standards Development Society India (TSDSI), in collaboration with the IITs, have been successful in getting the Low Mobility Large Cell (LMLC) use case accepted by ITU as one of the 5G requirements for rural area. LMLC reflects the need of rural India in which the distance between two Base Stations will increase up to 6 km against 1.73 km by other technology. This technology will be beneficial for India as well as other developing countries. The TSDSI has been established to enable Indian industry to take the lead in international standardization activities. Currently Indian contribution in design ownership of telecom products is very limited and the Indian market has been a significant user of global products. The Department have informed the Committee that LMLC is part of the IMT-2020 requirements for ITU. This mainly looks at rural connectivity by placing base stations at Gram Panchayats and providing connectivity to the neighbouring villages and farms. LMLC requirement was strongly supported by many African countries in ITU. The Committee have also been informed that the standard could be useful for deeper penetration in urban areas for other 5G applications. Director, IIT, Kanpur has hailed the achievement of TSDSI facilitating the LMLC contribution from India to ITU as an important beginning in 5G revolution. Commenting on the issue, Director, IIT, Madras also stated that the rural towers have to be located where the BharatNet fiber ends, i.e. at approximately 2.5 lakh Gram Panchayats. From the towers at these locations, neighbouring villages numbering more than 3.5 lakh villages have to be provided wireless coverage. Roughly 33 per cent of these villages are between 3-6 km away from the Gram Panchayats, the rest being within 3 km. Ensuring coverage to these villages at distance up to 6 km. is therefore crucial if a large fraction of rural Indians is not to be left out of 5G as well. The Department have also

informed the Committee that in addition to LMLC, academia, R&D units, startups and Indian companies are participating with Government in 3GPP, ITU, IEEE, IEC and are engaged in providing contributions to developing the standards and trying to incorporate Indian technologies. The Committee are given to understand that more efforts can be made by the Indian research community to take their research contributions to 3GPP and other global standards development organization such as IEEE through forum offered by TSDSI.

The Committee are of the view that LMLC is a suitable technology for providing telecom connectivity in rural India. The Committee are glad to note that for the first time a global standard is emerging from India at ITU. This will enhance rural coverage and reduce capex cost. It is indeed a big achievement to note that LMLC use case has been accepted by ITU as one of the 5G requirements for rural area. The Committee are given to understand that LMLC is a test configuration for rural eMBB use case which has become part of the IMT 2020 performance requirements at ITU. The Committee recommend the Department to make sustained efforts to contribute in development of 5G standards by engaging academia, R&D units, startups and Indian companies. The Committee desire that the Department continue to represent the aspirations of the rural population and facilitate their access to telecom services and keep on safeguarding their interest in international forums such as ITU.

<u>Need for Harmonization of Indian Standards with the Global Standards</u>

13. The Committee note that the need for enhanced rural coverage is one of the important aspects to cover rural and remote areas. IIT Madras and associate institutions have developed a variant to the 3GPP standard (Release. 15) with the objective to enhance coverage in the existing standards and also offered technology solution to implement it. This is called TSDSI RIT and is self-evaluated by an Independent Evaluation Group and submitted to ITU. The standard compliant to the requirements of 5G technology, the TSDSI

RIT along with the original 3GPP standard have been recommended by the ITU. Some of the other developing countries also supported the TSDSI RIT considering its relevance for enhanced rural coverage, which implies reduced capex costs to cover a certain defined area. One of the Indian operators also supported the TSDSI standard. The Department have also informed the Committee that after formal release of the standards, the TSDSI may recommend the standard to DOT for its consideration. DoT will take a policy decision after taking several factors into consideration on its Indian adoption. The Department have further stated that TSDSI RIT has been approved by ITU SG5 and one of the standards which has successfully completed all evaluation steps for IMT 2020. This is hence qualified for commercial deployments. It is in final stage of approval by the 193 member states of ITU. TSDSI-RIT (5Gi) is a standard/technology specification approved by ITU which meets the IMT 2020 requirements (including LMLC) with enhanced performance for LMLC rural eMBB use case. The concern of the TSPs relate to TSDSI-RIT.

COAI have submitted before the Committee that it is important to have globally harmonized standards for 5G to allow interoperability and economies of scale. India should adopt globally harmonized 3GPP standards. If India adopts any standard other than 3GPP, it would disconnect India from the globally harmonized standard, device & network ecosystem. This would severely impact 5G rollouts, its adoption in India and increase cost. Bharti Aitel also has submitted that current TSDSI RIT standards being proposed for 5G are not globally harmonized. The adoption of TSDSI RIT without global harmonization would make India an isolated island in the global 5G ecosystem. GSMA & GSA have raised concerns on the same with DOT. Bharti Airtel have also cited examples of similar efforts in the past by other countries like China (TS-SCDMA, local 3G standards), Korea (WiBro — local 4G standards) etc. which proved to be failures due to the lack of harmonization of these standards with the global ecosystem. COAI have further informed the Committee that even after submission of the inputs of the TSPs to TSDSI regarding technical errors, incompleteness, unimplementability aspects and

non-testability issues in TSDSI documents, these have not been incorporated in the TSDSI RIT. Issues related to interoperability of the proposed specification with global 3GPP specification still prevail and remain unaddressed. Performance gain of proposed specifications compared to 3GPP specifications have not been established. Also, the 3GPP has identified that there is an overlap in the signalling messages of TSDSI, which will cause interoperability issues. Globally harmonized standards also allow economies of scale. The network and customer devices when developed for mass market will have economies of scale; however, if isolated devices are to be developed for niche market, the cost will definitely rise. COAI have suggested that the timelines should to be laid down for resolution of gaps around Interoperability, Performance, Implementation, Alignment, and IPR in the proposed TSDSI RIT specifications.

When the Committee drew the attention of the Department to the above concerns around standards, the Department have stated that India should adopt standards that are harmonized sufficiently with global standards to ensure inter-operability, roaming, and to derive ecosystem benefits such as economies of scale. However, it is possible to adopt carefully enhanced variants of the global standard that specifically provide some features of importance to India such as enhanced rural broadband coverage, without compromising on either inter-operability or economy of scale. ITU standards are in final stages of approval for finalization. India has not adopted any standard for 5G services as yet. On the apprehensions that India will trap itself into a corner isolated from the global 5G ecosystem, Director, IIT, Madras has informed the committee that this is wholly misplaced, as inter- operability and compatibility between the 3GPP 5G and the TSDSI 5Gi standards can easily be ensured, since the latter is merely an enhanced version of the former. Moreover, there will be no cost implications as equipment will support both standards through mere software selection and in a manner transparent to the user.

The Committee find that the objective of TSDSI RIT to enhance rural coverage is a worthy initiative; however, the concerns raised by COAI and other TSPs are also alarming and a cause for concern. Going by the merits of the views given by the Department and experts on the one hand and the entirely different views of COAI and TSPs on the other, Committee would like to sound a word of caution that while continuing with fostering innovation in the field of development of 5G standards, India should adopt only those standards that are globally harmonized to ensure interoperability, economies of scale, and help build a conducive device & network ecosystem. Considering that similar efforts in the past by other countries like China, Korea, etc. have been failures due to the lack of harmonization of these standards with the global ecosystem, the Committee would want the Department to be extra careful before adopting such standards in the country. The Committee recommend that the Department should look into the concerns raised by COAI and TSPs and ensure that their concerns are adequately addressed. While emphasizing that India should adopt the standards that are good for the country, the Committee also desire that the Department should also take into consideration the interests of all before taking the final decision and adopt standards that will be in the best interest of the country.

<u>Promotion of Domestic Manufacturing of Telecom Equipment and Affordable 5G Handsets</u>

14. The Committee note that recently Government have taken many initiatives under —Make in India" and —Atma Nirbhar Bharat" for promotion of domestic manufacturing in the country. The Committee hope that domestic manufacturing in the country will receive a fillip through the implementation of these policies. The Committee are of the view that the promotion of proper R&D is absolutely necessary for the success of telecom manufacturing in the country. An ecosystem must be developed for complete manufacturing rather than just assembly, as manufacturing gives much higher value addition. A Telecom Research and Development Fund (TRDF) is to be created with an initial corpus of Rs. 1000 crore for promoting research,

innovation and manufacturing indigenous telecommunications equipment. The Committee recommend that TRDF as proposed by TRAI should be created at the earliest. Apart from this, the suggestions given by TEMA for extension of PPP MII policies to private telecom operators, and TEC, DOT technical specifications to all public or private operators as also State Government/State PSUs, may be given a thorough consideration by the Department. The Committee also note that India is a price-sensitive market. Therefore, the success of 5G rollout will also greatly depend on the availability of affordable 5G devices. The Committee note that the creation of a mobile manufacturing ecosystem, including components, in the country is the need of the hour. The Committee are also given to understand that the promotion of globally harmonised standards for 5G will allow the development of common smartphones/infrastructure, which will drive down the cost of services. The local standards approach will affect affordable 5G devices, making the devices cost higher apart from causing delay in the rollout of 5G. The Committee recommend that the ecosystem for 5G smartphones and devices is created and nurtured and right incentives are given to domestic manufacturers who should be encouraged under 'Make in India' and 'Atma Nirbhar Bharat" to ensure that affordable 5G devices and smartphones are readily available for the successful rollout of 5G services.

Development of Open RAN in the Telecom Network

15. The Committee note that in a single RAN model, the control to resolve many of the challenges that confronts the TSPs on a day to day basis lies with just one telecom vendor, which designed the particular hardware/software because the software and interfaces remain either proprietary or 'closed' by the individual vendor and are often tied to the underlying hardware by the same vendor. 'Open RAN' is a movement in wireless telecommunication to disaggregate hardware and software and to create open interfaces between them. Open RAN is about de-coupling of hardware and software and thus provides more choices and interoperability. In cost effective market like India,

Open RAN promises to offer a substantial saving to the telecom operators and also help in promoting 'Make in India' and 'Atma Nirbhar Bharat'. The Committee have been informed that Open RAN can have a large presence in India provided supportive policy and enabling environment are put in place to accelerate the revolution. Considering the fact that it has the potential to give the legacy telecom equipment vendor a strong and effective competition in the RAN market, the Committee desire that the Department create an enabling environment for Open RAN in the country by providing financial incentives for research, development and production of Open RAN solutions. The suggestion of the TSP for enabling Open RAN Centre for Excellence is worth consideration by the Department. This will not only lead to cost saving and other benefits for the TSPs but will also help India to emerge as a global leader in Open RAN hardware and software development. The Committee recommend the Department to take suitable policy measures for promotion of Open RAN in the telecom sector by providing requisite thrust in this direction.

Development of Indigenous 5G Technology

16. The Committee are given to understand that Reliance Jio had developed its own 5G technology using 100 per cent homegrown technologies and plans to offer it to other telecom companies. The Committee note that the Department have sought details from them. However, the Department have not tested the technology and examined it. Jio has also given an application for a trial using their own technology. With regard to the development of 5G technology by domestic industry, the Committee have been informed that apart from Reliance Jio, 5G Test Bed is coming up with technology, and the Department are also encouraging C-DoT to come up with 5G technology. ITI has also recently tied up with system integrators like Tech Mahindra, TCS etc. for 4G equipment. They are also discussing with couple of Indian companies with 4G upgradable to 5G solutions. ITI has the capabilities to take up manufacturing of Radio equipment for 4G/5G and has been discussing with Original Equipment Manufacturers to have transfer of technology to

manufacture these products. TEMA have also informed the Committee that Indian OEMs have proved time & again their expertise on technologies. Indian prowess on Software is recognized world over. In recent times there is more of software in telecom equipment than hardware. Indian telecom equipment has already proved them in implementing many mission critical and national importance networks (Bharatnet, NFS, AFNET etc) based on domestically developed equipment. 5G standards are Open standards. Foreign OEMs has an edge in 2G, 3G & 4G; however, in the case of 5G, this is not the case. All components can be developed individually with no dependency on one component working over the other, as 5G Use Cases do not just cover Mobile Users but a plethora of applications. TEMA requested that for 5G, domestic procurement be made mandatory, so that Indian companies are able to first have an in-country deployment base and then are enabled to enter the world market. The Director, IIT, Kanpur also emphasized on the need for developing indigenous 5G technology. According to him, India currently has an insignificant share of its own homegrown product or equipment manufacturing companies in the domain of mobile communication technology. As discussed earlier, we missed the 3G and the 4G bus already. However, due to the changed nature of network components and the architecture of 5G, we now have an opportunity to develop products in India. Unlike specialized hardware elements in the earlier generations of mobile networks, a large number of equipment/network entities in the 5G network will be based on software running on off-the-shelf hardware. Specialized chipsets and hardware elements may not be needed for most of the network entities in the 5G network, barring elements like Radio Frequency front-ends and the antenna sub-system. This provides an opportunity to Indian vendors (R&D and software vendors) to leapfrog and start developing a 5G network equipment for deployments in India and across the world, given our expertise in software.

The Committee are of the view that the development of indigenous 5G technology by the domestic telecom industry is very important in view of the fact that India is greatly dependent on the import of telecom equipment.

Considering that there will be multi-fold increase in demand for telecom equipment to provide ubiquitous connectivity, it is desirable that the Department should take initiatives to promote domestic capabilities and support Indian companies for developing homegrown technologies. This will not only help in addressing the burgeoning telecom import bill and help save precious foreign exchange, but will also help in addressing national security concerns. India has missed the 3G and 4G bus; however, it is comforting to note that, due to the changed nature of network components and the architecture of 5G, it offers us an opportunity to develop products in India. The Committee note that the key design principles used by 5G networks called `softwarization' of network components provides an opportunity to Indian vendors (R&D and software vendors) to leapfrog and start developing 5G network equipment for deployment in India and across the world, given our expertise in software. The Committee recommend that sincere efforts must be made by the Department so that India can take full advantage of the opportunities emerging out of 5G. It will be a great achievement if Indian companies can develop end-to-end 5G technology and emerge as global players in 5G technology. The Committee would like the Department to work in a mission mode in order to encourage Indian companies to develop home-grown 5G technologies. The Committee further recommend that the Department should make serious efforts to minimize their reliance on foreign support and wherever unavoidable due regard be paid to national security considerations.

<u>Uniform RoW Policy across States</u>

17. COAI have submitted that Uniform RoW policy across states has a critical role in the operationalization of a strong and robust 5G telecom network in the country. India lacks fiberized sites and there needs to be strong Government push to build at least 50 percent sites on fibre. Providing free RoW for this will be a great contributor in the national interest of providing 5G access to the entire nation. Explaining the difficulties, the representative of

Reliance Jio stated that there are multiple agencies right from State Governments, Municipalities to RWAs which have erected entry barriers to the laying of fibre. The ability of the TSPs to reach out to the customers is seriously hampered by delays, exorbitant costs and non-uniform RoW rules and this could be the single largest cause of delay in the expansion of the 5G network across the length and breadth of the country. The Department have stated that The Indian Telegraph Right of Way Rules, 2016 (IT RoW Rules, 2016) govern the RoW for setting up of towers and laying of fibre in the country. Some of the main challenges in providing RoW across all States/UTs are delay in issuing permissions due to lack of an online single window clearance system, lack of clarity regarding documents required for submission of application for RoW permission, multiple policies with multiple levies of charges and procedures by many States/UTs, lack of availability of Government Land & Buildings for installation of Mobile Towers (as procedure for the same has not been included by many States/UTs in their existing policies). The IT RoW Rules, 2016 provide uniform rates for granting RoW permission by the States/UTs. So far 16 States/UTs have aligned their RoW Policies/Rules with the Indian Telegraph Right of Way Rules, 2016. Various Seminars, Regional Workshops, Meetings are being held from time to time with the States/UTs, including other stakeholders, for reviewing the implementation of IT RoW Rules, 2016. Requests have been/are being made to Chief Ministers and Chief Secretaries of the remaining States/UTs from time to time for aligning their RoW Rules/Policies with the IT RoW Rules, 2016. The Committee have also been informed by TRAI that a very detailed recommendations have been made by them. They have suggested that a time-bound schedule should be prepared for grant of RoW permission and if required, Municipal Act or the Municipal Corporation Act and the Panchayat Act should be amended and specific provisions should be made. There is also increasing cost overruns and in many of the cases the rates are prohibitive. The Committee note that TRAI is going to work with the State Governments and they are preparing a White Paper on it. TRAI have also suggested that to

improve the quality of service, modification of building bylaws is also very much required. TRAI have taken up this particular issue with the Ministry of Housing and Urban Affairs.

The Committee note that the Right of Way issue is still a big concern in our country. Even though the Department had issued the Row guidelines in 2016, only 16 states have aligned their policies with the RoW rules. The result is that different states are having different rules. Since Local Bodies and municipal corporations are laying down separate rules and this has greatly hampered the work of TSPs to lay fibre, the Committee are of the view that considerable efforts need to be made by the Department on topmost priority for implementation of uniform RoW policies. If the present situation continues, then Row issues will definitely act as stumbling block and it will be difficult for the TSPs to provide the best quality of services. To solve the RoW issues, the Committee desire that the Department should look into the matter by taking various stakeholders on board and come out with coherent and practical solutions. In this regard, the Committee desire that the suggestions given by TRAI for the time-bound issue of RoW permissions, suitable amendment of Municipal or Panchayat Acts, building bylaws, fixing of uniform RoW rates across the country, etc. may be considered by taking it up with concerned Department/Ministry and appropriate authorities at the earliest. The Committee feel that there should be common guidelines for States/UTs for RoW permission and specific provisions for the same may be made in Municipal law. Since modification of building bylaws is also very much required, the Committee recommend that the Ministry of Housing and Urban Affairs may be impressed upon to furnish their views and comments at the earliest, to permit a suitable policy decision on RoW issues for the safe and convenient passage of fibre and also come out early with a White Paper by taking various stakeholders on board. The Committee also recommend that TRAI complete the consultation process on the —Roadmap to Promote Broadband Connectivity and Enhanced Broadband speed" so that suitable

recommendations may be issued to the Government for addressing all remaining issues relating to RoW permissions.

Fibre as National Asset

18. The Committee note that Infrastructure Providers Category-I (IP-I) are permitted to deploy and share passive infrastructure such as Dark fibre, Right of Way, Duct space, and Towers on lease/rent out/sale basis to the licensees of telecom services on mutually agreed terms and conditions. In the year 2009, the scope of IP-I registration was enhanced to cover the active infrastructure. However, IP-I providers are not permitted to own and share active infrastructure, i.e., these elements should be owned by the TSPs. TRAI has recommended to expand the scope of the IP-I providers, and permit them to own, establish, maintain, and work all such infrastructure items, equipment, and systems which are required for establishing Wireline Access Network, Radio Access Network (RAN), and Transmission Links. The recommendations are under consideration in DoT. Once implemented, this would increase sharing of common active sharable infrastructure established by IP-I providers resulting in efficient utilization of resources. The National Broadband Mission launched in December 2019, to achieve the NDCP goal of 'Broadband for All', highlights fiberisation of towers, to increase by around two and half times the current number of fiberized telecom towers in the country. As per the latest data available with TRAI, approximately 30 percent of the total base stations are connected through OFC. Further, TRAI has already taken steps to increase fiberisation through recent consultation paper on "Roadmap to Promote Broadband Connectivity and Enhanced Broadband speed", illustrating the current footprint status, existing bottlenecks, and opportunities to increase fibre penetration. As the Government is aiming to increase fibre footprint to 5 million-kilometer route and increase fiberized towers to 60 percent by 2022, TRAI would furnish its recommendations on fiberisation soon. The Committee also have been informed by the TSPs that 5G rollouts typically have been in countries which are already having more than 90 per cent fibre rollouts. They

have suggested that Government should incentivize the right of way by creating a free right of way and creating fibre as a national asset. They have asked for a well defined fibre sharing policy which can be shared by all from PSUs to TSPs, so that 5 lakh towers can be lit by fibre. The sharing of fibre and using fibre as a national asset has not been the case till now. Commenting on the issue, Bharti Airtel has submitted before the Committee that the connectivity of the BTSs through fiber is one important requirement for the roll-out of 5G services. However, India remains highly under-fiberized, providing connectivity to less than 30 percent of mobile towers and 7 percent of our homes. Fibre needs to be accorded the status of essential national infrastructure, and TSPs should be supported with zero RoW cost with single window clearance so that they can fiberize their BTSs. Sharing of fibre infrastructure across Govt. and private players should be made mandatory, and a pricing model for such sharing needs to be adopted.

The Committee are in full agreement with TSPs that sharing of fibre will provide a healthier competitive environment for telecom market. It will improve economies of scale, avoiding duplication of networks where unnecessary. The Committee note that, at present in India, IP-I providers are not permitted to own and share active infrastructure and TRAI had recommended to expand the scope of the IP-I providers. The recommendations are under consideration in DoT. The Committee recommend that the Department should consider the recommendation made by TRAI early, as this would increase sharing of common active sharable infrastructure established by IP-I providers, resulting in the efficient utilization of resources. The Committee further note that the main reason that India remains a fibre-challenged country in the world is because of difficulties, delays and costs associated with Right of Way permissions from various state/local authorities, and it is high time these issues are addressed. The Committee feel that there is an urgent need for a well defined fibre sharing policy which can be shared by all starting from PSUs to TSPs so as to increase fibre footprint and decongest our cities. The Committee are of the firm view that introducing an enabling policy like single

window clearance for the grant of permission for fibre laying will be of great help. The Committee recommend that the Department should take all necessary steps to increase India's fibre footprint so that the goal of covering 5 million kilometres and 60 per cent fiberized towers by 2022 is achieved.

Use of E and V Bands for Backhaul

19. The Committee note that fibre-based backhaul is still in its infancy in India. There is inadequacy in terms of optic fibre cable density, both in urban and rural areas, and a special focus for its densification in a time-bound manner is essential for 5G deployment. TRAI has recommended a number of strategies for increasing fibre penetration in the country and most of these strategies have been reflected in the National Digital Communication Policy (NDCP) 2018. The Committee have been informed that TRAI has recommended giving the E band and V band for backhaul and V band, for some portion, as a hotspot and Wi-Fi. The spectrum in E Band and V band will provide high capacity backhaul links for mobile networks and is very important specially for deployment 5G network. E-band was established in the US over 10 years ago. Since then, E-band has grown steadily. E-band is now open in more than 85 countries and the most common regulation for E-band assignment is link-by-link coordination. Over 70 countries across the world including US, UK, Korea, Japan, Australia, Sweden, South Africa among others, have already opened up the 60 GHz (V band) for delicensed usage. However, the Committee were disturbed to see the anguish and frustration of TSPs that in India, the decision to permit the opening of the E&V band for backhaul purposes is still pending. The Department have replied that the issue of allotment of Microwave Backhaul spectrum to the TSPs, which also include E&V Bands, is part of the ongoing process of finalisation of —Policy for Normative and Transparent Assignment/Authorisation of Spectrum". The TSPs have requested that Government may consider auction of E and V band along with the spectrum auction. They have expressed the view that this will be like providing airwave based fibre. TSPs have also expressed the view that delicensing is a problem.

They have informed the Committee that in the last 18 months, 550 MHz has been delicensed but this has not led to the proliferation of Wi-Fi. On the other hand, the Committee have been informed by the Department that while the TSPs want the E band to be auctioned, Internet Service Providers and others are of the opinion that it should not be auctioned. The Department have further stated that it will be allowed to be used for Wi-Fi only.

The Committee clearly note that TSPs are demanding an enabling policy for the E and V bands, keeping in view their usage for both integrated access and backhaul transmission. The Committee note that many fibre rich countries like Japan and South Korea, among others, are already using E&V band for backhaul transmission networks. Keeping in view the fact that the laying of fibre requires manpower, in addition to considerable investments, and that the provision of spectrum in the E&V band will provide the requisite high capacity backhaul links for mobile networks which is essential in 5G deployment, the Committee desire that the Department should identify the spectrum in E&V band and frame a policy and suitable guidelines to allocate them to TSPs for meeting their backhaul needs. The current cumbersome approval process should also be amended. On the issue of delicensing the E&V band, the Committee desire the Department to take a balanced approach where both TSPs and ISPs come to an agreement so that both will equally benefit from the allocation of this scarce resource. The Department should not lose sight of the fact that the telecom operators as they themselves pointed out to have invested thousands of crores in acquiring spectrum for providing telecom services and hence they should not be deprived of providing services in advanced technology due to want of backhaul requirements, which can be taken care of by spectrum in E and V band. The Committee expect the Department to evolve a policy that will give due consideration to all these aspects.

Security Scenario in 5G Climate

20. The Committee note that with so much data being shared through mobile network, there is an increased risk of hacking of data on 5G connections. Usually data including voice that goes through the network is protected, considering the fact the network protocols reliably take care of potential scenarios. Further, several applications, such as banking transactions, are protected end-to-end with application specific encryption keys. However, as 5G is a bouquet of technologies considered to work across platforms, devices, radio technologies, the threat perception may be higher considering the fact that rollouts have just begun and issues are still being studied. When asked about India's preparedness with regard to the security architecture for 5G, the Department have informed the Committee that Telecom Service Providers (TSPs) provide telecom service in India after obtaining licenses from DoT. Therefore, with regard to the security of Telecom networks, TSPs have to abide by the 'Security Conditions' specified in chapter 6 of the license agreement. Further, DoT has notified the Indian Telegraph (Amendment) Rules, 2017 enabling the Mandatory Testing and Certification of Telecommunication Equipment (MTCTE) which prescribes that any telegraph which is used, or capable of being used, with any telegraph established, maintained or worked under a licence granted by the Central Government in accordance with the provisions of section 4 of the Indian Telegraph Act, 1885, shall have to undergo prior mandatory testing and certification in respect of parameters as determined by the telegraph authority from time to time. The Committee have also been informed that mandatory testing and certification in respect of "Security requirements" is planned to be implemented through a scheme titled "Communication Security Certification Scheme" (ComSeC). National Centre for Communication Security (NCCS) is responsible for implementation of this scheme.

Reliance Jio has informed the Committee that from 5G onwards, technology will become much more intrusive in our business operations, given the applications, widespread digitisation, e-governance, the smart city

project, all the cameras in a city, the data centres, the device and the chipset in the devices, etc. Now, the more open and dense this whole network gets, the more vulnerable it becomes to threats. The threats are simple and can be represented by the term STRIDE, where 'S' stands for Spoofing, 'T' stands for Tampering, 'R' stands for Repudiation, 'I' for information disclosure, 'D' for denial of service making the network not available when it is needed, and 'E' for what they call the escalation of privileges. The mitigation strategy to combat STRIDE is to comply flawlessly with the right standards, ensuring that the IPR is either our own or is validated in such a foolproof way that there is absolutely no backdoor or hacking kind of scenario. TEMA have submitted that while the focus is on 5G, it is important not to lose sight of the cyber threats that are faced by existing infrastructure like small city networks, BharatNet, power grid infrastructure, banking infrastructure, etc. 5G infrastructure is going to be a national strategic asset. There is lot of data being shared on 4G networks and it will only increase multifold in 5G networks. Because of the increased dependency of communication networks, the hacking of 5G networks is a very clear national security risk. The Committee concur with the view that the only solution is to build secure and trustworthy indigenous communication infrastructure. Vodafone Idea has suggested that all our critical services should be hosted more from India as compared to being hosted from outside and the user data and user information should be secured in the Indian territories.

The Committee observe that while 5G promises to deliver low latency, high speed and more reliable connections, there is going to be heightened security risks in a 5G scenario. Managing security is going to be much more complex and complicated as 5G is a bouquet of technologies that are supposed to work across platforms, devices and technologies. STRIDE is just one of the threat models identified by Reliance Jio. The Committee can well foresee that 5G will generate massive data, both personal and non-personal, which will demand special efforts for its protection. The growing concern over availability and protection of user data and privacy will exacerbate with

security challenges in 5G. The Committee are aware the Personal Data Protection Bill, 2019 is still under consideration of the Government and will deal with various data security issues. The Committee recommend that to address the threat to data security, indigenous IPR, equipment and software should be encouraged and developed. It is important to examine in detail the need for critical services to be hosted from India so that user data and user information are secured within Indian territory, provided this does not impede India's access to global services and data flows. On the issue of mandatory testing of telecom equipment, the Committee are concerned to note that the Indian Telecom Security Assurance Requirement has still not been finalized and notified. The Committee recommend that it should be finalized at the earliest. The Committee also feel that cyber security threats are a collective concern and there is a need for a collective effort to build an effective Government data protection and security strategy. The Committee are hopeful that DoT will work in greater co-ordination with MeitY/Cert-In, State Governments and other agencies on cyber security in the 5G environment. The Committee also urge the Department to study the experience of other countries on 5G rollout and report to them about their experience with regard to security concerns.

<u>Threat from Imported Telecom Equipment</u>

21. The Committee are given to understand that there is a growing reluctance by a number of countries globally to allow Chinese telecommunications operators like Huawei and ZTE to rollout 5G services in their territories. The US and the UK have already banned Huawei over concerns of security. The Department have informed the Committee that they are closely watching 5G development around the world and would take an appropriate decision after evaluating all the pros and cons on 5G ecosystem including social, economic and security considerations. The Department have not specifically banned any company including Huawei and ZTE. In view of the security-related concerns raised by various countries, such as USA and European Union, the Committee feel that adequate precautions should also be

taken by India before installing telecom equipment from Chinese sources in the Indian telecom network including 5G. The Committee desire that in-built safety measures be put in place to ensure that the security of the country is not compromised. The Committee also desire that such safety mechanisms should be strictly adhered to by both the public and private telecom companies.

Availability of Reliable Power Supply

22. The Committee note that the availability of reliable grid power in India is one of the largest bottlenecks in upgrading the network. Only about 35 percent of the towers in the country are connected to reliable power supply. As regards rural areas, on an average, power supply is available for just 10-12 hrs. Since telecom services are to be maintained on 24x7 basis, the shortfall in the power supply is supplemented through alternate power sources like DG sets, renewable energy solutions and high efficiency battery deployment. The Committee are of the view that there is an urgent need to augment grid power supply, especially in rural areas, by taking up the matter with the Ministry of New and Renewable Energy. This will not only ensure better quality of service but will also help in the greening of the telecom sector. The Committee also recommend that the Department should make an active effort to introduce renewable energy, such as solar energy, to power telecom towers in the country. The Committee are also of the view that the Department must take the necessary steps to utilize the existing tower infrastructure for installing antennas of the TSPs.

5G to BSNL and MTNL

23. The Committee are concerned to note that 4G spectrum has still not been allocated to BSNL/MTNL, even though the Cabinet in its meeting held on 23.10.2019 had approved the administrative allotment of spectrum for 4G services through capital infusion. The funds for 4G spectrum has been allocated in FY 2020-21. BSNL had floated a tender on 23.03.2020 for a 4G

Mobile Network on turnkey basis. However, due to some policy issues, that tender has been cancelled and a fresh tender will be floated compliant with PMI provisions to give preferential treatment to domestic vendors as per Government of India guidelines. State-owned BSNL and MTNL have not yet planned the introduction of 5G services yet on their networks. TEMA has desired that to promote domestic manufacturing it is important that BSNL/MTNL survive, because only PSUs are placing orders for Indian manufactured goods. BSNL, which is of strategic importance, purchases Make in India, IDDM products which might remain unsold otherwise. The issue remains of why Indian manufactured products are not deemed sufficiently attractive by other entities.

The Committee observe that the revival of BSNL/MTNL is critical for domestic telecom manufacturing industries as they are the only ones purchasing Indian manufactured goods, and they have been implementing important schemes in remote rural areas and LWE affected areas. In such circumstances, the survival of BSNL/MTNL is in the national interest. In order for BSNL/MTNL to remain viable telecom service providers in the country, the Committee recommend that necessary measures be taken to allocate 4G spectrum to them at the earliest. The Committee also recommend that the Department also take adequate measures to ensure that 5G spectrum be allocated to BSNL/MTNL at the same time as private TSPs, so that they are in a position to compete and stay relevant in the market. They recommend that if necessary, the Government can provide necessary guarantees, such as through a Letter of comfort to BSNL/MTNL to facilitate 4G/5G allocation.

<u>Coordinated Effort Across Sectors for 5G Eco-system</u>

24. The Committee note that it is important to develop India-specific Use Cases across different verticals for utilizing the 5G ecosystem. The cross-sectoral Use Cases would require coordinated efforts in managing the 5G ecosystem with cross-sectoral involvement. The Committee have been informed that for cross-sectoral cases of M2M/ IoT, in order to bring M2M

industry concerns and regulatory bottlenecks, DoT has proactively formed an M2M Apex Body, a M2M Review Committee and a M2M Consultative Committee. Domain experts from every vertical that has been considered as a potential M2M/IoT market have to get together to address the concerns and also be enlisted to serve in an advisory role to the policy making bodies of the Government. A consultative Committee has been constituted incorporating representatives from Standardizing bodies such as Bureau of Indian Standards (BIS) and Telecom Standards Development Society of India (TSDSI) and sectoral industry representative bodies to bring M2M industry concerns and regulatory bottlenecks to the notice of the Apex body. The scope of the existing committees can be expanded or broadened for inclusion of all the 5G use cases.

The Committee observe that 5G will lead to the convergence of multiple sectors and critical sectors will no longer work in silos. This calls for convergence between various regulatory bodies/authorities so as to arrive at a consensus on multiple regulatory frameworks and different laws applicable to them. The Committee recommend that the scope of the existing Committees should be expanded or broadened for inclusion of all the 5G Use Cases. The Committee also recommend that efforts must be made by the Department to work in tandem with different Ministries so that an inter-sectoral regulatory body to deal with regulatory issues emerging due to the development of 5G Use Cases in different sectors may be identified and set up at the earliest. The Committee trust that such regulatory bodies shall intervene in conflict situations and also help formulate policies that will promote innovation in development of 5G Use Cases and local entrepreneurship in the country.

<u>5G and Health Concerns</u>

25. The Committee note that the International Commission for Non-Ionizing Radiation Protection (ICNIRP) issues guidelines for limiting exposure to electromagnetic fields which cover many applications such as 5G technologies, Wi-Fi, Bluetooth, Mobile phones, and base stations. The

Department have informed the Committee that WHO has concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields. In the year 2008, DoT adopted the ICNIRP guidelines that are recommended by WHO for basic restriction levels of electromagnetic emission from mobile towers. An Inter-Ministerial Committee (IMC) was constituted in 2010 to examine the effects of EMF radiation from base stations and mobile phones. The Committee note that based on the recommendation of IMC, the norms for exposure limit for the Radio Frequency Field (Base Station Emission) have been made further stringent and reduced to 1/10th of the existing limit prescribed by ICNIRP. After taking into consideration the concerns raised in public and report of the IMC, the Government in 2014 decided that the present prescribed limits are adequate and need no further change. WHO has again clarified in 2020 that to date, and after much research performed, no adverse health effect has been causally linked with exposure to wireless technologies. The Department have also informed the Committee that no information or report has come to their notice regarding any Government halting the rollout of 5G until their health authorities have reviewed its impact on the environment and human health. As earlier noted, the Committee have also been informed that there is a portal called TARANG Sanchar, where anybody can go and check the levels of emission taking place from any tower in their neighbourhood.

The Committee are glad to note that India had adopted an exposure limit of Base Stations that is 1/10th of the existing limit prescribed by ICNIRP, thereby ensuring that the levels of permitted exposures are much lesser in India when compared with other countries that have adopted the ICNIRP guidelines. However, there are many citizens' groups, RWA, local organizations which are not convinced of the findings made by WHO regarding the absence of adverse health effect due to exposure to radiation from base stations of mobile towers. The Committee have also received representations from noted citizens' groups expressing fear relating to radiation which they feel will escalate due to intrusive technology of 5G. The

Committee feel that 5G technology is still in a nascent stage and the real dangers of radiation for health will become clearer only when its application becomes all pervasive. The Committee recommend the Department not only to rely on the reports of WHO, but to keep their eyes and ears open to other studies and scientific researches that emerge from time to time on health hazards from 5G radiation. The Committee also recommend that the Department should collaborate with other Ministries and Institutes for a long-term India-specific research to study the impact of EMF from mobile towers and propose adequate budgetary allocation for this purpose. At the same time, the Department/TRAI should carry out a continuous and effective awareness programme to educate the masses. While appreciating the Department's launching the TARANG Sanchar Portal, the Committee are of the view that greater efforts need to be undertaken by the Department to increase the visibility and awareness of the portal among the general public.

Telecom Services as Essential Services

26. The Committee are of the view that telecommunications services have become inevitable for the growth of key sectors in the country. Its role and importance in business and Government, and in empowering different sections of society, can hardly be overstated. It is also becoming a force multiplier for various other sectors of the economy. Considering its importance for business, Governments and various other sectors, the Committee feel that it is a high time that the Government should treat telecommunications services as an essential service like water and electricity and accord ICT the status of essential national infrastructure. The telecom sector needs to be treated as an important strategic sector and no longer only as source of revenue for the Government. The Committee, therefore, desire that necessary legislation be formulated to declare telecom services as an essential service and telecom infrastructure as critical infrastructure of the country. The enabling legislation can also address several related issues such as theft of fibre, disruption of services, RoW, cyber security measures and other matters addressed in the present report, which are well beyond the

scope of the Indian Telegraph Act of 1885. Such new legislation can underpin the various measures reviewed by the Committee in this report, and equip the country better to take its place as a significant telecommunications power in the 21st Century.

New Delhi;
04 February, 2021
15 Magha, 1942 (Saka)

DR. SHASHI THAROOR,
Chairperson,
Standing Committee on
Information Technology.

Appendix-I

STANDING COMMITTEE ON INFORMATION TECHNOLOGY (2019-20)

MINUTES OF THE TWENTY-FIRST SITTING OF THE COMMITTEE

The Committee sat on Tuesday, the 11 August, 2020 from 1100 hours to 1345 hours in Main Committee Room, Parliament House Annexe, New Delhi.

PRESENT

Dr. Shashi Tharoor - Chairperson

MEMBERS

Lok Sabha

2. Smt. Locket Chatterjee
3. Dr. Nishikant Dubey
4. Smt. Raksha Nikhil Khadse
5. Ms. Mahua Moitra
6. Shri Santosh Pandey
7. Col. Rajyavardhan Singh Rathore
8. Shri L.S. Tejasvi Surya

Rajya Sabha

9. Dr. Anil Agrawal
10. Shri Syed Nasir Hussain
11. Shri Shaktisinh Gohil

Secretariat

1.	Shri Y. M. Kandpal	-	Director
2.	Dr. Sagarika Dash	-	Additional Director
3.	Shri Shangreiso Zimik	-	Deputy Secretary

List of Witnesses
Department of Telecommunications

Sl. No.	Name	Designation
1.	Shri Anshu Prakash	Secretary
2.	Shri K. Ramchand	Advisor
3.	Shri Hari Ranjan Rao	Joint Secretary
4.	Shri YGSC Kishore Babu	DDG
5.	Shri R. K. Pathak	DDG
6.	Shri Surendra Rai	DDG

Cellular Operators Association of India (COAI)

Sl. No.	Name	Designation
1.	Lt. Gen. Dr. S P Kochhar	Director General
2.	Shri Vikram Tiwathia	Dy. Director General
3.	Shri Vertika Misra	Sr. Director

Telecom Equipment Manufacturers Association (TEMA)

Sl. No.	Name	Designation
1.	Shri Ravi Sharma	Chairman, TEMA
2.	Prof N.K. Goyal	Chairman Emeritus, TEMA
3.	Shri Saurabh Kumar	Vice Chairman, TEMA Integration Council, Vice President, Sterlite Technologies Ltd.
4.	Shri Bharat Bhatia	Chairman, Empowering India through Wireless Spectrum Council and President ITU APT India.
5.	Shri Sandeep Aggarwal	Vice Chairman, TEMA, Chairman PH,D Telecom Committee, Co Chairman TEPC
6.	Shri Rajiv Aggarwal	Vice Chairman, TEMA Finance Committee, CFO Primetel Plus staff to help in adm maters
7.	Ms. Manisha Kumari,	GM, TEMA

2. At the outset, the Chairperson welcomed the Members to the sitting of the Committee convened for briefing by the representatives of the Department of Telecommunications on the subjects…..xxxxx…xxxxx….. and _India's preparedness for 5G' and to hear the views of the representatives of the Cellular Operators Association of India (COAI) and Telecom Equipment Manufacturers Association of India (TEMA) on the subject _India's preparedness for 5G'.

(The representatives of the Department of Telecommunications were then called in)

3. …..xxxxx…xxxxx…..…..xxxxx…xxxxx…..…..xxxxx…xxxxx…..

4. …..xxxxx…xxxxx…..…..xxxxx…xxxxx…..…..xxxxx…xxxxx…..

5. …..xxxxx…xxxxx…..…..xxxxx…xxxxx…..…..xxxxx…xxxxx…..

6. Thereafter, the Committee took up the subject _India's preparedness for 5G' for examination. The Chairperson in his initial remark drew the attention of the representatives of DoT to the findings of inter-Ministerial High Level Forum 5G India 2020, lack of preparedness, lack of spectrum, inadequate use case development, uncertainty around the sale of radio waves for 5G, etc.

7. The representatives of the Department made their submission on the issues pertaining to 5G such as Mobile Technologies and 5G, 5G vision for India, illustrations of 5G applications in the field of agriculture, transport, surveillance and traffic management, education, health, etc., status of setting up of indigenous 5G Test Bed and deployment strategy, India's contribution in 5G standard development, status of 5G technology development in India, etc. During the course of deliberation, Members raised queries on issues such as measures for promotion of domestic manufacturing industry, status of utilization of funds available with USOF, status of development of indigenous 5G Test Bed, status of utilization of funds allocated, criteria for selecting the institutes for development of 5G Test Bed, availability of spectrum, etc. The representatives of the Department responded to the above queries.

8. The Chairperson, then, thanked the representatives of the Department of Telecommunications for deposing before the Committee.

(The witnesses then withdrew.)

[The representatives of Cellular Operators Association of India (COAI) and Telecom Manufacturers Association of India (TEMA) were then called in]

9. The Chairperson welcomed the representatives of COAI and TEMA to the sitting of the Committee. The representatives of TEMA submitted before the Committee on the need for India to develop an eco system for complete manufacturing rather than just assembly to become global destination for manufacturing, need to promote R&D in security networks, immediate release of spectrum for industrial 4.0 uses. TEMA suggested that BSNL should be asked to promote connectivity in North-East, Left Wing Extremism Affected Areas and border and hilly areas on priority.

10. Thereafter, the representatives of COAI made their presentation focusing on issues, such as status of availability of 4G in India. impact of restricting Huawei and ZTE from supplying telecom equipment, need for inter-Ministerial consultation for spectrum allocation, support required from Government for 5G readiness viz. internationally harmonized spectrum, gaps and delay in allocation of trial spectrum for 5G, uniform RoW policy across States and need for high fiberization, etc. They emphasized on the need for 5G use cases and coordinated Government action for enabling digital transformation across sectors and a digital readiness index to measure the same. They urged for rationalization of regulatory levies such as License Fees, spectrum usage charges, USO Levy and costs, etc.

11. The queries raised by the Members were responded to by the representatives of TEMA and COAI. At the end, Hon'ble Chairperson thanked the representatives of COAI and TEMA for presenting their views before the Committee.

The witnesses then withdrew

Verbatim proceedings of the sitting have been kept on record.

The Committee, then, adjourned.

….xxxxx… Matters not related to the Report

Appendix-II

MINUTES OF THE FOURTH SITTING OF THE STANDING COMMITTEE ON INFORMATION TECHNOLOGY (2020-21) HELD ON 27th OCTOBER, 2020

The Committee sat on Tuesday, the 27th October, 2020 from 1600 hours to 1900 hours in Committee Room No. '3', Extension to Parliament House Annexe, New Delhi.

PRESENT

Dr. Shashi Tharoor – Chairperson

MEMBERS

Lok Sabha

2. Smt. Raksha Nikhil Khadse
3. Shri Dhairyasheel Sambhajirao Mane
4. Ms Mahua Moitra
5. Shri P.R. Natarajan
6. Dr. Gaddam Ranjith Reddy
7. Shri Jayadev Galla
8. Shri Bhanu Pratap Singh Verma

Rajya Sabha

9. Dr. Anil Agrawal
10. Shri Y.S. Chowdary
11. Shri Syed Zafar Islam
12. Shri Nabam Rebia

SECRETARIAT

1.	Shri Y.M. Kandpal	-	Joint Secretary
2.	Dr. Sagarika Dash	-	Additional Director
3.	Shri Shangreiso Zimik	-	Deputy Secretary

List of Witnesses

Reliance Jio Infocomm Limited

Sl. No.	Names	Designation
1.	Shri Shyam Prabhakar Mardikar	Group CTO
2.	Shri Mahipal Singh	VP, Regulatory
3.	Shri Ravi P. Gandhi	President, Reliance Retail

Vodafone Idea Limited

1.	Shri P. Balaji	Chief Regulatory & Corporate Affairs Officer
2.	Shri Mudit Agarwal	Executive Vice President - Technology
3.	Shri Sundeep Kathuria	Executive Vice President – Regulatory & Policy

Bharti Airtel Limited

1.	Shri Sandeep Gupta	Head Strategy and Architecture
2.	Shri Tarun Chitkara	General Manager (Regulatory Affairs)

Department of Telecommunications (DoT)

Sl. No.	Names	Designation
1.	Shri Anshu Prakash	Secretary (Telecom)
2.	Shri K. Ramchand	Member (Technology)
3.	Smt. Anita Praveen	Additional Secretary (Telecom)
4.	Shri Hari Ranjan Rao	Joint Secretary (T)

Telecom Regulatory Authority of India (TRAI)

1.	Dr. P.D. Vaghela	Chairman
2.	Shri S.K. Gupta	Secretary
3.	Shri Rajiv Sinha	Principal Advisor (NSL)
4.	Shri S.T. Abbas	Advisor (NSL-II)

2. At the outset, the Chairperson welcomed the Members to the sitting of the Committee convened to hear the views of the representatives of Telecom Service Providers (TSPs) i.e. Reliance Jio Infocomm Limited, Vodafone Idea Limited and Bharti Airtel Limited, Department of Telecommunications and Telecom Authority of India (TRAI) on the subject _India's preparedness for 5G'.

(The representatives of Reliance Jio Infocomm Limited, Vodafone Idea Limited and Bharti Airtel Limited were then called in)

3. Welcoming the representatives, the Chairperson sought the views of Telecom Service Providers (TSPs) on their preparedness for the 5G services in India and their level of engagements with DoT and TRAI on this issue.

4. Taking the floor, the Group CTO of Reliance Jio drew the attention of the Committee to the humungous amount of work required to be done in a country of this size with demographic disparities for launching of 5G services. Flagging concern over lack of digital fibre network and broadband challenges before the country, he expressed views that 5G would need a significant change in the way of policy, the subsequent implementation, the execution of right of way and availability of reliable grid power. The representative of Jio also submitted that right amount of spectrum at right prices as per the global practices would be essential to carry out 5G services effectively. To achieve the desired objectives, incentivisation of whole _Make in India' scheme and the right intellectual properties in the country would be essential from an affordability perspective as well as from compelling nature of technology, he added. On security aspect, he was of the view that 5G becoming more intrusive in the business operations, would become more vulnerable to threats which can be abbreviated as STRIDE (Spoofing, Tempering, Repudiation, Information Disclosure, Denial of Services and Escalation of Privileges) which could be mitigated through complying flawlessly with the right standards ensuring that the IPR is either our own or is validated in a foolproof way. On the issue of their current level of engagements with DoT and TRAI, the Committee were informed by the JIO representative that all the TSP are together and in discussion on trial spectrum and full trial labs.

5. Thereafter, the representatives of Bharti Airtel briefed the Committee about 5G. He alluded that right amount of spectrum with right pricing and development of IPRs in Indian market, including need of adequate and proper infrastructure with fibre sharing policy are essential pre-requisite for the 5G launch. He desired Committee to help Telecom Service Providers (TSPs) in getting the infrastructure ready for fibre rollout which is going to be the platform for 5G network. Expressing concern over creating islands of technology through some standards which are specific to India he apprehended that this will actually become bottleneck to the 5G mission and, therefore, stressed the need for harmonizing Indian standards globally. He added that smart phones and connected devices will be important pre-requisite for 5G and therefore an appropriate ecosystem for 5G smart phones and devices

with proper incentivisation under ‗Make in India' is the need of hour. The representative of Bharti Airtel also stressed the need for having innovations in 5G technology in right direction with global harmonization.

6. The representative of Vodafone who took the floor thereafter was of the view that lot of efforts are required to be made to derive huge socio-economic benefits of 5G which would need alignment of roadmaps with worldwide standards. He was of the view that India need to initiate the 5G trials now with an ecosystem. He supported the idea of use of wireless technology to reach people faster. In order to achieve the target of 90 per cent fibrization for 5G services, the representative of Vodafone pleaded for the auction for allocation of E&V band with spectrum allocation. Touching upon the issue of impact of 5G in HR development the representative from Vodafone seemed optimistic that early launch of 5G would open up many digital jobs in the world economy. He, however, insisted on price stability for the already stressed sector with the floor pricing in order to create a robust industry which may contribute to the exchequer as well as be useful by way of revenue sharing. He desired that National Digital Communications Policy 2018 should be implemented quickly in order to put more money in the hands of industry to invest faster and capitalize 5G movement.

7. On a specific query by the Chairman regarding building a competitive environment in order to give benefits to the consumers, the representatives of industry were of the views that a vibrant industry will be built on the certain price stability which all of them have requested for and sought intervention of the Committee in this matter.

8. The Chairperson drew the attention of the representatives to a TRAI report which speaks that India would be the largest user of E-band in the world and desired clarity in the matter. The industry representative informed the Committee that there were two bands E & V and both of them are available but unused which need to be delicensed in a systematic manner. The representatives sought help of the Committee in getting them E-band to rollout their so called fibre in air or wireless fibre.

9. On the issue of potential danger of 5G technology on health, the representatives informed that Indian standards are 1/10 of the global standards and therefore this is not a cause of concern. They further informed that they have a portal called *Tarang Sanchar* which enables anybody to go and see the rate of emission that is taking place in the tower of neighbourhood and suitable corrective measures including penalties have been put in place.

10. The Members raised various queries regarding the reserve price, better cash flow and profitability in the sector, price stability, low level of preparedness in rural areas, urban rural divide, inadequate fibrization of towers, identifications of bands for Service Providers, Defence, etc., cyber security, manufacturing of 5G handsets, global harmonization of standards, R&D, Chinese collaboration in the 5G business, etc. which were replied to by the TSPs. All the TSPs were unanimous in their demand for right amount of spectrum with right roadmap and right pricing along with

right infrastructure in order to give their best and affordable services to their customers.

11. The Chairperson thanked TSPs for appearing before the Committee and desired that the queries of Members which could not be replied may be sent in writing.

The witnesses then withdrew

(The representatives of DoT and TRAI were then called in)

12. The Chairperson while welcoming the Secretary, DoT, Chairman, TRAI and other officials of the DoT and TRAI to the sitting of the Committee drew their attention to the concerns expressed by the industry representatives over the minimal availability of spectrum and exorbitant pricing and level of support from the Government being given to these service providers. He also drew the attention of the representatives to the issues of gaps and delays in allocation of trial spectrums, implementation of uniform right of way policy across states, lack of a proper ecosystem for 5G rollout, not working with globally harmonised standards, etc. He also expressed concern over great deal of policy frustration and very slow decision making process on the part of the Government as informed by the TSPs.

13. Thereafter, the representatives of TRAI made a power point presentation on India's preparedness on 5G which inter alia highlighted on key performance indicators of 5G, 3 categories of Use Cases, requirements for 5G, 5G access spectrum, 5G ecosystem, steps taken by TRAI, recommendations for auction of spectrum of 5G, and sharing infrastructure for 5G, etc.

14. On the issue of providing E-band to the TSPs, the representative of DoT informed that it has not been open for access even on the recommendations of TRAI but being allowed to be used for wifi purpose only. According to the DoT representative, E-band is primarily for the Backhaul and also for the access of wireless wifi. They informed that Committee that limited Backhaul may not provide adequate speed and ultimately quality of service will suffer. According to them, E & V bands are very valuable bands and not auctioned in other countries also.

15. On the concern expressed by TSPs regarding high spectrum prices, the representative of TRAI informed that they have done a scientific exercise in a transparent manner and they have a consultation paper which is available on the website. Based on this, cabinet has to take a call on the pricing. They, however, expressed hope that the concern of the stakeholders will be taken into account.

16. Regarding the security concern over the use of 5G technology, the representatives of TRAI informed that the standards in India are far far more stringent and the radiation is set at lower in terms of what is permitted. This is much lower than the WHO standards.

17. On the issues of global harmonization of 5G standards, the representative of DoT informed the Committee that these standards are being followed as they believe in harmonious standards because there has to be an ecosystem which is operable.

18. Members also raised queries regarding recommendations of TRAI in the 3.3 GHz to 3.6 GHz which is going to be used for 5G, identification and allocation of spectrum to departments of ISRO, Department of Defence, Navy, etc., Inter-ministerial issues of band identification, connectivity of devices for 5G, 5G Use Cases, development of test beds in coordination with IITs and IISc, network slicing, involvement of Chinese companies and technology on 5G trials, etc. which were replied to by the representative.

The Chairperson thanked the witnesses for appearing before the Committee.

The witnesses then withdrew

Verbatim proceedings of the sitting have been kept on record.

The Committee, then, adjourned.

Appendix-III

STANDING COMMITTEE ON INFORMATION TECHNOLOGY (2020-21)
MINUTES OF THE FIFTH SITTING OF THE COMMITTEE

The Committee sat on Tuesday, the 10th November, 2020, from 1600 hours to 1730 hours in Main Committee Room, Parliament House Annexe, New Delhi.

PRESENT

Dr. Shashi Tharoor- Chairperson

MEMBERS

Lok Sabha

2. Shri Karti P. Chidambaram
3. Dr. Nishikant Dubey
4. Dr. Sukanta Majumdar
5. Shri Dhairyasheel Sambhajirao Mane
6. Ms. Mahua Moitra
7. Shri P. R. Natarajan
8. Shri Santosh Pandey
9. Col. Rajyavardhan Singh Rathore
10. Shri Sanjay Seth
11. Shri Bhanu Pratap Singh Verma

Rajya Sabha

12. Dr. Anil Agrawal
13. Shri Md. Nadimul Haque

Secretariat

1. Shri Y. M. Kandpal	-	Joint Secretary
2. Dr. Sagarika Dash	-	Additional Director

List of Witnesses

Department of Telecommunications

Sl. No.	Names	Designation
1.	Shri Anshu Prakash	Secretary, DoT
2.	Shri K. Ramchand	Member (Technology)
3.	Ms. Anita Praveen	Additional Secretary
4.	Shri Hari Ranjan Rao	Joint Secretary
5.	Shri R. K. Pathak	DDG(IC)
6.	Shri Kishore Babu	DDG(SRI)
7.	Shri Surendra Rai	DDG(NT)

Telecom Regulatory Authority of India

Sl. No.	Names(Mr./Ms.)	Designation
1.	Dr. P. D. Vaghela	Chairman
2.	Shri S. K. Gupta	Secretary
3.	Shri Rajiv Sinha	Principal Advisor (NSL)
4.	Shri S. T. Abbas	Advisor (NSL-II)
5.	Shri Sunil Kr. Singhal	Advisor (BB&PA)

2. At the outset, the Chairperson welcomed the representatives of the Ministry of Communications (Department of Telecommunications) and Telecom Regulatory Authority of India (TRAI) to the sitting of the Committee. After the initial remarks by the Chairperson, the representatives of the Department made a power-point presentation highlighting the advantages of 5G in agriculture, transport, surveillance and traffic management, education, health, smart homes, etc. The power-point presentation also included the status of 5G in India, setting up of an indigenous 5G test bed and its deployment strategy, broad areas of work of the Participating Institutes, contribution of TSDSI in global standards, 5G use case for banking and financial services, 5G Hackathon, etc.

3. Members raised queries on availability of spectrum, international parameter for pricing of spectrum, allocation of E and V band, spectrum for testing facilities, Low Mobility Large Cell (LMLC), Low standards of fiberization, identification of millimeter wave etc. which were replied by the Department.

4. Members also enquired about the 5G test bed project being developed by IIT, Madras, the timeline of the project, use cases of 5G fiberization status, right of way rules, non reliability of grid power, security related concerns, delicensing of E and V bands, Policy on affordable handsets etc. The Department submitted that for the right of way guideline and rules, they have made detailed recommendation to the Ministry of Urban Development and a time bound schedule needs to be prepared on the right of way rules.

5. The Department assured the Committee that the fears of danger caused by 5G radiation are unfounded and they will furnish in writing, the concerns about dangers posed by microwave radiation coming from 5G towers and steps taken by the Department to dispel these concerns.

6. The Chairperson, then, thanked the representatives of the Department of Telecommunications and TRAI for deposing before the Committee.

The witnesses then withdrew.

Verbatim Proceedings of the sitting have been kept on record.

The Committee, then, adjourned.

Appendix-IV

STANDING COMMITTEE ON INFORMATION TECHNOLOGY (2020-21)
MINUTES OF THE FIFTEENTH SITTING OF THE COMMITTEE

The Committee sat on Wednesday, the 3rd February, 2021 from 1400 hours to 1525 hours in Committee Room 'B', Parliament House Annexe, New Delhi.

PRESENT

Dr. Shashi Tharoor- Chairperson

MEMBERS

Lok Sabha

2. Shri Karti P. Chidambaram
3. Shri Sunny Deol
4. Smt. Raksha Nikhil Khadse
5. Shri Dhairyasheel Sambhajirao Mane
6. Shri P. R. Natarajan
7. Shri Santosh Pandey
8. Col. Rajyavardhan Singh Rathore
9. Dr. Gaddam Ranjith Reddy
10. Shri Sanjay Seth
11. Dr. T. Sumathy (A) Thamizhachi Thangapandian
12. Shri Bhanu Pratap Singh Verma
13. Smt. Sumalatha Ambareesh

Rajya Sabha

14. Dr. Anil Agrawal
15. Shri Shaktisinh Gohil
16. Shri Syed Nasir Hussain
17. Shri Syed Zafar Islam
18. Shri Nabam Rebia

Secretariat

1.	Shri Y. M. Kandpal	-	Joint Secretary
2.	Shri H. Ram Prakash	-	Director
3.	Dr. Sagarika Dash	-	Additional Director
4.	Shri Shangreiso Zimik	-	Deputy Secretary

2 At the outset, the Chairperson welcomed the Members to the sitting of the Committee convened to consider and adopt Draft Report on the subject 'India's Preparedness for 5G' relating to the Ministry of Communications (Department of Telecommunications). For the convenience of the Members, Hon'ble Chairperson gave a broad overview of the Observations/Recommendations contained in the Report.

3. The Committee, thereafter, took the draft Report in for consideration and adopted the same with certain modifications.

4. The Committee, also, authorized the Chairperson to finalize the draft Report and present the same to the House during the current session of Parliament.

The Committee, then, adjourned

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