Telecom Sector Demand 2020
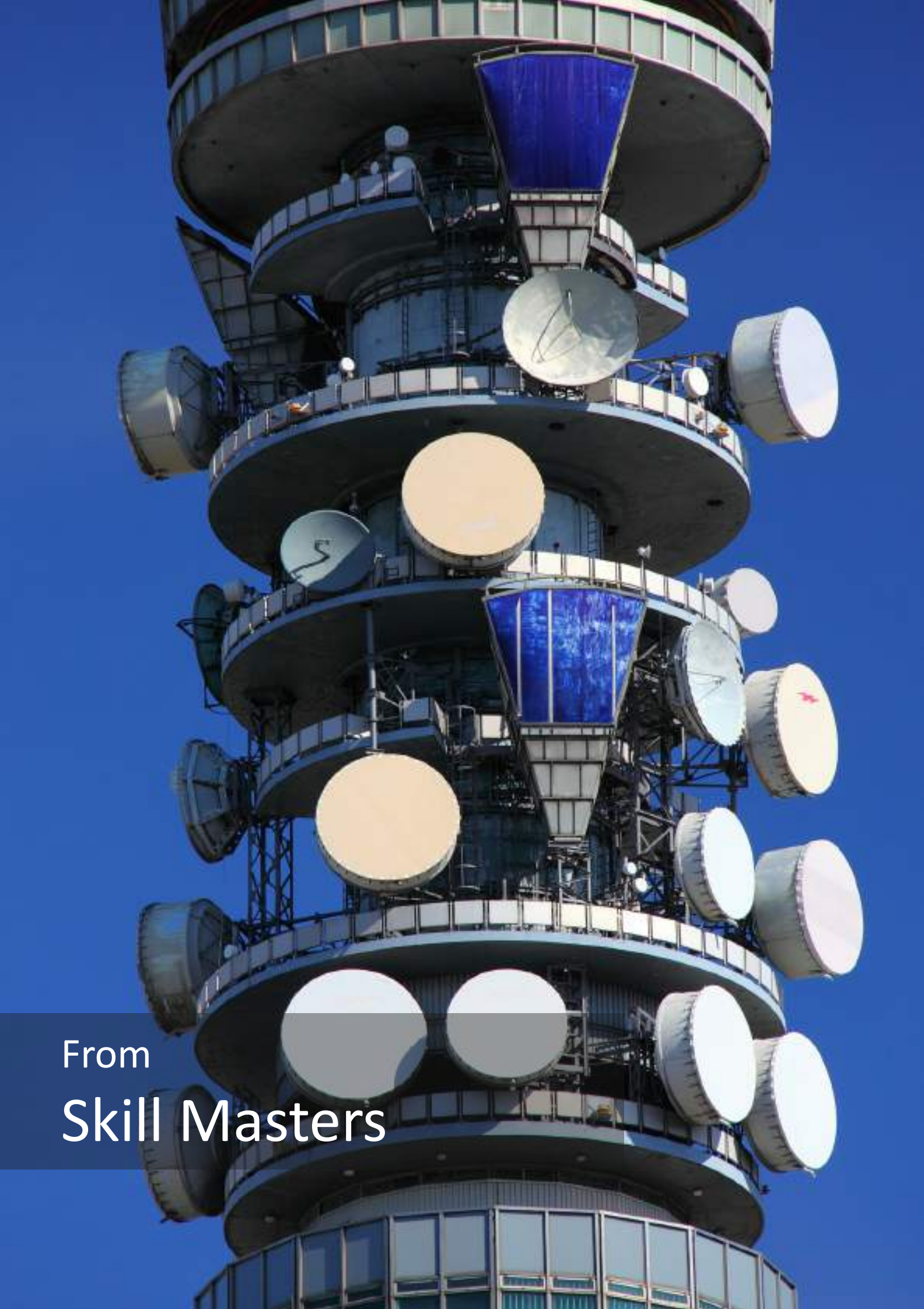
"

Now that our digital connectivity ecosystem has scaled many peaks, it is time to focus on self-reliance and security.

"

-Hon'ble Prime Minister Sh. Narendra Modi

From the MSDE's Desk

Shri Praveen Kumar
Secretary
Ministry of Skill Development and Entrepreneurship

Ministry of Skill Development & Entrepreneurship (MSDE) is committed to support various sectors of the economy by ensuring that skilled manpower of right quality and quantity is available in these sectors. Keeping in account the fact that a number of initiatives are being taken in the Telecom Sector, MSDE in partnership with the Telecom Sector Skill Council, is endeavoring to develop the required manpower for the same. Towards this end, this study on manpower requirement in the Sector will act as a major input in taking up skilling initiatives.

From the NSDC's Desk

Dr Manish Kumar
Managing Director & Chief Executive Officer
National Skill Development Corporation

Digital communications and mobile internet play the crucial role of making innovations accessible amidst technological disruptions and changing world-of-work. Studies show that the telecom sector has contributed significantly to the Indian GDP especially during the nationwide lockdown period. In this backdrop, it is highly useful to understand future demand for workers in the sector which can potentially guide individuals to take advantage of emerging opportunities through adequate skilling, reskilling or upskilling. I extend my compliments to the Telecom Sector Skill Council for their report studying the demand for workers in the telecom industry. I sincerely hope that the learnings are able to guide the training ecosystem and support towards bridging skill gaps in the telecom sector.

From
Governing Body's Desk

From the Governing Body's Desk

Mr. Akhil Gupta
Vice Chairman, Bharti Enterprises
President, TSSC

The telecom sector in India has grown by leaps and bounds over the last decade albeit with humungous challenges. Indeed, it is this growth that has enabled the economy, society and governance systems to continue functioning through the COVID-crisis. This rapid growth is expected to continue over the coming years driven by government policy, market-led innovations and consumer demand. The Telecom Sector Skill Council is proud to have been a part of the growth story of this pillar of the Indian economy.

Mr. P Balaji
Director-Regulator, External Affairs & CSR, Vodafone Idea
Vice-President, TSSC

The Indian telecommunications industry has leapfrogged the global industry with the roll out of mobile telephony at scale, which has supported many innovations in society and the economy. These are exciting times for the industry as the advances in the sector are expected to continue at pace over the coming years and decades.

Mr. Pankaj Mohindroo
Chairman, ICEA
Secretary, TSSC

The telecommunications sector is made up of numerous seen and unseen moving parts. From solutions for the individual to those for businesses, from front-facing distribution and sales activities to infrastructure roll-out at the back-end, from scaling up of existing technologies to developing completely new technologies, to becoming the global hub of manufacturing, the scope of the industry is vast. This complex and inventive sector will continue to grow over the coming years with increasing end-user demand for existing solutions as well as that for new and innovative technologies. TSSC is committed to creating the best in class global workforce for our nation.

Mr. Tilak Raj Dua
Director General, Tower and Infrastructure Providers Association
Treasurer, TSSC

The shared infrastructure model has enabled the data revolution across the length and breadth of India, from our largest cities to the remotest corners of the country. The sharing model has been emulated globally now. The digital infrastructure has laid a strong foundation for transforming India into a digitally empowered society and knowledge-based economy. The telecom infrastructure sector has stood the test of time during the current pandemic. It is heartening to see government's policy push towards strengthening of telecom infrastructure in the coming years, and the enhanced focus of the Government towards the policy implementation in the States through initiatives like Broadband Readiness Index and National Broadband Abhiyaan. I am confident that the telecom infrastructure industry is well poised to achieve the vision of providing "broadband for all" with the cooperation, engagement and collaboration amongst the Industry, State and Central Government.

"

Today, India is the second largest telecom market in the world, and it has surpassed the US and China to become the largest data consuming economy and that too at the lowest tariffs. This transformation is moving India towards becoming a 'knowledge society', riding on 'Digital Communications' in its true sense.

"

- Hon'ble Minister Sh. Ravi Shankar Prasad
Ministry of Communications

From the CEO's Desk

Today when one looks around, one finds devices speaking to one another through the Internet of Things. When one looks up, drones provide eyes in the sky. These are technologies that were unimaginable just a few years ago. Such transformational marvels rest on the innovations of the telecommunications industry. Indeed, from the most basic to the most ground-breaking solutions, modern society would come to a complete standstill without the power of telecommunications.

The world is preparing itself for a new industrial revolution and we must focus the next century of opportunities. As a social species, the world derives its ingenuity and intelligence through communication. So it is only natural that we seek to expand our horizons in the same. We have come a long way since the invention of the first telephone. What the last 150 years have shown, is that we are standing at the precipice of the new information age and it shall be facilitated by telecommunications technology.

As this report shows, the sector is continually expanding and evolving at a rapid pace. The push to the sector is coming both from the market demand for telecommunications services as well as policy drivers that recognize the significance of the sector. Several Indian companies have gone global, with facilities in India being used to export products and services. At the same time, international companies are setting up large facilities in India for manufacturing, supply, and R&D for India and for the world. That said, there remains a potential for substantial growth in research and development within India.

In this global context, for India to grow, become part of global value chains and be at par with the most advanced nations with respect to R&D, it is essential that the country has a ready pool of world-class skilled personnel that meet current and future-looking industry requirements. The Telecom Sector Skill Council is working towards enabling the creation of just such an ecosystem for skilling the youth of our nation.

Mr. Arvind Bali,
CEO
Telecom Sector Skill Council

" *In the coming years, India will be the biggest supplier of workforce to the world* **"**

-Hon'ble Prime Minister Sh. Narendra Modi

Contents

"

"I can say with utmost confidence that 5G will enable India to not only participate in the Fourth Industrial Revolution but also to lead it."

"

- Mukesh Ambani
Chairman, Managing Director
Reliance Industries Limited

Executive Summary

The reliance of the economy, society and governance on the telecommunications sector has been ever-growing. Indeed, telecommunications has become an essential service for improved efficiency and productivity of the economy. It **contributes to 6.5% of GDP, is the second largest source of private investment in infrastructure, and one of the largest recipients of FDI in India. The sector directly and indirectly generates employment for 4 million workers.**

The sector has been growing consistently and evolving rapidly over the last decade, with this growth and evolution expected to continue over the coming years as **existing voice and data services are extended to the unserved and underserved.** At the same time, **transformative new technologies such as 5G, Internet of Things, Cloud, Big Data and Artificial Intelligence** will be introduced and expand.

Government recognises the importance of the sector, with its policies such as the **National Digital Communications Policy aiming to attract USD 100 billion of investment** in the digital communications sector and **generating an additional 4 million jobs in the sector,** effectively doubling the existing number of jobs created by the telecommunications sector. Indeed such a skilled workforce across the existing and emerging value chain will be essential if the policy objectives of providing universal high-speed broadband to every citizen, six lakh villages and key development institutions; expanding the Internet of Things ecosystem to five billion devices; increasing the ratio of towers per 1000 population from 0.42 to 1; rolling out an additional 30 lakh kilometres of fibre to help catch up with developed economies (India's optical fibre network is only 7% of that in the US and Japan); driving innovation led start-ups; and enhancing India's participation in global value chains are to be achieved. **A growing pool of skilled manpower would be essential for achieving these goals.**

This report estimates that growth in connectivity (particularly in rural areas) as well as growing population and data use in urban areas supported by national policy targets would necessitate a substantial growth in tower and fibre infrastructure. As much as 3.6 lakhs of additional manpower across a variety of job roles may be required for installation and maintenance of this infrastructure in addition to manpower already deployed for maintenance of existing infrastructure. Furthermore, another gamechanger within the industry will be Fibre to the Home connectivity which would require skilled personnel.

With a low rural penetration of mobile telephony at present, at least 250 million additional connections may be expected over the medium term. Therefore, more trained manpower would be required for the sales, distribution and repair of handsets.

In addition to connecting citizens to networks, India is also aiming to transform itself from being one of the largest assemblers of mobile equipment in the world to one of the largest manufacturers of telecom gear through multiple incentives aligned with the *Atmanirbhar Bharat* initiative such as the Production Linked Incentive scheme. Government expects that over 2 lakh jobs could be created as a result of this scheme.

Given the growth and evolution of telecom service demand as well as underlying infrastructure, government needs to play a key role in enabling the availability of skilled manpower so that this core infrastructure industry can grow and evolve successfully. Indeed, given the importance of the telecommunications sector for the very functioning of the economy and the scale of manpower required by the sector, it becomes essential that the telecommunications sector job roles are prioritised amongst central and state government skilling schemes.

Introduction

I. Introduction

Telecommunications supports the lives of every one of us, be it a professional working in the formal economy, a rural migrant keen to stay in touch with family, a student accessing education, a startup providing services over a mobile app, a large business enhancing the efficiency of its operations, a family watching the latest entertainment, and importantly government in its efforts to provide benefits and other services.

Never has the importance of telecommunications been more apparent than **during the COVID crisis, when it has become a lifeline for the continuation of 30 to 35% of economic activity.** From a social perspective, telecommunications have been **the basis for providing citizen services and Direct Benefit Transfers** through the JAM trinity (Jan Dhan account, Aadhar and Mobile phone).

> Telecom has become essential infrastructure to support daily lives, business and even government services. Indeed, during the COVID-19 lockdown it enabled the continuation of 30-35% of economic activity.

Indeed, telecommunications is a basic service as important as the provision of water, electricity and roads for the smooth functioning of society and for improved efficiency and productivity of the economy. It c**ontributes to 6.5% of GDP, is the second largest source of private investment in infrastructure, and one of the largest recipients of FDI in India. The sector directly and indirectly generates employment for 4 million workers.**

The sector has been growing consistently and evolving rapidly over the last decade, with this growth and evolution expected to continue over the coming years as **existing voice and data services are extended to the unserved and underserved,** and as **transformative new technologies such as 5G, Internet of Things, Cloud, Big Data and Artificial Intelligence are introduced.** The strong base of the **telecommunications industry is a key enabler of the continuing digital revolution in society, economy and governance,** which in turn creates a multiplier effect across sectors.

> Telecom contributes to 6.5% of GDP, generates 4 million jobs, and is one of the largest sources of private investment in infrastructure and recipients of FDI.

Government recognises the importance of the sector, with its policies such as the **National Digital Communications Policy aiming to attract USD 100 billion of investment** in the digital communications sector and **generating an additional 4 million jobs in the sector,** effectively doubling the existing number of jobs created by the telecommunications sector. It intends to **train and retrain 1 million manpower to build new age skills.** Indeed such a skilled workforce across the existing and emerging value chain will be essential if the policy objectives of providing universal high-speed broadband to every citizen, 6 lakh villages and key development institutions; expanding the Internet of Things ecosystem to 5 billion devices; driving innovation led start-ups; and enhancing India's participation in global value chains are to be achieved.

> Telecom is enabling the digital revolution in society, economy and governance, creating a multiplier effect across sectors.

> Multiple government policies (eg, National Digital Communications Policy) are targeting increased investment (eg, INR 100 billion) and skilling / reskilling of manpower (eg, of 1 million people – or 25% of existing employment generated by the sector) to expand outreach to new geographies and provide robust technologies for the future.

Despite the rapid progress and telecom penetration in India, India remains behind other countries on many fronts. For

instance, the optical fibre network per kilometre per capita in India is only 7% of that in developed markets such as the US and Japan. **Skilled manpower would be required for catching up with the global levels of service provision** and achieving the goals of government's BharatNet initiative to connect all 2.5 lakh Gram Panchayats.

In addition to connecting citizens to networks, India is also aiming to transform itself from being one of the largest assemblers of mobile equipment in the world to one of the largest manufacturers of telecom gear through multiple incentives aligned with the *Atmanirbhar Bharat* initiative. These include the Production Linked Incentive scheme, scheme for Promotion of Manufacturing of Electronic Components and Semiconductors, and Electronics Manufacturing Clusters Scheme. Such emphasis on localisation of manufacturing has been forecast to result in a nearly 50% CAGR in the number of handsets manufactured in India over the next five years, thereby more than tripling the number of direct and indirect jobs from 6 to 7 lakhs to as many as 18 to 20 lakhs.

The progression of the telecommunications sector is continuing, for instance, with the emergence of next generation technologies for driving government's Smart Cities Mission, which is expected to expand from 100 cities to 4000 cities in its next phase. Installation of intelligent technologies will have the power to transform the quality of life of citizens through improved quality in water provision, waste management, traffic management, power and other services. Further transformation of the sector to 5G services is expected with a concomitant investment of $60 to 70 billion in infrastructure.

> The telecom sector is evolving with new technologies like 5G, Internet of Things, Big Data, Cloud etc requiring investment in robust infrastructure alongside skilled manpower for delivery in existing and emerging job roles.

Indeed with the existing technology, India has seen growing connectivity at competitive prices for end-users. This has led to a massive expansion in the provision of e-services both by government as well as a vibrant startup ecosystem working across sectors. A number of other sectors are able to serve their customers with greater efficiency and expand their outreach only through telecommunications platforms.

Such innovation and service delivery across sectors has been made possible by necessary investments by several hundred companies ranging from large global giants such as Google and Nokia to large and small local companies. These companies rely on the availability of skilled manpower across the telecommunications value chain. Such skilled workers are involved with a range of activities spanning from manufacturing mobile handsets and other telecommunications gear; installation and maintenance of a variety of essential infrastructure (eg, towers, optical fibre cables, public Wi-Fi); designing and managing telecom networks; distribution and sales of equipment and services;

> National and international companies are investing in the Indian telecom sector.

provision of voice, data, cloud and other services to end consumers and enterprises; customer service; and repair of handsets and other equipment. Growing network penetration will only increase the need for such manpower. The evolution of the sector is also creating a growing need for manpower in areas such a network security, management of e-waste as well a variety of transformative, emerging technologies.

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India is an important market for Ericsson, not only as a telecom market but also as a global hub for R&D.
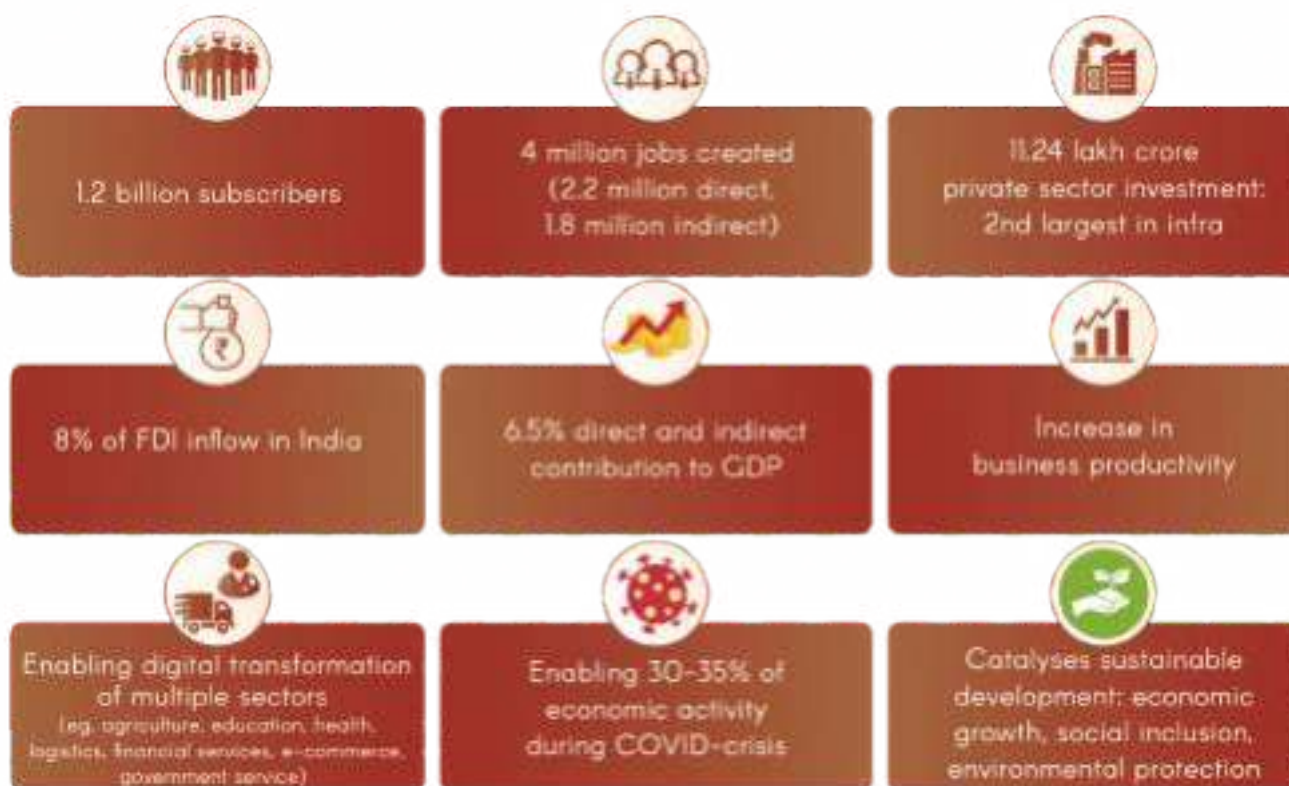
- Hans Vestberg

Importance of Telecom Sector

II. Importance of the telecom sector

The telecom industry is crucial for the smooth functioning of society and the economy. Its scale and contribution to the economy are immense.[1]

Indeed, skilling and employment to enable growth of the telecom sector could have the potential to drive employment across multiple other sectors. **Every 10% increase in mobile penetration leads to a 0.8% increase in GDP per capita growth** in emerging economies (World Bank estimates). This is the result of increased value addition by organisations across the value chain i.e. manufacturers, app developers etc, as well as **increase in business productivity** across multiple sectors such as agriculture, education, energy, financial services, government services, healthcare, logistics, manufacturing, trade, and transportation.[2] Similarly, **a 10% increase in internet penetration has been estimated to result in a 3.9% increase in per capita GDP.** This could imply a $600 to $650 increase in per capita GDP or equivalently value creation of $850 to $900 billion by 2025.[3] Telecom-enabled digital transformation of the economy would require personnel skilled in new-age digital skills such as social media, cybersecurity, cloud computing, big data analysis and network engineering.

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[1]   Cellular Operators Association of India (COAI), Annual Report 2019-20, available at https://coai.com/sites/default/files/COAI%20Annual%20 Report_2019-20.pdf; Department for Promotion of Industry and Internal Trade (DPIIT) referenced in https://www.ibef.org/download/ Telecommunications-July-2020.pdf; COAI, Annual Report 2019/20; Broadband India Forum (2018), 'Compendium of Reports and White Papers', available at https://www.broadbandindiaforum.com/files/reports-and-publications/Compendium%20of%20Reports%20and%20White%20Papers%20 2018.pdf

[2]   ICEA and KPMG (2019), 'Impact Assessment of Open OS Ecosystem for Devices in India', March, available at https://icea.org.in/wp-content/ uploads/2019/05/Impact-Assessment-of-Open-OS-Ecosystem-for-Devices-in-India.pdf

[3]   MEITY, 'India's Trillion Dollar Digital Opportunity'

Telecom –
A wide-ranging sector

III. Telecom: A wide-ranging sector

The telecommunications sector spans across a wide range of products and services, extending from a variety of telecom service provision and complex network managed services. Underlying these is a set of passive infrastructure and the manufacturing of telecom gear. All of these enable the provision of a variety of services by industry and government. All of these are supported by distribution, sales and customer service activities.

THE TELECOM VALUE CHAIN

Telecom enabled services
- Banking
- Entertainment
- Health
- Insurance
- Mobile cloud

Government services
- Database / bridge for benefit schemes / information dissemination

Upcoming services
- Internet of Things
- Drones

Telecom service providers
- Pre-paid
- Post-paid
- Broadband
- Direct to Home

Network managed services
- Network planning, design & optimisation
- Network management
- **Enterprise Services:**
  - Software-defined Wide Area Network
  - Private Network Operations
  - API Management
  - IoT Application Services
- **Cloud & IT Services:**
  - Cloud & IT Services Operations
  - Automated Business Services Management
  - Cloud Native Application Development
  - Digital Business Support Systems
  - Big Data and Data Analytics

Passive Infrastructure
- **Manufacturing:**
  - Tower Cables (fibre, co-axial)
  - Base transceiver station (BTS)
  - Antenna Batteries for towers
- **Deployment:**
  - Tower Cables (fibre, co-axial)
- **Maintenance:**
  - Tower Cables (fibre, co-axial)
  - Network Operating Centre

Manufacturing handsets and other gear
- Feature phones
- Smartphones
- Tablets
- Refurbishment
- Accessories (Eg. earphones, batteries, screenguards, AUX cables)
- E-waste management

Distribution — **Sales** — **Customer Service**

Telecom – A growing sector

IV. Telecom: A growing sector

The telecom sector is large and has been growing rapidly in recent years as a result of both strong market as well as policy drivers. This growth is expected to continue over the coming years.

1. Telecom subscribers

India has a growing telecom subscriber base that needs to be supported by strong capabilities for manufacturing handsets and other telecom gear, retail / customer service of handsets and mobile phone connections, as well as network installation,

Telecom subscriber base: growth drivers

Low rural teledensity (57%) relative to urban (156%)

Government policy to increase rural connectivity

Low tariffs / handset costs

maintenance, and management. The large and growing subscriber base provides opportunities to providers of multiple innovative services.

The subscriber base may be expected to continue growing at a 3% CAGR, increasing to as many as 1.4 billion subscribers by 2025, with over 80% expected to be smartphone users. Indeed, India is forecast to have 88 million 5G connections by 2025[4] and 270 million by 2035.[5]
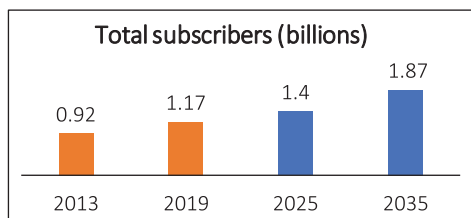
Total subscribers (billions)			
0.92	1.17	1.4	1.87
2013	2019	2025	2035

Source: COAI, 'Annual Report 2019/20'; COAI, 'White Paper on Communication and Digital Technology – Realm of Possibilities in 2035' and Primus Partners calculations.

Smartphones (millions)		
670	1170	1840
2019	2025	2035
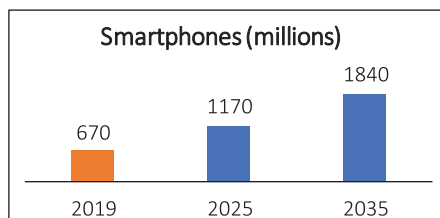
Source: COAI, 'White Paper on Communication and Digital Technology – Realm of Possibilities in 2035'

5G connections (million)	
0	270
2019	2035
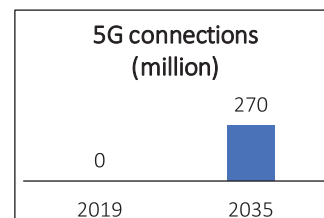
Source: COAI; https://www.investindia.gov.in/sector/telecom, accessed on 21st August 2020

Major Service Providers

The large Indian market is spurring global technology giants to launch India-specific services. Google's Android launched the Android One series of low-cost phones and is working with Reliance Jio on a smartphone that would retail for around $30.[3]

Global giants launch India-specific services

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[4]https://www.investindia.gov.in/sector/telecom, accessed on 21st August 2020

[5]COAI

2. Internet services

Increased Internet access and affordability driving India's digitisation

Starting off from a low base, India now has the second largest number of Internet subscriptions in the world, with the number of subscriptions having nearly trebled from 2013 to 2019 (from ~239 million[3] to ~688 million[8]), growing at a CAGR of 19%. Half the population now subscribes to the Internet, with nearly all (96%) of the subscribers doing so through wireless networks.
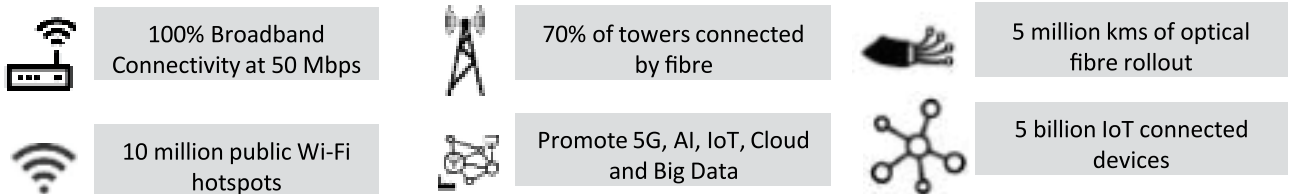
Internet subscribers and use: growth drivers

Government policy (eg, National Digital Communications Policy, National Broadband Mission)

Low tariffs / smartphone costs driving smartphone use

Increasing video and other data content

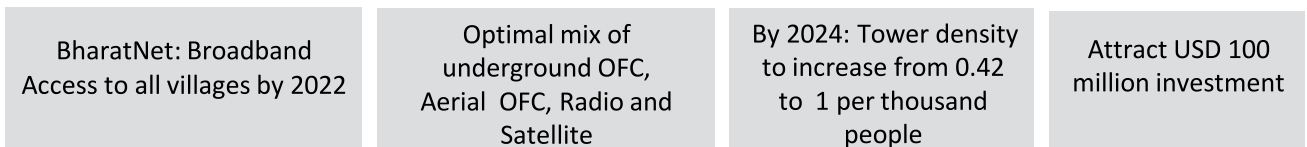Greater use potential through new technologies like IoT

The growing number of connected consumers have been leveraged by a variety of service providers (eg, e-commerce, payment gateways, media & entertainment content creation etc).[3] As of 2019, India has the second highest number of app downloads in the world.[10]

The growing connectivity expectations are driving technologies such as FTTX/Home as well as technologies such a low earth orbit satellites, particularly to serve geographies where towers and fibres cannot reach.

National Digital Communication Policy 2018: Targets

100% Broadband Connectivity at 50 Mbps	70% of towers connected by fibre	5 million kms of optical fibre rollout
10 million public Wi-Fi hotspots	Promote 5G, AI, IoT, Cloud and Big Data	5 billion IoT connected devices

National Broadband Mission

BharatNet: Broadband Access to all villages by 2022	Optimal mix of underground OFC, Aerial OFC, Radio and Satellite	By 2024: Tower density to increase from 0.42 to 1 per thousand people	Attract USD 100 million investment

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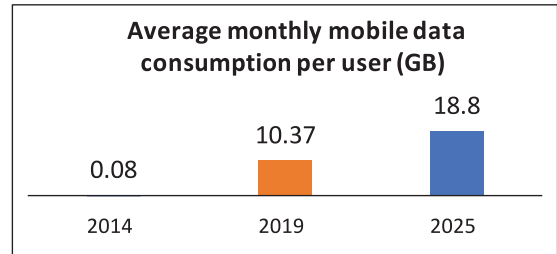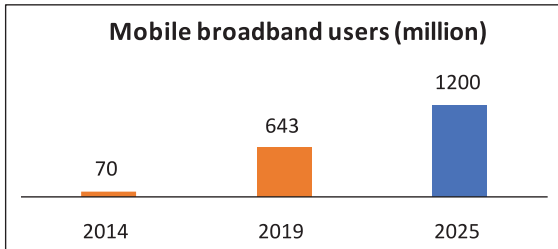
8   Department of Telecommunications, Annual Report 2019-20, data as of September / November 2019, Primus

10   IBEF website accessed on 7th August 2020 https://www.ibef.org/industry/telecommunications.aspx

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With the above policy and market drivers, the **number of mobile broadband subscribers have been forecast to nearly double by 2025** (growing at a CAGR of 11%), with monthly average mobile data usage per subscriber estimated to also grow at a CAGR of 10%.[8] At the same time, fixed line data consumption is also growing, having doubled over the preceding half decade.[3]

Mobile broadband users (million)

2014	2019	2025
70	643	1200

Average monthly mobile data consumption per user (GB)

2014	2019	2025
0.08	10.37	18.8

Source: COAI, 'Annual Report 2019/20'; COAI, 'White Paper on Communication and Digital Technology – Realm of Possibilities in 2035'

Major Service Providers

358 ISPs[9]

The major service providers are supported by other companies. For instance, ITI Limited and Tech Mahindra are planning to work on a pilot project for demonstrating 4G services for BSNL.[10]

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[8]COAI, 'White Paper on Communication and Digital Technology – Realm of Possibilities in 2035'
[9]TRAI, 'The Indian Telecom Services Performance Indicators. October – December 2019', https://trai.gov.in/sites/default/files/PIR_30062020.pdf
[10]https://trak.in/tags/business/2020/08/14/bsnls-4g-5g-will-be-run-by-indian-firms-iti-tech-m-instead-of-nokia-ericsson/

Industry speaks from the cutting-edge

Bharti Global Limited, who provides mobile services through Bharti Airtel, has acquired OneWeb, a provider of low latency satellite internet. OneWeb will be testing services from its constellation of 648 low earth orbit (LEO) satellites, with ground stations to be set up in different parts of India to deliver internet services by 2022.

This has huge potential for India as highlight by chairman Mr Sunil Bharti Mittal:

"India requires affordable rural broadband connectivity. We also very clearly know that reaching fibre or even terrestrial radio in some parts of deep Nicobar, deserts in Rajasthan or the deep forests in Madhya Pradesh is going to be almost impossible. But, why should these people be deprived of broadband connectivity?"[11]

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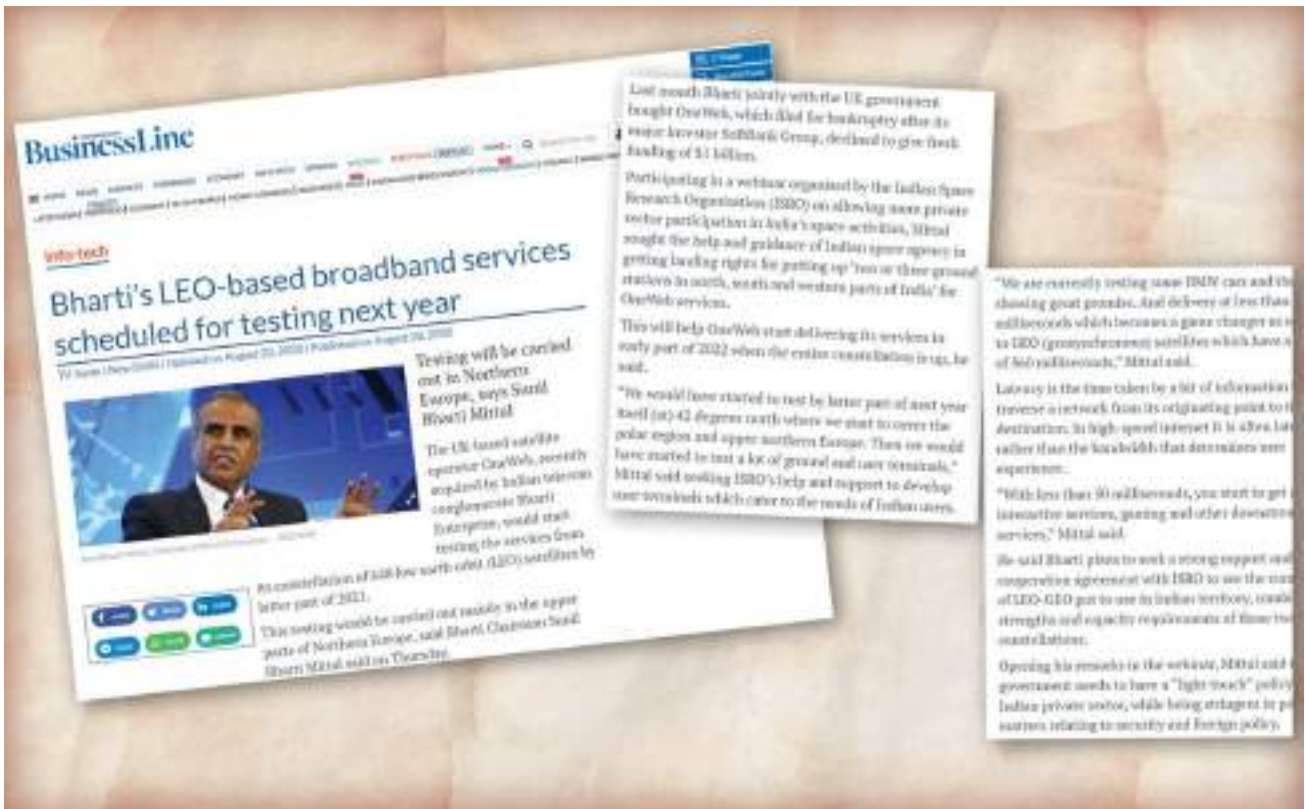
[11]The Hindu Business Line (2020), 'Bharti's LEO-based Broadband Services scheduled for testing next year'', August 20th,
https://www.thehindubusinessline.com/info-tech/bhartis-leo-based-broadband-services-scheduled-for-testing-next-year/article32401881.ece

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PARTNERS

3. 5G

5G is the next generation telecommunications technology. It is expected to increase network data speeds which would enable users to download large videos or games at faster speeds. 5G will also be at the core of emerging technologies like IoT, machine to machine communications, AR/VR which will require denser networks as well as drive a variety of innovative services such as driverless vehicles, telesurgeries etc. To deliver 5G services, there will need to be an additional investment of $60-70 billion as an upgradation of telecom networks alone will not be sufficient.[15]

The launch of 5G networks was initially expected by the end of 2020 or early 2021, but these are awaiting 5G spectrum auction and subsequent testing. Ericsson has forecast 5G to be available in India from 2022.[16]

The service providers are making plans for 5G deployment. For instance, Jio, is planning to partner with Samsung, Ericsson and Nokia for 5G trials.[17] Furthermore, Google intends to invest ~INR 34000 crore (USD 4.5 billion) in Jio for the 5G upgrade, with additional support from Qualcomm and Intel.

The transformative powers of 5G[18]

Smart Cities – 5G will enable thousands of IoT devices to connect to one another given its low latency and high bandwidth. Cities around the world have installed smart lighting systems that turn off when not needed, are managing traffic with greater efficiency and safety, using sensors to redirect water flow when sewer levels are too high, monitoring air quality using sensors, amongst other use cases for 5G to transform public service provision.

Precision agriculture – 5G-enabled IoT devices will monitor crop and soil conditions to provide precisely what is needed in terms of water, pest control etc thereby improving productivity and minimising the environmental impact of agriculture.

Driverless cars – The low latency of 5G will enable cars to communicate with one another and with sensors in traffic lights, road signs, pavements etc. This would make driverless cars a reality, with greater safety on roads as human error is done away with.

Telesurgery – Again, the low latency of 5G would ensure that surgeons in one location can operate using tools in another location, thereby bringing medical care to unserved geographies.

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[15] The Hindu (2019), 'How will a 5G network power the future', June 9th, https://www.thehindu.com/business/how-will-a-5g-network-power-the-future/ article27698653.ece

[16] Computer World (2020), 'When will 5G be available in India?', July 22nd, https://www.computerworld.com/article/3540254/when-will-5g-be- available-in-india.html#:~:text=For%20Indians%20to%20benefit%20from,are%20going%20to%20take%20time.

[17] Computer World (2020), 'When will 5G be available in India?', July 22nd

[18] Vmware (2019), '5 ways 5G will change our lives', April 29th, https://www.vmware.com/radius/five-ways-5g-will-change-our-lives/

Home-grown development of 5G solutions

Indian companies are making strides towards developing solutions within India as highlighted by Mr Mukesh D. Ambani, Chairman and Managing Director, Reliance Industries Limited:

"I have great pride in announcing that Jio has designed and developed a complete 5G solution from scratch...This made-in-India 5G solution will be ready for trials as soon as 5G spectrum is available and can be ready for field deployment next year...Once Jio's 5G solution is proven at India-scale, Jio Platforms would be well positioned to be an exporter of 5G solutions to other telecom operators globally, as a complete managed service" [15]

[15]Business Today (2020), 'How Reliance Jio is building its 5G story brick-by-brick', October 27th, https://www.businesstoday.in/bt-buzz/how-reliance-jio-is-building-its-5g-story-brick-by-brick/story/420013.html

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4. Handset manufacturing

Since 2018, India has been the **second largest manufacturer of mobile handsets** by volume after China.[20] Manufacturing units for mobile handsets & allied products have rapidly increased from only 3 in 2014 to 268 in 2018.[21] However, much of this growth has been focused on assembly of handsets from imported components.

With respect to electronics manufacturing in general, **costs in India are 8% to 11% higher** as a result of a lack of infrastructure, limitations of the domestic supply chain and logistics, higher financing cost, unreliable electricity availability, lack of design and R&D capabilities, and insufficient skill development.[22]

To **create a level playing field, a number of policies** have been introduced to promote manufacturing of handsets and other components such as semiconductors and display manufacturing, whose ecosystem is severely lacking.[23]

Handset manufacturing growth drivers

Budget 2020/21 accouncements
- Customs duties on various components of mobile phones

National Policy of Electronics 2019
- Working with government / industry / universities for skilling
- Promoting R&D and manufacturing hubs: indigenising microchips
- Promoting startup ecosystem in emerging tech (eg, 5G, IoT)
- 2025 target: Manufacture 1 billion handsets
- Fiscal incentives for export-led growth (export 600 million handsets)

Production-Linked Incentive Scheme for large scale electronics manufacturing
- 4 to 6% incentives on incremental sales of mobile phones and electronic components manufactured in India relative to 2019-20

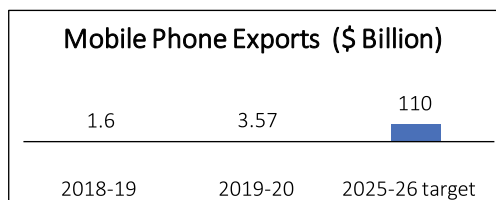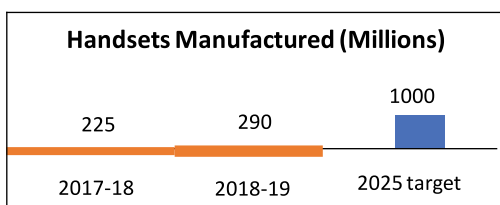Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (**SPECS**)
- Financial incentive of 25% of capex for manufacturing

Modified **Electronics Manufacturing Clusters** (EMC 2.0) Scheme
- Providing financial incentives for setting up manufacturing clusters and Common Facility Centres

Handset manufacturing: Growth potential

The National Policy of Electronics has targeted 1 billion handsets to be manufactured in India by 2025, an over four-fold increase relative to 2017-18 levels of 225 million (including 120 million smartphones), at a CAGR of over 48%. $110 billion worth of mobile phones are targeted to be exported.[24]

Handsets Manufactured (Millions)

2017-18	2018-19	2025 target
225	290	1000

Mobile Phone Exports ($ Billion)

2018-19	2019-20	2025-26 target
1.6	3.57	110

Source: National Policy on Electronics 2019, https://www.ibef.org/blogs/export-of-mobile-phones-from-india-over-100-growth-in-fy20, ICEA and EY, 'Mobile manufacturing in a post COVID-19 world', ICEA-McKinsey report, 2018 and Economic Survey 2019-20

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[20] ICEA (2020), 'Contribution of Smartphones to Digital Governance in India', July

[21] ICEA and KPMG (2019), 'Impact Assessment of Open OS Ecosystem for Devices in India', March

[22] MEITY page on Production Linked Incentive Scheme (PLI) for Large Scale Electronics Manufacturing, https://www.meity.gov.in/esdm/pli accessed on 21st August 2020

[23] ICEA and EY, 'Mobile manufacturing in a post COVID-19 world', available at https://icea.org.in/wp-content/uploads/2020/06/Mobile-manufacturing-in- a-post-COVID-19-world-1_compressed-1.pdf

[24] ICEA and EY, 'Mobile manufacturing in a post COVID-19 world'

Planned investments in manufacturing: selected examples

A number of handset manufacturers are planning to grow their operations in India. For instance, **Samsung** has set up the **world's largest mobile phone manufacturing factory In India** and aims to double the capacity from 68 million to 120 million units a year.[25] **Samsung India's 'Make for the World' initiative** aims to export mobile handsets produced in India to overseas markets.

Company	Planned investment	Planned manpower increase
Vivo[26]	INR 7500 crore investment to quadruple production capacity from 25 to 100 million devices	From 7500 to 40000 in the next decade
Foxconn (manufacturer for Apple and Xiaomi)[27]	$1 billion (~INR 7500 crore) in Tamil Nadu factory	Add 6000 jobs
Winstron (iPhone manufacturer)[28]	INR 2900 crore	from 1000 to 10,000

R&D in India: selected examples

Company	Planned investment
OnePlus29	Set up R&D centre in Hyderabad for technologies like camera, automation and networking, Plans to increase workforce from 200 to 1500 engineers
Lava International (India handset manufacturer)30	Intends to move its export production and design centre from China to India
Jio and Google agreement31	Develop affordable 4G and possibly 5G smartphones

Major Handset Manufacturers

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25 Eletimes (2019), 'Mobile Phone Manufacturing: 'Make in India' story is indeed a shining one', December 17th, https://www.eletimes.com/mobile-phone-manufacturing-make-in-india-story-is-indeed-a-shining-one#:~:text=Capturing%20the%2013%25%20of%20Indian,business%20in%20Q3%20of%202019.

26 Economic Times (2019), 'Vivo to invest Rs 7,500 crore to expand local manufacturing in India', August. https://economictimes.indiatimes.com/tech/hardware/vivo-to-invest-rs-7500-crore-to-expand-local-manufacturing-in-india/articleshow/70859741.cms

27 Livemint (2020), Foxconn to invest $1 billion in Tamil Nadu plant: report', July 11th, https://www.livemint.com/news/india/foxconn-to-invest-1-billion-in-tamil-nadu-plant-report-11594437407812.html 28Economic Times (2020), 'Wistron prepares for 'Made in India' iPhone 12; begins hiring: Report', August 18th, https://telecom.economictimes.indiatimes.com/news/wistron-prepares-for-made-in-india-iphone-12-begins-hiring-report/77608346

29 Economic Times (2019), 'OnePlus to invest Rs 1,000 Cr in Hyderabad R&D facility in 3 years', August 27th, https://economictimes.indiatimes.com/tech/hardware/oneplus-to-invest-rs-1000-cr-in-hyderabad-rd-facility-in-3-years/articleshow/70840906. cms?from=mdr

30 Business Standard (2020), 'With other countries also in race, make-in-India pitch will be challenging', May 18th, https://www.business-standard.com/article/economy-policy/with-other-countries-also-in-race-make-in-india-pitch-will-be-challenging-120051801613_1.html

31 Deccan Herald (2020), 'What do Mukesh Ambani, Sunil Mittal think about the future of telecom?', August 1st, https://www.deccanherald.com/business/business-news/what-do-mukesh-ambani-sunil-mittal-think-about-the-future-of-telecom-868260.html

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From the policy desk: Creating an *Atmanirbhar Bharat*

The [Production Linked Incentive Scheme] will create 300,000 direct and 900,000 indirect jobs. The domestic value addition is expected to grow from the current 15-20 per cent to 35-40 per cent in case of mobile phones and 45-50 per cent for electronic components."

"[Domestic companies like Lava, Dixon and Bhagwati (Micromax)] are expected to expand their manufacturing operations in a significant manner and grow into national champion companies in mobile phone production" – Shri Ravi Shankar Prasad, Minister of Electronics and Information Technology.[31]

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[31]Business Standard (2020), 'Apple vendors, Samsung apply for PLI; govt plans Rs 11-trn worth production'
https://www.business-standard.com/article/companies/apple-vendors-samsung-apply-for-pli-govt-plans-rs-11-trn-worth-production-120080101138_1.html

5. Passive Infrastructure

Telecom Towers

Policy push for an increased need to connect unconnected villages, as well as potential for tower companies to deploy new technologies and street level solutions will create a need for a skilled labour force for deployment and maintenance of towers and newer technologies.

Tower installation: growth drivers

National Broadband Mission target

- To increase tower density from 0.42 to 1 per thousand people by 2024

Connecting the unconnected

- 43000 villages (7% of India's villages) are unconnected by towers. Department of Telecom giving incentives / subsides for infrastructure development in non-profitable areas

Major Tower Companies

Next Gen technologies for infrastructure companies

| Last mile In-Building Solutions: To serve the 75-80% of mobile traffic that originates in buildings |
| Small cells: 250,000 deployments by 2025 for network densification required for 5G roll out |
| Wi-Fi offloading |
| Data centres |
| Edge computing |

Major companies also serviced by large vendors

Source: TAIPA 2017/18 annual report; EY, (https://www.ey.com/en_in/news/2019/10/industry-landscape-ripe-for-infracos-to-test-new-business-models-ey-report)

Fibre

The optical fibre cable (OFC) network infrastructure has immense potential for growth, as aligned with government initiatives such as Digital India and the Smart Cities Mission.

The India optical fibre cables market has been forecast to grow from $881.5 million in 2019 to $2.1 billion by 2024 at a CAGR of 19.7%.[32] With targets to more than treble the existing fibre network, there will be need for a large workforce to manufacture, install and maintain fibre infrastructure.

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[32]Business Wire (2019), 'Indian Optical Fiber Cables Market Analysis & Forecast 2014-2024', November 6th

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Fibre installation: growth drivers

Low fiberisation of towers relative to other countries
- Less than one fourth of telecom towers are fibre connected
- National Digital Communication Policy 2018 targeting 55% fiberisation by 2022 and 70% by 2024 - Fibre network to grow from 1.5 million to 5 million kms

BharatNet target: Broadband to 2.5 lakh Gram Panchayats / six lakh villages through optical fibre, radio and satellite (completed for 1.5 lakh + GPs)

High speed data requirements: Fibre to the Home / Business

Fiberisation of small cells for 5G (to increase network speed and reduce latency)

Smart cities

Data centres

New technologies such as 5G, cloud computing, Internet of Things, AI and M2M

Source: Department of Telecommunications, 'National Digital Communications Policy – 2018'; TAIPA 2017/18 Annual Report

Large investments in Fibre to the Home market

Company	Planned investment
Reliance Jio Infocomm[33]	Expand optical fibre network to over 1,100 cities under its Jio GigaFiber brand
Excitel (broadband service provider)[34]	To raise Rs 200 crore (US$ 28.37 million) in funding to expand FTTH (fibre to the home) deployment on its network and establish presence in 50 cities by December 2021

Major Fibre Optic Cable Companies (including large vendors of major players)

Fibre-to-the-Home

Provides high speed internet connectivity, and a number of other services such as TV over IP, Video On-Demand, Audio On-Demand, Remote Education, Video Conferencing Services, Interactive Gaming and Virtual Private LAN service.

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[33]India Brand Equity Foundation, https://www.ibef.org/download/Telecommunications-July-2020.pdf
[34]India Brand Equity Foundation, https://www.ibef.org/download/Telecommunications-July-2020.pdf

6. Wi-Fi access points

Current situation:

Low data offloaded to public Wi-Fi in India

India: 16%

Developed markets, eg, US, UK, France: 30% (driver: lower costs relative to 3G/4G)

Wi-Fi access points: growth drivers

National Digital Communications Policy target: 10 million public Wi-Fi points

Growing commercial interest

India has been stated to have potential for over 600 million people to use public Wi-Fi if three million access points are rolled out across the country (compared to around 90,000 today) including to three tier cities and villages.[35]

Large investments in Wi-Fi Access Points

A number of companies are showing growing interest in this area. For instance, Facebook's Express Wi-Fi project is rolling out 20,000 hotspots in partnership with mobile service provider Airtel.[3]

Atmanirbhar Bharat: Homegrown companies supplying the world

Tejas Networks, founded in 2000, manufactures optical fibre equipment, broadband wireless and data networking products for telecom service providers in over 65 countries. It has a revenue of over INR 400 crore.

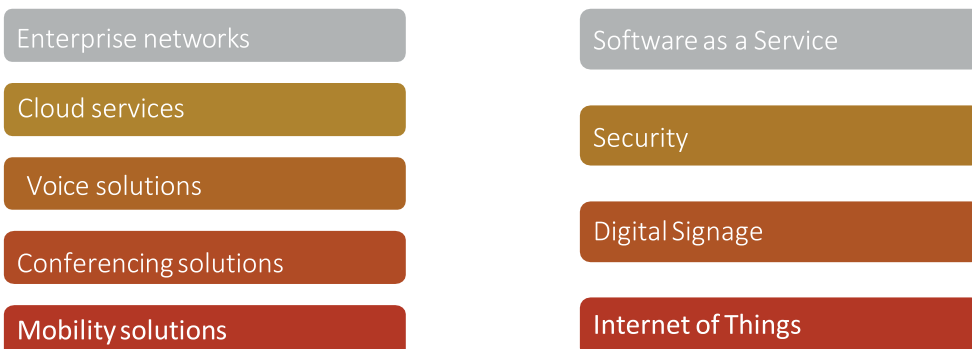Himachal Futuristic Communications Ltd manufactures optical fibres, optical transport, power electronics and broadband equipment for the telecommunications industry in India and abroad (UK, Eastern Europe, Middle East, Africa, South Asia and South East Asia). It has manufacturing facilities in Himachal Pradesh, Tamil Nadu and Goa. It has a revenue of over INR 4700 crore.

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[35]TAIPA 2017/18 Annual Report

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7. Business / enterprise solutions

Increasing efficiency and productivity with business / enterprise solutions

Enterprise networks	Software as a Service
Cloud services	Security
Voice solutions	Digital Signage
Conferencing solutions	Internet of Things
Mobility solutions	

8. Cloud infrastructure[36]

Cloud infrastructure is the back-end infrastructure (eg, servers, network devices, ethernet switches, data storage) that supports cloud computing. Cloud infrastructure enhances efficiencies, reduces server and storage costs, and enables flexible work practices. It has become increasingly important following the COVID crisis as people are increasingly working from home, with much of this shift expected to be permanent. The start-up ecosystem is also reliant on cloud infrastructure. Cloud infrastructure is also an enabler for newer technologies such as Internet of Things and AI, allowing the storage, management, communication and analysis of large amounts of data.

Cloud solutions: Growth drivers

Enabling flexible work, increased efficiency, reduced server costs

Enabler of new generation technologies like Internet of Things

The cloud infrastructure market has been forecast from reach a value of INR 196.46 billion by 2024, growing at a CAGR of 23.61% over the 2019 to 2024 period.

~INR200 billion by 2024

Major cloud service providers

The market in India includes global players such as Amazon and IBM as well as domestic players like Tata Consultancy Services and Wipro, who are upgrading existing data centres and setting up new data centres. Channel partners such as Cognizant and Mindtree are also important players who contribute to customer requirements.

[36]Business Wire (2020), 'Cloud Infrastructure Market in India (2019 to 2024)- ResearchAndMarkets.com', February 21st, https://www.businesswire.com/news/home/20200221005396/en/Cloud-Infrastructure-Market-India-2019-2024--#:~:text=The%20cloud%20 infrastructure%20market%20in,INR%20196.46%20Bn%20by%202024.

Research in India for India and the World

India as one of Qualcomm's largest IP design centres
Qualcomm, a company with revenues of over $19 billion develops platforms, chipsets, software, tools and services for wireless technologies. 5G and Artificial Intelligence are key areas of work for the company.
India hosts one of Qualcomm's largest IP design centre's in the world.

India: Becoming Amdocs' global development centre
Amdocs, a large telecom software solutions company with a global revenue of $4.1 billion has 10,000 of its global staff of 25,000 located in India. The company serves over 85 countries with innovative solutions through its expertise in network, IT, cloud and analytics. It is working with Airtel to provide machine learning and AI-based technologies to prevent and self-heal operational issues, use smartbots, and provide speedy launch of new services.

India: Steps towards becoming a hub of R&D for Ciena
Ciena's second largest R&D centre in the world is in India. Ciena is a global networking systems, service and software company with offices in 29 countries around the world. It provides innovative solutions such as automated, self-configuring and self-optimising networks for companies such as Reliance Jio Infocomm Limited; as well as partnering with Bharti Airtel Limited to provide programmable solutions for infrastructure.

India: The prime market for Ericsson
Ericsson has more employees in India than in any other country.
With regional headquarters in Gurgaon, Haryana, the Indian region has 19,971 employees working in engineering and research and development in areas such as revenue management, internet protocol, networking and big data. Ericsson touched new heights by successfully demonstrating the first live 5G end-to-end demonstration in India.

India: An integral driver for Nokia
Driving innovation for tomorrow and delivering technology today, we make businesses more productive, environments cleaner, workplaces safer, economies stronger and people's lives richer. Our communications service provider customers support more than 6.4 billion subscriptions with our radio networks, and our enterprise customers have deployed over 1,300 industrial networks worldwide.

9. Internet of Things

Within three to four years of the introduction of 5G, the number of Internet of Things connections in India may grow to **423 million**. Tower companies can play a role in deploying and maintaining sensors, as well as participating in the app- (including big data storage and analytics) and hardware- enabling connectivity value chains if they suitably upskill themselves.[37] Along with IoT, newer technologies such as low-power wide area networks (LP-WAN) are coming to the fore as a replacement of traditional wireless technologies as a result of their lower bandwidth and power consumption, leading to a battery life of IoT devices of several years.[38]

IoT: Growth drivers

Greater efficiencies, eg, in Smart Cities

5G as an enabler

10. Broadcast services and Cable TV services[41]

India has become the only large country to achieve 100% digitisation of the cable TV network.

India has four pay DTH service providers serving 69.98 million subscribers (in addition to subscribers of the free DTH services of Doordarshan).

There are 332 pay TV channels, 368 operational private FM radio stations in 105 cities run by 33 broadcasters, and 278 operational community radio stations.

11. OTT services

In addition to international OTT platforms, India has seen a growing number of home-grown platforms, with the OTT market estimated to grow to $1.5 billion by 2023.[42]

OTT services: Growth drivers

Low data costs broadening demographics subscribing to OTT platforms

Localised content

Major Service Providers

[39] Communications Today (2020), 'An Uphill Struggle', February 25th, https://www.communicationstoday.co.in/an-uphill-struggle/

[40] https://assets.ey.com/content/dam/ey-sites/ey-com/en_in/news/2019/10/ey-next-gen-infraco-report-interactive.pdf [41]TRAI, 'The Indian Telecom Services Performance Indicators. October – December 2019'

[42] Financial Express (2019), 'Subscription VOD market pegged to hit $1.5 billion by 2023: Report', November 15th

12. Mobile apps

India has the second largest developer ecosystem in the world and is estimated to overtake the US by 2021.[43]

Growth drivers

Over 5000 tech startups have registered over the last five years, making India the world's third largest startup ecosystem. 60% of these startups provide B2C services via mobile apps.[44] India has around 259 startups incubators and accelerators including large multi-national corporations such as ShellE4, Target, SAP, Microsoft, Qualcomm, Cisco, Google, Bosch, Intel, GE Healthcare and Intuit.

13. Telecom-enabled services

E-government transactions – Daily e-government transactions have increased rapidly from 6.5 million to 98 million (from 2013 to 2018).[45]

Common Service Centres for e-services – Functional government-run Common Service Centres providing e-services in rural and semi-urban areas have increased from 63,000 in 2013 to 292,748 in April 2018. 54,800 women have become village-level entrepreneurs, running these centres. These centres are helping consumers avoid travelling long distances for services such as Aadhar enrolment, PAN card applications, banking and education opportunities.[46]

Telecom-enabled services: Growth drivers

E-government transactions for welfare

E-commerce platforms

Ease and low cost of data access

E-commerce – E-commerce users increased from 40 million to 176.8 million (from 2013 to 2018).[47]

Social media and communication – Social media users increased from 90 million to 294 million (from 2013 to 2018), with WhatsApp subscribers increasing from 30 million to 200 million (from 2013 to 2018).[48]
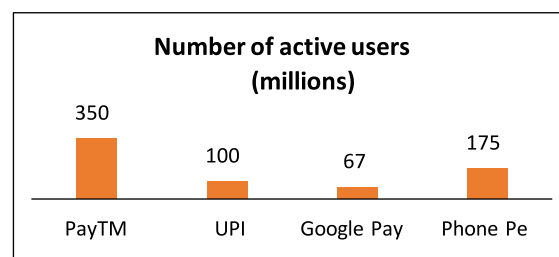
Digital payments – 542 banks have been permitted to provide mobile banking services in India as of January 2020.[49] The Department of Posts has also introduced mobile banking for its saving account customers.[50] Annual digital payment transactions (digital wallets, net banking, credit or debit cards) have increased from 2.5 billion to 24.3 billion (from 2013 to 2018).[51]

Number of active users (millions)

350	100	67	175
PayTM	UPI	Google Pay	Phone Pe

Source: https://www.ibef.org/industry/telecommunications. aspx

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43   ICEA and KPMG (2019), 'Impact Assessment of Open OS Ecosystem for Devices in India', March   44ICEA and KPMG (2019), 'Impact Assessment of Open OS Ecosystem for Devices in India', March   45(MEITY), 'India's Trillion Dollar Digital Opportunity'

46   (MEITY), 'India's Trillion Dollar Digital Opportunity'   47(MEITY), 'India's Trillion Dollar Digital Opportunity'

48   (MEITY), 'India's Trillion Dollar Digital Opportunity'

49   https://www.ibef.org/industry/telecommunications.aspx

50   https://www.ibef.org/download/Telecommunications-July-2020.pdf   (MEITY), 'India's Trillion Dollar Digital Opportunity'

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14. BPOs

The business-process outsourcing (BPO) industry in India employs 4 million workers.[52] The industry is facilitated by telecommunications infrastructure.

15. Electricity for powering telecom infrastructure

The telecom sector demands products and services from many other sectors. For instance, the telecom sector's electricity costs are 25% of total network operations costs. Growing infrastructure and expectations of continuous service provision create a need for electricity backup. Energy storage solutions such as Li-Ion batteries are a growing source of backup. India has the potential to integrate over 300 GWh of energy storage in the period up to 2025, with telecom being a major user.[53] In addition, Tower companies are working to connect towers in rural areas of decentralised electricity sources such as solar power.[54]

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[52](MEITY), 'India's Trillion Dollar Digital Opportunity'

[53]India Energy Storage Alliance, https://indiaesa.info/news-menu/71-iesa-press-release/1629-india-energy-storage-alliance-iesa-and-indian-electrical- electronics-manufacturers-association-ieema-to-conduct-2-nd-masterclass-on-advanced-energy-storage-manufacturing-in-india

[54]Communications Today (2020), 'An Uphill Struggle', February 25th, https://www.communicationstoday.co.in/an-uphill-struggle/

" *In this digital age, we have an opportunity to transform the lives of people in ways that was hard to imagine a couple of decades ago* **"**

-Hon'ble Prime Minister Sh. Narendra Modi

Manpower Requirements

V. Manpower requirements

The analysis in the previous section shows that the telecom sector is wide-ranging and growing. This implies a continued need for manpower both in the existing job roles as well as newer job roles as the industry evolves and adopts new technologies.

The National Digital Communication Policy and National Policy of Electronics have set out targets for skilling to bridge the skill gap in India.

National Digital communication Policy 2018 : Targets

Participate in Global Value Chains

4 million jobs in digital communications sector

1 million workers trained/retrained in new age skills

National Policy of Electronics 2019

Significantly enhancing availability of skilled manpower, including re-skilling in the ESDM sector

Strengthening/leveraging manufacturing, research, design and development hubs for promoting design and innovation

Working with government, industry, universities & other institutions of learning to design programmes to ensure availability of adequate skilled manpower

Creating schemes in partnership with the Ministry of HRD, state governments, NSDC, Telecom and Electronics Sector Skill Councils, NIELIT, Premier Institutes, targeted at job creation and bridging the skill gap

Promote/create a framework for start-up eco-system in emerging technologies like 5G, IoT, Artificial Intelligence, Augmented Reality and Virtual Reality, Machine Learning, Drones, Gaming and Entertainment, Robotics, additive manufacturing, Photonics, Nano-based devices etc, along with applications in smart cities, agriculture, health, defence, cyber security, automation etc

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Case studies for growth in delected job roles

Government policy described above along with market drivers are expected to lead to substantial growth in telecom demand and manpower requirements. Case studies for selected job roles based on alternative growth scenarios are developed and presented next.

Growth in teledensity: Scenarios

The growth in the number of connections is a substantial driver of growth in telecom sector manpower requirements. The national average teledensity (number of wireline and wireless telephone connections for every hundred individuals) equalled 85.98% in June 2020. The majority of this comprises of wireless phones, which constitute 98.30% of connections. Teledensity in rural areas (58.5%) is substantially lower than that in urban areas (138.4%). Teledensity also varies substantially across states ranging from as low as around 51% in Bihar and as high as over 147% in Himachal Pradesh. The teledensity in the low-density states is expected to increase over time, with that in the states with higher than 100% teledensity expected to reduce through rationalisation of SIM cards amongst subscribers with multiple connections.

Table V.1 below presents a scenario for the growth in teledensity and the number of connections in the state assuming each state catches up with the state with the highest teledensity in its region (excluding circles with higher than 100% teledensity). These regional catch-up scenarios imply a 227 million or nearly 20% growth in connections from current levels of around 1158 million.

In order to reach these teledensities, the states would have to be supported by necessary network infrastructure, as well as underlying manufacturing and service jobs. At the same time the states that already have high teledensity, as well as states with growing teledensity will need continuing manpower for maintenance of existing infrastructure. Furthermore, even geographies with high teledensity will require enhancement in infrastructure to improve data usage, speed and service quality.

Table V.1: Increase in wireless connections

	Number of connections (March 2020), millions			Teledensity (March 2020), %			Increase in teledensity to meet regional average, %			Increase in connections (by 2025), millions[1]	
	Total	Rural	Urban	Total	Rural	Urban	Rural	Urban	Catch up to state:	Rural	Urban
Northern											
Delhi	47.27	1.72	45.55	233.72			-	-	-	-	-
Himachal Pradesh	10.79	7.28	3.52	146.79	110.26	467.11	-	-	-	-	-
Punjab	37.74	13.48	24.26	125.3	75.54	197.58	-	-	-	-	-
Chandigarh	1.42	0.04	1.38	119.18			-	-	-	-	-
Haryana	30.66	12.79	17.87	105.31	73.67	152.03	1.87	-	Punjab	2.14	-
Jammu & Kashmir, Ladakh	11.86	5.73	6.13	87.16	60	151.22	15.54		Punjab	2.11	-
Western											
Goa	2.91	1.15	1.75	187.48	272.18	155.6	-	-	-	-	-
Maharashtra	127.72	44.36	83.36	103.51	68.79	141.53	4.09	-	Gujarat	5.05	-

	Number of connections (March 2020), millions			Teledensity (March 2020), %			Increase in teledensity to meet regional average, %			Increase in connections (by 2025), millions[1]	
	Total	Rural	Urban	Total	Rural	Urban	Rural	Urban	Catch up to state:	Rural	Urban
Gujarat	67.18	26.49	40.69	97.44	72.88	124.84	-	-	-	-	-
Rajasthan	65.53	35.59	29.94	83.63	61.55	145.84	11.33	-	Gujarat	8.88	-
Dadra and Nagar Haveli, Daman and Diu	0.76	0.23	0.52	73.9	100.44	66.2	-	-	-	-	-
Southern											
Lakshadweep	0.08	0.08		122.97		-	-	-	-	-	-
Kerala	43.35	19.94	23.41	122.72	181.93	96.09	-	-		-	-
Telangana	41.97	18.23	23.74	111.94	89.67	138.3			Telangana		
Tamil Nadu	80.81	25.4	55.41	106.22	70.13	139.02	19.54		Telangana	14.87	
Karnataka	67.63	28.47	39.16	101.9	75.27	137.18	14.4		Telangana	9.56	
Andhra Pradesh	45.89	24.84	21.04	87.35	72.45	115.37	17.22		Telangana	9.05	
Puducherry	1.17	0.32	0.85	76.09	69.57	78.9	20.1	10.77	Telangana rural	0.31	0.05
Central and Eastern											
Uttarakhand	13.32	6.34	6.98	118.09	85.82	179.27	-	-	-	-	-
West Bengal	79.77	35.83	43.94	81.76	57	126.58	5.25	-	Odisha	5.12	-
Odisha	33.33	22.3	11.03	75.98	62.25	137.14	-	-	-	-	-
Chhattisgarh	20.24	9.93	10.3	69.44	46.17	135.03	16.08	-	Odisha	4.69	-
Madhya Pradesh	55	24.42	30.58	65.89	41.02	127.77	21.23	-	Odisha	17.72	-
Uttar Pradesh	149.98	77.7	72.28	65.72	44.57	134.17	17.68	-	Odisha	40.35	-
Jharkhand	22.28	12.21	10.07	58.65	43.25	103.25	19	-	Odisha	7.22	-
Bihar	62.45	44.05	18.39	51.42	41.24	125.72	21.01	-	Odisha	25.52	-
Andaman & Nicobar Islands	0.38	0.18	0.2	94.42	76.89	118.23	-	-	-	-	-
North Eastern											
Mizoram	1.34	0.53	0.8	111.12	97.16	122.86	-	-	-	-	-
Sikkim	0.66	0.37	0.29	98.93	97.91	100.29	-	-	-	-	-
Arunachal Pradesh	1.31	0.76	0.56	86.41	66.33	146.76	30.83	-	Mizoram	0.47	-
Tripura	3.09	1.54	1.55	76.52	59.45	106.92	37.71	-	Mizoram	1.52	-
Nagaland	1.65	0.84	0.81	75.94	66.04	89.83	31.12	7.33	Mizoram rural	0.68	0.06
Manipur	2.33	0.96	1.37	74.22	44.55	138.32	52.61	-	Mizoram	1.65	-
Meghalaya	2.3	1.3	1.01	70.7	50.08	150.57	47.08	-	Mizoram	1.53	-
Assam	23.6	13.86	9.74	68.02	47.11	184.65	50.05	-	Mizoram	17.37	-
National	1157.7	519.3	638.5	85.9	58.5	138.4				226.7	0.2

Note: [1]Assumed that states' population grows at 1% per annum from July 2019 onwards.

Source: TRAI, The Indian Telecom Services Performance Indicators, January – March 2020

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Growth in telecom towers: Scenarios

At present, there are over 5.6 lakh telecom towers in India. The National Broadband Mission has a target of increasing the number of towers from 0.42 per thousand individuals in the population to 1 per thousand individuals. Indeed, an increase in the number of connections over time will require a growth in the number of telecom towers.

Table V.2 below presents these three alternative scenarios for growth in the number of towers:

⌘ High scenario – Assuming the tower to per 1000 population ratio increases to 1 in each state in accordance with the National Broadband Mission targets. Indeed, as data use increases and with a shift to 4G and even 5G there will be an increasing need for towers as higher generation towers have smaller coverage areas. This is an ambitious target that would require an additional 8.5 lakh towers and associated infrastructure being deployed.

⌘ Medium scenario – Assuming the tower to population ratio for each state increases to the regional maximum instead of the National Broadband Mission target. This would imply an additional 1.5 lakh towers.

⌘ Low scenario – Assuming additional towers are installed in each state in accordance with the growth in teledensity estimated in Table 1 above. An assumption is made that one tower would be able to serve 2000 customers, which is the current national median although this ratio varies from a high of 2900 in Eastern Uttar Pradesh to a low of 1200 in Jammu & Kashmir and Ladakh which may be a result of the region's topography. This scenario results in an additional 1.13 lakh towers assuming no improvement in national average tower : population ratio to enhance service quality.

Table V.2: Increase in Towers across states

License Service Area	Existing towers	Number of towers per 1000 individuals	Scenarios for increase in the number of towers		
			High: To meet National Broadband Mission target[1]	Medium: To meet the regional maximum tower to population ratio	Low: To meet teledensity growth[2]
Northern					
Himachal Pradesh	6,823	0.93	903		
UT of Delhi, Faridabad, Gurgaon, Ghaziabad, Gautam Buddh Nagar	26,763	0.90	4,409		
Jammu & Kashmir, Ladakh	9,581	0.70	4,720	3,324 (catch up to Delhi ratio: 0.90)	1,414
Punjab, Chandigarh, Panchkula	20,284	0.64	13,263	9,988 (catch up to Delhi ratio: 0.90)	
Haryana (excluding Faridabad, Gurgaon, Panchkula district)	12,828	0.49	14,421	11,761 (catch up to Delhi ratio: 0.90)	1,068
Western					
Gujarat, Dadra & Nagar Haveli, Daman & Diu	33,577	0.48	39,966		
Maharashtra (excluding Mumbai), Goa	42,851	0.41	67,523	10,112 (catch up to Gujarat ratio: 0.48)	5,910

License Service Area	Existing towers	Number of towers per 1000 individuals	Scenarios for increase in the number of towers		
			High: To meet National Broadband Mission target[1]	Medium: To meet the regional maximum tower to population ratio	Low: To meet teledensity growth[2]
Rajasthan	30,370	0.39	51,984	9,148 (catch up to Gujarat ratio: 0.48)	6,337
Southern					
Karnataka	36,278	0.55	33,476		6,747
Kerala, Lakshadweep	17,484	0.49	19,711	2,847 (catch up to Karnataka ratio: 0.55)	
Andhra Pradesh, Telangana	43,596	0.48	51,025	8,125 (catch up to Karnataka ratio of 0.55)	5.924 (Andhra Pradesh only)
Tamil Nadu, Puducherry, Karaikal district	31,173	0.40	50,402	13,417 (catch up to Karnataka ratio of 0.55)	9.873 (Tamil Nadu) 226 (Puducherry)
Central and Eastern					
Odisha	17,989	0.41	28,115		
Madhya Pradesh, Chhattisgarh	41,590	0.37	76,775	6,949 (catch up to Odisha ratio of 0.41)	10,715 (Madhya Pradesh) 2,979 (Chhattisgarh)
Uttarakhand, Uttar Pradesh (West) excluding Ghaziabad and Gautam Buddh Nagar	29,239	0.36	56,464	5,906 (catch up to Odisha ratio: 0.41)	25,028 (Uttar Pradesh)
Uttar Pradesh (East)	34,110	0.25	1,11,981	25,799 (catch up to Odisha ratio: 0.41)	
West Bengal (Excluding Kolkata), Sikkim, Andaman & Nicobar Islands	22,607	0.27	64,999	13,319 (catch up to Odisha ratio: 0.41	4,726 (West Bengal)
Bihar, Jharkhand	40,017	0.25	1,27,555	28,701 (catch up to Odisha ratio: 0.41)	15,002 (Bihar) 4,361 (Jharkhand)
North Eastern					
Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura	8,235	0.54	7,872		3,346
Assam	12,856	0.37	23,610	6,739 (catch up to other north-east states' ratio: 0.54)	9,727
National	**5,60,162**	**0.43**	**8,52,116**	**1,56,113**	**1,13,455**

Note: [1]Assumed that states' population grows at 1% per annum from July 2019 onwards 2 The high and medium scenarios have been developed for License Service Areas, whereas the low scenario is for states due to data availability reasons.

Source: Existing number of towers per state obtained from Department of Telecommunication, 'Telecom Statistics India 2019'.

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Growth in manpower requirements due to growing tower infrastructure: Scenarios

The need for continued maintenance of existing towers as well as installation and maintenance of new towers and associated infrastructure will have substantial implications for manpower requirements:

⌘ One Grass Root Telecom Provider per 10 towers in urban areas and one per five towers in rural areas[46]

⌘ One Tower Technician per 10 towers

⌘ One Network Engineer per 100 towers

⌘ One BSS Engineer per 100 towers[47]

Alongside tower infrastructure, there will be a continued and growing need for fibre infrastructure for connecting towers, particularly as data usage increases. This will require the following manpower:

⌘ One OFC splicer per 50 towers

⌘ One OFC technician per 50 towers

⌘ Wireless technician / network technician – One per 10 towers in urban areas

In addition, as the network expands and broadband demand increases, there will be a requirement for broadband technicians (one per 15/20 towers in urban areas and one per 10/15 towers in rural areas), along with technicians for rolling out and maintaining Fibre to the Home connections.

Table V.3 below estimates the number of employees required for installation and management of towers and associated fibre infrastructure to connect towers across the three tower growth scenarios. This ranges from over 3.6 lakh additional trained manpower under the high scenario to over 66,000 trained manpower under the medium scenario and over 36,000 under the low scenario.

Table V.3: Increase in manpower required due to enable and service tower infrastructure growth

	High: To meet National Broadband Mission target towers	Medium: States meet Regional maximum tower to population ratio	Low: States meet teledensity growth scenario requirements
Grassroot Telecom Provider	84,827	15,614	8,459
Tower Technician	84,827	15,614	8,459
Network Engineer	8,483	1,561	846
BSS Engineer	8,483	1,561	846
OFC Splicer	16,965	3,123	1,692
OFC Technician	16,965	3,123	1,692
Wireless / network technician	84,827	15,614	8,459
Broadband technician	56,551	10,409	5,639
Total	**3,61,929**	**66,618**	**36,090**

In addition to the job roles described in the case study in this section, the existing roles may be expected to evolve over time as technologies and demand / supply of services develops over time. This evolution is presented below.

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[46]This is broadly aligned with the Bharti Infratel ratio of towers to employees on rolls plus contractual employees on March 2020, which equalled 7. See Bharti Infratel Annual Report 2019-20 (number of towers: 42,053, on-roll employees: 1,248, contractual employees: 4,466)

[47]Telecom sector intelligence provided by the Telecom Sector Skill Council

SERVICE SEGMENT

Current job roles

Field Sales Executive

Sales Executive - Broadband

Customer Care Executive
Call Centre / Relationship

Evolving job roles

Artificial Intelligence-driven
customer service provision

HANDSET SEGMENT

Current job roles

Distributor Sales Representative

In-Store Promotor

Handset Repair Associate

Communication electronics

Surface Mount Technology (SMT) Technician

Hand Soldering

Telecom Embedded Hardware Developer

Line Assembler

Application Development

Native App Development

Android App Development

Evolving job roles

**Growth in manufacturing-related
job roles along value chain**

Manufacturing components of
handsets/accesories

Assembling handsets

Handset sales

Handset repair

Refurbishment

Upcoming job roles :

R&D into handset components

Manufacturing of handset components

Repairing wearable devices

Manufacturing IoT devices

E-waste management

PASSIVE INFRASTRUCTURE

Current job roles

Tower Technician

Optical Fibre Splicer/Technician

Fibre to-the Home (FTTH/X) Installer

Broadband Technician

Wireless Technician

FM Engineer

Infrastructure Engineer

Cluster In-Charge

Evolving job roles

High demand for skilled manpower due to expansion of high speed connectivity via fibre/ tower/ broadband in tier 2, 3 and 4 areas (including rural India)

Demand for Wi-Fi Infrastructure deployment in metro areas and tier – 1 & 2 cities

Smart City Infrastructure (100 smart cities which may be expanded to 4000 over time)

Use Cases of drone technology for asset management, surveying etc (using 4G/5G/Internet of Things)

NETWORK MANAGED

Current job roles

ICT Engineer

Drive Test Engineer

BSS Engineer

IoT:Installation and Service Technician

Evolving job roles

5G Technology

IoT Solution Planner and Integrator

Last Mile – Active Network Computer Technician

Active network – Network Operations Centre (NOC) management

Security Engineer

Telecom – AI & Machine Learning (for network optimisation, preventive maintenance, customer service through chatbots, business analytics based on big data)

Massive MIMO (Multiple Input – Multiple Output) to achieve higher data rates

Recommendations

The analysis in this report has presented the massive, continued growth and development of the telecommunications sector expected in the coming years. It would be necessary to have skilled manpower in place to enable this growth.

For instance, it has been estimated that increase in connectivity (particularly in rural areas) as well as growing population and data use in urban areas supported by national policy targets would necessitate a substantial growth in tower and fibre infrastructure. As much as 3.6 lakhs of additional manpower across a variety of job roles may be required for installation and maintenance of this infrastructure in addition to manpower already deployed for maintenance of existing infrastructure. Furthermore, another gamechanger within the industry will be Fibre to the Home connectivity which would also require skilled personnel.

With a low rural penetration of mobile telephony at present, at least 250 million additional connections may be expected over the medium term. Therefore, trained manpower would be required for the sales, distribution and repair of these additional handsets.

In addition to connecting citizens to networks, India is also aiming to transform itself from being one of the largest assemblers of mobile equipment in the world to one of the largest manufacturers of telecom gear through multiple incentives aligned with the *Atmanirbhar Bharat* initiative such as the Production Linked Incentive scheme. Government expects that over 2 lakh jobs could be created as a result of this scheme.

Given the growth and evolution of telecom service demand as well as underlying infrastructure, government needs to play a key role in enabling the availability of skilled manpower so that this core infrastructure industry can grow and evolve successfully. Indeed, given the importance of the telecommunications sector for the very functioning of the economy and the scale of manpower required by the sector, it becomes essential that the telecommunications sector job roles are prioritised amongst central and state government skilling schemes.

PRIMUS
PARTNERS

TSSC -
Initiatives & Events

TSSC: Thought leadership and events

National Edutech Innovative Summit and Awards

TSSC has received the award for Best Not-for-profit organization implementing skill development initiatives and creating employability in India at National Edutech Innovative Summit and Awards, Mumbai.

8.5 Lac +
Trained Manpower

5 Lac people are certified and ready for jobs

1000+
Training Centers

Spread across India – From Ladakh to Kanyakumari ; Rajasthan to Arunachal Pradesh

900+
Industry Partners

Major industry players across the telecom sector

26
Assessment Partners

3rd party assessment agencies conducting transparent and fair assessment

TSSC: A focus on placement

MoU between TSSC & mFilterIT

mFilterIt, the world's fastest growing ad-fraud and brand safety solutions company has joined hands with Telecom Sector Skill Council (TSSC) to offer certification programmes of various levels to professionals as well as students to prepare them for the rising demand of industry for such professionals.

Rozgar Mela

Telecom Sector Skill Council along with their Training Partners AISECT conducted Rozgar Mela at Dr. C V Raman University , Vaishali, Bihar in November, 2019.

The event was attended by more than 300+ students from technical streams and HR personnel from various companies.

Telecom Sector Skill Council

TSSC: Bringing emerging technologies to the fore

Telecom Manthan 2019

With a strategic focus on technology-based skills creating a demand for talent pool transformation, Telecom Sector Skill Council (TSSC) in association with Voice & Data organized the second edition of Telecom Manthan 2019 at The Lalit Hotel, New Delhi.

The objective of this annual event was to emphasize the importance of the emerging technologies and the need for skills for the future generation. The day long event was graced by the presence of Lt Gen Dr. S P Kochhar (ex-CEO, TSSC), Mr. Arvind Bali (CEO, TSSC) and Mr. P. Balaji (Board Member of TSSC). During the occasion, policy makers, academic bodies, decision makers from the telecom ecosystem and government dignitaries were present.

Telecom Coalescene 2020

The event focused on the latest developments transforming the telecom industry, such as 5G networks, AI and automation. Discussions covered strategy, innovation and partnerships for the telecom ecosystem. The Discussion delivered thought-provoking presentations from the TSSC Regional heads. Partners gathered to deliberate and discuss various opportunities/initiatives.

Seminar on High-End Courses

TSSC in association with MANAV KALYAN AVAM VIKAS SANSTHA conducted a seminar at SIX SIGMA INSTITUTE, Uttarakhand on high end offerings of TSSC. The seminar focused on new age technologies such as machine learning, drone technologies, cyber security to lay the groundwork for the acquisition of new knowledge.

Telecom Sector Skill Council

India Mobile Congress 2019

Mr. Arvind Bali sharing his insights on the upcoming tech trends at India Mobile Congress 2019. Mr. Arvind Bali emphasized the need for bringing together the industry, Government, academia, and other ecosystem players, to discuss and display the latest in the technology world. Not only is India Mobile Congress the biggest technology event in South Asia, it is also the biggest networking event in India in the digital technology space.

Haryana Institute of Public Administration

Mr. Arvind Bali delivered a lecture on New Age Technologies and its importance to the students of Punjab Engineering College, Chandigarh. The discussion highlighted the impact of the Internet of Things (IoT), Cloud computing, big data on the way industries functions and what will be the skill sets required by industry in the upcoming times.

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Training of Trainers (TOT)

Training of Trainers batch Successfully completed at TaTa Strive Mohali by TSSC.

The Training of Trainers (ToT) model is intended to engage master trainers in coaching new trainers that are less experienced with a particular topic or skill, or with training overall. A ToT workshop can build a pool of competent instructors who can then teach the material to other people.

TSSC conducted Training of Trainers batch Successfully at Ranchi from 17th Dec to 26th Dec 2019 . Total number of candidates trained were 23.

Notes

Notes

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