



Indian ICT Sector Profile Report



JANUARY 1, 2019



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1. Executive Summary

Information and Communication Technology (ICT) is generally the combination of Information technology (IT) and digital telecommunication. Information technology, which focuses on computers and related devices, and digital telecommunications, including cellphones, the internet and other digital networks. The information and communication technology (ICT) sector has played an important role in India's economic growth.

India is one of the fastest-growing IT markets in the world. The rapid emergence of Indian IT sector has transformed Indian economy as well as its image from a slow-moving low technology-highly bureaucratic economy to a high-tech land of innovative entrepreneurs. India is the world's largest sourcing destination for the IT industry, accounting for approximately 55% market share of the US\$ 185-190 billion global services sourcing business in 2017-18.

The country's cost competitiveness in providing Information Technology (IT) services, which is approximately 3-4 times cheaper than the US, continues to be its Unique Selling Proposition (USP) in the global sourcing market. This sector has evolved over the past few years with main focus on the execution of Business Processes and Information/ data Security, End User Privacy, Business Contingency, Technology, People Management and above all efficiency, productivity and customer satisfaction. According to Confederation of Indian Industry (CII), India's IT-business process outsourcing (BPO) industry revenue is expected to cross US\$ 225 billion mark by 2020. Over the last few decades, top IT companies in India such as **TATA Consultancy Services (TCS), Infosys, Tech Mahindra, Wipro, HCL Technologies** etc. have become the global leaders in information technology (IT) sector and contributing to the growth of technology not only in India but globally.

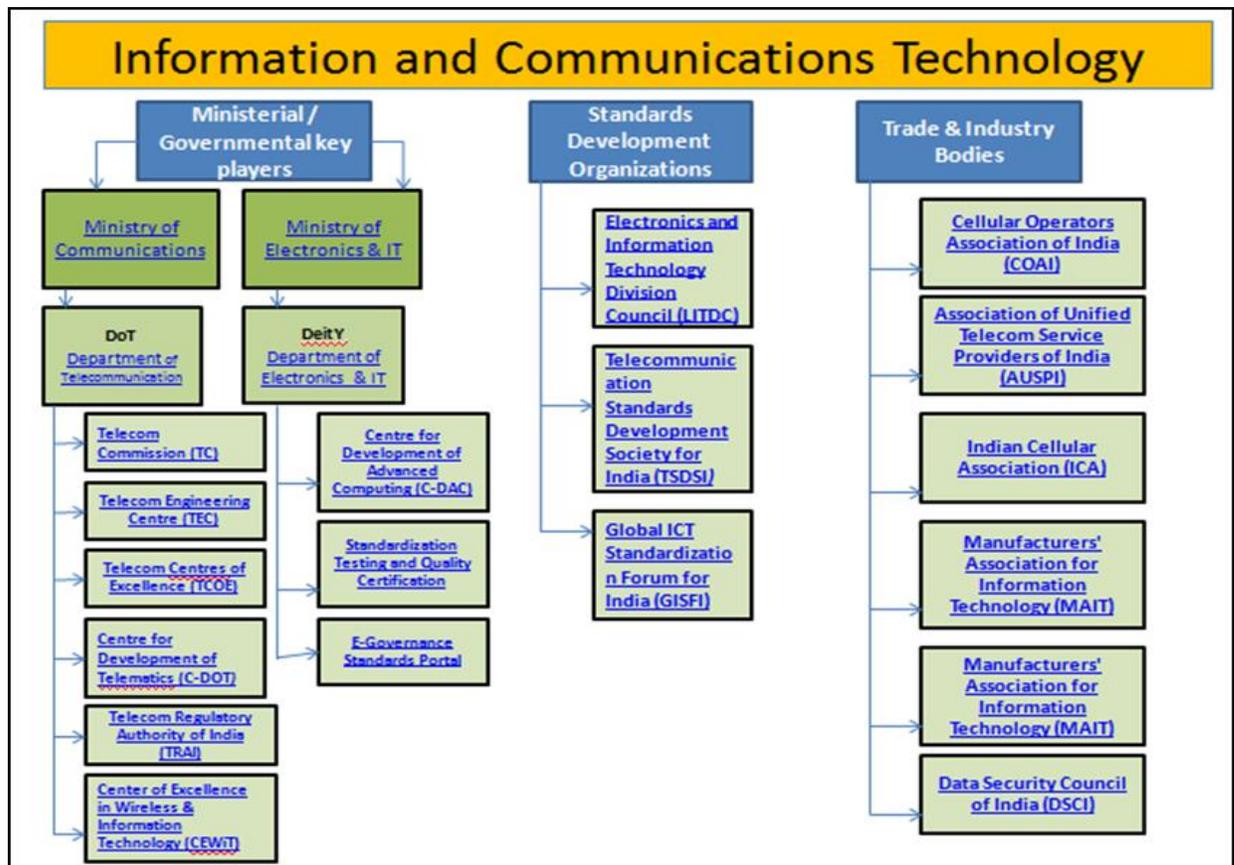
Similarly, the telecom sector has registered a phenomenal growth during the past few years and currently the world's second largest telecommunications market with a subscriber base of over 1 billion. India's internet population sits at 493.96 million as of March 2018 and according to a study conducted jointly by the Associated Chambers of Commerce (Assocham) and Deloitte, India will have 600 million internet users by 2020. It is predicted that imminent growth in telecom sector will be fueled by further and rapid diffusion of smartphones, deployment of new and emerging technologies such as 5G, Internet of Things (IoT), Artificial Intelligence (AI), Blockchain and Machine-to-Machine (M2M) etc. [According to a recent report published by Assocham and EY](#), IoT has the potential to reach an estimated 2 billion connections in India, unlocking revenues of \$11.1 billion by 2022. The Indian telecom industry has started witnessing consolidation thus increasing the industry's efficiency to share their network coverage assets. Consolidation has gained momentum in the industry with the intention of telecom operators to maintain their market share in order to compete with the new entrant Reliance Jio.

The spurt in growth of ICT sector in India and their significant contribution to the socio-economic development of the country has compelled the Government of India to create a favourable policy and regulatory environment for the further growth of these sectors. Suitable policy prescriptions by the government are necessary for ICT to become one of the key engines of economic development in India.

With more attractive and investor-friendly industrial policies such as **National Digital Communication policy 2018 (NDCP), National Policy on Information Technology 2012, National Cyber Security policy 2013, Internet of things policy, National telecom M2M roadmap etc. and foreign direct investment (FDI) policies**, India has become one of the favorite destinations for ICT investment portfolios. Another

significant development that has been witnessed is the single minded focus on the need for development and adoption of new technologies, Standardisation, Research & Development and capacity building.

In India, Bureau of Indian Standards (BIS), Telecommunications Standards Development Society, India (TSDSI) and Telecommunication Engineering Centre (TEC) are three main standards development bodies working towards formulating and recommending standards for the ICT Industry. The LITD technical division of BIS is mainly responsible for development of ICT standards and has recently formed new technical committees for Smartt City and Smart Infrastructure. TSDSI coordinate, contribute and work with global SDOs. Facilitate representation of Indian needs in global industry-driven bodies such as 3GPP, oneM2M, ITU etc. and ensure that home-grown technologies become part of international standards. The Telecommunication Engineering Centre (TEC) is the nodal agency of the Department of Telecommunication (DoT), Ministry of Communication (MoC) which is responsible for drawing up of standards; generic, interface & service requirements and specifications for telecom products, service and networks. TEC works very closely with ITU and various National Working Groups (NWGs) corresponding to respective ITU-T Study Groups have been formed by TEC.



Note: detailed information about Governmental/ministerial players, Standards Development Organizations (SDOs) and Trade & Industrial bodies in Indian ICT sector is available in our report titled "Indian Standardizations Report". This report can be downloaded [here](#)

Through this report it has been our endeavour to provide you with the holistic overview of the Indian IT and Telecom sector. The report is mainly divided into three main parts i.e.

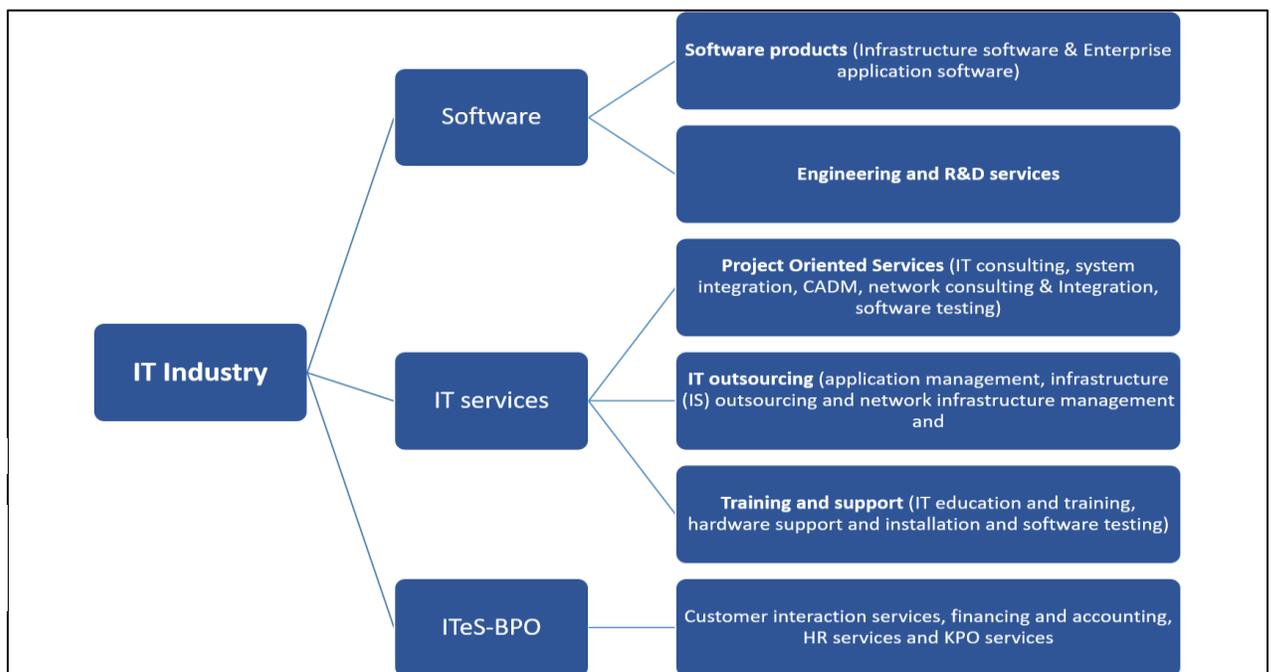
- Market trends for both IT and Telecom sector with future projections and key market players.
- The new policy and regulatory approach by the government for augmentation of these sectors
- The key standards development bodies in India responsible for the ICT sector

2. Information Technology (IT) Industry

2.1. Introduction

Information Technology (IT) industry in India can be broadly classified into three sectors as shown in below figure:

- Software
- IT services
- Information technology enabled services-business process outsourcing (ITeS-BPO)



Over the last few years, the Indian IT industry has emerged as a ‘sunrise industry’ and putting the country on the global map as the leader in the Information Technology (IT) and Business Process Outsourcing (BPO). The Direct employment in the IT services and BPO/ITeS segment is expected to grow by about 4.0 % reaching and add around 1,05,000 (over 1 lakh) employees during the year 2017-18 reaching a total of 3.96 million, which is a significant achievement for the sector. IT sector contributes around 7.9% to the Gross Domestic Product (GDP) of India.

The Information Technology (IT) and Information Technology Enabled Services (ITeS) sectors go hand-in-hand, in every aspect. The industry has not only transformed India’s image on the global scenario, but also

fuelled economic growth and has contributed a lot to social transformation in the country. India has the opportunity to tap a market that is growing day by day with its cost advantage, huge resource pool and expertise.

This sector has evolved with main focus on the execution of Business Processes and Information/ data Security, End User Privacy, Business Contingency, Technology, People Management and above all efficiency, productivity and customer satisfaction. The sector ranks 3rd in India’s total Foreign Direct Investment (FDI) share and has received US\$ 29.825 billion of FDI inflows between April, 2000 and December, 2017.

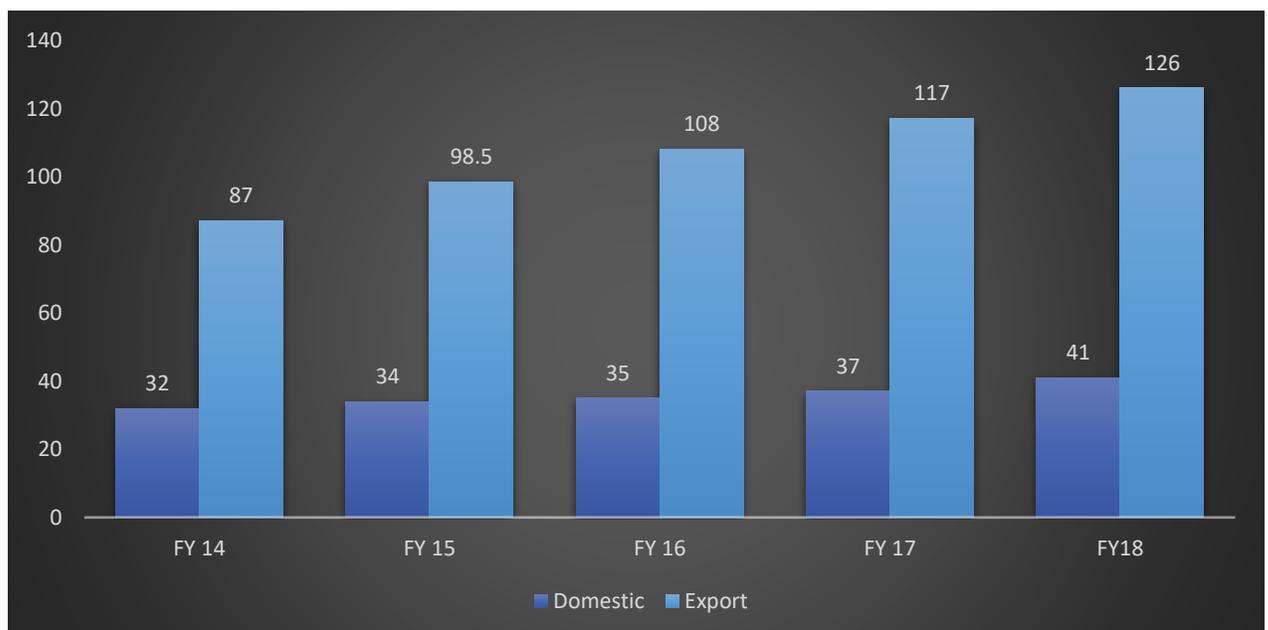
2.2. Current status

The IT and IT Enabled Services (ITES) industries have been one of the key driving forces fuelling India’s economic growth, contributing about 8% to India’s GDP in 2018 and employs nearly 4 million people in India. India is the leading sourcing destination across the world, accounting for approximately 55% market share of the US\$ 185-190 billion global services sourcing business in 2017-18. India acquired a share of around 38% in the overall Business Process Management (BPM) sourcing market.

Market Size: IT Industry (US\$ billion)

In FY 18, IT export revenue has reached US\$ 126 billion while domestic revenue stood at US\$ 41 billion (includes hardware revenue of US\$15 billion). The total revenue registered a growth of around 8.45% to US\$ 167 billion as compared to US\$154 billion in FY17. Information technology body NASSCOM anticipated that IT exports in India are expected to grow at 7-9% to be at US\$135 billion- US\$137 billion in FY19 while the domestic revenues (excluding hardware) is expected to grow by 10-12% to be at US\$28 billion-US\$29 billion in the ongoing financial year against \$26 billion in FY18.

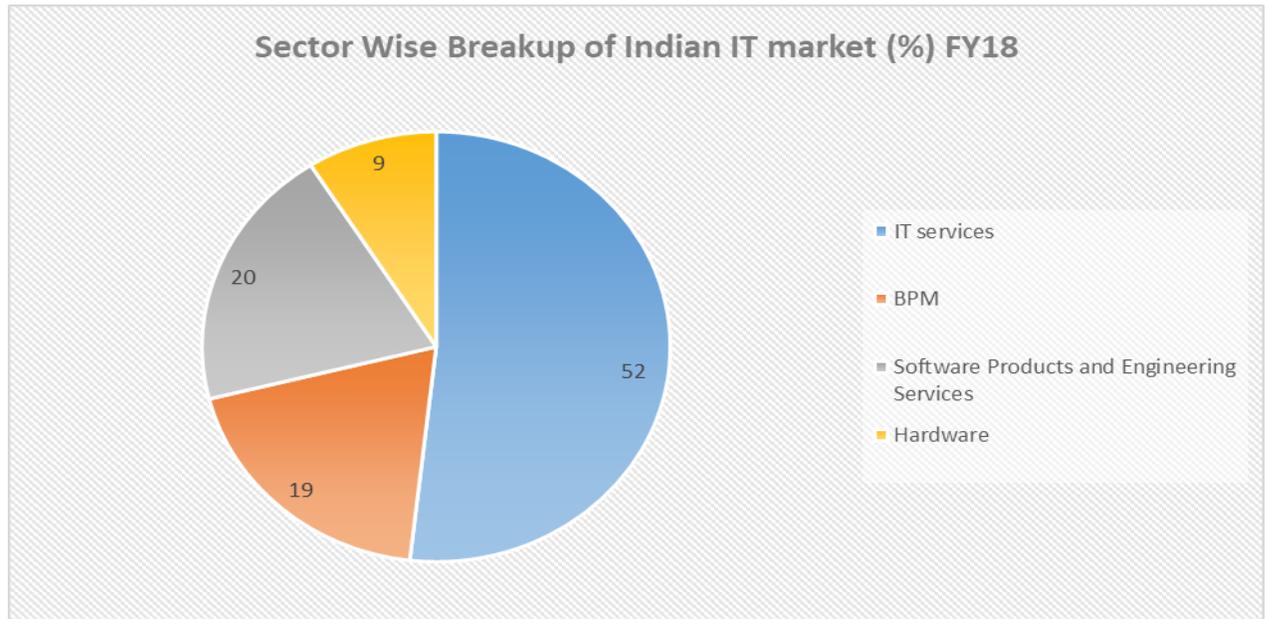
The overall growth of this sector over last five year is shown in below figure:



Source: [IBEF](#)

Sector-wise breakup of IT industry:

- **IT services:** IT revenue from IT Services reached US\$ 86 billion with share of 51.8% in the total IT sector revenues in FY18. Over 81% of revenue comes from the export market.



- **Business Processing Management (BPM)** accounts for 19.3% of the total IT industry revenue and IT revenue from BPM stood at US\$ 32 billion in year 2017-18. Around 87% of revenue comes from the export market.
- **Software products and engineering services:** This sector holds 19.9% of the total IT revenue and has reached at US\$ 33 billion in FY18. Around 84% of revenue comes from export.
- **Hardware:** IT revenue form this sector reached at US\$ 15.4 billion during the fiscal year 2018. This sectors accounts for 9% of the total IT revenue.

Domestic Market Revenue share of various segments in IT Sector:

The Size of the domestic market has become significant now in the IT Sector, though it largely remains export driven. As shown in below table, Domestic IT revenue (excluding hardware) grew to ~US\$26 billion in FY2017-18, as compared to US\$ 24 billion in FY2016-17, a y-o-y growth of around 8.7%. In FY 2018.

Quantum of contribution from each segment of IT sector over last five year is given in below Table (US\$ billion):

Year/ Segment	2013- 14	2014-15	2015-16	2016-17	2017-18
IT services	10.85	12.2	13.35	15.0	16.95
ITeS-BPO	2.92	3.2	3.5	4.0	4

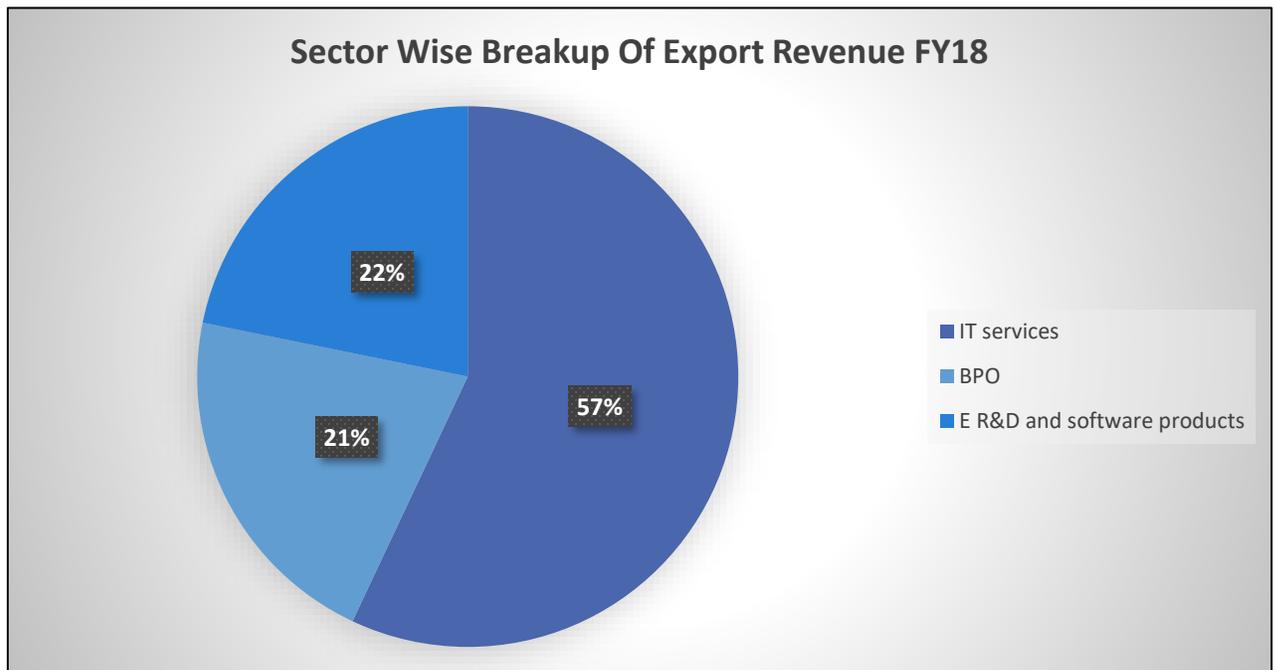
Software Products, Engineering Services, R&D	3.35	3.85	4.15	5.0	5
Total IT	17.13	19.24	21	24	25.95

Source: <http://meity.gov.in/content/performance-contribution-towards-exports-it-ITeS-industry>

- As per above table, the revenue contribution from Domestic operations of IT (excluding hardware) is around INR 1738 billion (~US\$17 billion) for FY2017-18 as compared to US\$15 billion in FY17. The growth over last year is at 13%.
- Domestic revenue from **ITeS-BPO** stood at 4 billion during the fiscal year 2018.
- The revenue contribution from **Software Products Engineering Services** reached to US\$5 billion in FY18.

Exports Revenue share of various segments in IT Sector

As per below figure, Exports revenue from IT services have the largest contribution of around 57% as a segment. The exports revenue generated from this segment stands at US\$ 69.3 billion for FY18 as compared to US\$66 billion in FY17. The ITES segment which mainly comprise the Business process outsourcing (BPO) has a share of 21.2% and contributes about US\$ 28.4 billion in FY18. Engineering R&D and Product Development contribution is pegged at US\$ 28.3 billion for the years 2017-18 as compared to US\$25 billion in FY17, registered a growth of 13.2% over the year.



It can be established from the below table that IT exports' contribution is reached at US\$ 126.0 billion for FY2017-18, registered a growth of 7.5% over the last year. Disruptive technologies like AI (Artificial

Intelligence), SMAC (Social Media, Mobility, Analytics and Cloud), embedded systems etc. are the emerging trends of the industry to create new paradigms.

Quantum of contribution from each segment of IT sector over last five year is given in below Table (US\$ billion):

Year/ Segment	2013- 14	2014-15	2015-16	2016-17	2017-18
IT services	49.2	55.3	61	66	69.3
ITeS-BPO	20.4	22.5	24.4	26	28.4
Software Products, Engineering Services, R&D	17.7	20	22.4	25	28.3
Total IT	87.3	97.8	107.8	117	126

Source: <http://meity.gov.in/content/performance-contribution-towards-exports-it-ITeS-industry>

2.3. Market Players

Over the last few decades, top IT companies in India have become the global leaders in information technology (IT) sector and contributing to the growth of technology not only in India but globally. The Indian IT sector employs more than 4 million people and is a €130+ billion industry. Some of the best Indian IT companies are part of the top software companies' world over.

Here is the list of the top 5 IT companies in India 2018 based on revenues:

- **TATA Consultancy Services (TCS):** TCS has become the first Indian IT company to have a market capitalization of 100 billion dollars and has over 400,000 employees. TCS generates roughly 70% of the revenue for Tata Sons, and is one of the global leaders in the sector. [About TATA Consultancy Services \(TCS\) >>](#)
- **Infosys:** Infosys is a household name of Information Technology space with workforce of over 200,000 people in different countries. The Company has a total revenue of INR 60,878 crores in last four quarters. [About Infosys Limited>>](#)
- **Tech Mahindra:** Tech Mahindra is a part of Mahindra group, which is one of the most reputed organizations in India with over 110,000 people employed across 90 countries. The Company had a total revenue of 23,562 crores in last four quarters. [About Tech Mahindra>>](#)
- **Wipro:** Wipro has a number of key focus areas like machine learning, Data Sciences and analytics and is currently investing heavily in block chain technologies and has over 160,000+ people employed

across 6 continents. The Company has a total revenue of INR 44,902 crores in last four quarters. [About Wipro Limited>>](#)

- **HCL Technologies:** HCL Technologies generated a revenue of more than INR 21,000 crores over the last four quarters and has a strong workforce of 117,000+ employees. [About HCL Technologies>>](#)

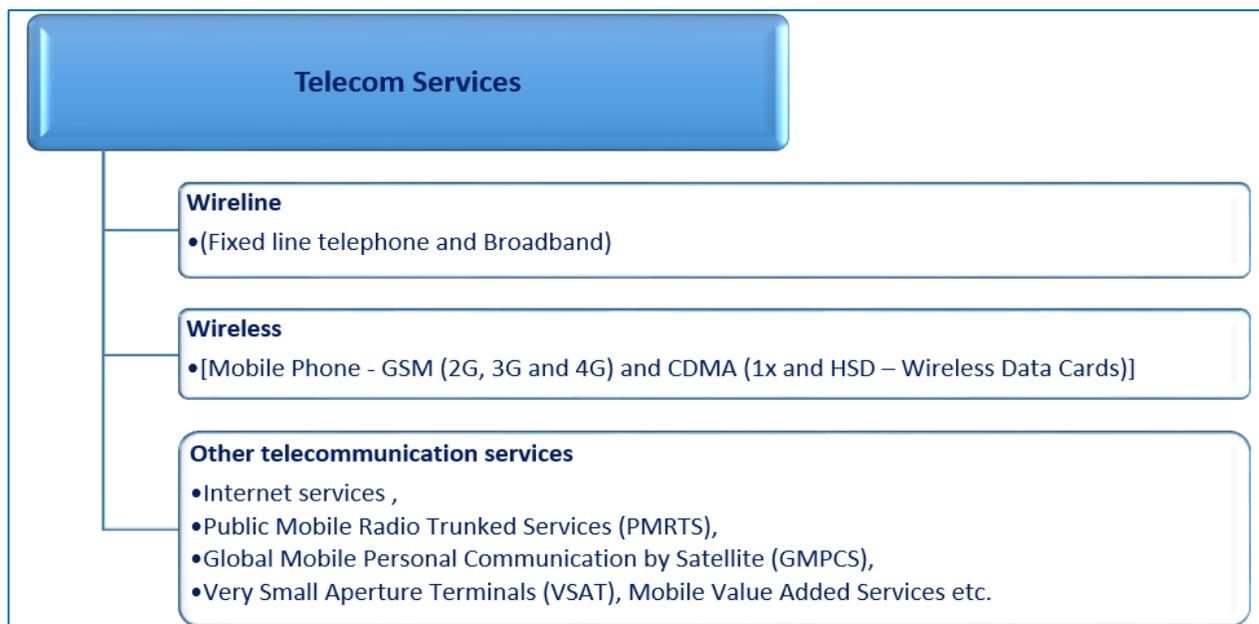
2.4. Growth Drivers

- **Availability of highly qualified talent pool:** Availability of highly qualified talent pool at lower rates helps in cutting the cost for about 60-70 % to source countries. This large pool of qualified skilled workforce has enabled Indian IT companies to help clients save US\$ 200 billion in the last five years.
- **Increasing adaption of emerging technologies:** Disruptive technologies like AI (Artificial Intelligence), Social Media, Mobility, Analytics and Cloud (SMAC), embedded systems etc. are the emerging trends of the industry to create new paradigms. India has been creating a future-ready digital workforce, with more than 0.15 million employees SMAC skills. The SMAC market is expected to grow to USD 225 billion by 2020.
- **Government policy support:** Government of India (GoI) envisions a digitally equipped India and emphasizing on activities to promote programmes for skill development and uplifting infrastructure capabilities. R&D programmes are being supported by GoI at every possible level to maintain India's strategic advantage in IT and IT-enabled Services in the global market.
- **Emerging geographies and verticals, non-linear growth** due to platforms, products and automation.
- **Use of IT in emerging verticals (retail, healthcare, utilities)** are driving growth in Indian IT sector.
- **Revival in demand for IT services** from US and Europe.

3. Indian Telecom Sector

3.1. Introduction

The telecom sector is one of the fastest growing sector in India that has undergone an innovative phase over the past few years and has become the second largest telecommunication market in the world after China. The telecom sector has assumed the position of an essential infrastructure for socioeconomic development in an increasingly knowledge-intensive world. As per below figure, the telecom services in India can be divided into two broad segments, **wire-line services** (includes fixed line telephone and Broadband) and **wireless services** (includes mobile phone – GSM and CDMA).



Other **telecommunication services** such as internet services, broadband services, VSAT, have also evolved gradually and have become an integral part of the Indian telecom industry. The wire line segment, which accounted for a major share at the start of the current decade, has witnessed a decline in its subscriber base in the last 5 years. The reach of telecom services to all regions of the country has become an integral part of an innovative and technologically-driven society. Studies have shown positive correlation of the Internet and Mobile Services on growth of the GDP of a country.

Telecommunication as a sector has delivered an amazing transformation to the society, the common man and India's overall socio-economic development. It has been made possible through the entrepreneurial spirit of the nation coupled with an enabling policy framework that has been fine-tuned and adapted from time to time to facilitate timely course corrections and incentivize growth and development.

However, in recent times, the financial downturn in the economy coupled with increased policy and regulatory uncertainty, have led to severely deteriorated fundamentals and have hampered the sector in performing to its true potential. Considering the role of telecom as the backbone of economic and social development, there is an urgent need to take corrective measures to put back the sector on track. As mentioned above some critical areas requiring immediate attention are rationalisation of levies, making more spectrum available and conducive policy for the consolidation.

3.2. Current status

Indian telecom industry is currently the world's second largest telecommunications market with a subscriber base of over 1 billion. India's mobile economy is growing rapidly and currently constitutes more than 98% of all telephone subscriptions. According to TRAI, total telephone subscribers are stood at 1193.72 million (including 1171.76 million wireless subscribers and 21.96 million wireline subscribers) at the end of November 2018. With the arrival of the 'unlimited service' subscription, the telecom industry is set to expand even further.

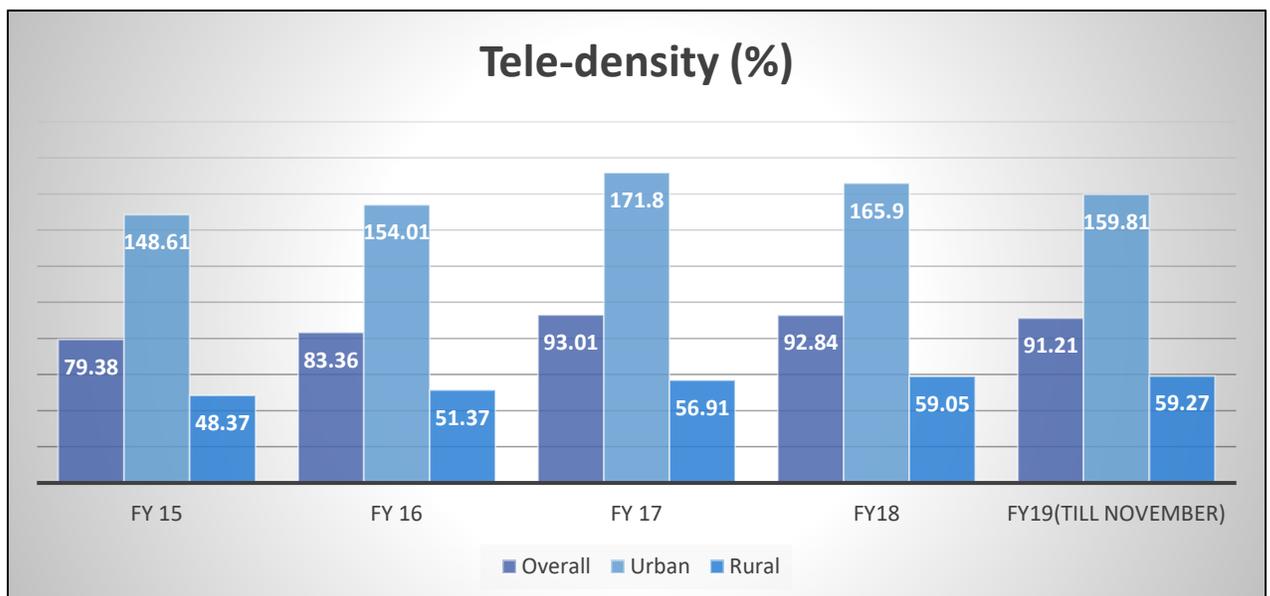
As a result of this growth, it is expected that India will have 600 million internet users by 2020, according to a study conducted jointly by the [Associated Chambers of Commerce \(Assocham\) and Deloitte](#). At the end of March 2018, India’s internet population sits at 493.96 million. With the rise in smartphone usage and increasing penetration of 4G and 3G services, the Internet user base is rapidly expanding and has reached a penetration of over 27% versus 50.3% penetration of China.

At present, telecom sector in India employs over 4 million people- directly and indirectly and [according to skill development body for the sector](#), telecom as well as telecom manufacturing sector are expected to create over 10 million employment opportunities in the next five years. The employment opportunities are expected to be created due to combination of government’s efforts to increase penetration in rural areas and the rapid increase in Smartphone sales and rising internet usage. Rise in mobile-phone penetration and decline in data costs will add 500 million new internet users in India over the next five years, creating opportunities for new businesses. [According to Swedish telecom gear maker Ericsson](#), the monthly data usage per Smartphone in India is expected to increase from 3.9 GB in 2017 to 18 GB by 2023.

With increasing subscriber base, there have been a lot of investments and developments in the sector. According to the data released by DIPP, the industry has attracted FDI worth more than US\$ 30 billion during the period April 2000 to March 2018 and, contributing 6.5% to India’s GDP.

Tele-density

Tele-density is the number of telephone connections for every hundred individuals living within an area. At the end of November 2018, the overall tele-density is stood at 91.21% as compared to 92.84% in FY18, registered a decline of 1.63 during FY19. The Urban Tele-density decreased from 165.9% in FY 2018 to 159.81% at the end of Nov-18, however Rural Tele-density increased from 59.05% to 59.27% during the same period and registered a marginal growth of 0.22. The trend of tele-density since FY 15 is depicted in figure given below:



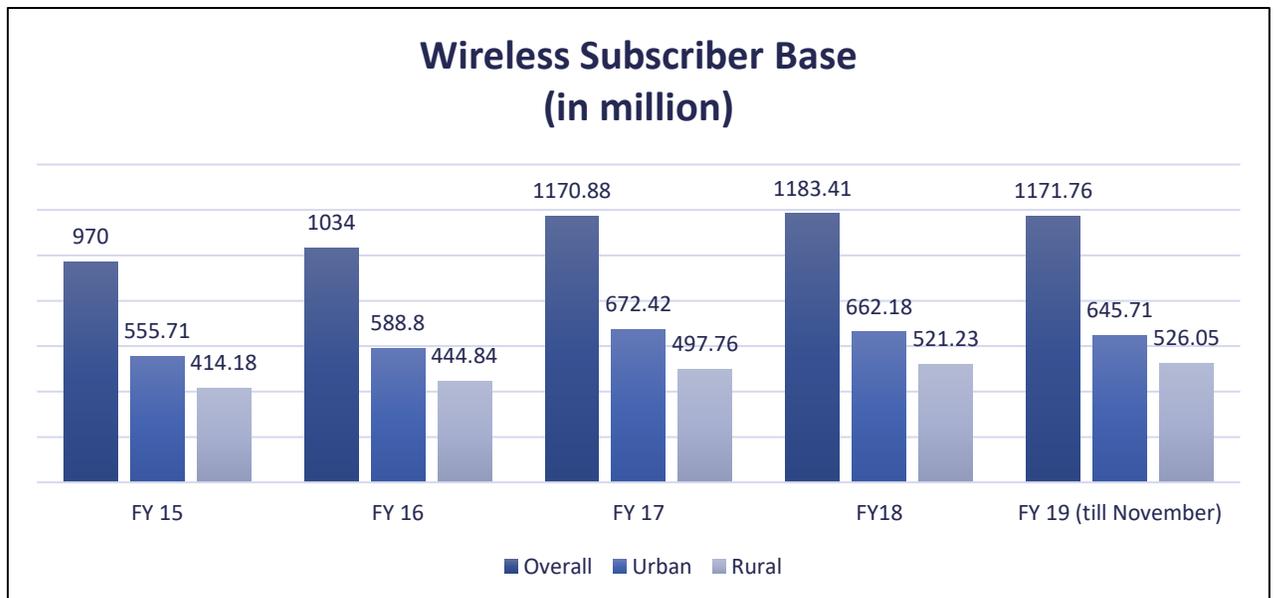
Source: TRAI

The share of urban and rural subscribers in total number of telephone subscribers at the end of Nov-18 is 55.67% and 44.33% respectively. The Wireless Tele-density (%) decreased from 91.09 in FY18 to 89.54 at the end of Nov-18. The Urban Wireless Tele-density (%) declined from 161.17 in FY18 to 155.28 at the end of Nov-18, however Rural Wireless Tele-density (%) increased from 58.67 to 58.92 during the same period. The share of urban and rural wireless subscribers in total number of wireless subscribers are 55.11% and 44.89% respectively at the end of Nov-18. The Overall Wireline Tele-density (%) declined from 1.76 at the end of FY18 to 1.68 in Nov-18. Urban and Rural Wireline Tele-density are 4.53% and 0.35% respectively during the same period.

Telecom wireless subscriber base

As per the data released by Telecom Regulatory Authority of India (TRAI), the total telecom wireless subscribers (GSM, CDMA & LTE) were increased from 1170.18 million in FY17 to 1183.41 million in FY18, thereby registered a annually growth rate of 1.13%. During FY19, wireless subscriptions declined to 1171.76 million (as on November 2018) from 1183.41 million in FY18.

Out of 1171.76 million wireless subscribers, 1,031.28 million wireless subscribers are active on the date of peak VLR (Visitor Location Register) in the month of Nov-18. The proportion of active wireless subscribers is approximately 86.83% of the total wireless subscriber base. At the end of Nov 2018, wireless subscription in Urban and Rural areas stood at 645.71 million & 526.05 million respectively. The wireless subscriber base since 2015 is depicted in Figure given below:

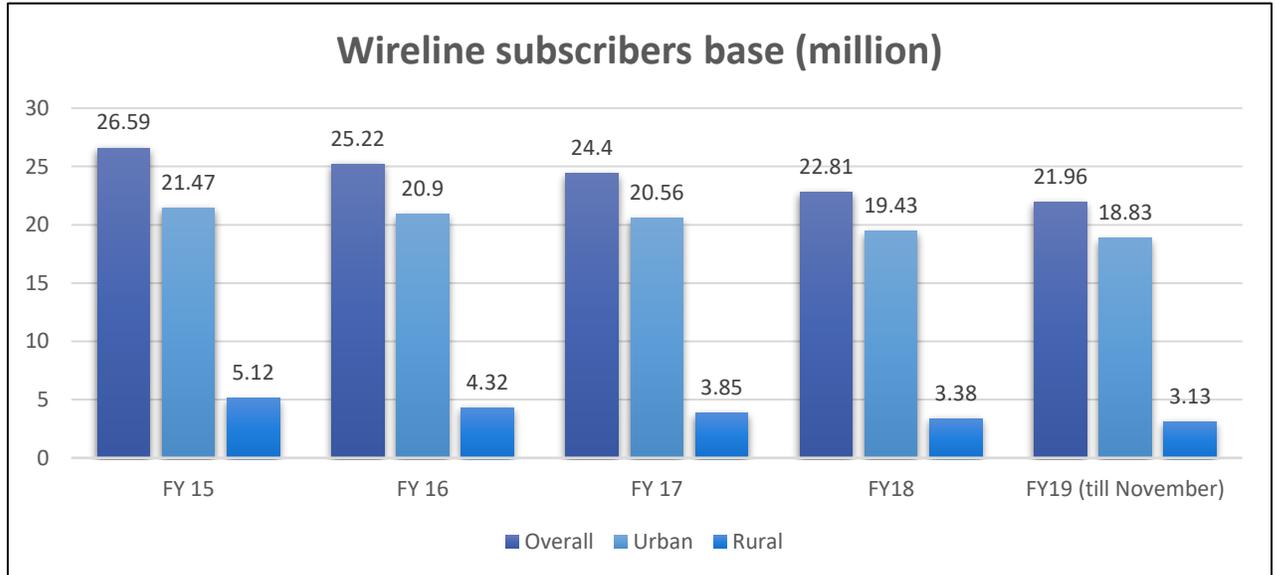


Source: TRAI

Telecom wire-line subscriber base

At the end of FY18, the total wireline subscriber base was stood at 22.81 million (including over 19 million subscribers in urban areas while over 3 million in rural areas) as compared to 24.11 million subscribers in FY17, registered a decline of 5.7% during the FY18. Wireline subscribers further declined from 22.81 million in FY18 to 21.96 million at the end of Nov-18. The share of urban and rural subscribers in total

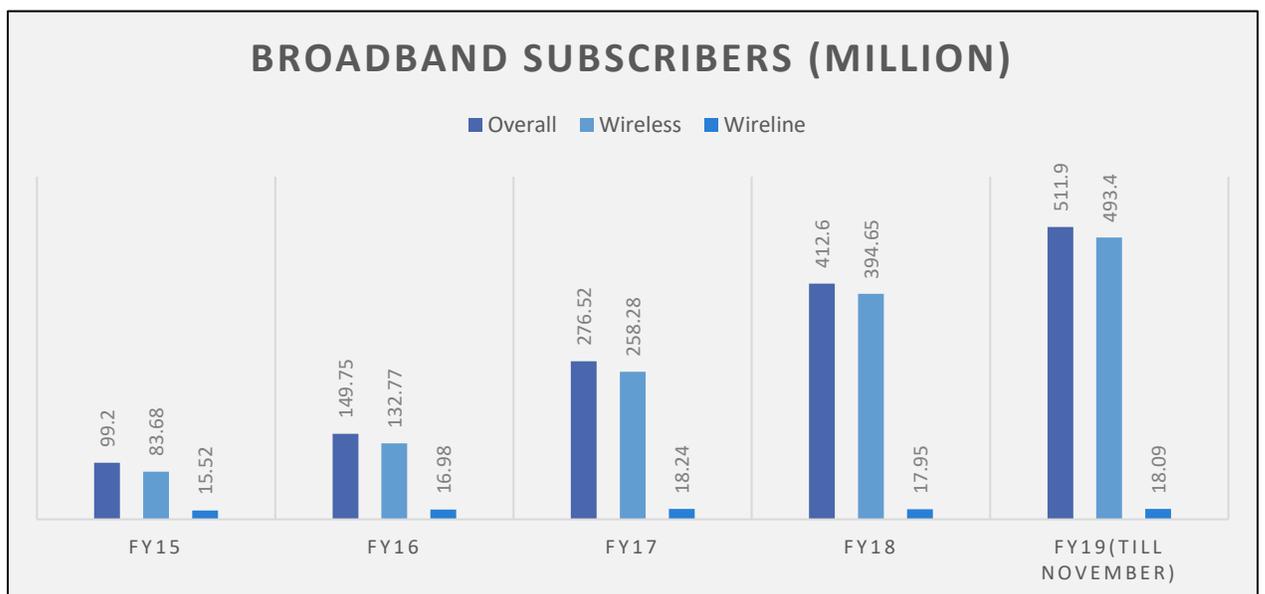
wireline subscribers were 85.76% (over 18 million) and 14.24% (over 3 million) respectively at the end of Nov-18. The wireline subscriber base since 2015 is depicted in Figure given below:



Source: TRAI

Broadband Subscribers

Amid explosive growth in data consumption, India’s broadband subscriber numbers registered a growth of over 24% to 511.90 million (including 493.40 million wireless subscribers and 18.09 million wired subscribers) at the end of November 2018 as compared to 412.60 million (including 394.65 million wireless subscribers and 17.95 million wired subscribers) in FY18, according to official data by the Department of Telecom (DoT). The growth in broadband subscribers since FY15 is shown in below figure:



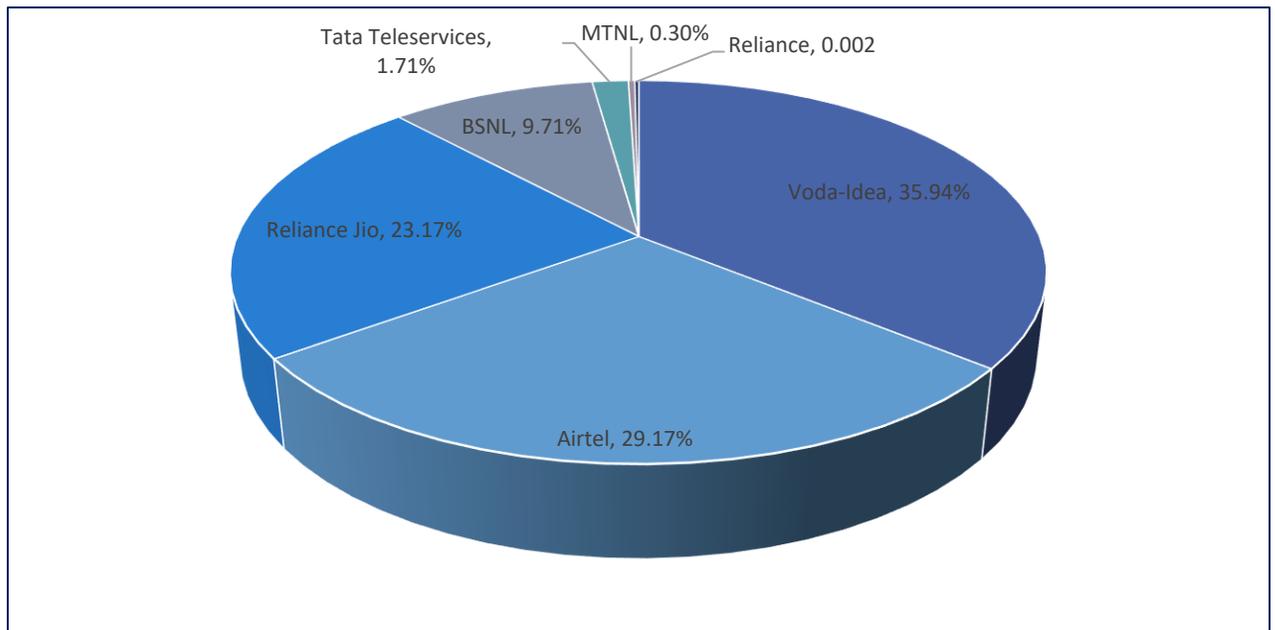
Source: TRAI

3.3. Market Players

The Indian telecom sector has mix of Indian and foreign telecom companies. Major players are:

- Vodafone-Idea
- Bharti Airtel
- Reliance Jio
- Government owned BSNL and MTNL
- Tata Teleservices*

According to TRAI, the private access service providers held 89.99% market share of the wireless subscribers whereas Government owned BSNL and MTNL had a market share of only 10.01% as on November, 2018. With Vodafone India and Idea Cellular merger, Vodafone-Idea displaced market leader Bharti Airtel to second position and has become market leader with largest share of 35.94% that represents a subscriber base close to 420 million wireless users. This is followed by Bharti Airtel, Reliance Jio and BSNL that have a share of 29.17% with a wireless subscriber base of nearly 342 million, 23.17% (wireless subscriber base of ~271.5 million) and 9.71% (~114 million wireless subscriber), respectively. The other telcos Tata, MTNL and Reliance have relatively a very smaller share in total wireless subscriber base as shown in the chart below:



Source: TRAI

Shareholders of **Bharti Airtel** has approved the proposed merger with **Tata Teleservices**, according to the company. The merger which is now looking for the approval from National Company Law Tribunal (NCLT) is expected to be finished by the end of March 2019. With the merger of Tata Teleservices, Airtel' subscriber base will receive a major boost. Airtel is currently the leading telecom operator in India with the subscriber base close to 350 million, however, the merged entity of Idea-Vodafone will dethrone Airtel to become the leading telco in terms of subscriber base with over 420 million users under its belt.

It is to be noted that the market share scenario was very different two years back in 2016 when Reliance Jio had not entered the telecom market. Reliance Jio commercially launched telecom services in September 2016 with its 'Welcome Offer' that provided free voice calls, free data services and no roaming charges across the country till the end of December 2016. Post this, the company continued to provide various attractive offers and cheap data services to its users which aided the telco to garner a market share of 20.5% in two years of its launch. Also, the company's entry reduced the number of telecom players and resulted in consolidation of the telecom industry.

*Note: *Bharti Airtel and Tata Teleservices are expected to become single merged entity by March 2019.*

3.4. Growth drivers

- **Growing young population & Changing lifestyle:** Mobile internet is predominantly used by youngsters, with 46% of urban users and 57% of rural users being under the age of 25. Urban India has around twice the proportion of users over the age of 45, while the age range of 25 to 44 has almost equal distribution of users in urban and rural areas. The next wave of growth in mobile internet users is going to come from rural areas, where mobile data penetration is as low as 18%.
- **Increasing rural market:** Rural market would be a key growth driver for telecom industry in coming years as telecom penetration in rural areas is still very low as compare to urban areas.
- **Favorable policy support:** Government of India has fast-tracked reforms in the telecom sector and continues to be proactive in providing room for growth for telecom companies. Some of major steps such as **Digital India Programme, National Digital Telecommunication Policy 2018, National e-Governance Plan** etc. have been taken by GoI to promote R&D, Innovation and to attract investment in Telecom sector in India.

4. Government policy initiatives

4.1. Information Technology (IT) industry

4.1.1. Internet of Things (IoT) Policy 2016

India, in the recent few years, has been moving towards becoming a digital economy. The digital space in India has seen a lot of transformations and Internet of Things (IoT) is a recent phenomenon. Hence the Department of Electronics and Information Technology (DeitY) has drafted India's first 'Internet of Things Policy' in October 2016.

Vision:

"To develop connected and smart IoT based system for our country's Economy, Society, Environment and global needs. "

Objectives:

- To create an IoT industry in India of USD 15 billion by 2020. It has been assumed that India would have a share of 5-6% of global IoT industry.
- To undertake capacity development (Human & Technology) for IoT specific skill-sets for domestic and international markets.

- To undertake Research & development for all the assisting technologies.
- To develop IoT products specific to Indian needs in all possible domains.
- The Policy framework of the IoT Policy has been proposed to be implemented via a multi-pillar approach. The approach comprises of five vertical pillars (Demonstration Centres, Capacity Building & Incubation, R&D and Innovation, Incentives and Engagements, Human Resource Development) and 2 horizontal supports (Standards & Governance structure).

India's first Internet of Things Policy comes at the most appropriate time when the country is moving towards digitalization and a policy like this will support the initiatives taken in this direction. Two major efforts taken by the Government of India which will lead to a rapid growth of IoT industry are Smart Cities project and Digital India Program.

[Read more/Download](#)

4.1.2. **National Cyber Security Policy 2013**

In 2013, Ministry of Communication and Information Technology of the Government of India had released the National Cyber Security Policy to protect information, such as personal information, financial/banking information, sovereign data etc. The policy has proposed to set up different bodies to deal with various levels of threat, along with a national nodal agency, to coordinate all matters related to cyber security. The government has also proposed to set up a National Critical Information Protection Centre (NCIIPC), which will act as a 24*7 centre to ward off cyber security threats in strategic areas such as air control, nuclear and space. It will function under the National Technical Research Organization, a technical intelligence gathering agency controlled directly by the National Security Adviser in the Prime Minister's Office. The existing agency, Computer Emergency Response Team (CERT) will handle all public and private infrastructures. As part of the policy, the government has proposed to create a workforce of around 500,000 trained in cyber security. It also proposes to provide fiscal benefits to businesses to adopt best security practices.

The salient features of the policy cover the following aspects:

- ✓ A vision and mission statement aimed at building a secure and resilient cyber space for citizens, businesses and the Government.
- ✓ Enabling goals aimed at reducing national vulnerability to cyber-attacks, preventing cyber-attacks and cybercrimes, minimizing response and recover time and effective cybercrime investigation and prosecution.
- ✓ Focused action at the level of Government, public-private partnership arrangements, cyber security related technology actions, protection of critical information infrastructure and national alerts and advice mechanism, awareness & capacity building and promoting information sharing and cooperation.
- ✓ Enhancing cooperation and coordination between all the stakeholder entities within the country.
- ✓ Objectives and strategies in support of the National cyber security vision and mission.
- ✓ Framework and initiatives that can be pursued at the Govt. level, sectoral levels as well as in public private partnership mode.
- ✓ Facilitating monitoring key trends at the national level such as trends in cyber security compliance, cyber-attacks, cyber-crime and cyber infrastructure growth.

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4.1.3. **National Policy on Information Technology 2012**

In order to promote further growth of ICT industry, the government has approved **National Policy on Information Technology 2012** which aims to make at least one individual in every household e-literate among other objectives. Here are some important points, just to glance through:

- ✓ To transform India into a global hub for the expansion of language technologies.
- ✓ To develop a pool of 10 million skilled manpower in the Indian ICT sector.
- ✓ To achieve significant market share in global technologies and services.
- ✓ To offer fiscal benefits to foreign investors and Small Medium Enterprises (SMEs).
- ✓ To promote adoption of ICTs in strategic and economic sectors to enhance the productivity and competitiveness of ICT
- ✓ Enhance transparency, accountability, efficiency, reliability and decentralization in Government
- ✓ Strengthening the Regulatory Framework etc.

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4.1.4. **Software Technology Parks of India (STPI)**

Software Technology Parks of India, is an Autonomous Society set up by the Ministry of Electronics and Information Technology (MeitY), Government of India in 1991, with the objective of encouraging, promoting and boosting the Software Exports from India. Software Technology Parks of India maintains internal engineering resources to provide consulting, training and implementation services. Services cover Network Design, System Integration, Installation, Operations and maintenance of application networks and facilities in varied areas. [Read more](#)

4.1.5. **India BPO Promotion Scheme (IBPS)**

The India BPO Promotion Scheme (IBPS) has been approved under [Digital India Programme](#), to incentivize BPO/ITES Operations across the country [excluding certain Cities and the States in North East Region (NER)], for creation of employment opportunities for the youths and growth of IT-ITES Industry. IBPS aims to incentivize establishment of 48,300 seats distributed among each State in proportion of State's population, with financial support up to Rs. 1lakh/seat in the form of Viability Gap Funding (VGF), with an outlay of Rs. 493 crore (~61.62 million Euros) up to March 2019.

The scheme provides following financial supports:

- ✓ Financial Support: Up to 50% of expenditure incurred on BPO/ITES operations towards capital expenditure (CAPEX) and/or operational expenditure (OPEX) on admissible items, subject to an upper ceiling of INR 1 Lakh/Seat.
- ✓ Special Incentives: The following special incentives will be provided within the ceiling of total financial support i.e. Rs. 1 Lakh/seat.

The objectives of IBPS are as under:

- ✓ Creation of employment opportunities for the youth, by promoting the IT/ITES Industry particularly by setting up the BPO/ITES operations.

- ✓ Promotion of investment in IT/ITES Sector in order to expand the base of IT Industry and secure balanced regional growth.

[Read more](#)

4.1.6. **Foreign Direct Investment (FDI) Policy**

As per the FDI policy, 100% FDI has been allowed in the software / IT industry under the automatic route (i.e., there is no need to obtain prior government approval).

4.2. **Telecom industry**

4.2.1. **National Digital Communications Policy 2018**

On 1 May 2018, the Department of Telecommunications (**DoT**) released the much-awaited [Draft National Digital Communications Policy – 2018 \(Draft Policy\)](#) for public comments. Draft policy seeks to unlock the transformative power of digital communications networks - to achieve the goal of digital empowerment and well-being of the people of India; and towards this end, attempts to outline a set of goals, initiatives, strategies and intended policy outcomes.

The National Communications Policy aims to accomplish the following Strategic Objectives by 2022:

- I. Provisioning of Broadband for All
- II. Creating 4 Million additional jobs in the Digital Communications sector
- III. Enhancing the contribution of the Digital Communications sector to 8% of India's GDP from ~ 6% in 2017
- IV. Propelling India to the Top 50 Nations in the ICT Development Index of ITU from 134 in 2017
- V. Enhancing India's contribution to Global Value Chains
- VI. Ensuring Digital Sovereignty

Missions:

In pursuit of accomplishing these objectives by year 2022, the National Digital Communications Policy, 2018 envisages three Missions:

- ✓ **Connect India**: Creating Robust Digital Communications Infrastructure
To promote Broadband for all as a tool for socio-economic development, while ensuring service quality and environmental sustainability.
- ✓ **Propel India**: Enabling Next Generation Technologies and Services through Investments, Innovation and IPR generation
To harness the power of emerging digital technologies, including 5G, AI, IoT, Cloud and Big Data to enable provision of future ready products and services; and to catalyse the fourth industrial revolution (Industry 4.0) by promoting Investments, Innovation and IPR.
- ✓ **Secure India**: Ensuring Sovereignty, Safety and Security of Digital Communications

To secure the interests of citizens and safeguard the digital sovereignty of India with a focus on ensuring individual autonomy and choice, data ownership, privacy and security; while recognizing data as a crucial economic resource.

In September 2018, Union Cabinet approved the National Digital Communications Policy-2018 (NDCP-2018).

[Read more/Download](#)

4.2.2. **Bharat Net/National Optic Fibre Network (NOFN)**

Bharat Net Project is the new brand name of National Optical Fibre Network (NOFN) which was launched in October, 2011 to provide broadband connectivity to all 2.5 Lakh Gram Panchayats. It was renamed Bharat Net in 2015. Bharatnet, the world's largest rural broadband project, which aims to deploy high-speed optical fibre cable (OFC) network to all the 2.5 lakhs gram panchayats (gps) across India. At present, a special purpose vehicle (SPV), Bharat Broadband Network Ltd (BBNL), under the telecom ministry is handling the roll out of optical fibre network. The project is being executed by BSNL, Railtel and Power Grid.

The implementation of this project has to be completed in two phases:

- Phase- I to connect 1 lakh GPs is completed.
- The second and final phase of project commenced on November 13, 2017 with an outlay of around `34,000 crore (€4.23 billion) to provide high-speed broadband in all GPs by March 2019. Telecom service providers (TSP's) are expected to provide at least 2 Mbps speed to rural households.

Status of Bharatnet as on 26.11.2018 (as published on bbnl website)

S.N.	Description of Work	Status
1	Length of OFC laid	2,98,406 Kms
2	No. of GPs where OFC Laid	1,21,511 GPs
3	GPs to which OFC connected & equipment installed	1,16,311 GPs

For more information please click here

4.2.3. **5G India 2020 – DoT Initiative for commencement and deployment of 5G Technologies**

The 5G technology has been conceived as a foundation for expanding the potential of the Networked Society. A digital transformation brought about through the power of connectivity is taking place in almost every industry. The landscape is expanding to include massive scale of “smart things” to be interconnected. Therefore, the manner in which future networks will cope with massively varied demands and a business landscape will be significantly different from today. The economic benefits from the 5G technology are also quite immense. As per the OECD (Organization for Economic Cooperation and Development) Committee on Digital Economic Policy, it has been stated that 5G technologies rollout will help in Increasing GDP, Creating Employment, Digitizing the economy.

For India, 5G provides an opportunity for industry to reach out to global markets, and consumers to gain with the economies of scale. Worldwide countries have launched similar Forums and thus, India has joined the race in 5G technologies. Constitution of High Level Forum for 5G India 2020 5G is the next technological frontier. Digital Transformation through 5G will fundamentally impact other national Mission Mode projects. 5G will provide a new dimension to the Digital India, Smart Cities & Smart Village missions. 5G has potentially large contributions to Make in India and Start-Up India missions. The objective is to position India as a globally synchronized participant in the Design, Development and Manufacturing of 5G based technology, products and applications.

In order to steer 5G India 2020, a High Level Forum has been constituted, with an aim to;

- a) Vision Mission and Goals for the 5G India 2020,
- b) Evaluate, approve roadmaps & action plans for 5G India 2020.

[Constitution of High Level Forum for 5G India 2020
Press Release on 26th September 2017
Making India 5G Ready-Report of the 5G High Level Forum](#)

4.2.4. Niti Aayog Discussion Paper on Artificial Intelligence

Artificial Intelligence presents opportunities to complement and supplement human intelligence and enrich the way people live and work. India, being the fastest growing economy with the second largest population in the world, has a significant stake in the AI revolution. Recognising AI's potential to transform economies and the need for India to strategise its approach, NITI Aayog was mandated to establish the National Program on AI.

In pursuance of the above, NITI Aayog has adopted a three-pronged approach – undertaking exploratory proof-of-concept AI projects in various areas, crafting a national strategy for building a vibrant AI ecosystem in India and collaborating with various experts and stakeholders.

NITI Ayog unveiled its discussion paper on national strategy on AI which aims to guide research and development in new and emerging technologies.

- This strategy document is premised on the proposition that India, given its strengths and characteristics, has the potential to position itself among leaders on the global AI map.
- NITI Aayog has identified five sectors — healthcare, agriculture, education, smart cities and infrastructure and transportation — to focus its efforts towards implementation of AI.
- The paper focuses on how India can leverage the transformative technologies to ensure social and inclusive growth.

[Download Niti Aayog Discussion Paper on Artificial Intelligence>>](#)

4.2.5. National telecom M2M Roadmap

Department of Telecommunications (DoT), Ministry of Communications and Information Technology had Published National M2M roadmap in May 2015. The roadmap covers global scenario on M2M Standards,

Regulation and policies, Initiatives, Make in India: Supported through M2M Adoption and Approach & Way Forward including set of recommendation:

- To facilitate M2M communication standards including encryption, quality, security and privacy standards from Indian Perspective and to recognize such standards for India.
- To release national M2M Numbering Plan (within year 2015).
- Address M2M Quality of Service aspects.
- To address M2M specific Roaming requirements.
- To formulate M2M Service Provider (MSP) registration process.
- To issue guidelines for M2M specific KYC, SIM Transfer, International roaming etc.
- Formation of APEX body involving all concerned stake holders.
- To address M2M specific spectrum requirements.
- To define frequency bands for PLC communication for various Industry verticals
- Finalization of M2M Product Certification process and responsibility centres.
- Facilitating M2M Pilot projects.
- Measures for M2M Capacity building.
- To establish Centre of Innovation for M2M.
- To assist M2M entrepreneurs to develop and commercialize Indian products by making available requisite funding (pre-venture and venture capital), management and mentoring support etc.
- Inclusion of M2M devices in PMA Policy.
- To take up matters with relevant ministries to boost M2M products and services.
- Define procedures for energy rating of M2M devices and implementation of same.
- To evolve suitable guidelines of EMF radiation of M2M devices based on research and studies by relevant bodies.

[Read more/Download](#)

In June 2016, DoT released draft guidelines for M2M Service Providers Registration covering:

- **General Conditions:** As part of general conditions, registration can be granted to any companies following certain guidelines. Also, M2M service providers shall not infringe upon the jurisdiction of any authorized telecom licensee/other service provider (OSP) and they shall provide only those services for which this registration is granted to them.
- **Technical Conditions:** As part of technical conditions, M2MSP can take telecom resources only from authorized telecom licensee, should adhere to the KYC norms and traceability guidelines, and ensure QoS stipulations.
- **Security Conditions and a provision** such as: The M2MSP shall induct only those devices/equipment in the network which meet TEC/TSDSI/BIS standards, wherever specified as mandatory by the Authority from time to time and in the absence of mandatory TEC/TSDSI/BIS standard, the M2MSP may deploy those devices/ equipment that is certified in compliance to meet the relevant standards set by National and International standardization bodies, such as 3GPP, BIS, TSDSI, ITU, OneM2M, IEEE, ISO, ETSI, IEC etc.

In February 2018, DoT issued 13-digit numbers for the trial of machine-to-machine (M2M) communications:

Department of Telecom (DoT) has issued 13-digit numbers to telecom operators for the trial of machine-to-machine (M2M) communications like swipe machines, smart electric metres and car tracking devices etc. that communicate through a SIM card. However, the new plan, which is to be implemented by telecom operators by July 1, will not impact the existing mobile phone users and is only meant for M2M equipment. The 13-digit numbers have been allocated to state-run firm BSNL and private telecom operators Bharti Airtel, Reliance Jio, Idea Cellular and Vodafone for testing purposes only. According to a letter sent by the DoT to operators, the authority has approved allocation of "1 million codes for testing purpose for each LSA (licence service area)" to service providers. The **Telecom Regulatory Authority of India** has [recommended](#) that all telecom licence holders should be allowed to provide M2M service using any spectrum. However, it has suggested that critical M2M services should be provided by those companies who have licensed spectrum. The regulator has also recommended that government to issue new category of licence for M2M services for companies interested in providing or operating services in this segment only. [Read more](#)

In May 2018, DoT released instructions in relation to SIM cards used for M2M communication services:

In May 2018, DoT issued [M2M guidelines](#) for implementing restrictive features for SIMs used only for M2M communication services (M2M SIMs) and related Know Your Customer (KYC) instructions for issuing M2M SIMs to entity/organization providing M2M communication services under bulk category and instructions for Embedded SIMs (e-SIMs). [Read more](#)

4.2.6. Digital India

Digital India is a programme promoted by the government to transform India into a digitally empowered society and knowledge economy. The initiative aims at making financial transactions electronic and cashless. Also, it aims at using this electronic service for financial inclusion and making it available to schools, farmers and includes installing public wifi hotspots. These are some of the initiatives promoted by this programme. In addition to this, the usage of e-wallets are believed to have increased post demonetization and also the trend of using banking applications by users have started increasing. These factors, in turn, are expected to increase the usage of mobile data consumption in the coming years.

[Read more](#)

4.2.7. Phased Manufacturing Programme (PMP)

Ministry of Electronics and Information Technology (MeitY) had notified [Phased Manufacturing programme \(PMP\)](#) in May 2017 for promoting the growth of domestic manufacturing of **Cellular mobile handsets** by providing tax relief and other incentives on components and accessories used for the devices. Its overall aim is to promote the indigenous manufacturing of populated printed circuit boards, camera modules and connectors in 2018-19, and display assembly, touch panels, vibrator motor and ringer in 2019-20.

[Read more](#)

4.2.8. **Mandatory Testing and Certification of Telecom Equipment (MTCTE)**

The Department of Telecommunications, Ministry of Communications, and Government of India vide [Gazette Notification No. G.S.R. 1131\(E\) dated 5th September, 2017](#) has amended the Indian Telegraph Rules, 1951 (Amendment 2017) to introduce Mandatory Testing & Certification of Telecom Equipment. TEC is implementing MTCTE in India and has framed a detailed procedure for **MT&CTE**. A brief analysis of the Rules and MT&CTE are as follows:

- 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) and mark or affix the equipment with appropriate Certification label.
- TEC has specified ERs for various telecom equipment, which would need to be met before TEC grants the certification. On the other hand, the DoT is yet to specify the security requirements for equipment. However, concerns have been voiced that ERs specified for certain equipment may not be standard and should be either modified or deleted.
- The equipment needs to be tested only in TEC designated CAB, or recognized CAB of MRA partner country. The test results/ test reports shall not be older than one year on the date of submission.
- The issued certificate shall be valid for five years from the date of issue.
- TEC may issue such directions to OEMs/ importers/ dealers/ users, consistent with the Act, Rule or this procedure, as may be necessary, for carrying out purpose of this Procedure.

In a [recent notification issued on 28th September 2018](#), TEC has extended the deadline for starting mandatory testing of telecom equipment including mobile devices and base transceiver stations (BTS) to April 1, 2019 from October 1, 2018.

[Read more](#)

4.2.9. **Preferential Market Access (PMA) Policy**

The Cabinet approved a revised version of the Preferential Market Access (PMA) policy that will apply to the supply of electronic and telecom equipment that has security implications. Preferential Market Access (PMA) policy linked to telecom equipment and other electronic products having security implications has been cleared.

[Public Procurement \(Preference to Make in India\) Order 2017- Notification of Telecom Products, Services or Works](#)

The Government has issued Public Procurement (Preference to Make in India) Order 2017 vide the Department of Industrial Policy and Promotion (DIPP) Order No. P-45021/2/2017- B.E.-If dated 15.06.2017 which is further revised vide No. P-4502 1/2/2017-PP (BE-II) dated 28.05.2018 to encourage 'Make in India' and to promote manufacturing and production of goods and services in India with a view to enhancing income and employment. The salient features of the aforesaid Order are as under:

- ✓ Department of Telecommunications (DoT) as the nodal Department for implementing the provisions related to procurement of goods, services or works related to the telecommunication sector.

- ✓ The order shall be applicable to all Central Schemes (CS)/ Central Sector Schemes (CSS), for which procurement is made by States and Local Bodies, if that project or scheme is fully or partially funded by the Government of India including Universal Service Obligation Fund (USOF) projects.
- ✓ Department of Telecommunications has prepared a list of telecom products, services and works for their purchase preference from local suppliers for public procurement.
- ✓ The local supplier has to manufacture equipment from component level in India and also develop local vendors for procurement of raw materials, components and parts for increasing local content.

[Read more/Download](#)

4.2.10. [Foreign Development Investment \(FDI\) policy](#)

100 percent FDI has been allowed in telecom sector, out of which 49 percent can be done through automatic route and the rest will be done through the FIPB approval route. The key objective behind increasing FDI cap in telecom industry is to help the sector to get fresh investment inflow in order to lower its financial burden. The industry has attracted FDI worth US\$ 31.75 billion during the period April 2000 to June 2018, according to the data released DIPP. The government of India is aiming the commercial rollout of fifth-generation or 5G services by the end of 2020. The newer technology is also expected to bring in potential investment in the country with an array of multinational expressing interest in the enterprise applications and utility services. [Read more](#)

5. Standardization Bodies

5.1. Bureau of India Standards (BIS)

[Bureau of Indian Standards \(BIS\)](#) is also actively involved in the ICT area through its **Electronics and Information Technology Division Council (LITDC)** who is in charge of electronics and telecommunications including information technology. This division council has developed more than 1600 standards till date. BIS has divided the work into following division council as follows:

- **BIS LITD 13: Information And Communication Technologies:** To prepare Indian standards relating to :
a) computer communication networks and interfaces to these computer communication networks including microprocessor systems, interfaces, protocols and associated interconnecting media for information and communication technology equipment etc. b) Telecom equipment and associated systems & devices.

Division Council	Corresponding ISO/IEC
LTD 13 : Information And Communication Technologies	ISO TC- 25 SC- 25 (P): Interconnection of information technology equipment ;ISO TC- 35 SC- 35 (P): User interfaces ;ISO TC- 6 SC- 6 (O): Telecommunications and information exchange between systems ;ISO TC- 6 SC- 6 (O): Telecommunications and information exchange between systems ;

- **BIS LITD 27: Internet of Things and Related Technologies:** To develop standards in the field of Internet of Things and related technologies including sensor networks; wearable electronic devices and technologies; and big data. LITD 27 acts as the National Mirror Committee for **ISO/IEC JTC 1/SC 41** Internet of Things and related technologies, **ISO/IEC JTC 1/WG 9** Big data, IEC/TC Wearable electronic devices. Comprises of Work Groups on IoT Architecture, IoT Interoperability, IoT Applications & Wearable Devices; and Study Groups on IoT Trustworthiness, Wearables, Industrial IoT, Real Time IoT, and Industrial IoT & Aspects of IoT Use Cases. BIS LITD 27 is currently evaluating some ISO Standards developed by JTC1/SC41 to adopt as National Standards.

Division Council at BIS	Corresponding ISO/IEC
LITD 27: Internet of Things and Related Technologies	ISO/IEC JTC 1/SC 41: Internet of Things and related technologies

- **BIS LITD 28: Smart Infrastructure:** Standardization in the field of Smart Cities (Electro-technical and ICT aspects) and related domains including Smart manufacturing & Active assisted living. Current Standards development on the following:
 - ✓ Reference Architecture for Unified Secure & Resilient ICT Infrastructure for Smart Cities
 - ✓ Unified Last Mile Communication Architecture & Protocols for Smart Infrastructure
 - ✓ Common Service Layer for Unified Smart Cities/Infrastructure ICT Architecture
 - ✓ Unified Data Semantics, Data Models & Ontology in Smart Cities & Smart Infrastructure Paradigm
 - ✓ Security & Resilience Framework
 - ✓ Use Cases in Smart Infrastructure Paradigm
 - ✓ Standards Inventory & Mapping for Smart Infrastructure Paradigm

The LITD 28 has also released a [Pre-Standardization Study Report on Technical Requirements Analysis of Unified, Secure & Resilient ICT Framework for Smart Infrastructure](#). It is aimed at providing some critical Actionable Insights for Smart City Planner in context of Unified Secure & Resilient ICT Infrastructure in Smart Cities. LITD 28 has also constituted a study group on 5G imperatives for Smart Infrastructure to define a smooth migration path from current frameworks and architectures to '5G inclusive' next generation homogeneous architectures.

Division Council	Corresponding ISO/IEC
LITD 28 : Smart Infrastructure	IEC TC-SyC SC- (P): <i>Smart Cities, Active Assisted Living, Smart Manufacturing</i>

- **BIS LITD 29: Blockchain & Distributed Ledger Technologies:** Recently, BIS has constituted LITD 29 to develop Standards in the field of blockchain technologies and distributed ledger technologies. LITD 29 is the National Mirror Committee of ISO/TC 307.

Division Council	Corresponding ISO
LITD 29: Blockchain & Distributed Ledger Technologies	ISO/TC 307: Blockchain & Distributed Ledger Technologies

- **BIS LITD 30: Artificial Intelligence (AI):** LITD 30 on Artificial Intelligence is the National Mirror Committee for ISO/IEC JTC1/SC42 with same Title & Scope.

Division Council	Corresponding ISO/IEC
LITD 30: Artificial Intelligence (AI)	ISO/IEC TC-JTC 1 SC-SC 42 (P): Artificial Intelligence

5.2. Telecommunications Standards Development Society, India (TSDSI)

[Telecommunications Standards Development Society, India \(TSDSI\)](#) is the recognized Telecommunications standards development organization in India founded in Nov 2013, mainly intended to develop standards that are suitable to Indian market. TSDSI aims at developing standardized solutions for meeting Indian requirements. It aims also at contributing to the international standards landscape, by being involved in global standardization initiatives in the field of telecommunications. TSDSI will maintain technical standards and other deliverables of the organization, safe-guarding the related IPR and helping create manufacturing expertise in the country, providing leadership to developing countries (such as in South Asia, South East Asia, Africa, Middle East, etc.) in terms of their telecommunications-related standardization needs.

Technical activities of TSDSI are conducted in two Study Groups as below:

1. **Study Group - Networks (SGN) and**
2. **Study Group - Services and Solutions.**

1. **Study Group – Networks (SGN):** SGN handles Standardization activities broadly in areas of:
 - I. Wireless communication systems, including overall system architecture, Radio-based access and Mobile core networks, the functional elements constituting these networks and the interfaces/protocols between these networks, Software Defined Network (SDN) and Network function virtualization (NFV) of the access and core networks.
 - II. Backhaul using wireless & wireline, microwave, optical and/or packet based transport networks and related SDN & NFV aspects, systems, equipment, optical fibre cables, along with the related control plane, network management, performance monitoring & reporting, synchronization, interfaces, multi-layer optimization techniques and testing aspects.
 - III. Spectrum studies related to the above areas and technical recommendations.
 - IV. Interference studies, including co-channel, adjacent channel, and inter-system interference

For details of SGN activities, please click [here](#)

2. **Study Group – Services and Solutions (SGSS):** SGSS is responsible for standardization activities for the following:
 - I. Definition of requirements for telecom industry and related services and applications, including:
 - Service level requirements and features for various domains and applications (e.g. IoT/M2M, Automotive, Public safety, Health).
 - II. Development of end-to-end service capabilities and architecture, based on the requirements, including:
 - Technical specifications for application layer functional elements and interfaces.

- System aspects such as QoS, interoperability, etc.
 - Data management aspects such as schemas, analytics, provisioning, etc.
 - Localization components in services and systems e.g. Indian languages.
- III. Security and Privacy aspects in the end to end telecom networks. It includes
- Determining the security and privacy requirements for telecom networks including the mobile cellular and fixed-line networks across user equipments, access network, transport network, core network and service layer security aspects.
 - Specifying the related security architectures and protocols.
- IV. Energy performance for telecommunication networks including access, user equipment, aggregation, core including the underlying transport systems, including:
- Setting the energy performance related requirements across the end to end network
 - Benchmarking network energy performance
 - Energy optimization for networks
 - Energy performance testing
- V. Recommendations of test requirements and evaluation methodologies for any service level conformance testing activities.

For details of SGSS activities, please click [here](#)

TSDSI Study Group on M2M/IoT has published following reports covering Indian Use cases:

S. No.	Title	Technical Report Number
1	Study on Machine to Machine Communication (M2M) Use Cases in Utilities Vertical from Indian Context	TSDSI RPT TR-1002 V1.0.0
2	Study on Machine to Machine Communication (M2M) Use Cases in Environment Pollution Monitoring and Control Vertical from Indian Context	TSDSI RPT TR-1003 V1.0.0
3	Study on Machine to Machine Communication (M2M) Use Cases in Smart Cities from Indian Context	TSDSI RPT TR-1004 V1.0.0
4	Study on Machine to Machine Communication (M2M) Use Cases in Industrial Automation Vertical from Indian Context	TSDSI RPT TR-1005 V1.0.0
5	Study on Machine to Machine Communication (M2M) Use Cases in Smart Governance Vertical from Indian Context	TSDSI RPT TR-1006 V1.0.0
6	Study on Machine to Machine Communication (M2M) Use Cases in Remote Asset Management Vertical from Indian Context	TSDSI RPT TR-1007 V1.0.0

7	Study on Machine to Machine Communication (M2M) Use Cases in Smart Homes Vertical from Indian Context	TSDSI RPT TR-1009 V1.0.0
8	Study on Machine to Machine Communication (M2M) Use Cases in Smart Health Vertical from Indian Context	TSDSI RPT TR-1010 V1.0.0
9	Study on Machine to Machine Communication (M2M) Use Cases in Transportation Vertical from Indian Context	TSDSI RPT TR-1011 V1.0.0

- Transposition of oneM2M Specifications Rel 2 (comprising 17 specifications and 10 technical reports) into TSDSI Standards. These have been published on TSDSI website. ([click here](#))
- Transposition of 295 Specifications of 3GPP (select specifications from Rel 10 to Rel 13) for IMT Advanced (as per ITU-R M.2012-3) into TSDSI Standards. ([click here](#))
- TSDSI has been mandated by Ministry of Communication (MoC) to develop Standards for Cloud Services Interoperability and adapt 3GPP specifications related to Security.

TSDSI at global SDOs:

1. **ITU:** TSDSI members' proposal on Low Mobility Large Cell (LMLC) configuration has been included as a mandatory test configuration under the Rural eMBB test environment in IMT 2020 Technical Performance Requirements (TPR) in ITU-R with an enhanced Inter Site Distance (ISD) of 6 km. Incorporation of LMLC in IMT2020 will help address the requirements of typical Indian Rural settings and will be a key enabler for bridging the rural-urban divide with 5G rollouts. TSDSI members are now working on a proposal for submission to ITU-R on candidate Radio interface technologies for IMT2020 (5G) specifications.
2. **3GPP:** TSDSI is Organizational Partner (OP) of [3GPP](#) along with six other Regional Standardisation bodies. This entitles TSDSI members to become individual members of 3GPP through TSDSI and to take their IP into the global arena. Membership of 3GPP enables members to contribute in the development of upcoming standards such as 5G.
3. **oneM2M:** TSDSI is Partner Type I of [oneM2M](#), one of the leading forums driving M2M service layer standards. TSDSI Member CDOT has been participating in the oneM2M TP and Interoperability events regularly.

Recently, TSDSI and 5G Infrastructure Association, representing the European industry in the 5G-PPP Research Programme, have signed a [Memorandum of Understanding](#) to foster collaboration on 5G development.

[Download TSDSI IPR Policy>>](#)

5.3. Telecommunication Engineering Centre (TEC)

[Telecommunication Engineering Centre \(TEC\)](#) is the technical wing of Department of Telecommunications (DoT). TEC is committed to develop standards in telecommunications sector in India, to ensure

development of world class telecom infrastructure and smooth interconnection of individual network. It discharges its functions as testing and certification body.

M2M working groups

- NT cell of DoT is working on framing policy on M2M communication. TEC had been assigned the task to undertake studies through stakeholders and finalize Indian specific standards/specifications and also to make contributions in International Standardization effort.
- To begin with, five multi stake holders Working Groups as detailed below were formed in TEC in March 2014. Working Groups are having members from TEC, DoT, Telecom Service Providers (TSPs), OEMs, R&D organizations, Vertical Industries, MNCs, IT / ITes, Semiconductor industries and standardization bodies (ETSI, TSDSI, BIS etc.)
 - a) Gate way and Architecture
 - b) Power
 - c) Automotive
 - d) Health
 - e) Safety and Surveillance
- Joint Working Group (JWG): It comprises members of all the working groups.
- Following new working groups have been created in June-2015
 - a) Security (End to End security of M2M domain)
 - b) Smart city
 - c) Smart Homes
 - d) Smart villages and Agriculture
 - e) Smart Environment (Environment monitoring and and Pollution Control)
 - f) Smart Governance
- Frame of Reference for the working Groups was prepared and approved in the JWG meeting. ([Click here](#))
- Since 2015, TEC has been regularly releasing study reports on various topics in M2M/IoT domain.

Technical Reports (Release 1 and Release 2) of M2M working groups given below:

M2M/ IoT Technical Reports (Release 1.0, May 2015):

- [M2M Gateway & Architecture](#)
- [M2M Enablement in Power Sector](#)
- [M2M Enablement in Automotive \(Intelligent Transport System\) Sector](#)
- [M2M Enablement in Remote Health Management](#)
- [M2M Enablement in Safety & Surveillance Systems](#)
- [ICT deployment and strategies for India's Smart Cities: A Curtain Raiser](#)

M2M/ IoT Technical Reports (Release 2.0, November 2015):

- [M2M Number resource requirement & options](#)
- [V2V / V2I Radio communication and Embedded SIM](#)
- [Spectrum requirements for PLC and Low power RF communications](#)

M2M / IoT Technical Reports (Release 1.0, March 2017)

- [M2M/ IoT Enablement in Smart Homes](#)

M2M / IoT Technical Reports (Release 1.0, July 2017)

- [COMMUNICATION TECHNOLOGIES in M2M / IoT Domain](#)

M2M / IoT Technical Reports (Release 2.0, January 2019)

- [DESIGN AND PLANNING SMART CITIES WITH IoT/ICT](#)

IoT / M2M Technical Reports (Release 1.0, January 2019)

- [Recommendations for IoT / M2M Security](#)

TEC at ITU:

Various **National Working Groups (NWGs)** corresponding to respective ITU-T Study Groups are being formed by TEC. Here is the list of NWGs formed in TEC:

- NWG-5- Environment and climate change
- [NWG-9, Television and sound transmission and integrated broadband cable networks.](#)
- [NWG-11, Signaling requirements, protocols and test specifications](#)
- NWG-12, Performance, QoS and QoE
- [NWG-13, Future networks including mobile and NGN](#)
- NWG-15, Optical transport networks and access network infrastructures
- [NWG-16, Multimedia coding, systems and applications](#)
- NWG-17, Security
- NWG- 20, for submitting contribution in ITU-T Study Group-20 ((IoT and its applications in Smart Cities)):- NWG 20 is having members from all stakeholders.

TEC contribution on spectrum management for ITU-R and WPC:

- Input papers for ITU-R Study Group-4: Satellite Services and Study Group-5: Terrestrial Services.
- Participation in NPC meeting for WRC-2015
- Input papers for review of national frequency allocation plan (NFAP) of WPC

6. R&D and Innovation

6.1. Centre for Development of Advanced Computing (C-DAC)

[Centre for Development of Advanced Computing \(C-DAC\)](#) is the premier R&D organization of the [Ministry of Electronics and Information Technology \(MeitY\)](#) for carrying out R&D in IT, Electronics and associated

areas. Different areas of C-DAC, had originated at different times, many of which came out as a result of identification of opportunities. The setting up of C-DAC in 1988 itself was to build Supercomputers in context of denial of import of Supercomputers by USA. Since then C-DAC has been undertaking building of multiple generations of Supercomputer starting from PARAM with 1 GF in 1988.

India has 32 supercomputers across institutions with a combined capacity of 12.77 petaflops with two machines—Pratyush at the Indian Institute of Tropical Meteorology in Pune, and Mihir at the National Centre for Medium Range Weather Forecasting in Noida—ranking in the top 100 supercomputers in the world. In March 2015, the Indian government has approved a seven-year [National Supercomputing Mission \(NSM\)](#) supercomputing program which will comprise a supercomputing grid of 70 geographically-distributed high-performance computing centers linked over a high-speed network at an estimated cost of about \$700 million (₹4,500-crore).

Source: <https://economictimes.indiatimes.com/news/science/supercomputers-will-aid-india-in-areas-ranging-from-weather-forecasting-to-drug-discovery/articleshow/66822268.cms>

Almost at the same time, C-DAC started building Indian Language Computing Solutions with setting up of GIST group (Graphics and Intelligence based Script Technology); National Centre for Software Technology (NCST) set up in 1985 had also initiated work in Indian Language Computing around the same period.

C-DAC has today emerged as a premier R&D organization in IT&E (Information Technologies and Electronics) in the country working on strengthening national technological capabilities in the context of global developments in the field and responding to change in the market need in selected foundation areas. In that process, C-DAC represents a unique facet working in close junction with MeitY to realize nation's policy and pragmatic interventions and initiatives in Information Technology. As an institution for high-end Research and Development (R&D), C-DAC has been at the forefront of the Information Technology (IT) revolution, constantly building capacities in emerging/enabling technologies and innovating and leveraging its expertise, caliber, skill sets to develop and deploy IT products and solutions for different sectors of the economy, as per the mandate of its parent, the Ministry of Electronics and Information Technology, Ministry of Communications and Information Technology, Government of India and other stakeholders including funding agencies, collaborators, users and the market-place.

For more information on CDAC please click [here](#)

6.2. Centre for Development of Telematics (C-DoT)

The [Centre for Development of Telematics \(C-DOT\)](#) is an autonomous Telecom R&D centre of [Department of Telecommunications \(DoT\)](#), Government of India. Over the years, C-DoT has evolved into a full-fledged telecom R&D institution that complies with level-5 maturity on CMMI Model, and has capabilities to undertake large scale state-of-the-art telecom technologies development programs. C-DoT's commitment to the cause of nation building continues with development of products of national and strategic importance. C-DoT as a torch bearer of indigenous telecom R&D continues to develop latest technologies products in areas like Optical, Switching, Wireless, Security and Network Management while working on futuristic technologies like M2M/IoT, 5G, AI etc.

C-DOT has developed [CCSP\(C-DOT Common Service Platform\)](#), the oneM2M standards compliant common service platform which can be deployed on any off-the-shelf generic server platforms or cloud infrastructure. The business application providers can deploy their oneM2M compliant applications in either co-located infrastructure or on any public or private cloud. Using the CCSP platform from C-DOT, the smart cities can reap all the benefits of using a standards compliant horizontal service layer and thus

be more efficient, economical and future proof. Along with the CCSP C-DOT has also developed various oneM2M indigenously designed hardware nodes like AND (Application Dedicated Node), ASN (Application Service Node) and MN (Middle node). To effectively showcase the strength of the platform, C-DOT has also developed various applications like Smart Living, Smart Street Light, Carbon Footprint Monitoring Application and Power Monitoring which are fully oneM2M compliant. C-DOT has also participated in two international interoperability events where the CCSP and the ADN were tested for interoperability with many other oneM2M compliant nodes from various international organisations like Interdigital, Herit, Huawei, HPE, NTT, KETI, LAAS-CNRS etc. C-DOT also participated in the conformance testing with ETSI.

For more information on CDOT Solutions, Product and Services please [click here](#)

6.3. Centre of Excellence in Wireless and Information Technology (CEWiT)

The Centre of Excellence in Wireless and Information Technology (CEWiT) is an autonomous research Society of IIT Madras set up by Ministry of Communication and IT in partnership with the Indian telecom industry. CEWiT's vision is to provide technological leadership to the Indian wireless industry and address the needs of the Indian market through advanced R&D and value creation. CEWiT works as a neutral partner to industry stakeholders and policy makers on various technological aspects of the wireless communication industry. The Center has several experts in the Radio access technologies, specifically focusing on 4G and 4G-Advanced technologies like LTE and WiMAX. CEWiT also provides technical leadership to the Broadband Wireless Consortium of India.

Today wireless research is moving rapidly beyond 3G and 4G technologies towards 5G technologies, which are required to satisfy the rapidly growing broadband wireless needs of large populations around the globe. CEWiT conducts research in 5G technologies and participates in global standardization. It is engaging very closely with academic and industry research groups in India to focus on areas with strong potential for contribution to global standards while keeping in mind operator requirements and usage scenarios. CEWiT with its vast knowledge and experience base provides consultancy and technical services to Telecom companies in India in the areas of 4G technologies like LTE and LTE-Advanced and the upcoming 5G technologies. It has built simulators and test beds which benefit the industry in its R&D and capacity building activities. CEWiT plays a key role in building a dynamic wireless R&D ecosystem in India. CEWiT made more than 25 contributions of which nine significant are accepted and became part of 802.16m specs in the areas of Conjugate data repetition (CDR); Collision free Interlaced pilots (CoFIP); Pilot modulation sequences; two-dimensional phase offset diversity (2D-POD); Open-loop region; Being member of 3GPP, CEWiT also made important contributions to 3GPP such as Proposal for '7-bit encoding for Indian Language SMS' accepted in TS 23.038 in Sept 2009; Consolidated requirements for Rel 12 from stakeholders in India presented at workshop held in Slovenia in June 2012 along with COAI; Seven contributions submitted for Rel 10 & 11 in CoMP, Cooperative MIMO, Cell Edge improvements, eCIC, Relays, eDDA; An element of CoFIP is part of Rel 11.

Towards 3GPP, CeWiT also submitted one proposal on EVDO Rev-C to give higher capacity to in-building users. Towards ITU CeWiT also technically led evaluation of IMT-Advanced technologies for ITU-R; and A new propagation model for Indian Rural scenario was analyzed and proposed in the IMT-Advanced evaluation report.

For more information on CEWiT please click [here](#)

6.4. Telecom centres of excellence (TCoE)

Telecom Centres of Excellence (TCoE) has been created as a PPP initiative by the Department of Telecommunications (DoT), Government of India in 2007, to strengthen the R&D ecosystem in Indian Information and Communication Technology (ICT) sector where Government works as a facilitator, Industry works as the ultimate user and Academia as the research unit.

Vision:

- Enable all Indians benefit from telecom technology for improving their quality of life; and strive to make India a leader in telecom over the next decade.

Objectives:

- Application oriented Telecom R &D and Innovation jointly with the Industry
- Capacity building through "Training the Trainers" & "Entrepreneurship Development"
- Think Tank activities for Policy Advocacy towards Governance & Regulation of Telecom Sector
- Influencing Global Standards to cater to Indian needs

The TCOE initiative was converted to reality with the signing of tri-partite Memoranda of Understanding (MoUs) between the Department of Telecom, Government of India, participating Institutes, and the sponsors from the Industry. List of TCOEs.

1. IIMA IDEA Telecom Centre of Excellence (IITCOE)
2. Vodafone IIT KGP Centre of Excellence in Telecommunications (VICET)
3. Reliance IITM Centre of Excellence (RITCOE)
4. Aircel IISc Centre of Excellence in Telecommunications (AIIScCET)
5. Airtel IIT Delhi Centre of Excellence in Telecommunications (AICET)
6. BSNL IITK Telecom Centre of Excellence (BITCOE)
7. Tata Teleservices IITB Centre of Excellence in Telecommunications (TICET)
8. RailTel IIT Roorkee Centre of Excellence in Telecom (RICET)

For more information on TCOE, please click [here](#)

6.5. Centre of Excellence for internet of Things (CoE-IoT)

The Centre of Excellence for IoT was announced by the Prime Minister Narendra Modi in July 2015 as a part of Digital India Initiative to jump start the IoT ecosystem taking advantage of India's IT strengths and help the country attain a leadership role in the convergent area of hardware and software. The main objective of the center is to create innovative applications and domain capability by harnessing the innovative nature of start-up community and leveraging the experience of corporate players.

Objectives:-

- To create innovative applications and domain capability across vertical for country's needs such as Smart City, Smart Health, Smart Manufacturing, Smart Agriculture, and others.
- To build industry capable talent, start-up community, and entrepreneurial ecosystem for IoT.
- To provide an ecosystem for innovation to thrive and embrace entrepreneurship.
- To energise research mind-set and reduce cost in Research and Development by providing neutral and interoperable, multi technology stack laboratory facilities.

- To reduce import dependency on IoT components and promote indigenization.
- To position India as a provider of end-to-end solution in engineering space.
- To provide environment for product creation, testing and validation.

[National Association of Software and Services Companies \(NASSCOM\)](#) is establishing the Centre of Excellence for Internet of Things (CoE-IoT) along with Meity/Deity, [ERNET \(Education and research Network\)](#) and State Governments to build IoT ecosystem on a pan-India basis partnering with start-ups, enterprises, academia and government to drive innovation in IoT space which will help India to attain leadership role in this field.

[Read more](#)

7. Conclusion

Indian ICT industry as a whole and IT and Telecom sub-sectors have become catalysts of higher Gross Domestic Product (GDP) growth and harbinger of prosperity over the last two decades in the Indian economy. The future holds promise of even higher growth and rapid consolidation on account of growing domestic demand and anticipated return of global economy to growth path. The fact that more and more business organizations in the world are relying on IT and communication infrastructures for enhancing their competitiveness and business prospects bode well for Indian IT and telecom companies.

The next phase of growth in the industry is hinged on convergence of ICT. Government of India has set its vision to transform the country into a digitally empowered society and a knowledge economy. Keeping in mind the importance of digitalization, the government of India has placed new emerging technologies such as IoT, M2M, AI, Blockchain etc. and deployment of 5G service at the heart of India's growth story with emphasis on policies such as Digital India, Make in India and Startup India and has approved **National Digital Communication Policy 2018**, with aims to train one million people in new-age skills and sectors such as 5G LTE and artificial intelligence etc. and propelling India to the Top 50 Nations in the ICT Development Index of ITU from 134 in 2017. The intent to increase digitalization in rural areas will further boost the Indian telecom sector. After launching flagship initiatives like 'Digital India' and 'Make in India' and amid some major developments towards a cash-free economy, India's IT spending is projected to total \$89.2 billion in 2019, an increase of 6.7% from estimated spending of \$83.6 billion in 2018, according to the latest [forecast by Gartner, Inc.](#)

Government of India is getting future ready and has started serious work on identifying and formalizing standards for implementing new emerging technologies such as AI, IoT/M2M, Blockchain etc. and for the roll out of 5G. In ICT sector, work must be carried out at the international as well as national level.

For additional information on Information and Communication Technology (ICT) Standards & Policy initiative covering M2M/IoT and its role in Smart Cities and Cyber Security please [click here](#) and download the study report which was released during [3rd Indo European Conference of standards and Emerging Technology](#), held in April 2018 in New Delhi.

8. Glossary

S.No.	Acronym	Expansion
1	CoE-IoT	Centre of Excellence for internet of Things
2	3GPP	3rd Generation Partnership Project
3	5G	Fifth Generation
4	AGR	Adjusted Gross Revenue
5	AI	Artificial Intelligence
6	BIS	Bureau of Indian Standards
7	BPM	Business Processing Management
8	BPO	Business process outsourcing
9	BSNL	Bharat Sanchar Nigam Limited
10	C-DAC	Centre for Development of Advanced Computing
11	CDMA	Code-Division Multiple Access
12	C-DoT	Centre for Development of Telematics
13	CEWIT	Centre of Excellence in Wireless and Information Technology
14	CII	Confederation of Indian Industry
15	DIPP	Department of Industrial Policy and Promotion
16	DoT	Department of Telecommunication
17	ETSI	European Telecommunications Standards Institute
18	FDI	Foreign direct investment
19	GDP	Gross Domestic Product
20	Gol	Government of India
21	GSM	Global System for Mobile communication
22	ICT	Information and Communication Technology
23	IEC	International Electro-technical Commission
24	IoT	Internet of Things
25	ISO	International Organization for Standardization
26	IT	information technology
27	ITeS	Information Technology enabled Services
28	ITU	International Telecommunication Union
29	JTC	Joint Technical Committee
30	KPO	Knowledge Process Outsourcing
31	LITDC	Electronics & Information Technology Division Council
32	M2M	Machine to Machine
33	Meity	Ministry of Electronics and Information Technology
34	MGS	Multiplier Grants Scheme
35	MNP	Mobile Number Portability
36	MoC	Ministry of Communication
37	MTCTE	Mandatory Testing and Certification of Telecom Equipment

38	MTNL	Mahanagar Telephone Nigam Limited
39	NASSCOM	National Association of Software and Services Companies
40	NCLT	National Company Law Tribunal
41	NDCP	National Digital Communication Policy
42	NeGP	National e-Government Plan
43	NOFN	National Optical Fibre Network
44	NOFN	National Optical Fibre Network
45	NSSO	National Statistical Survey Organization
46	NTP	National Telecom Policy
47	NWGs	National Working Groups
48	OSS	Open Source Software
49	PMA	Preferential Market Access
50	POI	Point of Interconnection
51	QoS	Quality of Service
52	R & D	Research and Development
53	SaaS	Software-as-a-Service
54	SDOs	Standards Development Organizations
55	SETU	Self-Employment and Talent Utilization
56	SEZs	Special Economy Zones
57	SIP-EIT	Support International Patent Protection in Electronics & IT
58	SMAC	Social, Mobility, Analytics, Cloud
59	SMEs	Small and Medium Enterprises
60	STPI	Software Technology Parks of India
61	SUCs	Spectrum Usage Charges
62	TCoE	Telecom Centres of Excellence
63	TEC	Telecommunication Engineering Centre
64	TRAI	Telecom Regulatory Authority of India
65	TRs	Technical Reports
66	TSDSI	Telecommunications Standards Development Society, India
67	TSPs	Telecom Service Providers
68	USP	Unique Selling Proposition
69	WG	Working Group

9. Sources

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<http://www.tec.gov.in/>

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<http://www.cdote.in/cdotweb/web/home.php>

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Telecom Regulatory Authority of India (TRAI)

<https://traigov.in/>

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<https://www.digitalindia.gov.in/>

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