BACKGROUND NOTE

Digital India and Telecommunication Infrastructure: An Update
Dr. Rajat Kathuria is the Director and Chief Executive at the Indian Council for Research on International Economic Relations (ICRIER), New Delhi. He has a distinguished career in economic policy on a range of issues relating to regulation and competition policy. He has worked with the World Bank, Washington DC as a Consultant and carried out research assignments for a number of international organizations. He has an undergraduate degree in Economics from St. Stephens College, a Masters from Delhi School of Economics and a PhD degree from the University of Maryland, College Park.
Introduction
The astonishing progress of communications networks and the massive increase in computational ability have been among the major drivers of economic liberalization and globalization. The process of economic liberalization has been helped in no small measure by the introduction of competition in provision of telecommunications services, once considered a natural monopoly. The emergence of competition and the accompanying technological progress resulted in dramatic reduction in the pricing of telecommunications services in India and is one of the principal reasons for the expansion of the knowledge-based services sector in which India enjoys a recognized competitive advantage.

From a macro and temporal perspective, telecommunication sector reform and development in India has been an unambiguous success. Overall teledensity i.e. number of connections per 100 population has increased from less than 1 percent in 1994, when murmurs of reform of the telecommunications sector were first heard in India, to more than 90 percent in December 2017. The initial National Telecom Policy (NTP) of 1994 set the stage for private sector entry, but it wasn’t until 1997 that an independent regulatory body, the Telecom Regulatory Authority of India (TRAI) was established and not until the beginning of this century that the rewards of competition began to manifest in sector outcomes. Riding on increasing competition, the evolution of wireless technologies, growing mobile penetration, and declining prices, the telecom sector arguably surged ahead of other infrastructure heavy sectors like electricity and roads to register very high rates of growth and impacts. By December 2017, the telecommunications sector in India constituted over 3 per cent of GDP and possesses the second largest stock of mobile and internet subscribers in the world. The achievements can be attributed to a combination of factors, including private sector participation, technological innovations and an enabling institutional and regulatory environment. Besides, India has the intrinsic advantage of being endowed with a large addressable market.

However, two areas - rural telephony and broadband internet have not fully lived up to expectations despite vast potential. Both these areas are vital to the success of the Digital India initiative launched by the government. The purpose of this paper is to identify strategies that will help the government in achieving its objectives, especially as they relate to accelerating the growth of broadband internet and rural telephony to realise the potential of digital India. The rest of the paper is organised as follows. The next section records the vast improvements in outcomes and the concomitant spillovers. Section 1.2 briefly defines the role of the key regulatory institutions, section 1.3 highlights the significant milestones in the sector with a focus on the foreign direct investment (FDI) regime. The purpose is to emphasize the gradual nature of reform and identify
the drivers. Section 1.4 provides an outline of the digital India initiative—the opportunities and challenges therein. Since the purpose of telecom sector is increasingly on creating an enabling environment that drives other sectors and initiatives, this section notes the considerable efficiency improvements that have been witnessed due to digitisation and the need to build on it. Section 1.5 provides the concluding observations.

India: increasing teledensity and vast spillovers

Technological progress undermined the natural monopoly characterization of the telecommunications sector. The process was aided by the state abandoning the monopoly model in favour of competition in the late 1990s. Competition and technological progress proved to be a heady mix. The combined effect was felt both within the sector and without—there was dramatic improvement in sectoral outcomes and vast spillovers experienced in user industries.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Subscribers</th>
<th>Fixed</th>
<th>Mobile</th>
<th>Teledensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>11.99</td>
<td>11.98</td>
<td>0.01</td>
<td>1.07</td>
</tr>
<tr>
<td>1995</td>
<td>14.58</td>
<td>14.54</td>
<td>0.03</td>
<td>1.29</td>
</tr>
<tr>
<td>1996</td>
<td>26.62</td>
<td>17.80</td>
<td>8.82</td>
<td>1.57</td>
</tr>
<tr>
<td>1997</td>
<td>22.79</td>
<td>21.59</td>
<td>1.20</td>
<td>1.94</td>
</tr>
<tr>
<td>1998</td>
<td>28.40</td>
<td>26.51</td>
<td>1.88</td>
<td>2.32</td>
</tr>
<tr>
<td>1999</td>
<td>36.01</td>
<td>32.44</td>
<td>3.58</td>
<td>2.33</td>
</tr>
<tr>
<td>2000</td>
<td>45.08</td>
<td>38.54</td>
<td>6.54</td>
<td>2.86</td>
</tr>
<tr>
<td>2001</td>
<td>54.42</td>
<td>41.42</td>
<td>13.00</td>
<td>3.58</td>
</tr>
<tr>
<td>2002</td>
<td>75.69</td>
<td>42.00</td>
<td>33.69</td>
<td>4.29</td>
</tr>
<tr>
<td>2003</td>
<td>98.42</td>
<td>46.20</td>
<td>52.22</td>
<td>5.11</td>
</tr>
<tr>
<td>2004</td>
<td>140.32</td>
<td>50.18</td>
<td>90.14</td>
<td>7.02</td>
</tr>
<tr>
<td>2005</td>
<td>206.82</td>
<td>40.77</td>
<td>166.05</td>
<td>8.95</td>
</tr>
<tr>
<td>2006</td>
<td>273.03</td>
<td>39.41</td>
<td>233.62</td>
<td>12.74</td>
</tr>
<tr>
<td>2007</td>
<td>384.79</td>
<td>37.90</td>
<td>346.89</td>
<td>18.22</td>
</tr>
<tr>
<td>2008</td>
<td>429.72</td>
<td>37.96</td>
<td>391.76</td>
<td>26.22</td>
</tr>
<tr>
<td>2009</td>
<td>621.28</td>
<td>36.96</td>
<td>584.32</td>
<td>36.98</td>
</tr>
<tr>
<td>2010</td>
<td>846.32</td>
<td>34.73</td>
<td>811.59</td>
<td>52.74</td>
</tr>
<tr>
<td>2011</td>
<td>951.34</td>
<td>32.17</td>
<td>919.17</td>
<td>70.89</td>
</tr>
<tr>
<td>2012</td>
<td>898.01</td>
<td>30.21</td>
<td>867.80</td>
<td>78.66</td>
</tr>
<tr>
<td>2013</td>
<td>933.01</td>
<td>28.50</td>
<td>904.51</td>
<td>73.32</td>
</tr>
<tr>
<td>2014</td>
<td>970.97</td>
<td>27.00</td>
<td>943.97</td>
<td>75.23</td>
</tr>
<tr>
<td>2015</td>
<td>1036.41</td>
<td>25.52</td>
<td>1010.89</td>
<td>79.38</td>
</tr>
<tr>
<td>2016</td>
<td>1151.77</td>
<td>24.40</td>
<td>1127.37</td>
<td>89.90</td>
</tr>
<tr>
<td>2017</td>
<td>1190.67</td>
<td>23.23</td>
<td>1167.44</td>
<td>91.90</td>
</tr>
</tbody>
</table>

Source: Author’s compilation.

Within the sector, it was the rapid spread of mobile telephony that persuasively demonstrated the benefits of telecom sector liberalisation. What has been remarkable about mobile is the pace of adoption—there were periods when India added more mobile phones in a month than it did phones in 50 years since Independence. At the fabled stroke of the midnight hour in August 1947, India had 100,000 fixed line phones for a population of 340 million. In December 2017,
it had over a billion mobiles. Teledensity increased from one-third of 1 per cent to over 90 per cent, emphatically underlining a “mobile first” development trajectory. For certain households, expenditure on communications outstrips expenditure on education and health for there is no doubt that for some small businesses and sole proprietorships, the mobile pays for itself. On the other hand, fixed line suffered, and penetration has declined as its value proposition deteriorated due \textit{inter alia} to poor quality of service and limited functionality (see Table 1).

Voice calls in India are amongst the cheapest in the world\textsuperscript{1}. The proximate reason is the explosive growth of mobile telephony, which has benefited from rapid technological progress as well as an increasingly liberal policy environment. Mobile phones are ubiquitous in some Indian cities, where teledensity is now comparable to that in certain Western European countries, that is, it exceeds 100. From a luxury when it was first introduced, the mobile service is now used every day by over a billion Indians.\textsuperscript{2} Evidence of the nature of competition can also be gauged from the Herfindahl-Hirschman Index HHI values that point to a high degree of rivalry in wireless (as opposed to fixed) telephony. \textit{See Table 2}\textsuperscript{3}

\begin{table}[h]
\centering
\caption{Operators in Different Circles and the Level of Concentration: Wireline and Wireless}
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
\textbf{Circle} & \textbf{Number of Operators (December 2017)} & \textbf{HHI (December 2017)} \\
 & \textit{Wireless} & \textit{Wireline} & \textit{Wireless} & \textit{Wireline} & \textit{Wireless + Wireline} \\
\hline
AP & 9 & 6 & 1929 & 5298 & 1907 \\
Assam & 7 & 2 & 2095 & 9624 & 2079 \\
Bihar & 9 & 4 & 2039 & 8584 & 2029 \\
Delhi & 8 & 6 & 1647 & 4039 & 1610 \\
Gujarat & 8 & 6 & 1833 & 6601 & 1797 \\
Haryana & 8 & 4 & 1832 & 6455 & 1825 \\
HP & 8 & 4 & 2038 & 9047 & 2044 \\
J&K & 7 & 1 & 2092 & 10000 & 2077 \\
Karnataka & 8 & 6 & 1833 & 6601 & 1797 \\
Kerala & 8 & 5 & 2092 & 8936 & 2135 \\
MP & 8 & 5 & 2144 & 5553 & 2119 \\
Maharashtra & 9 & 6 & 1912 & 5634 & 1869 \\
Mumbai & 8 & 6 & 1712 & 4168 & 1578 \\
NE & 7 & 2 & 2276 & 9979 & 2258 \\
Orissa & 8 & 4 & 1983 & 9094 & 1975 \\
Punjab & 8 & 7 & 1784 & 3932 & 1754 \\
Rajasthan & 8 & 6 & 1914 & 7071 & 1898 \\
TN (incl Chennai) & 8 & 5 & 1773 & 4936 & 1752 \\
UP(E) & 9 & 6 & 1635 & 5884 & 1631 \\
UP(W) & 9 & 5 & 1704 & 7779 & 1696 \\
Kolkata & 8 & 6 & 1539 & 5175 & 1499 \\
WB & 8 & 4 & 2446 & 9655 & 2425 \\
\hline
\end{tabular}
\footnotesize{Based on Data from TRAI Performance Indicators Report December 2017}
\footnotesize{Wireless includes GSM, CDMA and LTE}
\end{table}
On the demand side too, there have been many triggers for the massive increase in mobile penetration. The effective price per minute for an outgoing mobile call has dropped from Rs 15.30 in 1998 to less than Rs 1.00. Another measure of price, the Average Revenue per User (ARPU), is around Rs 80 per month, compared to about Rs 1550 in 1998. The launch of micro prepaid connections and handsets priced at less than Rs.1,000 have further reduced entry cost at the subscriber end and has therefore extended the demand. Not surprisingly therefore, 98 per cent of new subscriptions are prepaid, lifting the total number of subscribers on prepaid from 76 per cent in 2007 to about 95 per cent at the end of 2017. Income - measured by GDP per capita has also doubled since 1998, also contributing to demand.

In December 2017, mobiles accounted for 98 per cent of all access lines in India. Contrast this with the situation in 1999, when mobiles constituted just 5 per cent of all telephones. This is truly remarkable since no other ICT indicator comes close to mobile in penetration or rate of growth. Notwithstanding, it is the revival of the fixed line and further rapid expansion of optical fibre cable (OFC) infrastructure that is crucial to realising India’s digital ambitions, both local and global. India’s abiding aspiration is to serve as a global data hub while exploiting the data revolution for the benefit of the domestic economy. The immediate objective thus is to facilitate efficient and effective delivery of e-governance, e-health, e-education, e-banking and other internet-enabled services, especially to rural areas where there is a conspicuous undersupply. And even though data usage currently is quite ubiquitous in urban areas, it will pale in comparison when Internet of Things (IoT) comes to life with the introduction of 5G. Machines will talk to each other, videos will become routine, and one estimate places the amount of data generated in a day as 154 petabytes in 2021 compared to 40 petabytes today. The current trends signal an enormous demand for internet-based services that is unlikely to be met by mobile wireless data services alone. Data is more efficiently transported when backhaul is accomplished on OFCs. Because of the structural shift in favour of data, connecting the entire country, especially the deprived rural areas with high quality OFC is of the essence.

To achieve this, airwaves must be made less congested, and data offloaded to optic fibre infrastructure. The cliché of data being the new oil will work only if there are physical pipes to carry the new oil. Using tankers to carry oil congests the roads and is grossly inefficient, just as using expensive spectrum to carry data is. Liberalisation of the satellite market can complement and add to the stock of broadband infrastructure. In addition, the speed of connectivity ought to be harmonised with international benchmarks. According to Akamai technologies, India was ranked 89th globally with an average connection speed of 6.5 Mbps as of 2017 Q1. Along with Philippines, India is the lowest ranked country in Asia Pacific.

India’s mobile and internet achievements are a study in contrast. While there are over a billion mobile subscribers at present, the corresponding numbers for internet and broadband are 83.5 million and 362 million respectively. Internet and broadband penetration in India pale in comparison to mobile (See Table 3). The number of total internet subscribers would be significantly lower were it not for the rapid penetration of mobile internet. There are 424 million mobile subscribers accessing the internet through wireless networks today, compared to about 21 million who access it through the fixed network. India seriously lags on broadband. The regulator, TRAI has conceded that future targets are unlikely to be achieved, unless critical issues inhibiting broadband expansion in urban as well as rural areas such as Public Private Partnerships (PPP) and Right of Way (RoW) issues are addressed. Besides, what is particularly striking about broadband is the low threshold speed for the figures: any download speed above 512 kilobits per second (kbps) in India is classified as broadband, a level of service that would be seen as inadequate in most countries.
Table 3: All-India fixed, mobile, internet and broadband penetration rates

<table>
<thead>
<tr>
<th>Mobile Density</th>
<th>Fixed Line Density</th>
<th>Internet density *</th>
<th>Broadband density *</th>
</tr>
</thead>
<tbody>
<tr>
<td>90.11</td>
<td>1.79</td>
<td>34.42 (1.64)</td>
<td>28.01 (1.38)</td>
</tr>
</tbody>
</table>

Source: Author’s calculation based on TRAI data; number per 100 population for December 2017

*Quantity in parenthesis refers to the corresponding fixed line density

In a June 2017 consultation paper, TRAI recommended redefining the minimum broadband speed to 2 Mbps from the existing 512 kbps. That better broadband delivers better benefits can be gauged from the accompanying graph that shows a positive correlation between broadband connectivity and per capita income for Indian states (see Figure 1).

Figure 1: Per Capita State Domestic Product and Broadband Density for 19 Telecom Circles for 2016-17

Source: Author’s calculation.

Two notable implications follow from these developments. One, previously unserved or underserved people will for the most part gain access through wireless technologies for data. And secondly, given the importance of wireless to modern ICT infrastructures, it thus becomes crucial for policy to play an effective role in managing scarce frequencies for optimal use. Using spectrum for backhaul traffic may be an inefficient deployment of the scarce resource. We return to this point in the concluding section.

Attention of growth impacts and spillovers to other sectors of the economy has now inevitably shifted to the internet and more specifically to broadband. Internet and broadband are increasingly viewed as enablers of economic integration within and across countries allowing further tradability of many service activities as well as creating new kinds of tradable services. In addition, availability, quality and affordability of broadband services are important factors for investors when deciding investments in a specific region. Notwithstanding, the impact on GDP of increased connectivity in India has been salutary. Every 10 per cent increase in mobile penetration rate leads to 1.5 per cent increase in GDP with evidence of network effects which magnify the economic impact when the level of mobile penetration exceeds a critical mass of around 25 per cent⁷. The corresponding growth
impact of internet is higher. For every 10 per cent increase in the number of internet subscribers, there is an estimated 2.4 per cent increase in GDP for India8. Globally too the relative magnitudes of growth dividends of different communication technologies establish a sort of hierarchy of impacts, with fixed being the lowest and broadband being the highest⁹. That broadband investment has significant positive externalities is a critical underlying reason for government intervention to support roll out. Table 4 presents a summary of the growth impacts across different studies.

From a simple network connecting a few US universities in the 1960s, the Internet has grown beyond imagination to become an inalienable part of our daily lives. Much like electricity, the Internet is also considered a general-purpose technology (GPT).¹⁰ Its role in improving productivity and inspiring innovation can be seen in almost every sector of the economy. Its imprint is also visible in the interface between government and citizens. Governments are increasingly investing in e-governance initiatives to provide efficient citizen services that are easily scalable. For the average citizen, the Internet has facilitated easier engagement with the state, indeed enabled citizens to push the state to higher levels of accountability, besides empowering society at large.

The value of ICT connectivity can be particularly high in developing countries and laggard regions within a country because other forms of infrastructure may be absent or poor. At the same time, growth is limited due to a host of other reasons – poor governance, lack of capital, low skill levels and many others. It is unlikely that increased internet or broadband penetration by itself will be able to alleviate these other constraints on growth. Moreover, for internet and broadband to have meaningful and comprehensive impacts, an ecosystem around the service is required, in which supply of is just one, albeit, crucial component. For instance, higher internet infrastructure will not be sufficient unless relevant content also exists. The impact of internet is likely to be strongest when enough other infrastructures exist to permit its effective use.

| World Bank | 2009 | In high income economies a 10 per cent increase in broadband penetration yielded an additional 1.21 percentage points of GDP growth. A 10 per cent increase in broadband penetration yielded an additional 1.38 in GDP growth in low and middle income countries. |
| OECD | 2009 | A 10 per cent increase in broadband penetration raises per-capita GDP growth by 0.9-1.5 percentage points |
| ICRIER | 2009 | A 10 per cent increase in mobile penetration delivers, on average 1.2 per cent increase in GDP |
| ICRIER | 2012 | A 10 per cent increase in Internet subscribers delivers on average, 1.08 per cent increase in output. A 10 per cent increase in mobile penetration delivers, on average 1.5 per cent increase in GDP |
| ICRIER | 2016 | A 10 per cent increase in internet subscribers results in a 2.4 per cent increase in the growth of state per capita GDP |
| ICRIER | 2017 | A 10 per cent increase in global Internet traffic, delivers on average a 1.3 per cent increase in global GDP and a 10 per cent increase in global mobile Internet traffic, delivers on average a 0.7 per cent increase in global GDP. |

A 10 per cent increase in India’s total Internet traffic, delivers on average a 3.3 per cent increase in India’s GDP, and a 10 per cent increase in India’s mobile Internet traffic, delivers on average a 1.3 per cent increase in India’s GDP

Source: Author’s compilation.
A sustainably faster rate of growth can only be achieved by improving productivity, but underinvestment in infrastructure is a longstanding impediment in this regard. According to the Economic Survey 2018, there was massive under-investment in infrastructure because of collapse of Public Private Partnership (PPP) especially in power and telecom projects. Revival of investment in Indian telecom is crucial, especially in underserved rural areas where digital connectivity remains low, particularly with respect to Internet connections. Currently, India has 362 million broadband subscribers of which only 25 per cent are in rural areas. In contrast, there are nearly 1,200 million mobile connections. Although considerable progress has been made in mobile connectivity, approximately 55,619 villages still do not have mobile coverage. And while India’s digital divide is narrowing (See Fig 2), absolute subscriptions and mobile penetration figures in urban areas remain much higher. In rural areas, the teledensity is one-third that of urban areas (See Table 5) albeit the former is home to two thirds of India’s population. In other words, about 66 per cent of the people are covered by approximately 33 per cent of phones. As stated above, digital connectivity has vast growth impacts because it facilitates communication and commerce that propels economic growth. Individuals cannot transfer payments digitally, use e-governance portals to connect with the government, access information or make online purchases without continuous and reliable access to the internet or a phone.

**Figure 2: India’s Narrowing Digital Divide - Percentage Share of Rural and Urban Subscribers in Total Wireless Subscriber Base over time**

![Graph showing the percentage share of rural and urban wireless subscribers over time.]

*Source: Author’s calculation.*

While the preceding discussion clearly establishes the success of mobile telephony in India, the benefits of this development have, until now, been unevenly distributed within India. Some parts are clearly enjoying the benefits of new found access while others still lag. The recent narrowing of the rural urban divide for mobile telephony is a positive development but despite the rapid growth in mobile penetration rate – an acknowledged driver of growth – the divide for internet and broadband penetration remains high (See Table 6). Attention thus needs to shift to data and internet. That broadband investment has significant positive externalities is a critical underlying reason for government intervention to support roll out. The next few years mark a decisive phase for the telecom sector with high speed data services and rural expansion holding immense transformative potential. Rural coverage especially high-speed data has been the victim of both,
policy and market failure. With saturating urban voice markets and government turning attention to address policy failures, rural India might finally get access to high speed telecom infrastructure and services, which according to some needs much more of, to offset, at least in part, the deficit in other physical infrastructure. In what follows, we attempt to capture the progress made and highlight the policy and market failures that have inhibited growth of data services and rural coverage. In doing so, we also emphasise the significant opportunities in the Indian market.

**Table 5: Rural, Urban and Total Teledensities (2007-2017)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Urban Wireline Teledensity</th>
<th>Rural Wireline Teledensity</th>
<th>Urban Wireless Teledensity</th>
<th>Rural Wireless Teledensity</th>
<th>Total Urban Teledensity</th>
<th>Total Rural Teledensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>48.1</td>
<td>5.86</td>
</tr>
<tr>
<td>2008</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>66.39</td>
<td>9.46</td>
</tr>
<tr>
<td>2009</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>88.66</td>
<td>14.8</td>
</tr>
<tr>
<td>2010</td>
<td>7.7</td>
<td>1.2</td>
<td>112.03</td>
<td>23.08</td>
<td>119.73</td>
<td>24.29</td>
</tr>
<tr>
<td>2011</td>
<td>7.26</td>
<td>1.04</td>
<td>150.06</td>
<td>32.75</td>
<td>157.32</td>
<td>33.79</td>
</tr>
<tr>
<td>2012</td>
<td>6.73</td>
<td>0.89</td>
<td>162.82</td>
<td>38.33</td>
<td>169.55</td>
<td>39.22</td>
</tr>
<tr>
<td>2013</td>
<td>6.29</td>
<td>0.79</td>
<td>140.67</td>
<td>40.23</td>
<td>146.96</td>
<td>41.02</td>
</tr>
<tr>
<td>2014</td>
<td>5.92</td>
<td>0.69</td>
<td>139.86</td>
<td>43.27</td>
<td>145.78</td>
<td>43.96</td>
</tr>
<tr>
<td>2015</td>
<td>5.53</td>
<td>0.59</td>
<td>143.08</td>
<td>47.78</td>
<td>148.61</td>
<td>48.37</td>
</tr>
<tr>
<td>2016</td>
<td>5.28</td>
<td>0.49</td>
<td>148.73</td>
<td>50.88</td>
<td>154.01</td>
<td>51.37</td>
</tr>
<tr>
<td>2017</td>
<td>5.1</td>
<td>0.44</td>
<td>166.71</td>
<td>56.47</td>
<td>171.8</td>
<td>56.91</td>
</tr>
</tbody>
</table>

*Source: TRAI Performance Indicator Reports.*

**Table 6: Rural and Urban Internet Subscribers (per 100 people)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Urban Internet Subscribers (per 100 people)</th>
<th>Rural Internet Subscribers (per 100 people)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>49.07</td>
<td>12.89</td>
</tr>
<tr>
<td>2016</td>
<td>58.28</td>
<td>12.8</td>
</tr>
<tr>
<td>2017</td>
<td>70.83</td>
<td>15.49</td>
</tr>
</tbody>
</table>

*Source: TRAI Performance Indicator Reports.*

**Domestic Regulatory Regime in Telecommunications**

The agencies that form the core of the institutional framework are the Department of Telecommunications (DoT), the Telecom Regulatory Authority of India (TRAI) and the Telecom Disputes Settlement Appellate Tribunal (TDSAT). In addition, certification for telecommunications equipment is the responsibility of the Telecommunications Engineering Centre (TEC), which is a part of DoT as is the Wireless Planning & Coordination (WPC) which is responsible for frequency spectrum management. Figure 3 provides a schematic representation of the institutional framework. While DoT is part of the Ministry of Communications, TDSAT and TRAI were conceived as independent institutions, not accountable to the DoT. See Annex I for a complete description of the roles and responsibilities of all the regulatory institutions in India’s Telecommunication sector.

Under the Constitution, telecom is a Union subject. The legal and regulatory framework for telecommunications in India includes the Telegraph Act 1885 and the TRAI Act 1997. In addition
to the statutes, there are a host of rules and regulations. These statutes and rules and regulations are enforced by different regulatory agencies whose jurisdictional boundaries and lines of authority have evolved over time. These agencies are the DoT, TRAI and TDSAT. Each of these entities have distinct roles and responsibilities such as issuing licenses, making policies, regulating tariffs and resolving disputes and representing India in various international fora.

Reforms radically altered the telecom sector by creating new laws and institutions that profoundly changed the regulatory framework. Some elements of the Telegraph Act 1885 however still exist, although it is fair to state that the present landscape is vastly different compared to a decade ago. At present, the government issues separate licenses national and international long distance services and unified access services and internet services. Each license contains a detailed description of the licensed service. It also includes the terms and conditions on which the service can be offered and the licensees legal and contractual obligations. Licenses are required to pay an entry fee and a recurring fee that is a fixed percentage of the licensee’s annual revenue to the government.

**Figure 3: Schematic of the Institutional Framework in Telecommunication**

![Diagram of institutional framework in telecommunication](source)

TRAI was set up in January 1997 with a view to provide an effective regulatory framework and adequate safeguards to ensure fair competition and protection of consumer interests. It was also originally invested with certain quasi-judicial authority to adjudicate and settle disputes, which were in 2000 assigned to TDSAT. Conceptually, TDSAT was created as an alternative to the High Court to fast track telecom related disputes, while recognizing the importance of separation of powers principle in respect of the telecom sector. The separation of executive and adjudicatory functions is a model that has since become well entrenched in India and has been replicated in other sectors, including for the economy wide competition regulator.

To this day, the power to operate communications remains an exclusive privilege of the Central Government under the Indian Telegraph Act 1885. The government may and does delegate such powers by issuing licenses; in practice this power is exercised by the DoT. As a licensor, DoT is expected to consider recommendations made by TRAI. In 2000, it became mandatory for the government to seek the Authority’s recommendations prior to deciding the need and timing of a new service provider and the terms and conditions of new licenses. In a case that came up before it, the TDSAT also held that government’s failure to consult TRAI before introducing a new service
or modifying a license were a breach of the TRAI Act and therefore could call into question the legality of the government’s action.  

Telecom licenses in India are generally service specific although since 2003, mobile and fixed service licenses are covered under the Unified Access Service License (UASL). This was done in part to simplify the licensing regime. In part it was also the recognition of the increasing substitution between mobile and fixed services. The UAS license allows an operator to offer any type of access services, including Internet telephony, Internet and Broadband. In a significant announcement in November 2000, DoT did away with the long-standing requirement that an applicant for a license must have prior experience in the telecom sector.

The Wireless Planning & Coordination (WPC) is the National Radio Regulatory Authority responsible for frequency spectrum management, including licensing and caters for the needs of all wireless users (Government and Private) in the country. It exercises the statutory functions of the Central Government and issues licenses to establish, maintain and operate wireless stations. WPC is also a part of DoT. To address the market failure associated with availability of telecom services and infrastructure across all regions and people, a Universal Service Obligation (USO) Fund has been created and is administered by a separate organization which is established as an attached office of the DoT, headed by the USO Fund Administrator. On January 9, 2004, the USO Fund was given a statutory non-lapsable status.

The prevailing multi institutional approach to telecom regulation is vastly different from the single institution framework that existed when the first National Telecom Policy was formulated in 1994. The new institutional framework reflects in part the greater complexity in telecom service provision and therefore the need to create institutions that are specialized. In part, it also reflects the government’s objective of ensuring transparency and fairness in the functioning of the regulatory regime as a result of private sector participation. To what extent this goal has been achieved is described ahead.

**FDI regime and the Policy architecture**

The Indian telecommunications industry was state-owned until 1991, when the DoT began the process of introducing private participation in the sector by inviting bids for private sector participation. Ever since FDI inflows into the sector have increased. From a paltry US$ 177.69 million in 2000 to a high of US$ 6 billion in the current fiscal. The policy prescribed various ceilings for foreign equity in telecommunications and these ceilings have been liberalized over time. Legally these ceilings regulate the maximum amount of foreign equity participation in telecom companies which must be incorporated in India and registered as an Indian company. In November 2005, the Government, through Press Note 5 of 2005 raised the foreign direct investment limit applicable to the telecommunications sector from 49 per cent to 74 per cent. In 2010, 100 per cent FDI became applicable; wherein 49 per cent was allowed through the automatic route i.e. not requiring prior approval of the government. However, in view of the recent merger between two large players (Idea Cellular and Vodafone India), the earlier proposal of the Telecom Commission to allow complete 100 per cent FDI through the automatic route is being considered.

As Table 7 reveals FDI inflows have been erratic and can be linked to the prevailing regulatory and institutional framework. The current FDI regime is vastly liberal and that is reflected in the recent surge in inflows.
### Table 7: FDI Inflows - Telecommunication Sector

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>In Rs. Crore</th>
<th>In USD million</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-01</td>
<td>784.16</td>
<td>177.69</td>
</tr>
<tr>
<td>2001-02</td>
<td>3938.46</td>
<td>873.23</td>
</tr>
<tr>
<td>2002-03</td>
<td>907.73</td>
<td>191.6</td>
</tr>
<tr>
<td>2003-04</td>
<td>408.78</td>
<td>88.87</td>
</tr>
<tr>
<td>2004-05</td>
<td>569.54</td>
<td>124.53</td>
</tr>
<tr>
<td>2005-06</td>
<td>2774.18</td>
<td>623.16</td>
</tr>
<tr>
<td>2006-07</td>
<td>2155.08</td>
<td>477.74</td>
</tr>
<tr>
<td>2007-08</td>
<td>5102.61</td>
<td>1261.46</td>
</tr>
<tr>
<td>2008-09</td>
<td>11726.87</td>
<td>2558.39</td>
</tr>
<tr>
<td>2009-10</td>
<td>12338.32</td>
<td>2553.95</td>
</tr>
<tr>
<td>2010-11</td>
<td>7542.04</td>
<td>1653.23</td>
</tr>
<tr>
<td>2011-12</td>
<td>9011.53</td>
<td>1922.25</td>
</tr>
<tr>
<td>2012-13</td>
<td>1654.3</td>
<td>304.60</td>
</tr>
<tr>
<td>2013-14</td>
<td>7,987</td>
<td>1324.98</td>
</tr>
<tr>
<td>2014-15</td>
<td>17,372</td>
<td>2845.07</td>
</tr>
<tr>
<td>2015-16</td>
<td>8,637</td>
<td>1319.43</td>
</tr>
<tr>
<td>2016-17</td>
<td>37,435</td>
<td>5591.49</td>
</tr>
</tbody>
</table>


According to the Global Infrastructure Hub forecast, India needs huge investments in telecom infrastructure over the next two decades with the gap between current trends and the investments requirements widening over time (See Table 8). This gap can be plugged by good policy. A new National Telecom Policy (NTP) 2018 is on the anvil that follows three previous policies in 1994, 1999 and 2012 respectively. In addition to presenting a vision for the sector, all three previous policies focused on easing the within sector constraints, seeking to universalize access and instill transparency in the institutional mechanism especially relating to assignment of scarce resources. NTP 2018 comes at a time when the telecom sector is going through stress due to a huge debt pile, a tariff war and irrational spectrum costs.\(^{22}\) The policy will naturally try and address these costs wherever possible. But it is equally important for NTP 2018 to recognize that the telecom sector more than ever is an enabler for data and citizen centric services. For digital India, NTP 2018 has a vital role.

Enhancing soft and hard digital infrastructure such as network and cloud computing, fibre optic cables, and digital standards, are critical for promoting economic development. Digital provision of services for individuals and firms will help reduce transaction costs. Electronic databases and online applications for government departments will increase efficiency, automation and transparency. In the long term, digital connectivity will be important in empowering citizens by enhancing engagement, knowledge sharing, collaboration and providing opportunities for participative governance. This cannot happen without pervasive and affordable broadband. Thus, rolling out broadband infrastructure is among the highest priorities.
BharatNet, an initiative, implemented by the Bharat Broadband Network Limited (BBNL) to create high-speed digital highway for providing 100 Mbps connectivity to all 2.5 Lakh Gram Panchayats using optical fibre has been delayed. In the first phase, ending on 31 March 2017, 2.2 Lakh km underground optical fibre was to be installed to connect one Lakh Gram Panchayats. As of 5 March 2017, 1.76 Lakh km of fibre had been deployed with 77.8 thousand Gram Panchayats connected.23

BharatNet is now rescheduled to be completed by December 2018. Given the scope and ambition of the BharatNet programme, successful deployment must necessarily be collaborative as much as possible. Leveraging the private sector’s experience, technical expertise, and capacity for marketing and service delivery is key to creating the ecosystem necessary for broadband uptake, including for the delivery of the numerous Government services envisioned under the Digital India initiative. Building appropriate incentives into the implementation process itself can be an appropriate safeguard, keeping in mind that carrots are much better than sticks in achieving desired outcomes.

NTP 2018 will no doubt address these concerns and help fashion an environment to attract investments for the sector. TRAI anticipates investments of about USD 100 billion by 2022 and expects the sector to generate 2 million jobs, achieve 900 million broadband subscriptions with download speed of 2 Mbps and connect all gram panchayats with at least 1 gigabit per second with wireless broadband by 2022 to power digital India.

### Towards Digital India

That internet and broadband is yet to replicate the success of mobile will be stating the obvious. The broadband connectivity that India has been able to realize is skewed from several different perspectives. Both internet and broadband have been biased in favour of urban areas with broadband even more so. More than 35 per cent broadband subscribers are in the top ten metros and more than 60 per cent connections are in top 30 cities. Just 25 per cent of the broadband connections are in rural areas which are very few compared to about 42 per cent of total mobile telephone connections in rural areas24.

Broadband is now identified as an ecosystem comprising networks, services, applications, and users that depend on high-speed connectivity to interact in different ways. Providing high speed internet access is merely seen as a necessary condition to drive adoption and leverage the concomitant benefits of that access. At the same time, focus needs to be placed on applications, content and users. It is unlikely that addressing supply side constraints by itself will be able to alleviate these other constraints to growth25. The economic impact of internet is therefore likely to be strongest when the entire eco system is in place- networks, applications, services and relevant content with users demanding and driving greater investments in networks, thereby creating a virtuous circle for growth. Once broadband data networks are in place, they can carry all kinds

| Table 8: Investment in Telecom Infrastructure in India (in USD million) |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Current Trends in Investment | 3,396 | 11,261 | 14,253 | 14,821 | 15,387 | 16,536 | 22,176 | 28,448 |
| Investment Needs in Infrastructure | 3,396 | 11,261 | 18,072 | 18,876 | 19,679 | 21,303 | 29,311 | 37,952 |

Source - Global Infrastructure Outlook
of services providing voice (IP-based telephony services), video (through IPTV or Web-based applications), and data. Obviously the higher the connectivity speed, the higher the speed, the greater the functionality. Broadband will allow students and teachers, patients and doctors, citizens and government to augment and in some cases replace the traditional mode of face to face interaction. While e-education and e-health will not replace teachers and doctors, it has tremendous potential to supplement and increase their reach. Broadband networks connected to schools, government agencies and hospitals, especially rural telemedicine centers will help trigger network effects.

Applications—often called apps—are crucial to driving the broadband ecosystem. Delivery of public services to all citizens by electronic means by phasing out of manual delivery of services improves transparency, speed and efficiency. Mobile based applications in local languages will also drive the adoption of internet in rural areas. The average user in India holds nearly 80 apps and accesses over 40 of them. There has been a 60 percent growth in the total number of app downloads globally from 2015, with a total of more than 175 billion downloads in 2017. Alongside India, mobile users in China and Japan are reported to have over 100 apps on average. App downloads, particularly in India, have surged 215 percent in 2017 over 2015. In India, the top 10 most downloaded apps were WhatsApp, Facebook, Facebook Messenger, Truecaller, SHAREit, MX Player, UC Browser, Amazon, Paytm, and Instagram. Indians downloaded 6.2 billion apps through Google Play, up from 3.6 billion in 2015, according to a recent report by App Annie. Indians not only downloaded the highest greatest number of Android apps, but also clocked the most time spent on Android devices last year—145 billion hours.

Internet of Things (IoT) has enormous potential for India. The forecast is that IoT will be worth US$ 15 billion by 2020 and US$ 75 billion by 2025. The key drivers of this growth will be several government initiatives and the ‘Smart Cities’ programme. In addition, Smart Grids and Smart Transportation will propel the initiative. The potential for job creation is also attractive for India given the demographic profile of its population. Ericsson had invested $4 billion in R&D in 2016, and recently has raised $370 million to invest in 5G development and other mobile innovation.

As India finds itself truly on the cusp of a digital revolution, the way consumers, businesses and governments operate and collaborate will change dramatically. And it will continue to do so, occasionally being awkwardly disruptive. With increasing mobile and internet penetration, the financial architecture, for example, of the country has undergone massive transformation. A billion plus mobile connections, growing smartphone penetration and internet access having already crossed 450 million, the potential power of this revolution keeps swelling.

The mobile phone has become a vehicle for sophisticated financial integration, as made evident by the expanding usage of prepaid payment instruments and mobile banking. There has been renewed focus on reaping the benefits of digitisation even on part of the government, with Jan-Dhan Yojana (J DY) attempting to bring the marginalised and unbanked to the fore using technology. A total of 310 million bank accounts have been opened and 234 million RuPay cards have been issued under the latter, indicating the large unmet demand for banking services. The JDY forms the core of the government’s strategy—with a bank account, every household could potentially gain access to banking and credit facilities and participate in the formal system. The Aadhaar identity card is envisaged as the sole KYC proof, besides serving as the backbone for Direct Benefit Transfer (DBT) when linked to bank accounts. As of December 2017, 1.1 billion citizens have been allocated an Aadhaar card. Linking the Aadhaar number to an active bank account is part of the inclusion drive of the government, by making income transfers predictable.
and targeted. There is already evidence that payments through Aadhaar-linked bank accounts have increased efficiency and reduced leakages.

As the Jan-Dhan-Aadhaar-Mobile (JAM) trinity leads the disruptions in the traditional banking and payments market in India, security is a key challenge. With data breaches in mind, the Reserve Bank of India (RBI) recently announced a policy attempting to fortify the digital financial economy. It mandated ‘unfettered access’ to payment systems data for ‘supervisory purposes’, and hence such data must be ‘stored only inside the country’ and specified a timeline of 6 months for compliance by all payment system operators (PSOs). On a bigger scale, there are concerns about the lack of a robust cybersecurity infrastructure for the functioning of 5G and IoT. The government has announced adoption of block-chain technology for a robust security framework. Other prerequisites for 5G include spectrum policy reform inclusive of cost effectiveness of harmonisation and delicensing of spectrum. Use of unlicensed spectrum bands like E-bands and V-bands can aid last mile mobile connectivity issues and help in extending broadband connectivity from existing points of presence to nearby locations for several applications.

**Conclusions**

During the past two and a half decades and more, India has moved away from its former ‘command and control’ policies to become a market-based economy. Because of the liberalization, GDP per capita rose sharply to over 6 per cent annually during the last decade compared to an annual growth of GDP per capita of just 1 per cent in the three decades from 1950 to 1980. As a result, India is now ranked as the third largest economy in the world in 2018 (after the United States and China and Japan when measured at purchasing power parity), accounting for over 7.5 per cent of world GDP. Although India’s current growth rate is among the highest in the world, it remains a low middle-income country. With a per capita income of US$1948 in 2017, India ranks 141 among all nations. As well as a low average income, there are substantial disparities in economic performance between states. The average per capita Gross State Domestic Product (GSDP) of Delhi, the richest state, is almost seven times that of Bihar, the poorest. There is a broad consensus that growth needs to become more inclusive. Research suggests that the differences in economic performance across states are associated with the extent to which they have introduced market-oriented reforms, alongside measures to improve infrastructure, education and basic services.

Lack of good quality infrastructure has been India’s limitation especially in achieving higher and more inclusive economic growth. The lack of adequate infrastructure is particularly acute in rural areas, home to almost 70 per cent of India’s population and 52.1 per cent of the total workforce is primarily engaged in agriculture and related activities. Agriculture in India accounts for about 16 per cent of national income (2017) and supports approximately 58 per cent of the population, implying extremely low agricultural productivity. The resulting migration of excess farm labour to urban areas in search of jobs is straining urban infrastructure and increasing the population living in city slums. India’s urban population is expected to double over the next two decades, to 600 million by 2035 and over 800 million in 2050.

Any policy that seeks to address the problem of inclusive growth will therefore have to contend with the predicament of low productivity in agriculture, rapid urbanization and the need to create productive jobs. There is a case for wide-ranging educational reforms which makes it easier for the poor to access quality education; and there is a case for revamping primary healthcare to make it much more accessible to impact poverty and growth. Productivity needs to increase both as part of the development process and for the 270 million Indians who live in poverty.
Technology offers immense hope. Riding on increasing competition, the evolution of wireless technologies, growing mobile penetration, and declining prices, the telecommunications sector in India is now worth over US$ 60 billion and constitutes over 3 per cent of GDP. India boasts of the second largest stock of mobile and internet subscribers in the world and a large addressable market. Two areas – rural telephony and broadband internet have not fully lived up to expectations despite vast potential. Both these areas are vital to the success of the Digital India initiative launched by the government.

The government plans to connect about 250,000 gram panchayats with broadband infrastructure by the end of this year. Once this core network is established, last mile access can be wireless or wireline; or any other technology that is suited to local conditions; market forces will decide the blend. In emerging markets, where mobile phones outnumber internet connections, wireless technology is playing a significant role in expanding internet access. There seems to be no doubt that new users in India will mostly access the internet on their mobile phones. Once in place, broadband digital connectivity will ease communication and commerce and drive economic growth. Broadband will allow students and teachers, patients and doctors, citizens and government to supplement and increase their reach. Broadband networks connected to schools, government agencies and hospitals, especially rural telemedicine centers will help trigger network effects.

A technology opportunity beckons India. The digital economy has the potential to address India’s multitude deficits—from financial inclusion, better targeting of social welfare programmes and improved governance. It also promises imparting skills and creating jobs. India’s start-up edifice represents an encouraging picture. It is home to some 4,750 tech start-ups—the highest number in the world after the United States and Britain. India has emerged as one of the top three countries globally in terms of the number of start-ups founded. At the other end of the spectrum, India aspires to be the global hub for data and innovation. The attraction of IoT and 5G lies as much in its ability to drive smart cities, intelligent transport networks and consumer durables as it does in affording revenue opportunities for the government to meet its development expenses. NTP 2018 due shortly is keenly anticipated to help lock in an exciting digital future that helps India realise its wide-ranging ambitions.
Annex I: Regulatory regime in the Indian telecommunications sector

Telecommunications in India is a Union subject i.e. the federal government has the exclusive authority to legislate on it. The key Acts of Parliament which govern the Indian telecommunications sector are:

- Indian Telegraph Act 1885
- Indian Telegraph (Amendment) Rules 2004
- Indian Wireless Act 1933
- Information Technology Act 2000
- Communication Convergence Bill 2001
- Telecom Regulatory Authority of India Act 1997

The texts of these Acts are available on the DoT website http://www.dot.gov.in/Acts/acts.htm). The institutional framework for regulating telecom in India comprises the following key agencies:

**Telecom Commission**

The Telecom Commission was set up by the Government of India in 1989 with administrative and financial powers of the Government of India to deal with various aspects of telecommunications. The Commission consists of a Chairman and four full time members who are ex-officio Secretaries to the Government of India in the DoT, besides there are four part time members who are Secretaries to the Government of India of the concerned departments.

**Department of Telecommunications (DoT)**

The Department of Telecommunications is part of the Ministry of Communication and Information Technology of the Government of India. It is the authority in India which looks after licensing and overall policy making in India. Together the main functions of the Telecom Commission and the Department of Telecommunications include:

- Policy formulation
- Review of performance of the sector
- Licensing
- Wireless spectrum management
- Administrative monitoring of Public Sector Undertakings in telecom (including BSNL and MTNL)
- Research and development
- Standardization/validation of equipment
- International Relations

**Telecom Regulatory Authority of India (TRAI)**

TRAI was formed in 1997 by an Act of Parliament as an independent regulator for the Indian telecommunications industry. Subsequently, in 2000, the adjudicatory powers of TRAI were separated and entrusted to the Telecom Dispute Settlement & Appellate Tribunal (“TDSAT”).
TRAI’s mission is to create and nurture conditions for growth of telecommunications in the country in a manner and at a pace which will enable India to play a leading role in emerging global information society. One of the main objectives of TRAI is to provide a fair and transparent policy environment which promotes a level playing field and facilitates fair competition. In pursuance of the above objective, TRAI has issued from time to time a large number of regulations, orders and directives to deal with issues coming before it and provided the required direction to the evolution of the Indian telecoms market.

The key functions of TRAI include:

- Regulation of tariff, interconnection and quality of service;
- Making recommendations to the Government on policy issues, licensing, terms & conditions, licence revocation, competition facilitation etc. It is mandatory for the Government to seek recommendations of TRAI in respect of specified matters.

**Telecom Dispute Settlement & Appellate Tribunal (TDSAT)**

The Telecom Regulatory Authority of India Act, 1997 was amended by the Telecom Regulatory Authority of India (Amendment) Act, 2000. The amendments were brought about to remove certain difficulties that had arisen in the implementation of the Act. A clear distinction was made between the recommendatory and regulatory functions of TRAI by the setting up of a separate dispute settlement mechanism. By the Amendment Act, an Appellate Tribunal known as the Telecom Disputes Settlement & Appellate Tribunal was set up to adjudicate disputes and dispose off appeals with a view to protect the interests of service providers and consumers of the telecoms sector and to promote and ensure orderly growth of the sector. The Appellate Tribunal came into existence on 29th May 2000 and started hearing cases from January 2001. The functions of the appellate tribunal are:

To adjudicate any dispute:

- between a licensor and licensee;
- between two or more service providers;
- between a service provider and a group of consumers;
- To hear and dispose of appeals against any decision or order of TRAI.

Broadly, the issues involved in cases filed before the Appellate Tribunal relate to interconnection, challenging the basis of computation of licence fee by the licensor, wrongful levy and charge of royalty and licence fee for frequency allocation, blocking of calls by one group of service providers, disputes relating to default traffic, challenges to tariff fixed by TRAI, encashment of bank guarantees, disputes between broadcasters etc.

**Wireless Planning & Coordination Wing (WPC)**

The Wireless Planning & Coordination Wing of the Ministry of Communications, created in 1952, is the National Radio Regulatory Authority responsible for frequency spectrum management, including licensing and caters for the needs of all wireless users (Government and Private) in the country. It exercises the statutory functions of the Central Government and issues licences to establish, maintain and operate wireless stations. WPC is divided into major sections like Licensing and Regulation (“LR”), New Technology Group (“NTG”) and Standing Advisory Committee on Radio Frequency Allocation (“SACFA”). SACFA makes the recommendations on major frequency
allocation issues, formulation of the frequency allocation plan, making recommendations on the various issues related to International Telecom Union (“ITU”), to sort out problems referred to the committee by various wireless users, site clearance of all wireless installations in the country etc.

**Telecom Engineering Centre (TEC)**

Telecom Engineering Centre is a technical body representing the interest of the Department of Telecommunications, Government of India. The role of TEC is to bring together the telecom industry to decide the standards that network elements and services would have to conform to in order to make the Indian telecom network deliver acceptable service in a multi-operator environment at par with global standards. TEC is responsible for the formulation of Generic Requirements (“GR”) for network elements, Interface Requirements (“IR”) for interfaces between different network elements, Service Requirements (“SR”) for networks and services and Test Schedule and Test Procedures (“TSTP”) thereof.

**Key functions of the TEC include the following:**

- Specification of common standards with regard to telecom network equipment, services and interoperability;
- Issuing Interface Approvals and Service Approvals;
- Formulation of Standards and Fundamental Technical Plans;
- Interacting with multilateral agencies like APT, ETSI and ITU etc. for standardisation;
- Developing expertise to imbibe the latest technologies and results of R&D;
- Providing technical support to DoT and technical advice to TRAI & TDSAT;
- Coordinating with C-DoT on the technological developments in the telecom sector for policy planning by DoT.

**Universal Service Obligation Fund (USOF)**

The Universal Service Support Policy came into effect from 01.04.2002. The guidelines for universal service support policy were issued by DoT and were placed on the DoT website www.dot.gov.in on 27th March 2002. Subsequently, the Indian Telegraph (Amendment) Act, 2003 giving statutory status to the Universal Service Obligation Fund (USOF) was passed in December 2003. The Fund is to be utilized exclusively for meeting the Universal Service Obligation by providing access to telegraph services to people in the rural and remote areas at affordable and reasonable prices. The USO Fund was established with the fundamental objective of providing access to ‘basic’ telegraph services. Subsequently, an Act has been passed on 29.12.2006 as the Indian Telegraph (Amendment) Act 2006 to amend the Indian Telegraph Act, 1885 to enable provision of all types of telegraph services. The USOF is headed by a Universal Service Fund Administrator.

**Key functions of USOF Administration include the following**

- To formulate USOF projects under the various streams provided in the Indian Telegraph Rules, in consultation with telecom services providers and various stakeholders.
- To design the bidding process and carry out tendering.
- To enter into implementation agreements with Telecom Service Providers (TSPs).
- To monitor the implementation of USOF projects and to disburse subsidy in accordance
with terms and conditions of USOF agreements.

- To design the format of various records and returns to be maintained by the TSPs.
- To carry out post implementation review of USOF Schemes.
- Budgeting and Audit of USOF Activities.
- Interface with International Organizations such as ITU, APT and USO Funds of other nations.

Endnotes

1. A survey by New America Foundation’s Open Technology Initiative compared the costs and types of mobile cell phone packages available to consumers around the world. The survey concluded that Canadians pay 70 times more than what Indians pay for voice calls. Indian consumers pay $0.01 per minute, Hong Kong being the only other country close to India.

2. Reported by Telecom Regulatory Authority of India (TRAI), March 2011

3. Herfindahl-Hirschman Index (HHI) is a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in a market, and then summing the resulting numbers. The HHI number can range from close to 0 to 10,000. It is expressed as: HHI = s1^2 + s2^2 + s3^2 + ... + sn^2 (where sn is the market share of the ith firm). The closer a market is to being a monopoly, the higher the market’s concentration (and the lower its competition). If, for example, there were only one firm in an industry, that firm would have 100 per cent market share, and the HHI would equal 10,000 (100^2), indicating a monopoly. Or, if there were thousands of firms competing, each would have nearly 0 per cent market share, and the HHI would be close to zero, indicating nearly perfect competition. The United States Department of Justice uses the HHI for evaluating mergers. It considers a market with a result of less than 1,000 to be a competitive marketplace, a result of 1,000-1,800 to be a moderately concentrated marketplace, and a result of 1,800 or greater to be a highly concentrated marketplace. In the EU, an HHI between 1000-2000 raises no competitive concerns.

4. TRAI Performance Indicators Report, December 2017


6. Telecom Regulatory Authority of India, Recommendations On Growth of Broadband June 2017

7. For a description of the model and results see “Mobile India Revisited: Analysis of Impact of Communication on the Indian Economy”, NCAER Centre for Macro Consumer Research, 2011

8. “India: Impact of Internet”, Rajat Kathuria, Mansi Kedia


11. Three Year Agenda, Niti Aayog, 2018

12. This aspect is further examined in section 5.

13. The government stopped awarding Cellular Mobile Telephone Service (CMTS) and Basic service licenses after issuing the guidelines for Unified Access (Basic & Cellular) Service License (UASL) on 11.11.2003. Some of the operators were permitted to migrate from CMTS License to UASL.


16. Internet Service Providers Association of India v Union of India Petition 7 of 2005 Telecom Petitions 2005, TDSAT

17. TRAI issued guidelines on the UAS, effective 11 November 2003. UAS operators are free to provide, within their area of operation, services covering collection, carriage, transmission, and delivery of voice and/or non-voice messages over the licensee’s network. http://www.dot.gov.in/basic/basicindex.htm.

18. See DoT Press Note 10, November 2005
22. Economic Survey 2018
23. NITI Aayog, Three Year Action Agenda
24. TRAI National Broadband Plan Recommendations, 8th Dec 2010
25. Building broadband: Strategies and policies for the developing world, Yongsoo Kim, Tim Kelly, and Siddhartha Raja (Global Information and Communication Technologies (GICT) Department World Bank January 2010) According to this report a speed-based definition leads to an incomplete conceptualization of broadband. More than just a network, broadband is an ecosystem comprising various elements that depend on high-speed connectivity to interact in different ways.
26. The 99 Smart Cities Mission cities are envisaged to have total investment of Rs. 2,03,979 crore. With a per city allocation of Rs 100 crore for each of the five years of the mission period, the central assistance to the mission is around Rs 50,000 crore.