Role of Broadband in achieving Sustainable Development Goals

in Indian context

A Dissertation submitted to the Panjab University, Chandigarh for the award of Master of Philosophy in Social Sciences, in Partial Fulfilment of the requirement for the Advanced Professional Programme in Public Administration (APPPA)

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NEW DELHI

CERTIFICATE

I have the pleasure to certify that **Shri Yogesh Kumar Maurya** has pursued his research work and prepared the present dissertation titled **"Role of Broadband in achieving Sustainable Development Goals in Indian context"** under my guidance and supervision. The dissertation is the result of his own research and to the best of my knowledge, no part of it has earlier comprised any other monograph, dissertation or book. This is being submitted to the Panjab University, Chandigarh, for the purpose of Master of Philosophy in Social Sciences in Partial fulfilment of the requirement for the Advanced Professional Programme in Public Administration of Indian Institute of Public Administration (IIPA), New Delhi.

I recommend that the dissertation of **Shri Yogesh Kumar Maurya** is worthy of consideration for the award of M.Phil degree of Panjab University, Chandigarh.

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Abstract

The seventeen SDGs have become *de-facto* international obligations and have potential to guide in domestic spending priorities of the countries till 2030, however not legally binding. The SDGs are expected to stimulate action over the next 15 years in areas of critical importance for humanity and the planet. The member countries are supposed to take ownership and establish a national framework for achieving these Goals and align its' own sustainable development plans, policies and programmes. The countries are expected to have follow-up and review at the national level regarding the progress made in implementing the goals and targets.

NITI Aayog developed the SDG India Index Baseline Report and an accompanying Dashboard in December 2018 in collaboration with UN India. It not only presents a snapshot of progress at the national level but also comprehensively documents and measures the achievements made by States and UTs towards various SDG targets and also ranks them on a select set of indicators. The SDG India Index has enabled States and UTs to identify priority areas and benchmark their progress relative to others, thus promoting competition among them for improving performance. India stands at 117th position with a score of 61.9 amongst 166 countries with major challenges in many areas like Health, Gender equality, inequalities etc. The regional SDG index score is 77.2 against India's score of 61.9. Further, the Covid-19 may also affect India's position adversely. Needless to state, India needs to put a lot of efforts and perform better.

Broadband is a basic and critical building block in programmatic efforts to achieve the UN sustainable development goals and a marginal investment in broadband is found to impact on achieving the SDGs. Increasing broadband penetration is expected to help accelerate social inclusion, drive our leadership as a knowledge-based economy, foster

entrepreneurship and jobs and reduce the parallel economy through increased transparency and governance. The roles of government and the private sector are complementary, and governments are required to bring out a favourable policy for better domestic and foreign investments for rapid percolation of broadband.

Various studies by academia, industry and institutions have observed a positive relation of broadband penetration with GDP and employment generation. They observed that broadband stimulates economic growth both directly, indirectly and induced. It facilitates information exchange and reduces the transaction costs in any economy. Broadband has major impact on economic and social development, including income growth and community resilience. Broadband is the enabling force for software development, disseminating e-agriculture and e-health information, distance learning and mobile money and establishing mechanisms to provide early warning of natural and man-made disasters.

The governments need to identify new technologies and tools to create awareness, implement and monitor SDG implementations with reference to various aspects including - improving quality and efficiency of services and benefits reaching unto the target beneficiaries without relying on middlemen as well as to analyze the implementation and take corrective actions. The broadband technologies have made a paradigm shift in working styles of Governments. Broadband networks have the power to accelerate this journey in a way that no other technology can by enabling greater inclusion in vast cities and remote villages, transforming communities, delivering healthcare in ways never imagined, opening doors to education, employment and income opportunities, creating smarter cities, empowering people with the tools they need to thrive and driving a more sustainable planet.

The urban sector in India saw a major growth in recent years, though the rural sector,

which houses around 67% of the population, saw a little growth. The rural broadband connections contribute only to around 38% of total broadband connections of the country.

Therefore, study was undertaken to observe the role of broadband on achieving SDGs. The research design for this study comprises of analysis of primary data collected through questionnaire and study correlation between secondary data collected from TRAI, ITU, DoT, Ministry of Statistics and Programme Implementation and NITI Aayog.

The first round of selection of SDGs and the respective indicators was done by the author himself. Subsequently, an experts' opinion survey through google forms was elicited to narrow down these shortlisted SDG indicators. For this second stage of filtration, experts amongst a few government officials (at various levels) dealing with the subject were requested to provide their inputs on the indicators which can be influenced by broadband.

To identify the issues and challenges faced in implementation of broadband connectivity primary survey was conducted by using a semi-structured tool to elicit opinion of officials dealing with broadband related policy/installation/operation activities in the country.

The study concludes that broadband penetration does affect achievement of certain indicators 'directly' and some other indicators 'indirectly, though it cannot be concluded that broadband alone can lead to achievement of SDGs. There may be some other factors as well which affect the SDGs achievement and need to be further studied.

It is recommended that to address the impediments and measures to improve the broadband penetration, the action at people (citizen), policy, legal framework and regulatory guidelines is required.

Abbreviations

Abbreviation	Definition
ADSL	Asymmetric Digital Subscriber Line
AI	Artificial Intelligence
AIDS	Acquired Immunodeficiency Syndrome
AP	Access Point
ARPA	Advanced Research Projects Agency
ARPANET	Advanced Research Projects Agency Network
BB	Broadband
BBNL	Bharat Broadband Network Limited
BPL	Broadband Over Power Lines
BSNL	Bharat Sanchar Nigam Limited
BTS	Base Transceiver Station
BWA	Broadband Wireless Access
CAG	Controller and Audit General of India
COAI	Cellular Operators Association of India
CSCs	Common Service Centres
DBT	Direct Benefit Transfer
DoT	Department of Telecommunications
DSL	Digital Subscriber Line
EGDI	E-Government Development Index
EU	European Union
FAQs	Frequently Asked Questions
FCC	Federal Communications Commission
FDI	Foreign Direct Investment
FTTB, FTTC, FTTH	Fibre To The Block, Complex, Home
FWA	Fixed Wireless Access
GDP	Gross Domestic Products
GHG	Greenhouse Gas
GPs	Gram Panchayats
GSM	Global System for Mobile Communication
GSMA	Gsm Association
HCI	Human Capital Index
HDSL	High-Bit-Rate Digital Subscriber Line
HFC	Hybrid Fibre Coaxial
HSDPA	High Speed Data Packet Access

Abbreviation	Definition
HSPA	High Speed Packet Access
ICC	International Chamber of Commerce
ICT	Information and Communications Technology
ICT4D	ICTs For Development
IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
IT	Information Technology
ITU	International Telecommunication Union
Kbps	Kilobits per second
LAC	Latin American and Caribbean
LAN	Local Area Networks
LMC	Last Mile Connectivity
LTE	Long-Term Evolution
MDG(s)	Millennium Development Goal(s)
MeitY	Ministry of Electronics and Information Technology
MoSPI	Ministry of Statistics and Programme Implementation
MTNL	Mahanagar Telephone Nigam Limited
NCP	Network Control Program
NDCP	National Digital Communications Policy
NFHS	National Family Health Survey
NHAI	National Highways Authority of India
NIF	National Indicator Framework
NITI Aayog	National Institution for Transforming India Aayog
NTP	National Telecom Policy
OECD	Organisation for Economic Co-operation and Development
OFC	Optical Fibre Cable
OTT	Over-The-Top
PDOA	Public Data Office Aggregator
PLC	power line communication
PoP	Point of Presence
PSU	Public Sector Units
RoW	Right of way
QoS	Quality of service
SDG(s)	Sustainable Development Goal(s)
SME	Small and Medium-Sized Enterprises
TCP/IP	Transmission Control Protocol/Internet Protocol

Abbreviation	Definition
TII	Telecommunications Infrastructure Index
TRAI	Telecom Regulatory Authority of India
TSP	Telecom Service Providers
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
USD	United States Dollar
USOF	Universal Service Obligation Fund
UT	Union Territory
VNR	Voluntary National Review
VSNL	Videsh Sanchar Nigam Limited
WANI	Wi-Fi Access Network Interface
wLANs	Wireless Local Area Networks
xDSL	Sum Total of Digital Subscriber Line

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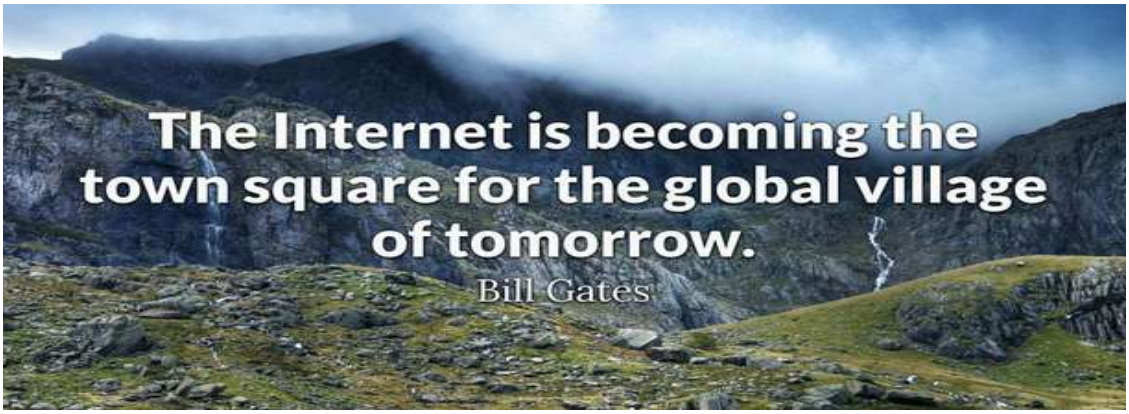


1.1 Background

The successful implementation of SDGs will enhance the life on the planet in many ways. The agenda for SDGs focuses not only on economic growth, but also on fair and more equitable societies along with a more protected and prosperous earth. The agenda is designed with trust that the works of peace, justice, environmental protection and industrial development are not separate from each other but are part of the same change. This ambitious plan necessitates a renewed partnership between governments, businesses, enlightened societies and individuals. The progress on implementation of 169 objectives will be turning national development on a more sustainable and more robust path. The Sustainable Development Report (2020), published by Cambridge University Press, ranks India at 117th position, below Bhutan, Nepal and Bangladesh (Table 1.1). Therefore, there is an urgent need for India to act hard on all possible measures to perform better in achieving the SDGs. Broadband is seen as an enabler to implement the SDGs worldwide and various studies have indicated its impact on most of the SDGs. The role of broadband has further become important in the times of COVID-19 pandemic due to limitations on travel affecting corporates and governments and also limiting physical accessibility as well as delivery of services to the citizen.

A lot of thrust is being put up globally on the faster roll out of broadband services. ITU and UNESCO set up the Broadband Commission for Digital Development (2010) in May 2010 to step-up UN efforts to meet the MDGs with the aim of boosting the importance of broadband on the international policy agenda and expanding broadband access globally as key to accelerate progress towards development targets.

The Commission was re-launched as the Broadband Commission for Sustainable Development (2015) after adoption of the UN's SDGs in 2015 The Commission embraces a range of approaches to promote the roll-out of broadband in addition to providing a fresh approach to UN and business engagement to expedite use of ICT and broadband-based technologies for sustainable development. Broadband Commission has developed its own targets for Sustainable Development 2025 Targets of UN. Broadband has been transforming many economies of the world and rapidly becoming a utility. UN has noted that broadband is helping in achieving many Sustainable Development Goals (UNDP, 2015) through useful applications for medical diagnosis and treatment, clean water, improved sanitation, energy conservation, export of commodities and food security.

Table 1-1 The 2020 SDG Index scores

Rank	Country	Score
1	Sweden	84.7
2	Denmark	84.6
3	Finland	83.8
31	United States	76.4
41	Thailand	74.5
48	China	73.9
49	Vietnam	73.8
53	Brazil	72.7
60	Malaysia	71.8
80	Bhutan	69.3
94	Sri Lanka	66.9
96	Nepal	65.9
101	Indonesia	65.3
109	Bangladesh	63.5
117	India	61.9

Source-SDG Report 2020

Evolution of Internet to Broadband

Broadband is essentially internet with a specific download speed, defined differently by different countries. Internet is defined as ‘a global computer network providing a variety of information and communication facilities, consisting of interconnected networks using

standardized communication protocols' by Oxford dictionary. Merriam-Webster defines it as 'an electronic communications network that connects computer networks and organizational computer facilities around the world —used with *the* except when being used attributively.' The United States government in 1958 created the Advanced Research Projects Agency, (ARPA) which later developed ARPANet and the Internet. Leonard Kleinrock is given credit for the initial concept towards establishing packet-switching theory that developed into the World Wide Web. The transition of the ARPANET host protocol from NCP to TCP/IP on January 1, 1983 was an interesting challenge, requiring all hosts to convert simultaneously or be left having to communicate via ad-hoc mechanisms.

In a short time, the Internet evolved from a simple, four-hub, military-only data grid to a planet-wide, universally accessible informational universe that we know and love today, and address as broadband', its influence is felt throughout society as we move toward increasing use of online tools to accomplish electronic commerce, information acquisition, and community operations. Table 1.2 depicts important milestones in the evolution of internet in India.

Table 1-2 A brief timeline of evolution of internet in India

Year	Event
Before 1995	Internet was only used by military and research purposes,
1995	Internet launched to public in six cities through telephone connection.
1997	Telecom Regulatory Authority of India (TRAI) formed
1998	Sabeer Bhatia sold his Hotmail to Microsoft for $400 million
1999	Many private internet companies popped up leading to dot com bubble.
2000	Information Technology Act was passed by parliament
2001	Online booking started by Indian railways.
2003	Online flight booking started.
2004	Broadband policy released by DoT.
2006	Facebook started services for Indian users.

Year	Event
2008	Apple's iPhone launched in India.
2014	Broadband definition revised by DoT. India became the third largest internet users' community with around 20 crore users
2016	TRAI decided to continue net neutrality.

(Source-Author)

Definition of Broadband

Broadband, in simple words, is the access to internet while meeting certain parameters defined by an authority in the respective geographical area. Broadband is widely used as shorthand for high-speed Internet access (Kim, Kelly and Raja, 2010; Sacks, 2002). Most people define it as high-speed internet access. The term 'broadband' became popular in 1990s as the internet access, which was faster than dialup access, the available internet access technology at that time. The dial up internet access was limited to a maximum bandwidth of 56 kbit/s. This interpretation does not hold good in technical terms. Broadband can also be defined in terms of the technology used, in terms of the transmission capacity provided, or in terms of the functionality enabled (Kim, Kelly and Raja, 2010; Sacks, 2002). In many literatures, the internet access at a particular speed of transmission or a certain set of services, such as digital subscriber loop (DSL) or wireless local area networks (wLANs) is referred as broadband. Ultimately, as a user, broadband access enables one to send and receive large amount data at a same time through a medium. Technically, this is possible due to high bandwidth supported by the electronic equipment. Compared to traditional narrowband connections, broadband access is immediate (always-on) and large volumes of data can be transmitted instantly, thus waiting times are reduced and efficiency for user is improved. In contrast narrowband connections are slow where it is estimated that one third of user time online is spent waiting (Spurge and Roberts, 2005).

Bandwidth can be defined as the amount of data transmitted through the connection, which is possible because the signal travelling in the medium occupies multiple (non-masking, orthogonal) passbands, through complex electronics in the transmitter/receiver circuitry. Bandwidth is measured in bits per second (b/s) or Kilobits per sec (Kbps) or Megabits per second (Mbps) and now a days, terms like Gigabits per second (Gbps) and Terabits per second are also getting popular.

Now, all the internet access is on broadband and the old dial-up connection and 2G mobile are the only non-broadband internet service (which are still prevalent in some parts of the globe) and are comparatively low-cost service.

Broadband Technologies

Broadband includes several high-speed transmission technologies such as:

Digital Subscriber Line (xDSL)- this works on copper wire covering various technologies like ADSL, HDSL, VDSL etc, ADSL being most popular, for providing broadband over copper line.

Optical Fibre- The fibre optics technology is deployed to individual houses (FTTH), commercial buildings (FTTB) and complexes (FTTC). Hybrid Fibre Coaxial (HFC), Fibre to the Curb (FTTC) and Fibre to the Home (FTTH) etc. The fibre-based systems provide converged network that can deliver triple play services (voice, data and video).

Wireless Technologies- Terrestrial wireless is used for Broadband in thinly populated areas, which inter-alia include those based on IEEE 802.11b and 802.11g standards, has been issued.

Cable Modem- Cable TV connection as last mile infrastructure reaches many households and is leveraged as stimulus to Broadband penetration. Cable TV network for provisioning Broadband services.

Satellite- Broadband through Very Small Aperture Terminals (VSAT) are useful to serve remote and inaccessible areas. However, the cost per Mbps is significantly higher dure to technological issues.

Broadband over Powerlines (BPL)- Broadband over power lines (BPL) is a method of power line communication (PLC) that allows relatively high-speed digital data transmission over the public electric power distribution wiring.

Broadband definition in Indian perspective

There was no specific definition of broadband in India before announcement of Broadband Policy 2004 by DoT and an always-on highspeed internet access at 128 kbps was considered as 'Broadband'. Later, The Broadband Policy 2004 announced by DoT vide letter dated File No.813-07/03-LR defined broadband as follows-

'An 'always-on' data connection that is able to support interactive services including Internet access and has the capability of the minimum download speed of 256 kilobits per second (kbps) to an individual subscriber from the Point of Presence (POP) of the service provider intending to provide Broadband service where multiple such individual Broadband connections are aggregated and the subscriber is able to access these interactive services including the Internet through this POP. The interactive services will exclude any services for which a separate license is specifically required, for example, real-time voice transmission, except to the extent that it is presently permitted under ISP license with Internet Telephony.'

Broadband definition according to TRAI

The Telecom Regulatory Authority of India (TRAI) was established by an Act of Parliament, called the Telecom Regulatory Authority of India Act, 1997, with effect from 20th February 1997. TRAI mandate include regulation of telecom services and fixation/revision of telecom services tariffs which were earlier done by Department of Telecom (DoT). The TRAI is authorised to issue directions, orders and regulations covering subjects including tariff, interconnection and quality of service as well as governance of the Authority. As per quality of service of broadband service (Second Amendment) regulations, 2014 of TRAI, a minimum download speed of 512 kbps over internet, which may be provided over wireline or wireless technologies, is considered as Broadband. “A data connection using any technology that is able to support interactive services including Internet access and support a minimum download speed of 512 Kilobits per second (Kbps)”.

Based upon the advice of TRAI, DoT modified the broadband definition as- “Broadband is a data connection that is able to support interactive services including internet access and has the capability of the minimum download speed of 512Kbps to an individual subscriber from the Point of Presence (POP) of the service provider intending to provide the Broadband service” (Annexure- 1)

Sustainable Development Goals

The UN Conference held in 2012 at Rio de Janeiro, Brazil, on the 20th Anniversary of the 'Rio Earth Summit' (held in 1992), initiated the debate and work towards post-2015 development agenda targets. A document titled "Transforming our World: the 2030 Agenda for Sustainable Development" which consisted of 17 Sustainable Development Goals (SDGs) and associated 169 targets was adopted by United Nations in its 70th

Session of the General Assembly held on 25th September 2015. Sustainable development means a developmental strategy which fulfils the needs of the present generation and at the same time, ensures that the future generation need not make any kind of compromise to fulfil their needs. The SDGs seek to address the root causes of poverty as well as the universal need for development to provide a life of dignity to all. The Sustainable Development Goals cover comprehensively the goals integrating social, economic and environmental dimensions of development.

These seventeen SDGs came into force with effect from 01st January 2016. Though the SDGs are not legally binding, yet they have become de facto international obligations and have potential to guide in domestic spending priorities of the countries till 2030. The member countries are not only expected to take ownership but also establish a national framework for achieving these Goals and align countries' own sustainable development policies, plans and programmes. It is the primary responsibility of countries to have follow-up and review at the national level regarding the progress made in implementing the goals and targets over the implementation period. Built on the principle of *'sabka saath, sabka vikas'* (leaving no one behind), the new Agenda emphasizes a holistic approach to achieving sustainable development for all.

The SDGs are integrated and indivisible and balance the three dimensions namely, economic, social and environmental, of sustainable development. The SDGS cover all the crucial parts of the human society and represent our determination towards People's life, Planet, Prosperity, Peace and Partnership to achieve them.[1]

People: The SDGs intend to not only end poverty and hunger but also aspire to ensure that all human beings fulfil their potential in equality, dignity and in a healthy environment.

[1] https://www.undp.org/content/undp/en/home/2030-agenda-for-sustainable-development/people.html

Planet: SDGs seek to protect the planet from degradation through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.

Prosperity: SDGs attempt to ensure prosperous and fulfilling lives for all human beings and ensure that social, economic and technological progress occurs in harmony with nature.

Peace: SDGs propose to foster peaceful, inclusive and just societies which are free from fear and violence, acknowledging that there can be no sustainable development without peace and no peace without sustainable development.

Partnership: Its implement for achieving SDGs through a revitalized Global Partnership of all countries, all stakeholders and all people, with a spirit of strengthened global solidarity and focused on the needs of the poorest and most vulnerable.

The seventeen sustainable development goals (SDGs) identified to transform our world are described below:

GOAL 1: No Poverty- Still more than 800 million people around the world live on less than $1.25 a day and now it's time to end poverty altogether in all forms by 2030.

GOAL 2: Zero Hunger- nearly 1 out of every 9 people on earth who go to bed hungry every night. Together, we need to end hunger, achieve food security and improve nutrition and promote sustainable agriculture by 2030.

GOAL 3: Good Health and Well-being- Around 6 million children die every year before their fifth birthday and many die due to non-accessibility to health care systems We need to ensure healthy lives and promote well-being for all at all ages.

GOAL 4: Quality Education- Poverty, armed conflict and other emergencies keep many kids around the world out of school. We need to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Figure 1.1 The 17 sustainable development goals

Source: http://strive.lshtm.ac.uk/news/un-task-team-social-protection-and-hiv

GOAL 5: Gender Equality- The Sustainable Development Goals aim to end the discrimination against women and girls everywhere and achieve gender equality and empower all women and girls.

GOAL 6: Clean Water and Sanitation- Water scarcity affects more than 40 percent of people around the world, and that number is projected that by 2050 at least one in four people is likely to be affected by recurring water shortages. SDGs propose availability and sustainable management of sanitation and water for all.

GOAL 7: Affordable and Clean Energy- The fossil fuels and greenhouse gas emissions are making drastic changes in the climate, leading to big problems on every continent.

Therefore, we need to ensure access to affordable, reliable, sustainable and modern energy for all.

GOAL 8: Decent Work and Economic Growth- The job growth is not keeping pace with the growing labour force. We need to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

GOAL 9: Industry, Innovation and Infrastructure- We need to promote inclusive and sustainable industrialization, build resilient infrastructure and foster innovation.

GOAL 10: Reduced Inequality- We must adopt policies that reduce inequality within and among countries and create opportunity for everyone, regardless of who they are or where they come from.

GOAL 11: Sustainable Cities and Communities- To make cities sustainable for all, we need to upgrade slum settlements, create good and affordable public housing. We need to make cities and human settlements inclusive, safe, resilient and sustainable.

GOAL 12: Responsible Consumption and Production- We need to manage our natural resources more efficiently, dispose of toxic waste better and ensure sustainable consumption and production patterns.

GOAL 13: Climate Action- With the political will and technological measures, we can limit the global mean temperature rise to two degrees Celsius above pre-industrial levels and take urgent action to combat climate change and its impacts.

GOAL 14: Life Below Water- Marine and coastal diversity support livelihoods to more than 3 billion people. We need to conserve and sustainably use the oceans, seas and marine resources for sustainable development.

GOAL 15: Life on Land- Sustainable use of terrestrial ecosystems, combat desertification, sustainably managed forests, and halt and reverse land degradation and halt biodiversity loss need to be attained.

GOAL 16: Peace and Justice Strong Institutions- SDGs propose to provide access to justice for all and build effective, accountable and inclusive institutions at all levels and also peaceful and inclusive societies for sustainable development.

GOAL 17: Partnerships to achieve the Goal- Internet has interconnected the world today more than ever before and there's a growing consensus about the need to work together to stop climate change. We need to strengthen the means of implementation and revitalize the global partnership for sustainable development.

1.2 Current Scenario

Year 2021 marks the start of the 'Decade of Action' to deliver the SDGs by 2030. It is a critical period for counties to develop a shared vision and accelerate responses to the world's gravest challenges ranging from eliminating poverty and hunger to reversing climate change. However, the swift spread of the novel coronavirus turned a public health emergency into one of the worst international crises of our lifetimes, changing the world as we know it. This has globally impacted the progress towards SDG achievements. by Cambridge University Press in its SDG Report, 2020[2], majorly observed following effects of Covid-19-

- Around 1.6 billion already vulnerable workers (half the global workforce) in the informal economy may be significantly affected due to unemployment and

[2] The report was prepared by the United Nations Department of Economic and Social Affairs in collaboration with over 200 experts from more than 40 international agencies using the latest available data and estimates.

underemployment, with their incomes estimated to have fallen by 60 per cent in the first month of the crisis.

- Rising prices, lost incomes and limited social protection may put at risk of poverty and hunger to even those who were previously secure. The first rise in global poverty since 1998, may push around 71 million people into extreme poverty in 2020,
- Disruption to vaccination and health services along with limited access to diet and nutrition services have the potential to cause tens of thousands of additional maternal deaths and hundreds of thousands of additional under-5 deaths in 2020. A surge in reports of domestic violence against women and children noticed in many countries.
- Worldwide, more than one billion slum dwellers are acutely at risk of suffering from a limited access to formal health care facilities, no running water at home, lack of adequate housing, little or no waste management systems, shared toilets and overcrowded public transport.
- Children in poor and disadvantaged communities are at much greater risk of child labour, child marriage and child trafficking as more families fall into extreme poverty. In fact, the first time in 20 years, the global gains in reducing child labour are likely to be reversed.
- School closures have kept around 1.57 billion (90 per cent of students worldwide) out of school and affected over 370 million children to miss out on school meals they depend on. Moderate to severe disruptions or a total suspension of childhood vaccination services during March and April of 2020 reported by about 70 countries.

- Lack of access to internet and computers the at home means remote learning is out of reach of many.
- The report also states that climate change is still occurring much faster than anticipated as year 2019 was the second warmest on record and the end of the warmest decade of 2010 to 2019. Further, land degradation continues, ocean acidification is accelerating, unsustainable consumption and production patterns remain pervasive and massive numbers of species are at risk of extinction.

1.3 Broadband and SDGs

UN's SDGs were described as 'a plan of action for people, planet and prosperity'[3] and as demonstrating 'the scale and ambition' of the United Nations '2030 Agenda for Sustainable Development' which is designed to 'shift the world on to a sustainable and resilient path'. SDGs embrace a wide range of environmental, social and economic issues, including poverty, food supply and security, healthcare, education, gender, climate change, energy, water stewardship, marine conservation, biodiversity, sustainable production and consumption, equality, peace and economic growth. The United Nations called on all governments and also emphasised that business community had a vitally important role to play in addressing these goals. The findings of Koutroumpis are quite relevant who estimated data of 15 EU countries for year 2003 to 2006 and concluded that a 10% increase of broadband for a particular year increases GDP by about 3% which was later complemented by Czernich et al. Several leading ICT firms had suggested that their sector can play a central and vital role contributing to the achievement of the SDGs, though, ICT is not mentioned in any of the 17 SDGs and is

[3] Https://sustainabledevelopment.un.org, 2015

noted in just 4 of the 169 targets. Tim Unwin, Director of the ICT4D Collective, argued that 'the almost complete omission of ICTs from the final agreed SDGs was a very serious failing' and that 'those determining the SDG agenda for the next 15 years barely gave them any recognition at all'[4].

Broadband and SDGs Inter-relation

Broadband connectivity not only transform individual human potential but also foster digital transformation in government services and digital transition, provide greater value for citizens and consumers, and revolutionise industry working culture. A meaningful universal broadband connectivity is a critical enabler of efforts to achieve the UN Sustainable Development Goals. The concept of '*meaningful universal connectivity'* encompasses broadband adoption that is not just *available, accessible, relevant* and *affordable,* but that is also *safe, trusted, empowering users* and leading to *positive* impact[5]. Universal connectivity offers a powerful platform to deliver essential services like e-governance, tele-education, e-health, financial inclusion etc and ensure that no-one is left behind.

Mobile Connectivity and SDGs

Worldwide around 85%[6] of the broadband users use wireless media wherever in India it is 97%[7], as such, majority of public uses Mobile as a media to connect to internet. The mobile Internet has made a huge impact on the global economy and it is likely to act as a catalyst to SDG implementation. David Nabarro, Secretary-General on the 2030 Agenda for Sustainable Development also acknowledges the role of mobile '*Mobile*

[4] https://unwin.wordpress.com, 2015
[5] Broadband as a Foundation for Sustainable Development, September 2019
[6] https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx
[7] TRAI Data of Telecom subscriber

phone technology has already transformed societies around the globe, even the poorest countries and communities. It is helping to empower women, create jobs, spur financial independence, improve education, boost agriculture production, and promote better health'[8] he states. Mats Granryd, Director General of GSMA have suggested '*as an industry we have an important opportunity to leverage the mobile networks that we have built and the services we deliver to help achieve the Sustainable Development Goals'* he further adds that '*mobile networks …… are essential in achieving the goals'*.[8]

GSMA (2017)[9] the industry categorizes the SDGs in further three categories-

HIGH POTENTIAL: The mobile industry can have significant impact in delivering or enabling the SDG and it can play a critical or leading role (SDGs 1,5,8,9,10 and 13).

MEDIUM POTENTIAL: The mobile industry can make an important and distinctive contribution to the SDG but is reliant on other participants or industries (SDGs 2,3,4,7,11,12 and 17).

LOW POTENTIAL: The mobile industry can make an important contribution to the SDG but the impact is narrow in nature, as it only relates to a small number of targets and/or does not have the potential to drive significant impact across a majority of countries (SDGs 6,14,15 and 16).

1.4 Regulatory Framework Governing Telecom Industry in India

Department of Posts and Telegraphs separated was in 1985 in the Department of Post (**DoP**) and Department of Telecommunications (**DoT**). Indian telecom sector was liberalized in the early 1990s and private sector participation was permitted through a

[8] Mobile Industry Impact Report-2016
[9] Mobile Industry Impact Report-2017

gradual process. The important departments/agencies that regulate the telecom sector in India are as follows:

1. **Department of Telecommunications:** The telecommunications regulatory framework for India is prescribed under Telegraph Act which defines various powers to DoT to operate and regulate telecoms services in the country. DoT is authorised to formulate and implement the telecoms licensing regime for granting licences and approvals to telecoms players for providing telecoms services in India.
2. **TRAI:** TRAI is regulatory authority for the telecoms and broadcasting sector, established under Telecom Regulatory Authority of India Act, 1997, with the power to make policy recommendations on related issues. The TRAI Act also provides for the adjudication of disputes between the telecoms licensees and the DoT through the Telecom Disputes Settlement and Appellate Tribunal (TDSAT). Though it is mandatory for DoT to ssek TRAI recommendations on policy issues beforehand, DoT has the discretion to either accept or reject the recommendations of TRAI.
3. **TDSAT:** The Telecom Regulatory Authority of India Act, 1997 was amended to establish Telecom Disputes Settlement and Appellate Tribunal (TDSAT) in year 2000, with exclusive powers to adjudicate any dispute between the DoT and a licensee, between various service providers and between service providers and groups of customers.

Various laws and regulations that govern the telecom industry in India are as follows:

- Indian Telegraph Act 1885 (the Telegraph Act);
- Indian Wireless Telegraphy Act 1933 (the Wireless Act),
- National Telecom Policy 1994,
- Telecom Regulatory Authority of India (TRAI) Act 1997,
- New Telecom Policy 1999,
- Information Technology Act 2000 (the IT Act),
- Broadband Policy 2004,
- National Telecom Policy 2012 (NTP 2012),
- Prohibition of Discriminatory Tariffs for Data Services Regulations, 2016, and

- Telecom policy amended from time to time, the latest being the National Digital Communications Policy 2018 (the NDCP 2018).

Apart from the above-mentioned legislation, the under Foreign Direct Investment (FDI) Policy, although FDI up to 100 per cent is permitted for most of the telecom services, certain service-specific conditions and entry restrictions for the investment coming from outside India may apply. Any amount of investment beyond 49 per cent in the telecom entity would require the prior approval of the government.

In addition to UL, DoT also provides Internet Service Provider (**ISP)** licenses under three categories as mentioned below to run the business of Broadband in India**:**

1. Class A (National Area)
2. Class B (Telecom Circle/Metro Area)
3. Class C (Secondary Switching Area).

The list of TSPs and ISPs are available at DoT website.

1.4.1 National Digital Communications Policy 2018 (NDCP-2018)

Improvement in regulation and ongoing structural reforms are the pillars of a sound policy initiative. Regulatory reform is not a one-off effort, but a dynamic, long-term and multidisciplinary process. The Policy recognises the importance of continued improvement in the regulatory framework for attracting investments and ensuring fair competition, to serve the needs of Indian citizens. To serve this objective, the Policy further aims to pursue regulatory reforms to ensure that the regulatory structures and processes remain relevant, transparent, accountable and forward-looking.

India needs to particularly ensure that its communications infrastructure supports the entire population, whose demographic profiles vary widely across various indices such as literacy, economic conditions and urbanisation. At the current pace of digitisation and

digitalisation, it is estimated that India's digital economy has the potential to reach one trillion USD by 2025. It has been broadly estimated that a 10% increase in broadband penetration in a country could potentially lead to an over 1% increase in GDP. However, studies in India estimate that the impact could be significantly higher for the country, given the increased productivity and efficiency gains that are likely to accrue to the economy. India has embarked on one of the world's largest rural optic fibre rollouts in the world, aiming to connect 600,000 of its villages to broadband through its flagship initiative called 'BharatNet'.

NDCP (2018) Strategic Objectives-

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

1. Provisioning of Broadband for All
2. Creating 4 Million additional jobs in the Digital Communications sector
3. Enhancing the contribution of the Digital Communications sector to 8% of India's GDP from ~ 6% in 2017
4. Propelling India to the Top 50 Nations in the ICT Development Index of ITU from 134 in 2017
5. Enhancing India's contribution to Global Value Chains 6. Ensuring Digital Sovereignty.

1.5 Government Initiatives

A. OFC Connectivity to every village

Addressing the nation on this independence-day (15th Aug 2020), the Hon'ble PM

announced Government's resolution to connect all villages with OFC within 1000 days and barely 36 days after the announcement, work started on the '*Har Gaon Mein Optical Fibre Dwara Internet Suvidha'* project on September 21, 2020. The importance of the high-speed Internet connectivity can be gauged from the fact that India is one of the leading countries in the world in terms of digital transactions. It plans to put-

- A Wi-Fi Hotspot to be installed in every village and a common service centre to provide Internet service,
- One Wi-Fi and one FTTH connection each will be provided for free to selected Government institutes.

Objectives of The Scheme

- To transform all villages into Digital Villages,
- Digital empowerment of villagers, spreading Digital empowerment, bringing the Digital Gulf and providing digital services to all villagers,
- To encourage inclusive Socio-Economic Development.

B. Wi-Fi Access Network Interface (WANI)

In December 2020, DoT announced its policy guidelines to leverage public Wi-Fi network for delivery of broadband services by rolling out WANI infrastructure. It is proposed to extend broadband services to public through a network of public Wi-Fi access points (AP). The backhaul connectivity will be provided by various TSPs and ISPs. In the WANI eco-system Public Data Office (PDO) will establish, maintain and operate WANI compliant Wi-Fi APs and deliver broadband services to subscribers. The

Public Data Office Aggregator (PDOA) will be responsible for aggregation of PDOs and perform the functions relating to Authorization and Accounting. Further, there will be an App Provider to develop an App to register users and discover WANI compliant Wi-Fi hotspots in the nearby area and display the same within the App for accessing the internet service. The Central Registry will maintain the details of App Providers, PDOAs and PDOs. WANI ensures the interworking among systems and software applications used by these distributed entities. The user will have a choice to select TSP/ISP and data pack through App. The small shop owners can become PDO to earn extra revenue.

The government is targeting a four-fold increase in public Wi-Fi access points to two million by the end of 2021, thus increasing broadband proliferation.

C. Mitigating Digital Divide

Technological innovations continue to develop ICTs and the Internet, bringing more innovative and better ways to communicate, and also creating new jobs and contributing to global economic growth. Studies have concluded that developing countries with higher levels of connectivity out-perform significantly than those with limited connectivity. A sound ICT infrastructure is enabler for improved health care delivery and trade and market opportunities, reduced inequalities and unemployment and a better quality of life.

Unfortunately, despite the revolutionary aspects of ICT capabilities, it is unevenly distributed across countries, regions in countries and areas then urban-rural, male-female or rich-poor. Simply put, the advantages and opportunities powered by ICT are more enjoyed by richer countries and richer individuals have more access and a greater ability to reap the benefits. This discrepancy in access to ICT has created the so-called digital divide. The Digital Divide, or the digital split as it is sometimes called, is a social issue

referring to the differing amount of access to the Internet (or rather ICT) and those who do not have. The term ‘digital-divide’ became popular among scholars, policy makers and advocacy groups in the late 1990s.

The access to the Internet is just one aspect, other factors such as the quality of connection and related services at an affordable cost and quality are also equally important. As per the TRAI report for the quarter ending June 2020, Urban Internet Subscribers per 100 population stands at 98.35 as compared to 33 for rural population. Further, as per National Family Health Survey (NFHS-S), 2019-20 for 22 States/UTs, observed that 62.16% men have internet accessibility as compared to 42.6% of women.

Various academicians, researchers and institutes have opined that those without ICT capabilities are deprived of the multiple opportunities and benefits that ICT creates and will therefore fall further behind in socio-economic terms. The United Nations has considered one of its Sustainable Development Goals (SDG) to "significantly increase access to information and communications technology and strive to provide universal and affordable access to the internet in least developed countries by 2020", to address the issue of digital divide.

NFHS data shows urban-rural, gender gaps in Internet use

KAUNAIN SHERIFF M
NEW DELHI, DECEMBER 13

THERE IS an urban-rural gap as well as gender divide with respect to the use of Internet in 22 states and union territories, according to data collected by the fifth National Family Health Survey (NFHS).

On an average, less than 3 out of 10 women in rural India and 4 out of 10 women in urban India ever used the Internet, according to the survey.

In 2019, for the first time, the NFHS-5, which collects data on key indicators on population health, family planning and nutrition, sought details on two specific indicators: Percentage of women and men who have ever used the Internet.

An analysis of the data by The Indian Express reveals a telling pattern on the key indicator on the use of the Internet in the country. First, only an average of 42.6 per cent of women ever used the Internet as against an

(50.8%), Meghalaya (57.8%), Mizoram (83.8%), Nagaland (66.5%), Sikkim (90%), J&K (55%), Ladakh (66.5%), and Lakshwadeep (61.8%).

The five states reporting the lowest percentage of women, who ever used the Internet in urban India were Andhra Pradesh (33.9%), Bihar (38.4%), Tripura

than 50 per cent of men who had ever used the internet. The worst-performing states in urban India for men were Bihar (58.4%), Meghalaya (50.2%), West Bengal (64.6%), Andhra Pradesh (65.1%) and Assam (67.4%).

In rural India, only eight states reported more than 50 per cent men, who had ever used the

On an average, less than 3 out of 10 women in rural India and 4 out of 10 women in urban India ever used the Internet, according to the survey. /File

1.6 E-Government Development Index (EGDI)

UN Member States reaffirmed that democracy, good governance and the rule of law, at

the national and international levels and an enabling environment, are essential for sustainable development, through Resolution 66/288 entitled 'The Future We Want'.

Member States stressed that ICT is facilitating the flow of information between governments and the public, and have recognised the power of communication technologies, including connection technologies etc for sustainable development.

The EGDI presents the state of E-Government Development of a country and incorporates the access characteristics, such as the infrastructure and educational levels.

Figure 1.2 The EGDI Model

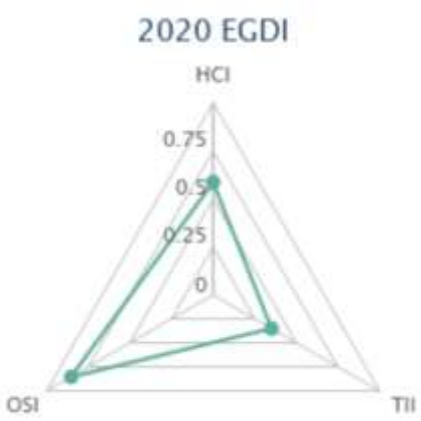


Figure 1.3 India EGDI status

source-https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/77-India

The EGDI is a composite measure of three important dimensions of e-government, namely: provision of online services (Online Service Index-OSI), telecommunication connectivity (Telecommunications Infrastructure Index-TII) and human capacity (Human Capital Index-HCI). The EGDI gives a performance rating of national governments relative to one another. India stands at 100th position with a score of 0.5964 as compared to 96th position in 2018 amongst 193 countries[10]. India scored HCI=0.5848, OSI=0.8529 and TII=0.3515 during 2020 survey.

[10] Content and image source-https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/77-India

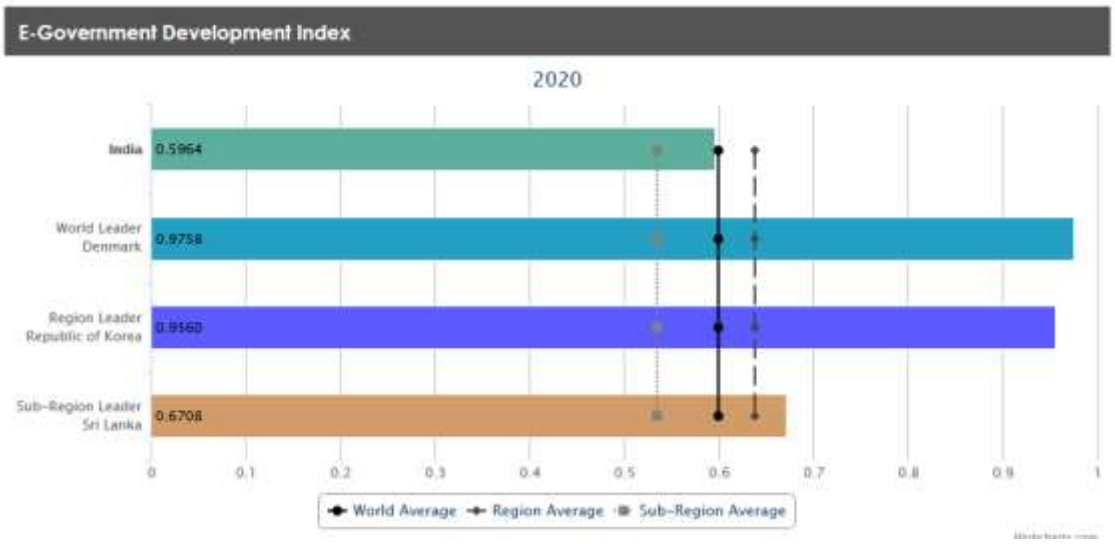


Figure 1.4 E-Government Development Model

source-https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/77-India

As seen from above figure, India's position stands below world average and region average, as such, much efforts are required to improve upon all the three segments of EGDI.

1.7 About the study

1.7.1 Statement of the Problem

Despite a long time since independence, India is not only still a developing country but also suffering from some basic problems. The main problems that India has to contend with are poverty and unemployment, illiteracy, castiesm and racism, increasing population, the pitiful situation of women and poor health support system. The other problem is urban-rural divide. After 1991 liberalization there has been a large imbalance between rural and urban India. After liberalization, rural India could not take advantage of the opportunities created by jobs due to its decaying education system and urban India moved ahead. India is a large country with diverse public and geography. Many of the

area of the country are still not connected by road network to deliver government services/schemes. The quality of governance and public service delivery affects economic growth through its impact on poverty and inequality, human capital and corruption. The policymakers at both central and state levels find it challenging to ensure 'inclusive' growth so that the gains from increased national income are shared across all sections of society. The administration is lacking to provide the Government services to nook and corner of the country. Further, there are also issues of favouritism based on caste, religion and community.

As observed by various researchers, the quality of public services affects economic growth through its impact on poverty alleviation, corruption alleviation and human capital formation. The Indian government has been omnipresent in the lives of its citizens as envisaged by the architects of the nation after independence in 1947. As such, despite Government's sincere efforts to implement SDGs across country, there is gap in implementation mechanism in terms of universal access to all. The implementation phase of any policy/scheme is faced with numerous problems as an effective implementation needs a chain of commands and the capacity to reach, coordinate and control. Generally, there are shortfalls in this exercise specifically in a developing country like India. Therefore, the weaker sections of the society, for whom these schemes are primarily proposed, are mostly not benefited as they are not suitably empowered to access the benefits due to them.

The implementation of SDGs requires every country to judiciously prioritise and adapt the goals and targets in accordance with local challenges, capacities and resources available. The capacity of the Government to implement and monitor public program effectively, efficiently and stem leakages of public funds is limited due to many constraints in developing countries. The limitation on part of state capacity can result

into significant implications for achieving SDGs. Similar implication may result into under achievements of SDGs due to poor implementation/monitor and thus, Governments are required to make use of various tools made available by technological innovations. The Government needs to identify new technologies and tools to reach to the target beneficiaries, remove middlemen, improve quality and efficiency of services, plug loopholes, monitor and analyze the implementation and take corrective actions without delay.

To summarize-

- The implementation of SDGs requires any country to judiciously prioritize and adapt the goals and targets in accordance with local challenges, capacities and resources available.
- The capacity of the Government to implement and monitor public program effectively, efficiently and block/curtail leakages of public funds is limited due to many constraints in developing countries which can result into significant implications for achieving SDGs.
- As a result, governments need to identify new technologies and tools to monitor SDG implementations with reference to various aspects including - improving quality and efficiency of services and benefits reaching unto the target beneficiaries without relying on middlemen as well as to monitor and analyze the implementation and take corrective actions.
- More particularly, broadband technologies have made a paradigm shift in working styles of Governments.
- The role of Broadband technologies is palpable in developing countries too.

Therefore, exploratory studies in developing country like India needs to be undertaken

to observe the role of Broadband on achieving SDGs.

1.7.2 Research Objectives

This study would be an effort at understanding the role of Broadband in achieving identified indicators of selected Sustainable Developmental Goals ie if the availability of Broadband plays an enabler in achieving the identified indicators of SDGs. Thus, the objectives of the research will be the following:

To study the progress made towards Broadband Connectivity across India in various States since announcement of SDGs.

1. To identify some of the indicators of SDGs where broadband penetration can play direct role in achieving them.
2. To examine the role of broadband penetration in achieving the identified SDG indicators in India.
3. To recognize/explore/ascertain the factors impeding penetration of broadband connectivity in India.
4. To suggest policy inputs to strengthen broadband ecosystem in India.

1.7.3 Research Strategy and Research Design

The study would be both qualitative (explanatory) and quantitative (exploratory, descriptive).

This study discusses the pace of broadband growth and the achievement in identified indicators of selected SDGs in four states (as described in section Sample and Research Tools) in India starting from a historical background and launching of broadband services

in India in the year 2010. Therefore, an exploratory approach has been taken in this research.

Further, the research design for this study shall comprise of analysis of primary data collected through questionnaire and analysis and correlation between secondary data collected from TRAI, ITU, DoT, Ministry of Statistics and Programme Implementation and NITI Aayog.

1.7.4 Research Methods/ Data Sources

To answer the research questions posited, following methods of data collection/ study are proposed:

Identification of SDG indicators for each of these goals which are likely to be directly influenced by broadband connectivity to be studied in this research, are of utmost importance. The first round of selection of SDGs and the respective indicators was done by the author himself. Subsequently, an experts' opinion survey through google forms was elicited to narrow down these shortlisted SDG indicators. For this second stage of filtration, experts amongst a few government officials (at various levels) dealing with the subject were requested to provide their inputs on the indicators which can be influenced by broadband. Care was taken to restrict the choices of indicators to only those which have been delineated by NITI Aayog in Indian context in NIF.

The status of the identified SDG indicators was sought from the official reports of NITI Aayog and MoSPI whereas the broadband connectivity established in terms of its users was collected from the related reports published by TRAI and DoT.

Interdependence of the identified indicators with broadband penetration in better performing and poor performing states was done by comparative analysis.

To identify the issues and challenges faced in implementation of broadband connectivity primary survey was conducted by using a semi-structured tool to elicit opinion of officials dealing with broadband related policy/installation/operation activities in the country.

The background information of the topic including the basic list of issues and challenges has been gleaned through literature survey of academic journals, websites, periodicals, policy documents, academic reports, annual reports, relevant reports released by Government of India, DoT, TRAI, MeitY, GSMA, ITU, Broadband Commission and even APPPA dissertation on similar topics.

1.7.5 Sample and Research Tools

Two research tools had been designed, one for the identification of SDG indicators (Annexure-2) and the second for finding of issues in improving the penetration of broadband and possible solution (Annexure-5).

Identification of Indicators: The first tool was administered to a sample size of 75 senior and middle level officers of MoSPI, NITI Aayog and DOT (dealing with broadband) as well as from state-level officers who are directly involved in SDG implementation/monitoring,

Finding the Issues: Similarly, 150 middle and senior level officers of Government of India from Department of Telecom/Private Telecom Providers were requested to provide their experience/observations broadband implementation and policy making. Time given to submit response was given fifteen days.

In both the cases, since the target population is homogeneous, random purpose sampling method was employed to choose the sample.

Choice of states to study: The states were indexed as per the achievement of the identified indicators, with the limitation that data for some states are not published by NITI Aayog and TRAI.

1.7.6 Rationale / Justification

The Union Government of India is firmly committed to the 2030 agenda, including the Sustainable Development Goals, as evidenced by various actions taken by it. India's National Development Goals and the policy initiative for inclusive growth "**Sabka Saath Sabka Vikas**" are in line with the SDGs. India is likely to play a leading role in determining success in achieving the SDGs worldwide. *NITI Aayog* identified SDGs and plans related to its objectives and has also identified leading and supporting ministries for every purpose. It has adopted a vision of sustainable development throughout the government system and has emphasized that the SDGs are interlinked in social, economic and environmental aspects. States were also advised to identify and align their schemes along with centrally sponsored schemes in the same way.

Apart from improving state capacity to create a direct interface between the central or state governments and the beneficiaries by reducing or eliminating the many intermediaries involved in public service delivery, the use of Information and Communication Technologies (ICT) offers an efficient and economical approach. The Governments can not only create the awareness among the target groups but can also deliver and monitor implementation and results of various majors taken by it. ICT enable the Governments to monitor various results in real time and take a timely corrective step, wherever required.

Government of India is rolling out its ambitious BharatNET project to connect approx. 2.5 Lakh Gram Panchayats of country at a massive cost of around Rs 42000 Cr. Recently,

Hon'ble PM, during his address to the nation on the occasion of Independence Day, announced that approx. 6 lakh villages will also be connected with fibre in 1000 days, which will also require a huge amount of money to be spent. This fibre will provide digital connectivity to the targeted villages at highspeed broadband. Apart from this, USOF and many State Governments are also putting up wi-fi Hotspots for providing high speed connectivity to citizens. DoT has also announced policy document of WANI in Dec'20 which is expected to boost broadband penetration. Lakhs of Crores of rupees are also being spent by Telecom Service Providers to provide wireless Broadband through mobile services. As part of the digital agenda, the Government wants to make every household and every individual digitally empowered. The emphasis is also being made in budget on e-Governance, computerization, e-Visas, FDI in e-Commerce, digital classrooms, etc.

Use of broadband will facilitate better information flows, lower transaction costs, lead to disintermediation of economy and makes those things possible and affordable, which are seen as non-feasible to be delivered, especially in a diverse country like India. Broadband can cater to various sectors like healthcare, education, automotive, retail, banking, energy, agriculture, Public Service delivery, DBT etc by supporting tailored applications.

The outcome of the research on the role of broadband in achieving SDGs may become a guiding principle for Government and to put more focus on it for effective and equitable implementation of SDGs.

1.7.7 Research Questions

In an attempt to study the present broadband scenario and its relevance in achieving SDGs in India, the following research questions have been formulated keeping in view

the objectives of the study:

1. What progress has been made towards Broadband Connectivity across India in various states since announcement of SDGs (2015 and onwards)?
2. Which are the indicators of SDGs where broadband penetration can play role in achieving them?
3. What roles are played by broadband connectivity in achieving SDGs in India?
4. What are the factors which impede broadband penetration in India?
5. What are the possible policy inputs for improving the Broadband ecosystem?

1.7.8 Scope / Limitations/ Delimitation

This study is limited to identified indicators of selected SDGs as stated under topic 'Sample and Research Tools'.

1. Various states have registered varying degree of achievements, which could be attributed to many factors, apart from Broadband penetration, like literacy, industrialisation status, economic condition, availability of required resources etc. However, due to paucity of time frame available to conduct the study, the interdependence of these variables/ the causal relationship on each other as well as on state performance has not been considered.
2. The study has been undertaken with a special focus to two best performing and two poor performing states for the identified indicators.
3. Achievement of various indicators are affected by the Broadband to varying degrees, making greater effect on certain targets. Selected four indicators of SDGs on which

broadband is likely to play role in achieving them were studied for selected four states.

4. The study combines different type of broadband services like fixed broadband, mobile broadband and Wi-Fi in a single group of broadband service and segregation of broadband services and impact of each on economic growth has not been done for study and analysis purposes.
5. The study is limited to states for whom state-wise achievements of selected indicators are published by NITI Aayog, and for the states whom TRAI publishes state-wise telecom data.
6. No causal study has been undertaken.

1.7.9 Chaptarization Scheme

The broad chaptarization scheme for this research report is as follows: -

Chapter 1	Introduction.
Chapter 2	Review of Literature.
Chapter 3	Indian Context: SDGs and Broadband
Chapter 4	Critique of Role of Broadband in Achieving SDGs
Chapter 5	Findings and Conclusions
	References**.**

2 Literature Review

2.1 Background

Literature Review of broadband in India requires a review of various factors that might affect the national level growth of broadband and the relationship between broadband Internet and the global competitiveness of a nation. This chapter contains a literature review, which will illustrate how previous studies have analysed the contribution of broadband infrastructure on sustainable development goals and the conclusions they draw.

Broadband provides numerous socio-economic benefits to individuals as well as communities. Greenstein and McDevitt (2011) observed that broadband internet accounted for an estimated twenty-eight billion dollars in U.S. GDP during the year 2006, much before the audio and video streaming services gained popularity, mainly contributed by households upgrading from dial-up to broadband service. Dutz, Orszag, and Willig (2009) found that broadband internet accounted for an estimated thirty-two billion dollar per year in US in net consumer benefits in the year 2009. These findings are broadly consistent with studies that cover other countries.

Many of the leading information and communication technology (ICT) firms and Internet Society have suggested that ICT sector and internet can play a central and vital role contributing to the achievement of the SDGs. In the context of developing countries,

Jones, Wynn, Hillier and Comfort (2017) have observed that the rapid pace of technological development within the ICT industry may revolutionize how the SDGs can be achieved. The Big Data Analytics not only provides decision making tools but also help to provide more effective services and incubate more responsive local governance systems in Indian Context as studied by Malhotra, Anand and Singh (2017).

International financial and telecommunication organisations such as the World Bank, ITU and United Nations Conference on Trade and Development[11] (UNCTAD) have conducted quantitative research studies and clearly established a positive impact of broadband on economic growth. The most substantial validation of broadband and its positive impact on economic growth was put forth by ITU study (2012) which further validate the positive contribution of broadband to GDP growth both for developed and developing countries.

As observed by Madden and Savage (1998), Roller and Waverman (2001), Datta and Agarwal (2004) investments in telecommunications and more specifically in broadband have long been credited with boosting productivity and economic growth. Building on these findings, several scholars have examined the relationship between broadband investments and aggregate economic activity. In other words, these studies attempt to establish whether the internet has a positive effect on economy. Broadband Commission for Sustainable Development (2016) in Financing for ICT Infrastructure Issue stated the impact of broadband includes:

(1) direct effects through large-scale infrastructure investments which lead to increased economic activity in the investment area,

[11] UNCTAD is the part of the United Nations Secretariat dealing with trade, investment, and development issues. The organization's goals are to: "maximize the trade, investment and development opportunities of developing countries and assist them in their efforts to integrate into the world economy on an equitable basis".

(2) indirect- or long-term effects that spur innovation and productivity through improved broadband speeds, and

(3) induced effects such as spill-over into other economic sectors by enabling access to education, healthcare, banking services, e-commerce and others like entertainment.

The benefits of faster broadband include economic effects like increased innovation and productivity, social effects (access to services) and improved healthcare and environmental effects (efficient energy consumption).

Gillett Lehr, Osorio and Sirbu (2006) examined the impact of broadband availability on economic activity in the US and based on panel data for year 1998 to 2002 and a standard OLS (ordinary least squares) model with controls by zip code, the study finds that the availability of broadband services (regardless of actual adoption) adds as much as 1.4% to the employment growth rate. A World Bank study has estimated that a 10% increase in broadband connectivity leads to 1.38% increase in Gross Domestic Product (GDP).

2.2 Broadband as Catalyst for Development

Broadband infrastructure has become strategically important with the emergence of electronic commerce for a nation's economic prosperity [(Garfield and Watson, 1997), (Oxley and Yeung, 2001), (Lee, Keefe and Yun, 2003), (Greenstein and Prince, 2006), (Turk, Blažič and Trkman, 2008), (Czernich, Falck, Kretschmer and Woessmann, 2011)].

Success, Esiobu and Onubuogu (2016) critically analysed the secondary data and concluded that adoption and proper utilization of broadband in ICT will lead to sustained increase in economic growth, hence aggregate national development. Government at all

levels should, as a matter of urgency, intensify awareness about broadband and encourage the development of broadband-enabled applications and services, build ICT skills and technological capabilities among firms and her citizen as this would enhance the nation's annual Gross Domestic Product (GDP) positively.

The future contribution of internet to the nation's economic wealth will be increasingly significant with migration towards a heavily e-commerce dependent-economy, [(Garfield and Watson, 1997), (Oxley and Yeung, 2001)].

OECD (2008) study found Broadband critical in the functioning of national economy, the social interaction, and facilitates connection among businesses, governments, and consumers.

2.2.1 Impact of Fixed Broadband

1. Barro (1991) while adding the years since broadband appearance to control for timing effects, because broadband was introduced in different years for different countries, concludes that an increase in broadband penetration by 10% increases GDP growth by 0.65%.
2. Roller et al. (2001) found that telecom sector increased the economic growth of an OECD state by about one third during the studied period. The findings inspired more research in this field and most of further studies confirmed a strong positive impact of the broadband connections on economic growth.
3. Waverman, Meschi and Fuss (2005) also stated that mobile telephone connections have twice positive impact on economic growth in developing countries compared to the developed ones.
4. Lehr, Osorio, Gillett, and Sirbu (2006) concluded that interaction between broadband

penetration and economic impact is probably non-linear and the impact of the broadband internet on GDP must be the highest at the early stage of deployment, as dearly users get the largest advantage. Review of scientific works on the subject allows to conclude that the impact of the broadband connections on the GDP growth differs in high-income and low-income countries.

5. The findings of Koutroumpis (2009) are very relevant who estimated data of fifteen EU countries for year 2003 to 2006 and concluded that a 10% increase of penetration factor for a particular year increases GDP by about 3% which was later complemented by Czernich, Falck, Kretschmer and Woessman (2009) using per capita GDP growth equation with a model of technological diffusion to form instrumental variables. Their analysis of 24 OECD countries for period 1996-2007 demonstrated that a 10% increase of broadband connections increases per capita GDP by 0.9- 1.5%.

6. Qiang, Rossotto and Kimura (2009) while conducting the World Bank research of 186 countries, concluded that for the high-income countries the additional 10% broadband connections increased GDP by 1.21%, while for the low-income countries the GDP growth was by 1.38% higher for every 10% increase of penetration.

7. Research by Thompson Jr and Garbacz (2007), Chavula (2013), Borena and Negash (2016) and Mayer et al. (2019) that the impact of ICT, including the broadband network, on economic growth significantly differs for high-income and low-income countries.

8. The World Bank (Qiang et al.,2009) used a cross sectional analysis to examine the impact of various ICTs including fixed broadband on GDP growth during the period 1980-2006 for 120 developing and developed countries. The study concludes that a

10%point increase in fixed broadband penetration would increase GDP growth by 1.21% in developed economies and 1.38% in developing ones.

9. Koutroumpis (2009) conducted a research covering 15 European Union countries based 60 observations on data collected for the period year 2003 to 2006. It found broadband penetration to have a significant impact on GDP growth ranging from 0.26% to 0.85% for each 10% point increase in penetration.

10. A panel study with twenty five Organization for Economic Co-operation and Development (OECD) countries covering the period year 1996 to 2007 was carried out to estimate various broadband impacts and relationships (Czernich et al., 2009), which found that GDP per capita growth is 2.7 to 3.9 percent higher after the introduction of broadband.

11. While analysing broadband economic impact in twenty six Latin American and Caribbean (LAC) countries for the period year 2003 to 2009 (Zaballos and Rivas (2012)) selected some indicators assumed to have an impact on the factors affecting GDP (e.g., investment, consumption, public spending, and trade surplus or deficit). The results found that a ten percent increase in fixed broadband penetration triggered an average increase of 3.19 percent in per capita GDP.

12. Scott (2012) updated Quiang's model using recent data for 86 countries for year 1980 to 2011. The results were essentially the same as before with a 10% point increase in fixed broadband generating a 1.35% increase in per capita GDP for developing countries and a 1.19% increase for developed countries.

13. Mayer, Madden and Wu (2019) further complement the works by Koutroumpis and Czernich et al. by introducing the indicator of broadband speed into the dynamic model of economic growth in addition to penetration.

Table 2-1 Fixed broadband impact on GDP

Study	Number of countries	Years	Increase in GDP per 10 percentage point increase in fixed broadband penetration	Comment
Qiang et al. (2009) (High- income economies)	120	1980-2006	1.2	Impact on per capita GDP
Qiang et al. (2009) (Low- income economies)		1980-2006	1.4	Impact on per capita GDP
Czernich et al. (2009)	25 OECD (300 observations)	1996-2007	0.9-1.5[12]	Impact on per capita GDP
Koutroumpis (2009)	15 European Union (60 observations)	2003-2006	0.3-0.9[12]	Impact on GDP
Zaballos and Rivas (2012)	26 Latin America and the Caribbean (121 observations)	2003-2009	3.2	Impact on per capita GDP

Source- Exploring the Relationship Between Broadband and Economic Growth, Michael Minges

2.2.2 Impact of Mobile broadband

Studies on mobile broadband are more relevant considering the rapid diffusion of mobile technology in developing countries.

1. Study by Thompson Jr et al. (2007) uses panel data for a sample of developed countries covering the years 2005 to 2009 to measure the impact of fixed and mobile broadband on GDP per household. The study included country and time fixed effects, finding that every 10% point increase in fixed broadband household penetration increases GDP per household by 0.77 (significant at the 10% level). On the other hand, every 10%point increase in mobile broadband household penetration is found to reduce GDP per household by 0.52.

2. Deloitte (2012) in a study conducted for the GSM Association, has estimated the impact of a substitution from 2G to 3G penetration on GDP per capita growth using a panel of 96 countries for year 2008-11. The study estimates that a 10% higher 3G

[12] More than one regression method used.

penetration results in an increase of 0.15 percentage points in the annual growth rate of GDP per capita. The study also estimated the impact of mobile data usage across fourteen countries finding that a doubling of mobile data consumption raises GDP by 0.5 percentage points.

3. The studies conducted by GSMA are also relevant which are discussed under separate heading.

Various studies referred under the section indicate that the ICT and internet (including broadband) have capacity to improve education (which we have witnessed during the pandemic times when whole of education system depended on broadband), facilitate monitoring of response system for environment management and effective use of resources by agriculture and industry. ICT and broadband have positive impact and can transform the economic growth, invite FDI, makes rural people better informed and can impact health, commerce etc thus making a positive impact on achievement of related SDGs. Many studies have found that 10% increase of penetration factor of fixed broadband for a particular year increases GDP by about 1% to 4% depending up on the country income group and penetration level. Similarly, mobile broadband also has positive impact on GDP.

As such, ICT and broadband play a vital role as a mean for economic growth. Therefore, it seems necessary for all countries to increase their ICT use index through increasing the number of internet users, fixed broadband subscribers and the number of mobile subscriptions to boost economic growth.

2.2.3 Impact of Broadband in various countries

China- Feng and Ma (2013) analysed the mutual effects between broadband diffusion and economic growth, using administrative data covering thirty-one provinces, municipalities and autonomous regions in China from year 2004 to 2009. They found that for every 10%point increase in broadband penetration there was a 2.14% increase in GDP.

Germany- Katz, Vaterlaus, Zenhäusern and Suter (2010) conducted a study using data from 424 German Landkreise (administrative unit beneath a 'Länder') to calculate the impact on the growth in GDP between year 2003 and 2006 for each percentage change in broadband growth. The study predicted that for each 10% increase in broadband penetration growth, GDP growth increases by 0.255.

United States- Crandall, Robert, Lehr and Litan (2007) analysed data for forty eight states covering the year 2003-2005 period to measure the impact of broadband on GDP. It uses non-traditional independent factors such as temperatures, union membership and tax rates that the authors believe could account for the growth in output, in addition to an employment variable. Though the effect of broadband is positive, the estimated coefficients are not statistically significant.

Ecuador- Katz and Callorda (2013) studied the impact of broadband using micro data from 24,028 Ecuadoran urban (rural data was not collected due to low level of broadband) household surveys carried out between year 2009 and 2011. The study found that if a household had broadband the average annual increase in income was US$25.76 (3.67%).

Panama and Philippines- The Broadband Commission for Digital Development and the ITU sponsored two studies on the economic impact of broadband.

Katz and Koutroumpis (2012b) while studying Philippines, looked at the economic impact of both fixed and mobile broadband using quarterly data at a national level for the period year 2000- 2010. The study found that a 10% point increase in mobile broadband penetration was found to contribute 0.32% to GDP.

The study for Panama (Katz et al. 2012a) (covering the same period as the Philippines), found that a 10% point increase in fixed broadband penetration boosted GDP by 0.44%.

Senegal- Katz et al. (2012c) covering the years 2004 to 2011 used a production function to estimate the impact of broadband on economic growth. The results found a negative impact for fixed broadband although the results were not statistically significant, though a simple 2G mobile penetration was found to have a bigger and more significant impact than fixed broadband on the Senegalese economy. Each 10% point increase in mobile penetration was found to raise GDP growth by 0.44%.

Malaysia- ITU study (2012) estimates the contribution of broadband to GDP growth in Malaysia. For this purpose, the GDP Growth (2007-2008), Broadband penetration, Health infrastructure, Infrastructure development, economic activity, literacy rate (2000) and road development index (2005) were analysed. Study found that growth in broadband penetration per household, has a statistically significant coefficient with the expected positive sign and it indicates that an increase of 10 per cent in broadband penetration will contribute to 0.7 percentage points to regional GDP growth. However, it is lower than the 0.4 per cent impact on GDP per 10 per cent of broadband penetration per inhabitant estimated for Malaysia by McKinsey and Co Inc (2009).

Indonesia- In this study by ITU (2012), independent variables used in the model included the unemployment rate lagged one period, the average of the broadband penetration per household, the years of education of the labour force and the difference

between the years of education between male and female economic active population. The contribution of the broadband variable appears to be an extremely contributor to the reduction of unemployment, with a negative effect of -8.61 per cent. This means that for each 1% increase in the penetration rate of the service among the Indonesian households, the unemployment growth would be reduced it by 8.61% points.

Korea- Hong (2016) in his study on "*Causal relationship between ICT R&D investment and economic growth in Korea"* examined the Granger-causality between R&D investment and economic growth for Korea's ICT industry. Bidirectional Granger-causality was observed between ICT R&D investment and economic growth implying that ICT R&D investment is driven by economic growth and vice- versa.

India- Chew, Levy and Ilavarasan (2011) in their study titled '*The Limited Impact of ICTs on Microenterprise Growth: A Study of Businesses Owned by Women in Urban India'* stated that the data supports the notion of a positive impact of total ICT on business growth. Increased ICT access appears to be the driver of microenterprise growth. Researchers further argued that many of the gains from the use of ICTs had come from the decoupling of communication from transportation.

A study by Shreeti and Urdhwareshe (2016) finds that a 10% increase in internet subscribers results in an increase of 2.4% in the growth of state per capita GDP in Indian scenario. Separating the samples with respect to State prosperity (measured using GDP) into developed and developing States, the study observes growth dividends to be significantly higher for developed States. A 10% increase in internet subscribers leads to a 3.3% increase in the growth of State per capita GDP for a developed state and 2.1% for a developing state.

The ITU (2012) study to estimate the impact of broadband on Indian employment, a

database containing information for India's 20 telecom circles was compiled. The data included broadband penetration for period 2007-08, employment growth (year 2008-2009), GDP per capita by region (year 2005), number of micro, small and medium enterprises (year 2006), number of banking offices per lakh of population (year 2002), bank credit per capita by region (year 2002), total road length per hundred sq. Km by area (year 2001) and average population growth by state (year 2001-2011). The study found that an increase in one percentage point in broadband penetration growth results in 0.028 percentage points increase in the employment rate. The study further estimated that the broadband has generated nearly 9 million jobs in direct and indirect ways.

However, study concluded that while the econometric models of broadband impact on Indian employment have yielded strong estimations, the one focused on understanding the contribution of the technology to GDP growth has to be discarded until better data sets are available.

Table 2-2 Comparative estimate of broadband impact on GDP growth

Study	Region/Country	Impact on GDP growth for each 1% increase of broadband penetration	Observations
Koutroumpis (2009)	5 OECD countries[13] with penetration higher than 30%	0.023	**Statistically significant coefficient at 1% level** 132 Observations
	8 OECD countries with penetration between 20% and 30%	0.014	**Statistically significant coefficient at 1% level** 132 Observations
	8 OECD countries with penetration under 17%	0.008	**Statistically significant coefficient at 5% level** 132 Observations
Katz *et al.* (2010a)	High Developed Counties in Germany	0.0256	**Statistically significant coefficient at 1% level** 214 observations
	Less Developed Counties in Germany	0.0238	**Statistically significant coefficient at 1% level**

[13] Denmark, Norway, Netherlands, Sweden, Switzerland

Study	Region/Country	Impact on GDP growth for each 1% increase of broadband penetration	Observations
			210 observations
Qiang *et al.* (2009)	Countries of medium and low economic development	0.138	**Statistically significant coefficient at the 10% level** Human capital carries insignificant explanatory power, which indicates that most variation in her dataset is explained by the dummies and the constant
ITU (2012) study	Latin America and the Caribbean	0.0158	**Statistically significant coefficient (t-statistic = 1.98)** 49 observations
	Arab States	0.02076	**Statistically significant coefficient (t- statistic = 1.62)** 60 observations
	Brazil	0.008	**Statistically not significant coefficient (t-statistic = 0.16)** 27 observations
	Chile	0.009	**Statistically significant coefficient (t-statistic = 2.04)** 13 observations
	India	0.031	**Statistically significant coefficient (t-statistic = 1.97) 19 observations** Potential endogeneity
	Malaysia	0.077	**Statistically significant coefficient (t-statistic = 5.81)** 15 observations
	China		**Statistically not significant coefficients 30 observations**
	Indonesia		**Statistically not significant coefficients 93 Observations**

Source- ITU-BB-Reports-Impact of Broadband on the Economy (2012)

From above studies spread across globe, covering developed and developing countries, it is evident that broadband/internet has positive effect on economy of country, family

income and GDP. For Indian scenario, the internet/broadband penetration results in to creating a conducive environment for micro-enterprises, in addition to generating employment and affecting GDP by 2.1%-3.3% of various states.

Table 2-3 Comparative estimate of broadband impact on employment growth

Study	Region/Country	Impact on job creation for each 1% increase in rate of growth of broadband penetration		Observations
		Employment	Unemployment	
Katz *et al.* (2010a)	High developed counties in Germany	0.0061		Statistically significant level at 1% • 214 observations
Shideler *et al. (2007)*	Kentucky, USA	0.14-5.32		• Statistically significant level at 1% (total employment) • Significance level varies depending on the industry analysed- from not significant to significant • 114 observations (total). Range varies according the industry analysed (from 20 to 120)
ITU study	Brazil		-0.0449	• Statistically significant coefficient (t-statistic=1.73) • 27 observations
	Chile	0.181		• Statistically significant coefficient (t-statistic = -8.29) • 13 observations
	India	0.02825		• Statistically significant coefficient (t-statistic = 1.86) • 19 observations
	Saudi Arabia		-0.2434	• Statistically significant • coefficient (t-statistic = -8.29) • 13 observations
	Indonesia		-8.6163	• Statistically significant coefficient (t-statistic = -2.58) • 99 observations
	Dominican Republic		-0.2952	• Statistically significant coefficient (t-statistic = -2.22) • 32 observations

Source- ITU-BB-Reports-Impact of Broadband on the Economy (2012)

2.3 Broadband and SDGs

Biberman and Bajpai (2020) have concluded that the southern states of Kerala and Tamil Nadu have come closest to achieving the SDGs, particularly when it comes to social and economic goals. Various mountain and north-eastern states have also performed well on SDG environmental targets. The northern states of the Gangetic Plain, collectively known as the Hindi belt, have overall made the least progress towards achieving the SDGs. However, the paper does not study any correlation with broadband.

Tjoa and Tjoa (2016) found that ICT is definitely an enabler to more efficient resource usage, education and business operations which is critical success factor for achieving the SDGs.

Mats Granryd, Director General, GSMA states "*as an industry we have an important opportunity to leverage the mobile networks that we have built and the services we deliver to help achieve the Sustainable Development Goals*". He further adds that Mobile networks are transforming the world and are a revolutionary force in overturning the status quo – and they are essential in achieving the Goals (GSMA, 2016).

"*While the economic impact of broadband connectivity is immense and has been proven time and again, it also has the potential of having a cascading effect on other sectors as well. From education and health to disaster management; from financial inclusion to e-commerce; from public safety to entertainment; broadband connectivity has the power to make services and applications available to all to transform our country into a digitally empowered society and knowledge economy*" states Secretary, DoT (Deloitte, 2016).

While the growth effect of broadband on economy is deemed stronger, changes in income distribution also have an important effect on poverty reduction, argues Ravallion (2004)

and, Cruces and Gasparini (2013).

CAF[14] (2017) argues that broadband stimulates economic growth both directly, indirectly and induced. The creation of employment and the improvement of economic growth are direct effects while increases in a country's productivity is affected indirectly. Further, broadband generates new business activities by encouraging entrepreneurship as an induced effect. The report also finds that broadband has social impact, mainly in education, health and rural development.

The report using the multiplier method works-out the economic benefits from the broadband expansion in Mexico, Colombia and Peru. The report estimates following cumulative impact by year 2020 in terms of contribution to GDP (1.8%, 2% and 1.4%) and jobs (2%, 1.9% and 1.4%) to the economically active population in Mexico, Colombia and Peru.

Ono, Iida and Yamakazi (2017) explain how the SDGs relate to corporate activities and presents the Fujitsu Group's assessment methods regarding its contributions to achieving the SDGs through the provision of ICT. The Fujitsu Group has provided ICT services that will contribute to the 17 SDGs.

2.4 Organisational Studies

1. **World Bank Working Paper (2016)-** Deichmann, Goyal and Mishra (2016) in their working paper for World bank observes that despite many individual success stories of ICT interventions in many sectors of economy, there has been limited evidence of aggregate improvements in important development outcomes. It clarifies that digital

[14] The Corporacion Andina de Fomento (CAF) is a development bank that has a mission of stimulating sustainable development and regional integration by financing projects in the public and private sectors in Latin America and providing technical cooperation and other specialized services.

dividends, faster growth, more jobs and better services will fall short if digital investments are not supported by reforms in countries' regulations, skill development systems and public sector governance. It again points out that new technologies like internet and mobile which facilitates information exchange and other forms of communication will reduce the transaction costs in any economy.

The study also finds that, for many SDGs (SDG 1, 2, 3, and 10), the impact on achieving the SDGs of a marginal increase in mobile investment or investment in digital infrastructure is like (and in some cases even larger than) that of a marginal increase in expenditures on utilities. Study developed quantitative evidence of the effect of telecom infrastructure on achievement of SDG 4 (Quality Education), SDG 5 (Gender Equality), and SDG 9 (Industry, Innovation, and Infrastructure), and the estimated coefficients for telecom infrastructure indicates that they have an impact on the SDG indicators. For the remaining SDGs, a qualitative analysis was developed based on case studies. The study recommends that due to the evidence showing that telecom infrastructure fosters sustainable development, these kinds of investments, and digital investments more broadly, should be strongly incentivized.

2. **ITU-2012-** The ITU study '*Impact of Broadband on the Economy (2012)*' with the objective to provide evidence on the economic impact of broadband, while recognizing that the discipline aimed at measuring these effects is still in its infancy, primarily due to the limitations in data, but also resulting from the still evolving analytical tools. However, the study claims to have generated a considerable amount of proof that broadband has considerable positive spill-over effects on the economy, both in terms of fostering growth and creating employment.

The evidence generated for this study as well as the results of prior research validate the positive contribution of broadband to GDP growth both for developed and developing countries and regions. While limited in the number of countries studied, these analyses confirm that broadband has a directionally positive economic impact.

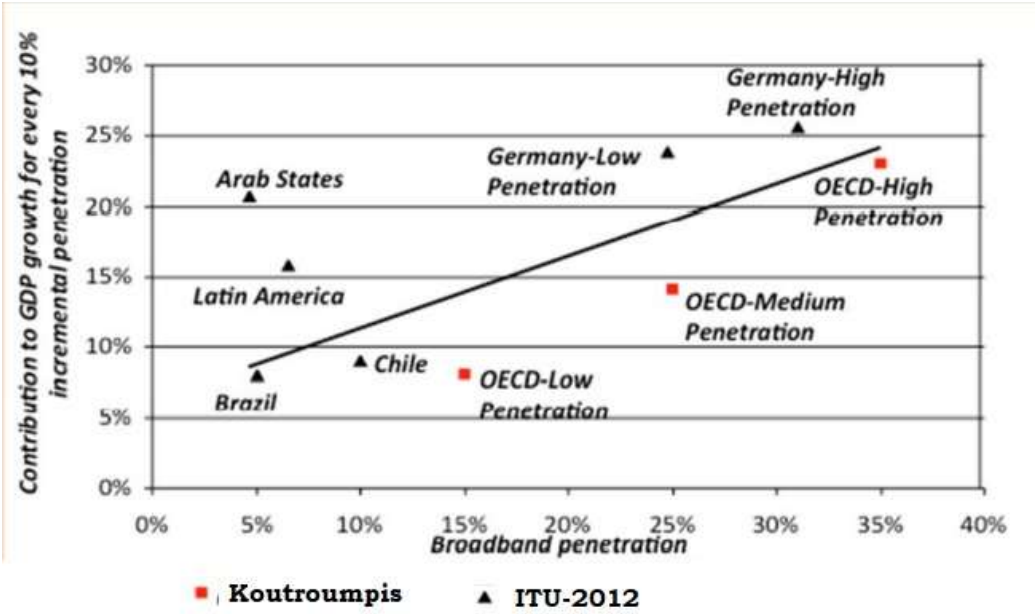


Figure 2.1 Relationship between Broadband penetration and GDP growth
Source: ITU-2012

The results of the analyses also consistently validate the positive contribution of broadband to job creation in developed and developing countries.

3. **ITU/UNESCO Broadband Commission Report-** The study is conducted by ITU/UNESCO Broadband Commission for Sustainable Development titled '*The State of Broadband: Broadband as a Foundation for Sustainable Development (2019)'* finds that broadband connectivity does not merely transform individual human potential, it also underpins national efforts to develop knowledge economies, foster digital transformation in government services and digital transition across economic sectors, expand

opportunities for enterprises and provide greater value for citizens and consumers, therefore, broadband connectivity is a critical enabler of efforts to achieve the UN sustainable development goals. This report reflects on the policies and recommendations that have made an impact in reaching the 51% adoption threshold and considers different approaches that may better address the needs of the next 49%, including measures to ensure current internet users continue to see net positive returns from participating online. The report finds that broadband connectivity is critical for efforts to achieve the Sustainable Development Goals, providing a basic building block in programmatic efforts in support of the 17 goals and 169 targets. The report, inter-alia, recommends to increase efforts to improve digital skills, including basic digital skills, to help users, SMEs and public sector agencies make the most of digital opportunities, as well as skills to distinguish online disinformation and other threats to the right to information, and so empower internet users to avoid becoming either victims or unwitting distributors of disinformation.

4. **USAID. "Investing to Connect" (2019)-** The 2019 report by USAID[15] and Intellecap details the multisectoral impacts of internet connectivity, particularly for lower income communities, and highlights the opportunities for impact investors to reach their social impact goals through investments in internet to underserved communities. The study finds how internet connectivity services provided by last mile connectivity (LMC) enterprises lead to social development outcomes, including income growth and community resilience.

[15] The United States Agency for International Development (USAID) is an independent agency of the United States federal government that is primarily responsible for administering civilian foreign aid and development assistance.

5. **The Internet Society Report -**The Internet Society in its report '*Internet and Sustainable Development (2015)*' claims that internet has already had a major impact on economic and social development, and it can help implement SDGs. It states that Governments, business, civil society and individuals have adopted them extensively and mobile telephony, Internet access and social media have transformed communications opportunities for individuals, while governments and businesses increasingly rely on the Internet for communications and administration, delivering services and disseminating information. It further states that many governments and development agencies have adopted strategies to leverage ICTs for development (ICT4D) and introduced programmes that take advantage of the internet – stimulating access to information through telecentres and mobile applications; promoting business sectors such as outsourcing and software development; disseminating e-agriculture and e-health information, distance learning and mobile money; and establishing mechanisms to provide early warning of natural and man-made disasters.

Progress towards the SDGs has global, regional and national dimensions. Efforts to implement them at national level must respond to the diverse national contexts of different countries. The best ways to integrate and leverage ICTs will also vary between different national contexts.

6. **COAI**- COAI[16] in its White Paper on 'Communication and Digital Technology – Realm of Possibilities in 2035', estimates IoT installed units to reach 10,000 by the year 2035 in India from the current level of around 2,000 units (year 2020). Apart from

[16] The Cellular Operators Association of India, is an industry association of mobile service providers, telecom equipment, internet services providers and other digital technologies' companies and businesses in India.

other services driven by Broadband, AI alone has the potential to add approx. one trillion to India's economy by year 2035. The paper expects that the digital economy will account for around 25% of the total GDP of the country by year 2035, resulting in more growth and productivity, thereby providing new and improved employment opportunities.

7. **ICT Sustainable Development Goals Benchmark, Huawei (2017)-** The study finds that ICT is highly correlated with country-level SDG performance (89%), suggesting that countries that perform well on ICT also perform well on the SDGs. It also found that progress on certain SDGs is more highly correlated with ICT development, specifically SDG 9 (Infrastructure, Industrialization and Innovation), SDG 4 (Quality Education) and SDG 3 (Good Health and Well-being), suggesting that these may be the areas with the highest potential for leveraging ICT for sustainable development.

The study observes that developed countries generally have higher ICT scores than SDG scores, whereas, developing countries generally have a higher SDG achievement score than ICT development score, suggesting that developing nations may benefit from policies that aim to increase investment in ICT and improve ICT infrastructure.

The study recommends that countries should be investing more in ICT to support progress on the SDGs. The report also shows that developed countries need to revisit how ICT investments are supporting their sustainable development goals, while lesser-developed countries have an opportunity to shape services and policies more conducive to sustainable communities with the help of ICT.

8. **GSMA Studies-** GSMA[17] published its first report, termed as GSMA (2016), providing critical insights into the transformative impact of the mobile industry on individuals, societies, and economies in developed and developing countries. Every year since, GSMA has produced this report to monitor progress, showcase its success stories and identify areas where industry can do better.

GSMA (2016) establishes a benchmark through which the industry can assess its success in contributing to the SDGs. The report maps the industry drivers that influence the SDGs, links the mobile industry's activities to the SDGs and their targets, and assesses the impact of these activities on the SDGs. The report claims that though the mobile telecom industry impacts all SDGs to varying degrees, it has larger impact on SDG 9 (Industry, Innovation and Infrastructure), SDG 1 (End Poverty), SDG 4 (Quality Education), and SDG 13 (Climate Action). The industry activities that drive the impact are spread across the value chain consisting operational activities (30%), connectivity (27%), services or content that are based on that connectivity (32%) and non-core activities (11%). This body of evidence is then used to reflect the implications of current trends and what the industry can do to enhance the impact.

GSMA (2017) states the progress the digital industry has made in terms of impacting each SDG. GSMA underscores that three underlying trends explain much of the improvement in the industry's impact across all 17 SDGs**Error! Bookmark not defined.** i n 2016. The three trends include huge investment in expanding infrastructure and improving the quality of service, efforts to connect the unconnected and users becoming increasingly sophisticated in how they use their mobile phones and accessing more advanced mobile-enabled services such as mobile money and government services.

[17] The GSM Association is an industry organisation that represents the interests of mobile network operators worldwide. More than 750 mobile operators are full GSMA members and a further 400 companies in the broader mobile ecosystem are associate members.

Nevertheless, the mobile industry is still far from realizing its potential impact.

GSMA (2018a) shows how the mobile industry proved to be an important lifeline during the 2017 hurricane season in the Carib bean wherein around 60% of population used their mobile phones to access essential information and communication services. Mobile operators were thus crucial in saving lives by delivering early warning messages about approaching hurricanes, updating people regularly on restoration efforts, and offering free or reduced-price SMS, calls, and data, as well as free wi-fi and charging facilities in certain locations to ensure consistent access to communication. Therefore, the report recommends that the mobile industry and other stakeholders (government agencies, vendors, commercial power suppliers and other multinational organizations) strengthen and enforce coordinating procedures.

GSMA (2018b) focuses on the contribution of the mobile industry to economic growth in Sub-Saharan Africa. It states that mobile technologies and services generated 7.1 percent of GDP (a contribution that amounted to US$110 billion of economic value) across Sub-Saharan Africa during 2017. The mobile ecosystem also generated almost 3 million jobs in 2017 and made a substantial contribution to the funding of the public sector, with almost US$14 billion raised in 2017, including general taxation and sector-specific levies on the consumption of mobile services.

GSMA (2019) claims that mobile subscribers are increasingly using mobile to access an array of life-enhancing services that contribute to and catalyse the achievement of the UN Sustainable Development Goals (SDGs). Industry finds that this is the other main driver behind the industry's increased impact, for example, 1.9 billion mobile subscribers use their phone to purchase goods and services – an increase of 160 million since 2017. Some 1.3 billion subscribers use mobile health services – an increase of 230 million since 2017. The study states that increasing mobile subscribers and migrating the network to

high data rates (3G and 4G), reflects the role of mobile networks in providing critical infrastructure that spurs inclusive and sustainable development, in addition to greater innovation.

However, the study notes that despite its achievements, the mobile industry is not on track to deliver the full potential of mobile's contribution to the SDGs by 2030. SDG 9 remains the only SDG where mobile has reached more than half its potential impact. Improvements in other SDGs are not enough. Faster adoption of mobile technology and enabling life-enhancing services can help to maximise the full contribution of mobile to deliver all 17 SDGs. Despite its achievements, the mobile industry is not on track to deliver the full potential of mobile's contribution to the SDGs by 2030. SDG 9 remains the only SDG where mobile has reached more than half its potential impact. Improvements in other SDGs are not enough. Faster adoption of mobile technology and enabling life-enhancing services can help to maximise the full contribution of mobile to deliver all 17 SDGs.

GSMA (2020) takes a note of COVID pandemic and finds that mobile technology is the primary and often only method of digital access for people around the world. By expanding connectivity and making new digital services available at the touch of a button, mobile has driven significant social, economic and environmental benefits, and has contributed to all 17 SDGs. The report finds that during 2019, the average SDG impact score across the 17 Goals increased to 48, meaning that the industry achieved 48% of its potential contribution to the SDGs, up from 33% in 2015. The study further reports that since 2015, mobile connectivity has contributed an incremental $360 billion in global GDP, or 4% of overall growth. In the same timeframe, the industry has increased global employment by around 5 million and it supported roughly 30 million jobs in 2019. The use of mobile technology has also powered a global reduction in

greenhouse gas (GHG) emissions that is 10 times greater than the global carbon footprint of the mobile industry itself.

9. **Ericsson-** Ericsson and Earth Institute (2017) argue that ICT, especially mobile broadband, will be the essential infrastructure platform for the SDGs. The study identifies five major ways that this will occur: (i) accelerated upscaling of critical services in health, education, financial services, smart agriculture, and low-carbon energy systems; (ii) reduced deployment costs addressing urban and rural realities; (iii) enhanced public awareness and engagement; (iv) innovation, connectivity, productivity and efficiency across many sectors; and (v) faster upgrading in the quality of services and jobs.

10. **DoT and Deloitte (2016)-** The study, titled Broadband Infrastructure for Transforming India, reports that the Indian telecom sector has contributed significantly to the country's overall growth - India is amongst the largest telecommunications market in the world with over one billion subscribers (as on March 16) and ~80% mobile penetration. While India represents ~13% of global telephony subscriptions, they account for only ~2.7% of global revenues.

Rise in broadband penetration to 60% in India is expected to translate into a 5-6% increase in the country's GDP, to the tune of ~USD 135 billion. Additionally, it will help achieve the goals set as part of the Government's strategic programs such as Digital India, Skill India, e-Governance, etc. Increasing broadband penetration is expected to help accelerate social inclusion, drive our leadership as a knowledge-based economy, foster entrepreneurship and jobs and reduce the parallel economy through increased transparency and governance. High speed internet plays a pivotal role in enabling these

programs. Broadband needs to be considered as a growth lever, else we are at a grave risk of losing competitiveness to other countries.

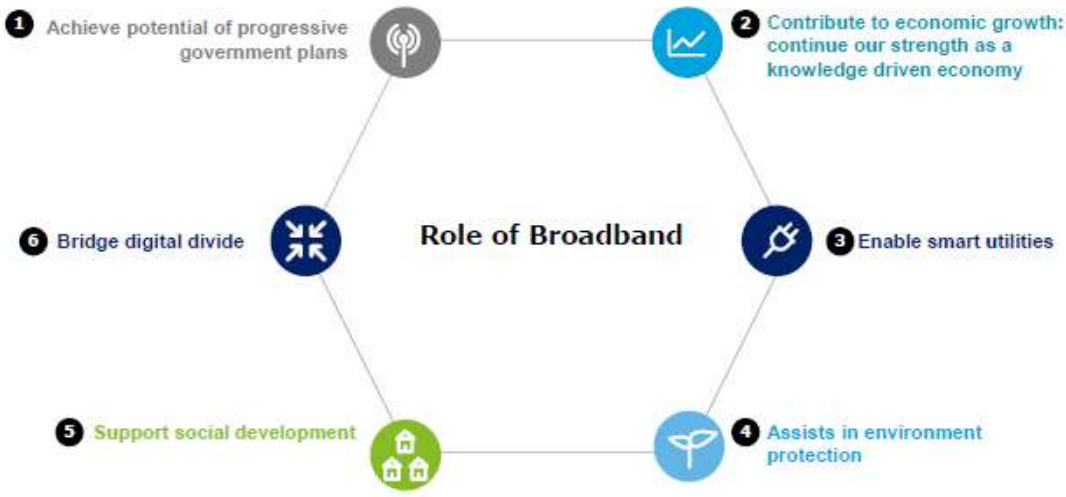


Figure 2.2 Role of Broadband in India
Source: DoT and Deloitte Report (2016)

The report concludes that India is on the brink of entering a new phase of growth, facilitated by the Government's ambitious and progressive programs. Broadband can stimulate this growth significantly, provided all stakeholders come together to define ambitious yet realistic goals and then work towards achieving them.

2.5 Studies on Policy matters

Hon (1992) suggests that a proactive government strategy is the driving force behind the successful Internet deployment, taking Singapore as a success story of a most comprehensive and coordinated effort to promote information technology. Cane (1992) argues that managerial and regulatory obstacles tend to inhibit diffusion of IT despite the availability of significant resources, well-built infrastructures, computer and telecom

industries, in an analytical study of developed OECD nations. Investigating the patterns and problems of Internet diffusion in less developed countries, Goodman, Press, Ruth and Rutkowski (1994) identified (i) government policies, laws, and practices (ii) technical barriers and (iii) local/cultural factors, as three barriers to the wider distribution of Internet.

John Leslie King, Gurbaxani, Kraemer, McFarlan, Raman and YapKing (1994) observed that the process of institutionalization of policies to accelerate and support IT innovation started in various newly industrialized and developing nations, though the developed countries had already established policies to promote IT innovation.

Garfield and Watson (1997) found a significant role of national culture in the policy decisions and development of country-level information infrastructures while analyzing seven developed countries. Hargittai (1999) found that the most significant predictors of country-level internet uptake were the country's economic wealth and telecommunications policy in a study examining the factors that encourage internet diffusion across OECD countries. OECD (2001a) and OECD (2008) found that the most viable factor governments could use for the faster broadband internet uptake was infrastructure competition and removing differences in broadband internet access. The studies also emphasized the importance of more competitive environment for the broadband providers through policies, such as local loop unbundling and line sharing, as secondary necessary step to boost broadband internet diffusion. Han (2003) found that the combination of government's ICT policy and the unique cultural traits was the driving force behind the rapid diffusion of the broadband access, in a comparative study on the adoption processes of the broadband access in the United States and Korea.

These studies cited were centred on factors responsible for the growth of broadband internet penetration. Most studies, like Lee et al. (2003) and Choudrie and Lee (2004),

analyzing the link between country's competitive advantage and growth in various broadband-related industrial sectors, have compared United States with many Asian countries. The government policies related to funding for small and medium-sized IT companies, special demonstration projects, adoption of global standards and skills development are found to be key to the Internet development at country level. Choudrie et al. (2004) identified government leadership, fierce competition, low prices, cultural aspects, and geographic and demographic aspects as the driving factors behind broadband internet growth after studying broadband development in South Korea.

Analyzing African least-developed economies, Mbarika and Byrd (2009) found domestic and foreign investment in ICT, wireless and satellite infrastructure, self-sufficiency, government regulatory policies, local capacity, and degree of privatization of telecommunications sector influenced the Internet development at country level.

Roetter (2013) in paper titled 'Global Broadband Benchmarking 2013: Best Practice Lessons for Governments' studies factors of successful (and unsuccessful) broadband policies in the areas of public-private partnerships, public funding of broadband, effectively competitive markets, spectrum management and the role of government intervention. The study suggests that the roles of government and the private sector must be complementary. The report concludes that the profits and propensity to invest of the private sector depend on their access to attractive domestic markets and, increasingly, access to foreign markets for their products and services, which are unlikely to develop or be sustainable in the absence of a reasonably well-functioning government.

Traditionally, governments used push strategy to promote and develop ICT infrastructure by providing the right environment. Increasingly, the governments will need to switch their focus to pull strategy of internet development by promoting digital literacy, establishing an enabling environment and fostering the development of applications,

including local content (Kelly, Mulas, Raja, Qiang and Williams (2010)). Picot and Wernick (2007) concluded that successful governmental strategies include both public good and competition-related aspects of broadband.

Sharma and Pandey (2015) studied 'Problems and Prospects of Broadband Services in India' and observed that broadband plays a significantly important role in the successful running of business, transparent and smooth functioning of Government but also day to day life of even a common man is governed by it. The limited availability of spectrum, higher tariff of internet usages, non-availability of last mile broadband connectivity, non-availability of electricity, non-availability of mobile networks, less awareness about eServices and quality of services rendered are the main constraints in ubiquity of Broadband.

Summary

Various studies by academia, industry and institutions have observed a positive relation of broadband penetration with GDP and employment generation. They observed that broadband stimulates economic growth both directly, indirectly and induced. It facilitates information exchange and reduces the transaction costs in any economy. Broadband has major impact on economic and social development, including income growth and community resilience. Broadband is the enabling force for software development, disseminating e-agriculture and e-health information, distance learning and mobile money and establishing mechanisms to provide early warning of natural and man-made disasters.

Broadband a basic and critical building block in programmatic efforts to achieve the UN sustainable development goals and a marginal investment in broadband is found to

impact on achieving the SDGs. Increasing broadband penetration is expected to help accelerate social inclusion, drive our leadership as a knowledge-based economy, foster entrepreneurship and jobs and reduce the parallel economy through increased transparency and governance. The roles of government and the private sector are complementary, and governments are required to bring out a favourable policy for better domestic and foreign investments for rapid percolation of broadband.

3 Indian Context: SDGs and Broadband

India played a critical role in shaping the Sustainable Development Goals (SDGs) and therefore, it is strongly committed to achieving SDGs. Even country's national development goals are mirrored in the SDGs. India affirmed its commitment to the SDGs during Sustainable Development Summit in New York on 25th September 2015. The Speaker of the Lok Sabha organised briefing sessions on the SDGs for Members of Parliament, including bringing together legislators from South Asia and other BRICS nations to collectively propel the SDG agenda forward.

Being the second most populous country in the world, India will play a leading role in determining the relative success or failure of the SDGs. National Development Agenda of the country delineates the measures it is taking on issues like poverty, sustainable growth, health, nutrition, gender equality and quality education, among several others. For example, *Ayushman Bharat Yojana*, which covers 500 million persons, closely aligns with SDG 3 (health and well-being) and SDG 10 (reduced inequalities). India is amongst the forty countries which have volunteered to take part in the Voluntary National Reviews (VNRs) at the High-Level Political Forum (HLPF) 2017. India's moto 'Sabka Saath Sabka Vikas' (ie 'Collective Effort, Inclusive Development' or 'no-one left

behind') forms the cornerstone of India's national development agenda. NITI Aayog's strategy document charting a path of transformation until 2022, focuses on how the strategies put forward will help the country meet its SDG targets.

However, it is recognized that SDGs cannot be achieved by launching an individual scheme for different goals being horizontally inter-connected. It requires a multi-pronged strategy and convergent set of interventions at different levels of government on a sustained basis.

3.1 India and the SDGs

The Parliament has organized several forums to develop policy and action perspectives on elimination of poverty, promoting gender equality and addressing climate change. The NITI Aayog has carried out a detailed mapping of the 17 Goals and 169 targets to Nodal Central Ministries, Centrally Sponsored Schemes and major government initiatives. Most state governments have also carried out a similar mapping of the SDGs and targets to the departments and programmes in their respective states.

The Ministry of Statistics & Programme Implementation developed a list of draft national indicators considering the global SDG indicators and placed the draft in the public domain for wider consultation. Many of Government's programmes and schemes directly contribute to advancement of the SDG agenda. NITI Aayog led the process of VNR preparation and a multi-disciplinary Task Force was constituted to coordinate the review and process documentation.

3.2 Localisation of SDGs

'Localising' is the process of recognising subnational contexts starting from the setting

of goals and targets, to decide how to implement, determine indicators to measure and monitor achievements and to raise awareness[18]. Localisation relates both to how local and sub-national governments can support the achievement of the SDGs through bottom-up action as well as how the SDGs can provide a framework for local development policy.[19] These necessitate participatory planning, implementation and evaluation.

Localisation of SDGs in Indian context can be seen as an ongoing process in three phases, often occurring simultaneously.

i. Identifying institutions and assigning specific mandate to deliver on the SDGs

ii. Raising Awareness and Advocating for SDG implementation

iii. Bringing on board Ministries, State governments and the UTs.

Institutions for delivering on SDGs- The agencies/authorities responsible for spearheading the work on SDGs include:

NITI Aayog: NITI Aayog is mandated to coordinate work on SDGs by adopting a synergistic approach, involving central ministries, States/Union Territories (UTs), civil society organizations, academia, business sector to achieve India's SDG targets etc and developed a comprehensive mapping of SDG targets with schemes and programmes. NITI Aayog carried out many consultations with concerned stakeholders focussing on different goals, capacity building, evaluation framework, sharing of new knowledge and best practices, and progress mapping. It sensitises and makes aware relevant stakeholders, builds capacities and facilitates implementation and monitoring of

[18] Localising SDGs: Early Lessons from India (2019)

[19] UN Habitat Report and global Task Force, 2016: Roadmap for localising the SDGs: Implementation and Monitoring at sub-national level

SDGs/targets through aligned programmes/ schemes in collaboration with related institutions including academia, civil society, UN and international organisations. NITI Aayog also drives several innovative programmes and initiatives in several sectors corresponding to the SDGs. NITI Aayog uses the framework of cooperative as well as competitive federalism to align the policies and schemes of State and Central Governments in sectors like health, nutrition, education, water resource management, agriculture etc to achieve the SDGs.

Ministry of Statistics and Programme Implementation (MoSPI): MoSPI has drafted the National Indicator Framework (NIF) in consultation with Ministries and States/UTs in addition to leading discussions at the global level on the indicator framework for the SDGs.

Other Institutions at Central level: The Fifteenth Finance Commission has been set up with a specific task to use SDGs as a framework to provide incentive grants to the states. National training institutions are responsible for designing tools and programme for capacity development of officials and undertake capacity development of senior government officers.

Controller and Audit General of India (CAG): It is responsible for conducting audit on the preparedness to achieve the SDGs.

States/UTs: Several States/UTs have mapped State and centrally sponsored schemes vis-a-vis the SDGs and undertaken long-term (visioning), medium-term (strategy development) and short-term (action plan) exercises. All States/UTs have formally identified nodal departments for coordinating the SDG implementation process. Many states have established SDG cells/ centres and have set up thematic or goal wise coordination groups to organise and professionalise the work and systematically build up

expertise.

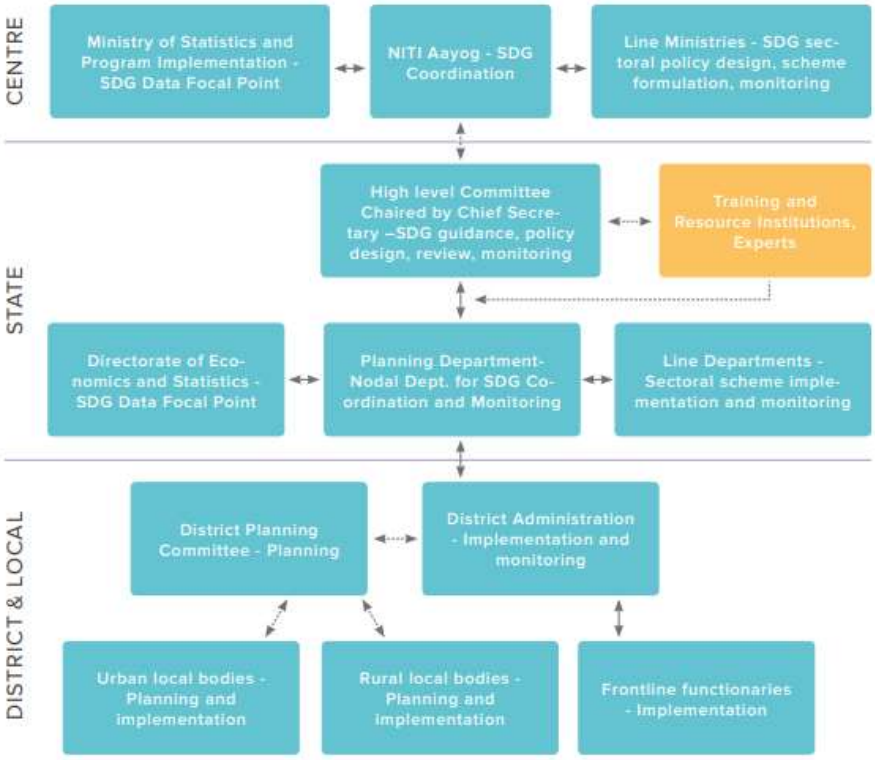


Figure 3.1 How India is delivering on the SDGs

Source- Niti Aayog

Other Institutions at State level: Office of the Chief Secretary of the State is responsible for guiding and overseeing work on SDGs. The Chief secretary has an important role in advising the government and overseeing implementation of all programs in the State. The Planning Department is nodal department for coordinating SDG implementation and Directorate of economics and Statistics is the focal point for data, sectoral line ministries and training institutions. The line departments are required to formulate, implement and monitor schemes and programs that contribute to achieving SDGs.

At district level: At the district (sub-State) and local levels, elected representatives of

Panchayati Raj Institutions[20] and Urban local Bodies, District administration and frontline functionaries are vital for action on SDGs.

3.3 Monitoring mechanism

The implementation of SDGs is likely to produce huge data which needs to be analysed to monitor achievements and related decision making. The data driven decision making requires purification and interlinking of produced data. MoSPI in collaboration with the UN in India has developed an SDG India dashboard (https://sdgindia2030.gov.in) which is a data repository of the National Indicator Framework on SDGs. The dashboard brings together data from various datasets, portals and sectors to one common place to track its progress towards achieving the SDGs.

The finalisation of the National Indicator Framework (NIF) started in December 2018 with launch of SDG India Index 1.0 (SDGII 1.0) which was computed using 62 indicators covering 13 SDGs (excluding SDGs 12, 13, 14, and 17 due to lack of data). SDG India Index were made available for public, civil society, businesses and policymakers which gave insights into the economic, social and environmental status of the country.

A Committee having members from NITI Aayog, MoSPI, UN agencies and key ministries worked out framework for SDG India Index 2.0 (SDG II 2.0) covering all 17 SDGs and 169 targets, and is based on data on indicators for the first 16 goals and a qualitative assessment for Goal 17. Ministries were also consulted to arrive at suitable proxy indicators. SDG II 2.0 constitutes of 100 indicators wherein 68 are entirely aligned to NIF, 20 are derived from NIF and 12 are constructed in consultation with line

[20] Panchayati Raj Institutions are institutions of rural local self-governance and have a three-tier structure - at the village (Panchayat) level, block level and district level. Direct elections are held for all the three levels with at least one-third of the seats reserved for women in all States (50 percent in some States).

ministries.

The targets for indicators were set considering benchmarks set by Government of India (22 indicators), the UN at the global level (62 indicators), international development organisations or international standards (5 indicators). No targets were not set for remaining five indicators (under Goal 14), because their ideal value is not fixed but falls within a range. The indicators for which data were not available for all States/ UTs, were marked as "null" and were not assigned any weightage in Index estimation.

A High-Level Steering Committee (HLSC) under the Chairmanship of Chief Statistician of India (CSI) & Secretary, MoSPI with members from NITI Aayog, Ministry of Health and Family Welfare, Ministry of Home Affairs, Ministry of Finance, Ministry of Environment, Forest and Climate Change (MoEFCC) has been constituted to review and refine the NIF. NITI Aayog proposed addition/deletion/refinement of indicators (during year 2020) after due consultation with the line ministries. The competent authority accorded approval for these changes/updates and the revised NIF, termed as NIF (version 2.1), consisting of 302 national indicators covering all 17 SDGs was announced. Several indicators which are found relevant to more than one target and are repeated under such targets.

Figure 3.2 Stages of building the SDG India Index,

(Source-NITI Aayog SDG report)

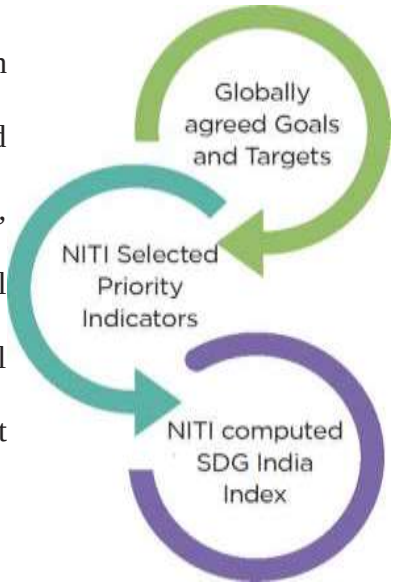


Table 3-1 The goal-wise distribution of NIF

(original as well as version 2.1)

Goal	Number of indicators in NIF (original)	Number of indicators in NIF (version 2.1)
Goal 1: No Poverty	19	21

Goal	Number of indicators in NIF (original)	Number of indicators in NIF (version 2.1)
Goal 2: Zero Hunger	19	19
Goal 3: Good Health and Well Being	41	42
Goal 4: Quality Education	20	19
Goal 5: Gender Equality	29	29
Goal 6: Clean Water and Sanitation	19	16
Goal 7: Affordable and Clean Energy	5	5
Goal 8: Decent Work and Economic Growth	40	32
Goal 9: Industry, Innovation and Infrastructure	18	16
Goal 10: Reduced Inequalities	7	9
Goal 11: Sustainable Cities and Communities	16	15
Goal 12: Sustainable Consumption and Production	17	15
Goal 13: Climate Action	4	5
Goal 14: Life Below Water	13	11
Goal 15: Life on Land	21	16
Goal 16: Peace, Justice and Strong Institutions	18	19
Goal 17: Partnership for the Goals	0	13
Total Number of Indicators	**306**	**302**

Source-Niti Aayog 2019-20 SDG-India-Index-2.1

However, there are 34 targets, as mentioned below, against which no indicators have been assigned so far (till SDG Report-2020, ver 2.1)-

Table 3-2 List of targets against which no national indicators have been identified in NIF

SL	Target No.	Target
1	1.2	By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions
2	2.b	Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round
3	3.d	Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks

SL	Target No.	Target
4	4.7	By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development
5	4.b	By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries
6	6.a	6.a: By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
7	7.a	By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
8	8.a	Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-related Technical Assistance to Least Developed Countries
9	9.a	Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States
10	10.3	Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard
11	10.5	Improve the regulation and monitoring of global financial markets and institutions and strengthen the 1.71implementation of such regulations
12	10.6	Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions
13	10.7	Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies
14	10.a	Implement the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with World Trade Organization agreements

SL	Target No.	Target
15	10.b	Encourage official development assistance and financial flows, including foreign direct investment, to States where the need is greatest, in particular least developed countries, African countries, small island developing States and landlocked developing countries, in accordance with their national plans and programmes
16	11.c	Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials
17	12.8	By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
18	13.a	Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible
19	13.b	Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities
20	14.6	By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation
21	14.7	By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism
22	15.a	Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems
23	16.8	Broaden and strengthen the participation of developing countries in the institutions of global governance
24	16.a	Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime
25	16.b	Promote and enforce non-discriminatory laws and policies for sustainable
26	17.2	Developed countries to implement fully their official development assistance commitments, including the commitment by many developed countries to achieve the target of 0.7 per cent of gross national income for official development assistance (ODA/GNI) to developing countries and 0.15 to 0.20 per cent of ODA/GNI to least developed countries; ODA providers are encouraged to consider setting a target to provide at least 0.20 per cent of ODA/GNI to least developed countries
27	17.5	Adopt and implement investment promotion regimes for least developed countries

SL	Target No.	Target
28	17.7	Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed
29	17.8	Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology
30	17.9	Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the Sustainable Development Goals, including through North-South, South-South and triangular cooperation
31	17.10	Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations under its Doha Development Agenda
32	17.12	Realize timely implementation of duty-free and quota-free market access on a lasting basis for all least developed countries, consistent with World Trade Organization decisions, including by ensuring that preferential rules of origin applicable to imports from least developed countries are transparent and simple, and contribute to facilitating market access
33	17.14	Enhance policy coherence for sustainable development
34	17.15	Respect each country's policy space and leadership to establish and implement policies for poverty eradication and sustainable development

Source-Niti Aayog 2019-20 SDG-India-Index-2.1

While working out the scores, MoSPI normalises the raw indicator values to arrive at normalised scores through computation of State/UT-wise score for each goal. This is estimated for each State/ UT as the arithmetic mean of the normalised values of all indicators under the goal. Equal weight is assigned to each indicator.

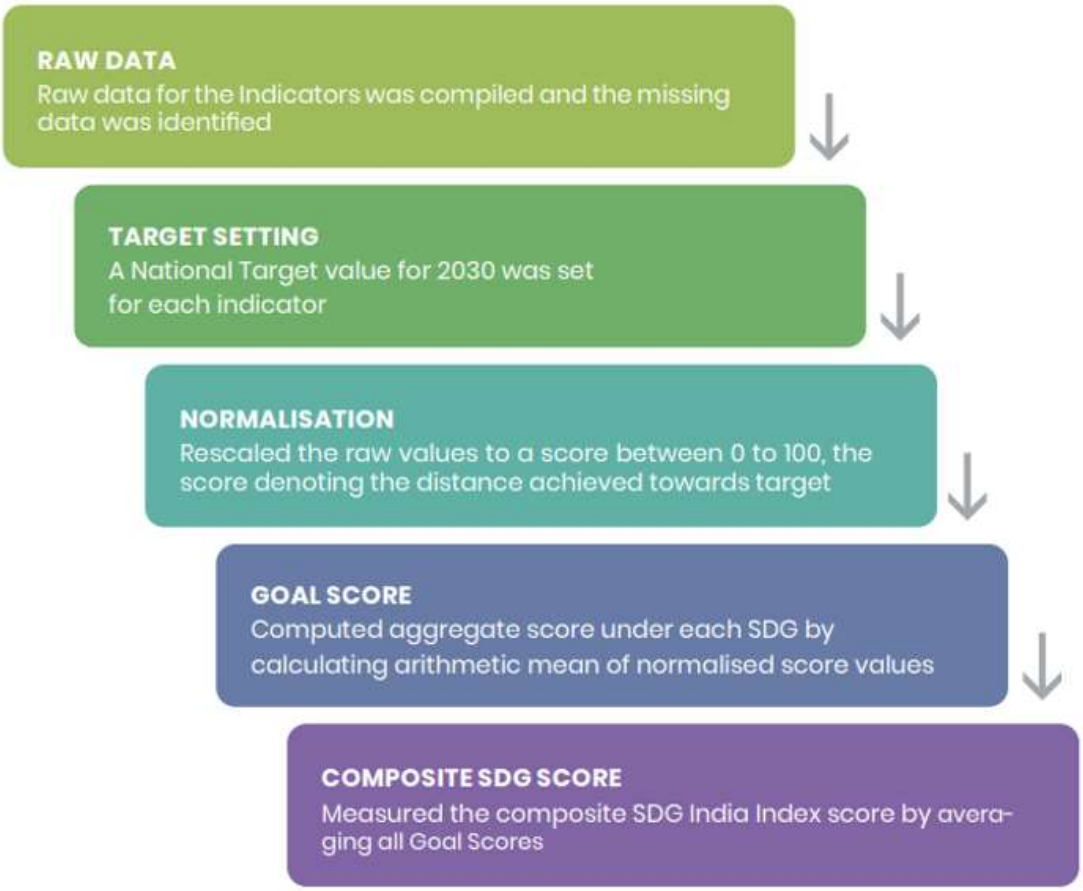


Figure 3.3 Methodology of construction of index

Source-NITI Aayog National Indicator Framework report

3.3.1 Categorisation of States/UTs

Considering the vastness and inter-dependencies of SDGs, government of India has adopted a clean and simple mechanism of classification based on the score of each state across all 17 SGDs. The states are classified into the 4 categories based on their status for target. An '*Achiever'* state is one with a score of 100 per cent, state with 65 per cent or more progress is classified as '*Front Runner'*. '*Performers'* are states with above 50 per cent and rest are termed as '*Aspirants'*.

3.4 Status of India in achieving SDGs

India stands at 117th position with a score of 61.9 amongst 166 countries as per Sustainable Development Report 2020 published by Cambridge University Press. The SDG levels and trends dashboard indicate that India has achieved SDG on Climate action (SDG-13) and is on track for SDGs 1, 6 and 8. India is one of the six countries (Philippines, Bhutan, Ethiopia, Costa Rica and Kenya being others) which have made sufficient commitments and efforts to hold global warming well below 2°C. However, India has major challenges in many areas like Health, Gender equality, inequalities etc.

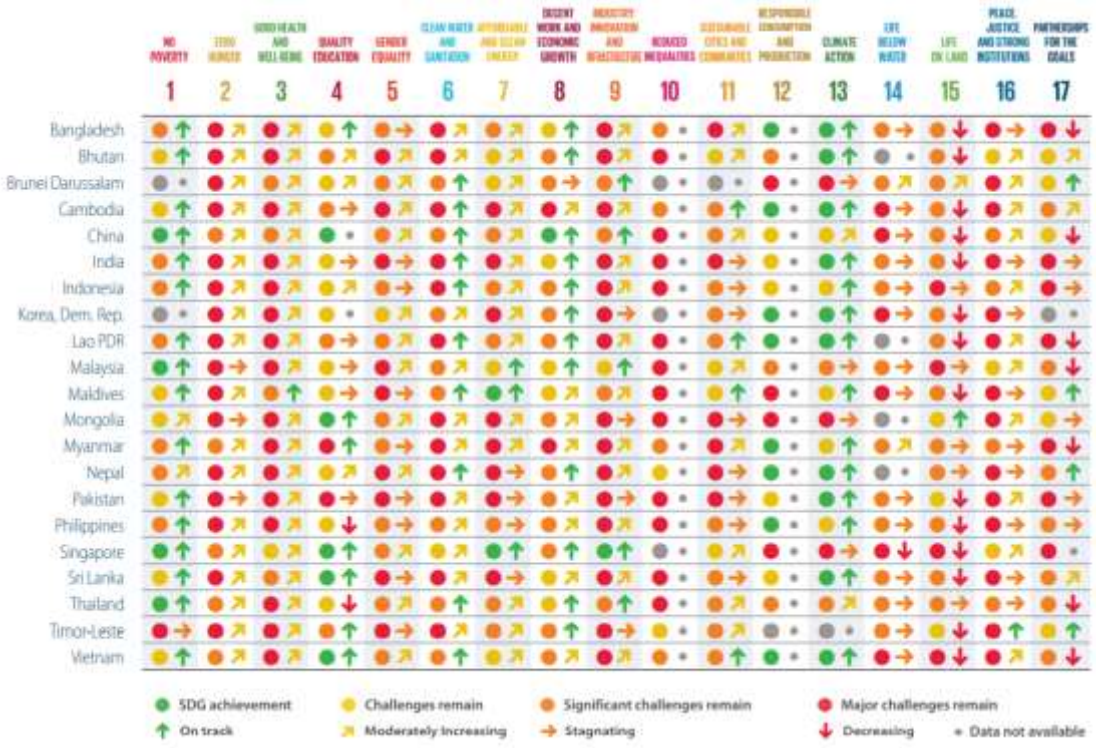


Figure 3.4 2020 SDG dashboards (levels and trends) for East and South Asia

Source- Sustainable Development Report 2020

Due to its large population, India is 23.8% of the total achievement gap on Zero Hunger (SDG 2). The world would be 27.4% closer to achieving the SDG target on undernourishment if India eradicated undernourishment (about 14.5% of the Indian population).

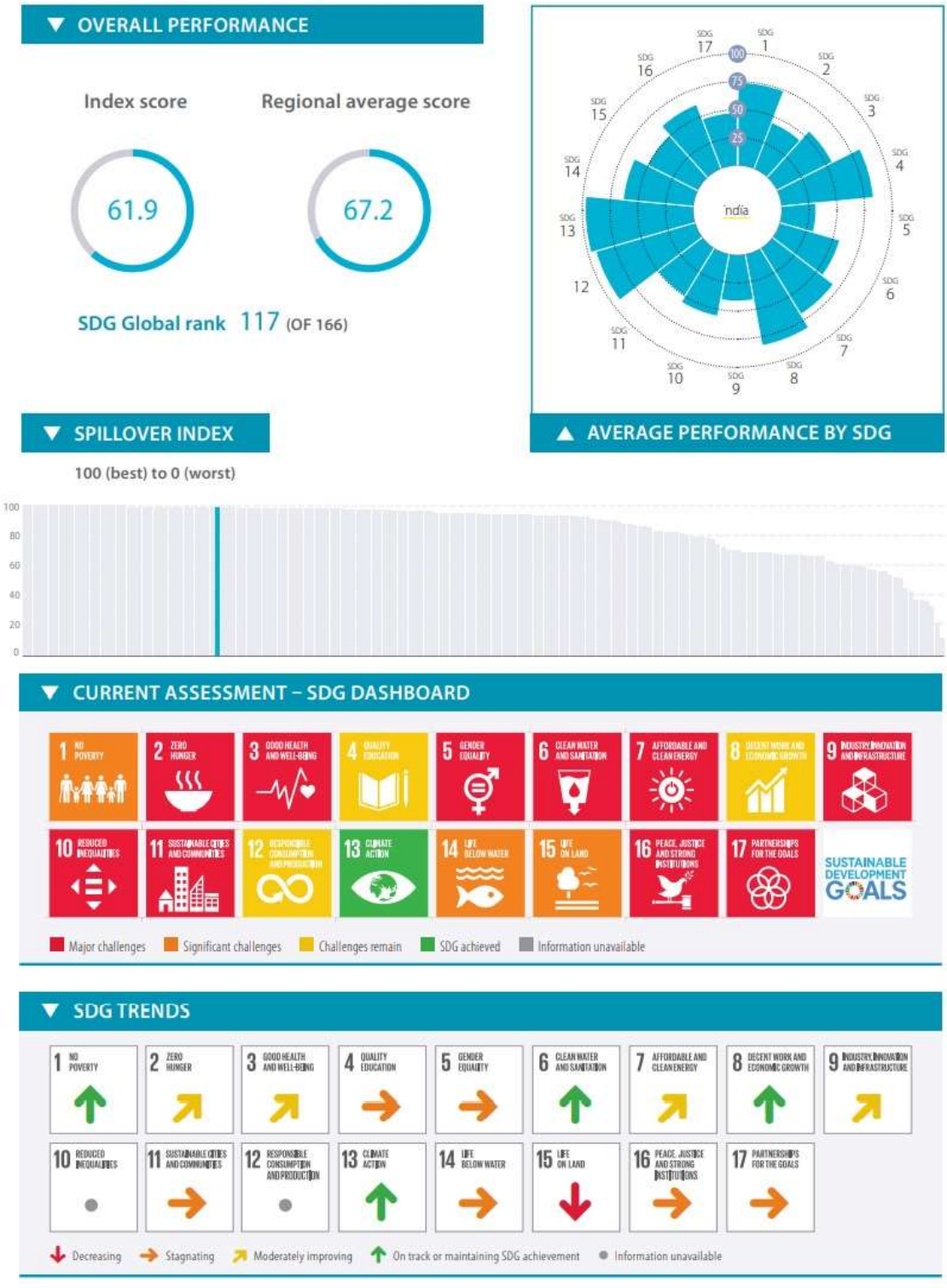


Figure 3.5 India's performance and trends

Source- https://sdgindex.org

3.4.1 SDG Achievements by states and UTs

NITI Aayog has published 'Sustainable Development Goals - National Indicator Framework Progress Report, 2020 (version 2.1)' which contains SDGs monitoring/achievement at national level and also the gaps.

Niti Aayog at https://sdgindiaindex.niti.gov.in/#/ranking displays the SDG achievements at country level vis-à-vis state ranking. This dashboard presents SDG India Index analytics for year 2018 and year 2019. It shows how the progress on these goals is measured in India. However, as per the SDG Report 2020 (ver 2.1), the indicators have further been refined, data collection and reporting processes improved, and the potential for disaggregating data is likely to be explored over the coming years.

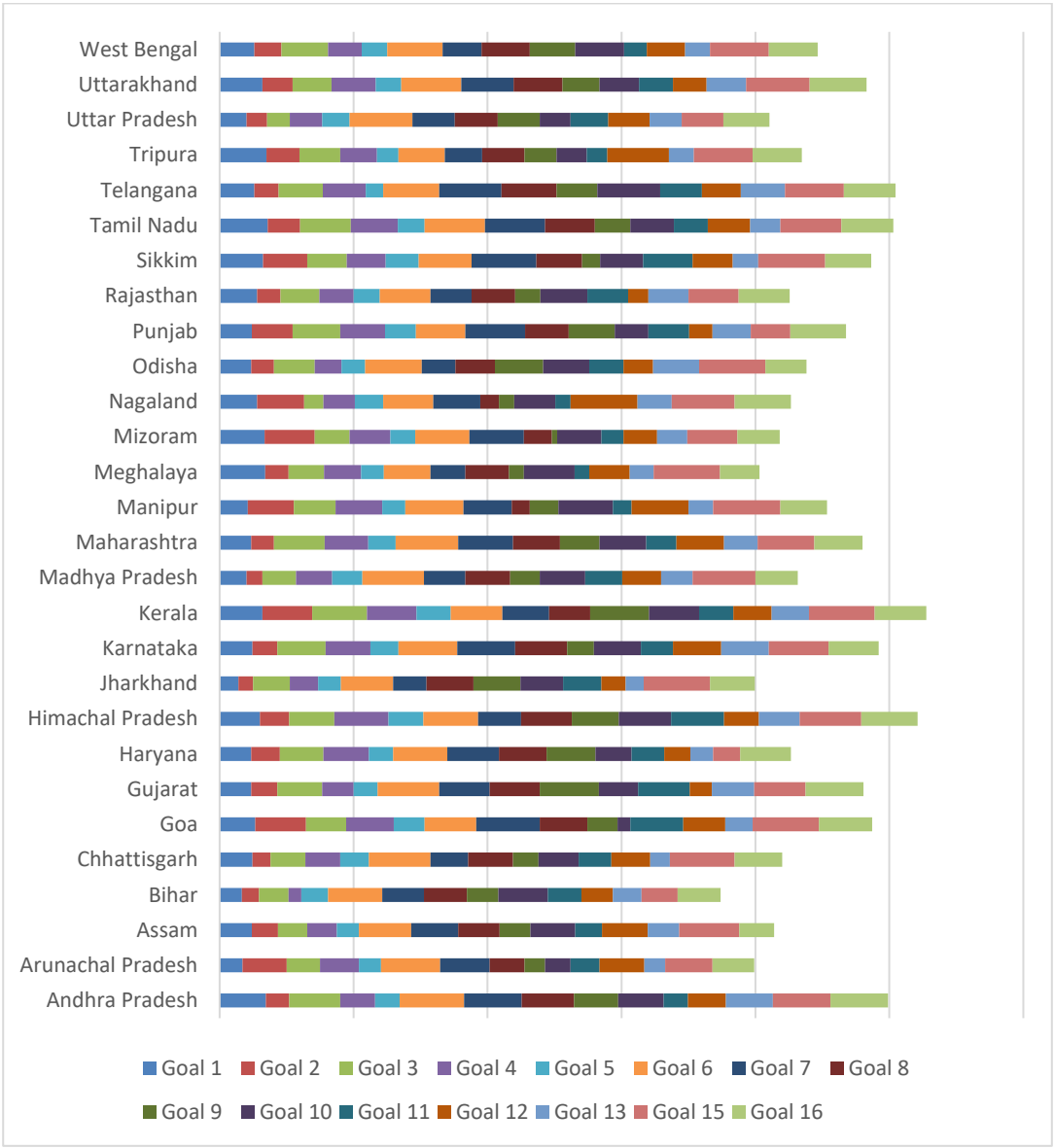
Table 3-3 State-wise SDG performance

AREA	SCORE 2018	SCORE 2019	RANK 2019	Category
Kerala	69	70	1	Front Runner
Himachal Pradesh	69	69	2	Front Runner
Andhra Pradesh	64	67	3	Front Runner
Tamil Nadu	66	67	3	Front Runner
Telangana	61	67	3	Front Runner
Karnataka	64	66	6	Front Runner
Goa	64	65	7	Front Runner
Sikkim	58	65	7	Front Runner
Gujarat	64	64	9	Performer
Maharashtra	64	64	9	Performer
Uttarakhand	60	64	9	Performer
Punjab	60	62	12	Performer
Manipur	59	60	13	Performer
West Bengal	56	60	13	Performer
Madhya Pradesh	52	58	15	Performer
Odisha	51	58	15	Performer
Tripura	55	58	15	Performer
Haryana	55	57	18	Performer
Nagaland	51	57	18	Performer
Rajasthan	59	57	18	Performer
Chhattisgarh	58	56	21	Performer
Mizoram	59	56	21	Performer
Assam	49	55	23	Performer

AREA	SCORE 2018	SCORE 2019	RANK 2019	Category
Uttar Pradesh	42	55	23	Performer
Meghalaya	52	54	25	Performer
Arunachal Pradesh	51	53	26	Performer
Jharkhand	50	53	26	Performer
Bihar	48	50	28	Performer

(Data source- NITI Aayog)

Graph 3-1 State wise SDG achievement (Year 2019)



(Data source- NITI Aayog)

3.5 Internet in India

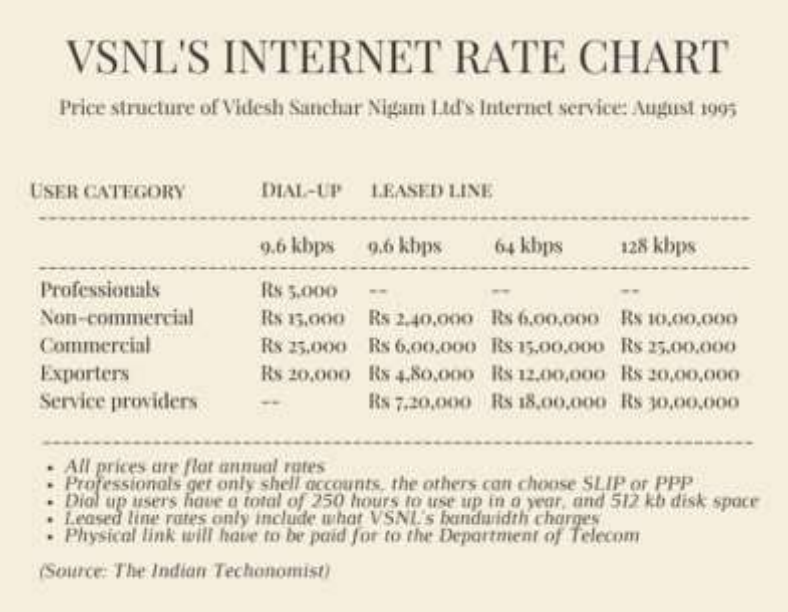
Internet (or broadband, as it evolved later) has been and continues to be one of the critical elements that impact human life. It sweeps over the personal, professional, social, and economic aspects for corporations and consumers globally. India has also witnessed the impact of internet on its commercial, public, and social sectors since it was launched commercially by VSNL.

Though earlier internet access was limited to wireline segment only, the wireless connectivity seen a tremendous evolution over past few years. Today, the 4G and high-speed Wi-Fi connectivity powered by fibre at the backend, are necessities and going ahead, technologies such as IoT (Internet of Things) and 5G will play a crucial role in influencing the lifestyles of the generation.

The Videsh Sanchar Nigam Ltd. (VSNL), a PSU owned by DoT at that time, (now known as Tata Communications Ltd) launched internet for the public in India on 15 August 1995. Since most of the lines at that time were telecom copper line and majority of technologies had not evolved, the access to the Internet was using a modem that enabled a computer to transmit data over telephone or cable lines by converting analog signals into digital ones and vice versa and provided a limited bandwidth due to technological limitations.

The last 25 years have seen an evolution of technology on an unprecedented scale looking specifically at India. In the beginning, connecting to the Internet required a dial-up connection through landline phone at a slow speed. Today, lakhs of people access the

Internet in India on their touchscreen phones on the go, at high speeds from any location. The credit for this level of universal internet access across country goes to Mobile revolution of India.



VSNL'S INTERNET RATE CHART

Price structure of Videsh Sanchar Nigam Ltd's Internet service: August 1995

USER CATEGORY	DIAL-UP	LEASED LINE		
	9.6 kbps	9.6 kbps	64 kbps	128 kbps
Professionals	Rs 5,000	--	--	--
Non-commercial	Rs 15,000	Rs 2,40,000	Rs 6,00,000	Rs 10,00,000
Commercial	Rs 25,000	Rs 6,00,000	Rs 15,00,000	Rs 25,00,000
Exporters	Rs 20,000	Rs 4,80,000	Rs 12,00,000	Rs 20,00,000
Service providers	--	Rs 7,20,000	Rs 18,00,000	Rs 30,00,000

- *All prices are flat annual rates*
- *Professionals get only shell accounts, the others can choose SLIP or PPP*
- *Dial up users have a total of 250 hours to use up in a year, and 512 kb disk space*
- *Leased line rates only include what VSNL's bandwidth charges*
- *Physical link will have to be paid for to the Department of Telecom*

(Source: The Indian Techonomist)

Figure 3.6 VSNL's internet rate chart

The internet services in the initial years were mainly narrowband services, working on copper lines of DoT, BSNL[21] and MTNL. Though VSNL launched its services in 1995, GoI opened the sector to Private Operators for provisioning of Internet Services in November 1998. The License conditions for providing Internet services were liberal with no License Fee and allowed unlimited number of players for delivering this service. ISPs could decide their own tariff plans and can even setup their own International Gateways.

More than 95% subscribers were using dialup access at that time, where the speed was limited to approximately 56 Kbps only. Initially the subscriber base grew more than 200 percent per year, from 0.28 million in March 1998 to 3.04 million by March 2001 due to supportive government policy and entry of large number of private players resulting in lower Internet tariffs boosting subscribers' growth. However, from April 2001 onwards,

[21] BSNL was incorporated by Department of Telecommunications, Ministry of Communications, Government of India on 1 October 2000. All the assets and liabilities of DoT, along with majority of staff, were transferred to BSNL. It took over the telecom services all over India (except Delhi and Bombay (now Mumbai) which were being served by MTNL) being run by DoT.

the growth rate started declining and reduced to just 7% at the end of March 2003.

Department of Telecom issued Broadband Policy in October 2004. The Broadband Policy announced by Government of India defined the Broadband as '*An `always-on' data connection that is able to support interactive services including Internet access and has the capability of the minimum download speed of 256 kilobits per second (kbps) to an individual subscriber from the Point of Presence (POP) of the service provider intending to provide Broadband service where multiple such individual Broadband connections are aggregated and the subscriber is able to access these interactive services including the Internet through this POP. The interactive services will exclude any services for which a separate license is specifically required, for example, real-time voice transmission, except to the extent that it is presently permitted under ISP license with Internet Telephony'*.

BSNL launched its ADSL services across country in the later part of 2005 which enabled high-speed internet (which fell into the definition of broadband, declared later by DoT) allowing real-time multimedia (video/music) streaming. The ADSL services ran on conventional copper pairs of the service providers but put a limit on the distance of subscriber from the service providers PoP.

The BB Policy gave a push to Broadband services across country and as on 31st December 2005 the total Internet users in the country were 6.70 million including 0.9 million Broadband subscribers and by the end of June 2007, the Internet subscribers grew to 47.24 million and broadband subscribers to 2.42 million. TRAI also issued Regulation on 'International Telecommunication Access to Essential Facilities at Cable Landing Stations' on 7th June 2007. This was crucial as decrease in international Bandwidth charges brought down the Broadband charges as international bandwidth charges

accounted for approx. 65% of total cost for providing Broadband services. The urgency to provide impetus to the growth of Broadband was recognised by GoI and the Government declared Year 2007 as 'Year of Broadband'.

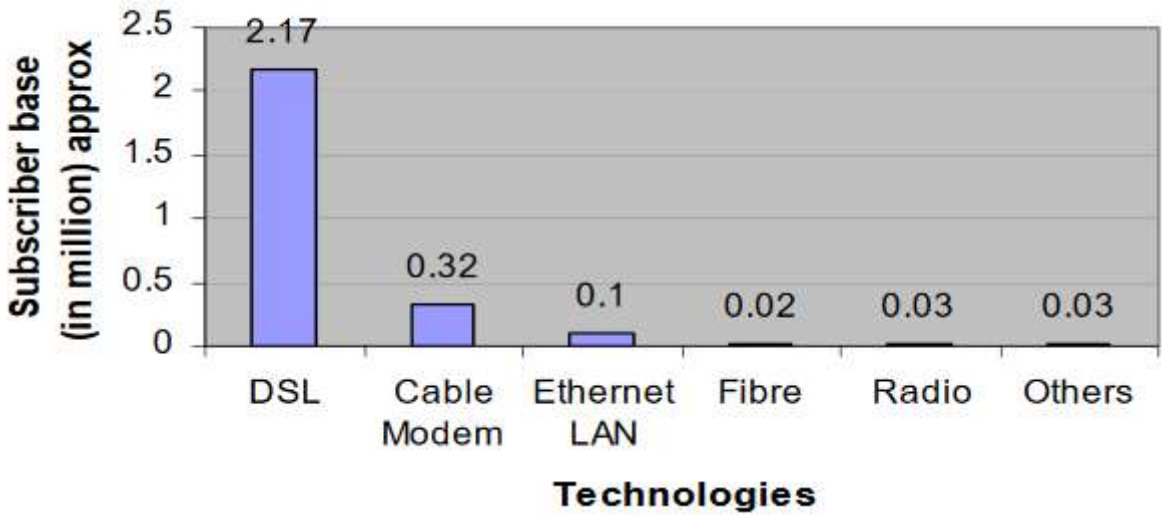


Figure 3.7 Technology trends for Broadband (Sep-2007)
Source- DoT Statistical Bulletin

Indian broadband market till year 2007 was dominated by DSL technology (served mainly by BSNL) with nearly 81% share as compared to nearly 12% of Cable, nearly 4.4% of Ethernet LAN and nearly 0.8% of Fibre, whereas International Broadband market had 66.1% DSL connections as compared to 20.3% of cable modem and 10.7% of FTTx while other technologies accounted for 2.9% market share.

The Broadband Policy-2004 had estimated more than 40 million cooper loops (including 14 million loops are in rural areas) in the country with BSNL and MTNL. It was estimated that initially around 25-30% of the 26 million-cooper loops in urban area (Approx. 8 million) could be leveraged for providing broadband services by both the incumbents i.e. BSNL and MTNL. BSNL and MTNL were supposed to provide 1.5 million broadband connections by the end of year 2005 whereas they could provide only

0.5 million by 2005. Even at the end of March 2007 BSNL and MTNL together provided just 1.45 million broadband connections using DSL technology. As such available copper loop to provide broadband connections could not be effectively utilised.

However, the competition by State PSUs and Private players brough down the tariff for broadband services drastically from Rs.1500/ per month in 2004 to Rs. 200/- a month in 2007. Except unlimited packages the download charges ranged from Rs.0.70 to Rs.1.50 per MB. Some of the companies started offering broadband services with zero rental schemes, though, in such schemes per MB download charges were comparatively high i.e. ranging from Rs.1.50/- to Rs.2/- per MB. Inspite of affordable tariff, the growth remained poor.

3.6 Status of Broadband in India

Since launch of internet services by VSNL in 1995 and later contributed by many private ISPs, India today is amongst the largest telecom markets in the world with over a billion subscribers and more than 80% mobile penetration. The technological development and growth in mobile telephony in the last two decades has proved to be game changer. The initial growth in the narrowband is transforming to Broadband and we are now at the threshold of a digital revolution with focus on delivering quality broadband to the masses and leveraging its significant potential for economic growth and social inclusion. Govt of India's vision of Digital India with high speed broadband as basic infrastructure for every citizen, provision of government to citizen services online and empowerment of citizens in governance lays out a roadmap for further spread of quality broadband services.

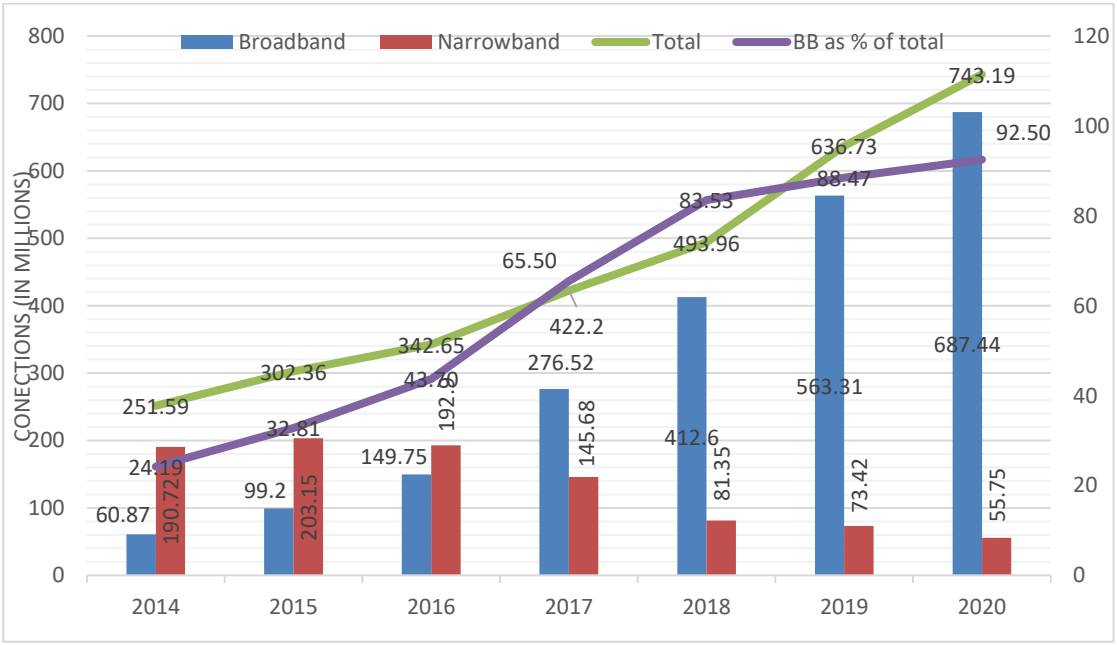
Table 3-4 Internet Subscribers in India (Millions) (2007-2020)

At the end of March	Total	Narrow band	Broad band	Wired	Wireless	Urban	Rural
2007	-	-	2.34	9.27	31.3	-	-
2008	-	-	3.87	11.09	65.5	-	-
2009	-	-	6.22	13.54	117.82	-	-
2010	16.18	7.41	8.77	16.18	177.87	-	-
2011	19.68	7.79	11.89	19.68	381.4	-	-
2012	19.51	5.7	13.81	19.51	448.89	-	-
2013	21.61	6.56	15.05	21.61	143.2*	-	-
2014	251.59	190.72	60.87	18.5	233.09	-	-
2015	302.36	203.15	99.2	19.07	283.29	194.8	107.56
2016	342.65	192.9	149.75	20.44	322.21	230.71	111.94
2017	422.2	145.68	276.52	21.58	400.62	285.68	136.52
2018	493.96	81.35	412.6	21.24	472.72	348.13	145.83
2019	636.73	73.42	563.31	21.68	615.05	409.72	227.01
2020	743.19	55.75	687.44	22.42	720.78	457.23	285.97

Source – TRAI subscriber data report,

Note: - Not Available * Actual users considered instead of enabled customers.

With the launch of 3G mobile services in 2008 and subsequently delicensing of 2.4GHz band in 2005 and 5.8GHz band in 2007 and subsequently auction of 4G spectrum gave boost to the wireless broadband subscription on mobile.



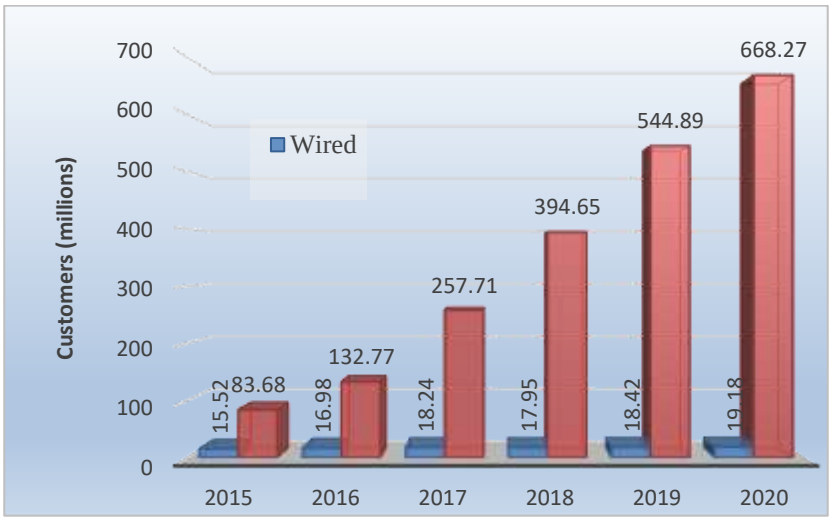
Graph 3-2 India Broadband connections (2014-2020)

Data Source-TRAI performance indicator reports

3.6.1 Technology-wise broadband data

During the initial roll-out of internet, the connections were mainly provided on dial-up technology, which essentially used copper pair. BSNL and MTNL were the main service provider at that time. Some of the private operators also used coaxial cable, but all these were wired line technologies. Even the broadband connections during the initial rollout by both BSNL and MTNL were on copper line using ADSL technology.

Wireless broadband refers to technologies that use point-to-point or point-to-multipoint radio or microwave frequencies to transmit signals between hub sites and an end-user receiver. India entered the 3G arena with the launch of 3G enabled Mobile and Data services on 11th December 2008 by MTNL in Delhi and later in Mumbai, becoming the first 3G Mobile service provider in India. After MTNL, another state operator Bharat Sanchar Nigam Ltd. (BSNL) launched 3G services on 22 Feb 2009 in Chennai and Kolkata and later launched 3G as Nationwide. The auction of 3G wireless spectrum was announced in April 2010 and 3G Spectrum allocated to all private operators on 1st September 2010. This enabled wireless broadband through mobile services and resulted into rapid growth of wireless broadband services.



Graph 3-3 Technology-wise broadband customers

Data Source- TRAI subscriber data reports

On 19th May 2010, the broadband wireless access (BWA) or 4G spectrum auction in India ended. On 10 April 2012, Airtel launched 4G services through dongles and modems using TD-LTE technology in Kolkata, becoming the first company in India to offer 4G services. Jio, which launched 4G services in September 2016, well after Bharti Airtel (2012) and Vodafone (2015), gave a big push to affordable broadband services.

The use of wireless broadband is growing rapidly, primarily in areas where mobile connectivity exists. Maturation of third generation (3G) wireless network services, the development of affordable smart phones and other mobile computing devices, the emergence of new classes of connected devices and the rollout of fourth-generation (4G) wireless technologies such as Long Term Evolution (LTE) are the key drivers. The wireline customers base, despite some FTTH connections, grew very slowly as compared to wireless. As of now, majority of the broadband customers are on wireless technologies.

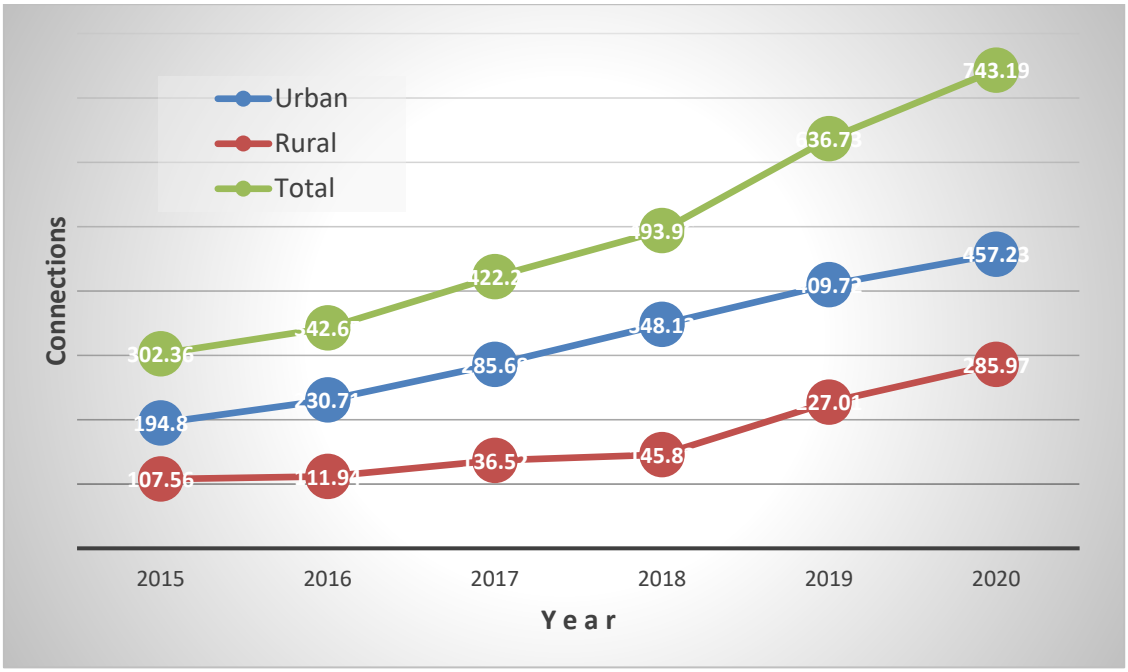
Wireless connectivity appears to be the technology to connect masses as scaling a wireless network with a dedicated spectrum is quite easy and enables faster rollout. However, though wireless does connect to the Internet easily, it is the wireline that provides consistent connectivity. Still, Wireless and wireline are not competitors. The backend connectivity will remain fibre to create seamless ubiquitous access to the Internet. FTTH is the required technology (as of now) to provide a stable, required speed and enhanced user experience for multi-media and OTT services.

3.6.2 The Rural-Urban Divide

Access to Broadband has become critical, making the development of its infrastructure a priority for the Government and the industry. Significant efforts need to be made to reduce the digital divide to unleash the power of the 67% rural population as well as

strengthen the productivity of urban populace. Subscriber growth is concentrated in densely populated urban areas, accounting for approximately 61.5% of the broadband subscriber base om March'2020. Further, as of March 2020, only 32.24% of the rural populace were having access to internet.

The graph below depicts the difference in rural and urban penetration of internet.



Graph 3-4 Rural and Urban internet connections (2015-2020)
Data Source-TRAI reports

In order to give a push to the penetration of broadband in rural areas, DoT envisaged a state-of-art, future-proof fibre optic network in rural India by undertaking a phased implementation of BharatNet, the national optical fibre network project connecting all 2,50,000 gram panchayats. This has further been extended to cover 6lakh villages across country.

Table 3-5 Internet Density (Internet Subscribers Per 100 Inhabitants)

At the end of	Total	Urban	Rural
2013	13.45	-	-

At the end of	Total	Urban	Rural
2014	20.29	-	-
2015	24.09	49.07	12.89
2016	26.98	58.28	12.80
2017	32.86	70.83	15.49
2018	38.02	84.74	16.41
2019	48.48	97.94	25.36
2020	55.12	99.12	32.24

Source – TRAI reports Note: - Not Available

As on 10th July 2020, a total of 1,53,810 GPs has been connected by laying 4,39,555 km OFC and out of these in 1,41,563 GPs necessary equipment for delivering high-speed connectivity have also been installed, i.e., these GPs are service ready. In the remaining GPs, the project is under implementation.

DoT is continuously releasing spectrum for telecom operators in a transparent and competitive manner and pursuing reforms with respect to spectrum management. The last spectrum auctions facilitated deployment of various wireless broadband technologies such as LTE (4G), resulting in improved data access for citizens. The 5G spectrum auction is also likely to happen soon. Further, a host of measures are being undertaken by GoI to spread digital awareness and the government has been digitizing its service offerings to ensure fast, reliable and effective delivery of services as well as to increase digital literacy to bridge the digital divide.

3.6.3 State-wise Broadband connections

The urban/rural break up of internet subscribers (as on June 2020) are as per the following table: -

Table 3-6 Breakup of Rural-Urban internet subscriber base (in millions)

Telecom Service Area	Narrowband		Broadband		Total (March 2020)	
	Rural	Urban	Rural	Urban	Rural	Urban
Andhra Pradesh	1.830	1.620	24.217	31.484	25.509	33.143
Assam	0.607	0.329	7.960	5.567	8.313	5.934
Bihar	3.045	1.149	28.634	16.761	30.533	17.862
Delhi	0.164	2.655	0.619	37.175	0.755	40.242
Gujarat	0.869	1.099	13.088	30.434	13.671	31.645
Haryana	0.409	0.495	6.504	9.924	6.811	10.368
Himachal Pradesh	0.174	0.140	3.729	2.041	3.793	2.207
Jammu & Kashmir	0.318	0.161	3.040	4.009	3.445	4.234
Karnataka	1.521	1.611	15.121	27.860	17.013	28.820
Kerala	0.711	0.947	10.477	15.316	10.754	15.793
Kolkata	0.059	1.150	1.416	14.902	1.418	15.987
Madhya Pradesh	1.963	1.736	18.397	27.892	19.746	28.971
Maharashtra	2.048	2.170	23.807	36.076	25.164	37.848
Mumbai	0.064	1.810	1.660	25.936	1.533	28.768
North East	0.279	0.209	3.831	3.722	3.973	3.996
Orissa	1.121	0.356	11.633	6.591	12.365	6.915
Punjab	0.569	0.864	7.992	17.033	8.432	17.698
Rajasthan	1.601	1.287	18.660	20.735	20.022	22.482
Tamil Nadu	1.414	2.286	12.383	34.959	13.819	37.819
UP (East)	3.374	1.337	26.405	24.107	28.915	25.681
UP (West)	1.301	1.263	13.136	22.131	13.341	24.458
West Bengal	1.856	0.868	15.087	15.780	16.647	16.353
Grand Total	**25.296**	**25.544**	**267.795**	**430.435**	**285.969**	**457.225**
	50.840		**698.231**		**743.194**	

Source-TRAI subscriber data reports

Top five service areas in terms of internet subscriptions (wired+wireless) are Maharashtra (64.10 million), Andhra Pradesh including Telengana (59.15 million), U.P.(East) (55.22 million) Tamil Nadu including Chennai (51.04 million) and Madhya Pradesh including Chhatishgarh (49.99 million). The internet density data is depicted below: -

Service Area	Internet Subscribers (in million)			No. of Internet subscribers per 100 population		
	Rural	Urban	Total	Rural	Urban	Total
Andhra Pradesh	26.05	33.10	59.15	47.75	92.97	65.61
Assam	8.57	5.90	14.46	29.05	111.21	41.57
Bihar	31.68	17.91	49.59	23.38	73.07	30.99

Service Area	Internet Subscribers (in million)			No. of Internet subscribers per 100 population		
	Rural	**Urban**	**Total**	**Rural**	**Urban**	**Total**
Delhi	0.78	39.83	40.61	528.15	197.47	199.88
Gujarat	13.96	31.53	45.49	38.13	93.85	64.79
Haryana	6.91	10.42	17.33	39.79	88.01	59.33
Himachal Pradesh	3.90	2.18	6.08	59.06	289.06	82.63
Jammu & Kashmir	3.36	4.17	7.53	35.12	102.50	55.23
Karnataka	16.64	29.47	46.11	44.01	102.75	69.35
Kerala	11.19	16.26	27.45	103.79	65.96	77.47
Madhya Pradesh	20.36	29.63	49.99	25.05	93.41	44.24
Maharashtra	25.86	38.25	64.10	42.44	109.53	74.72
Mumbai	1.72	27.75	29.47			
North East	4.11	3.93	8.04	39.99	77.30	52.34
Orissa	12.75	6.95	19.70	35.59	86.07	44.87
Punjab	8.56	17.90	26.46	47.96	132.32	84.32
Rajasthan	20.26	22.02	42.28	34.94	106.79	53.79
Tamil Nadu	13.80	37.25	51.04	37.65	90.69	65.68
UP (East)	29.78	25.44	55.22	24.47	84.14	38.73
UP (West)	14.44	23.39	37.83			
Kolkata	1.47	16.05	17.53	29.02	92.56	51.74
West Bengal	16.94	16.65	33.59			
Total	**293.09**	**455.98**	**749.07**	**33.00**	**98.35**	**55.41**

Source-TRAI subscriber data reports

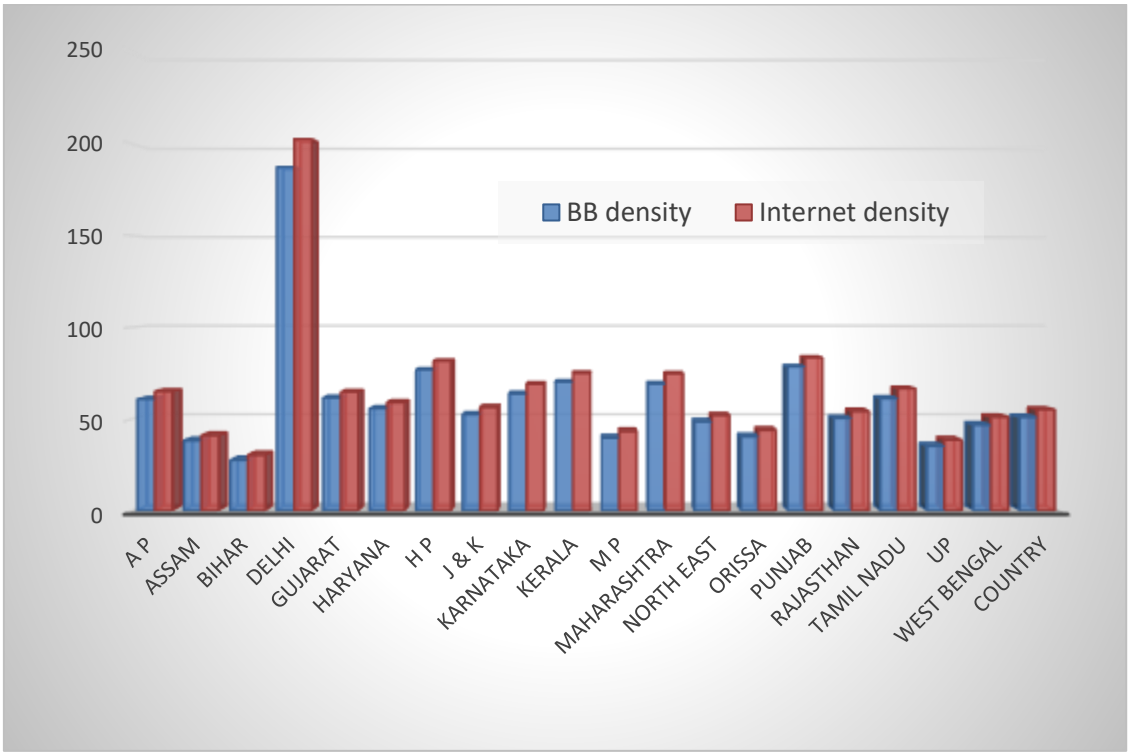
Table 3-7 Service Area wise number of Internet Subscribers per 100 population at the end of Jun-2020[22]

[22] Notes:

1. No. of total internet subscribers per 100 population is derived from the subscriber data provided by the operators and the population projections of the country from the Report of the technical group on population projections published by National Commission on Population, Ministry of Health & Family Welfare. (Based on Census of India 2011)

2. Data/information for Andhra Pradesh includes Telengana, Madhya Pradesh includes Chhatishgarh, Bihar includes Jharkhand, Maharashtra includes Goa, Uttar Pradesh includes Uttarakhand, West Bengal includes Sikkim and North-East includes Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland & Tripura states.

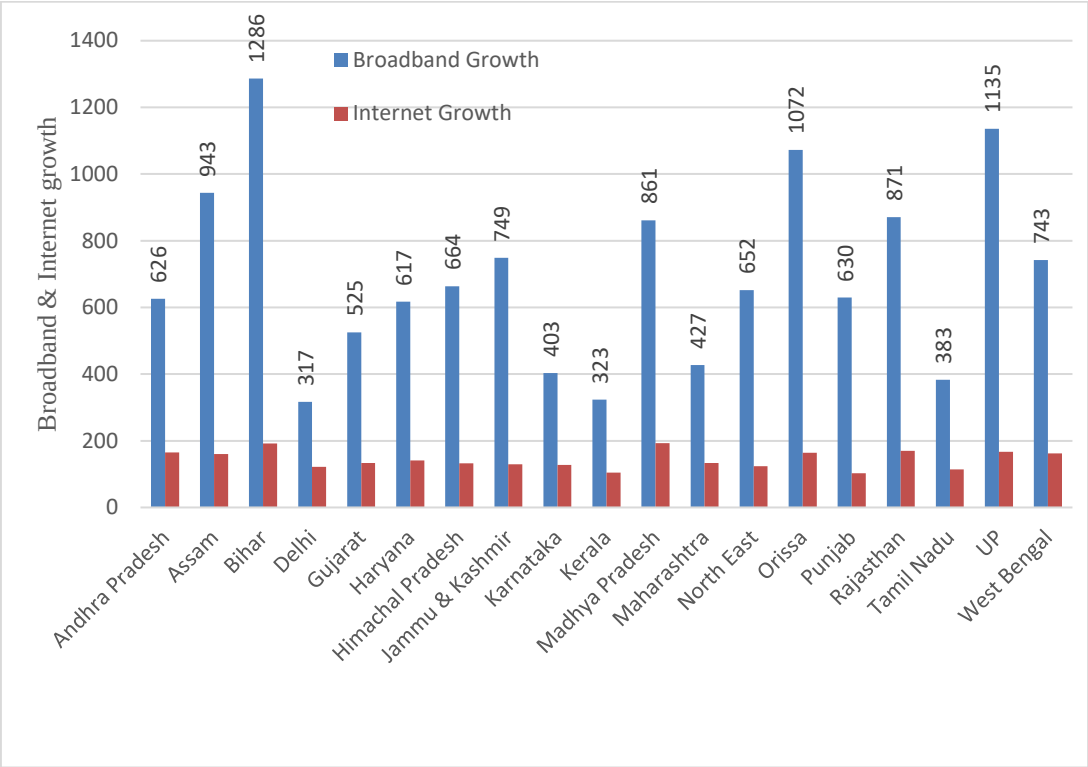
Top five service areas in respect of broadband subscriptions at Q.E. Jun-20 are Maharashtra (59.88 million), Andhra Pradesh including Telengana (55.70 million), U.P.-East (50.51 million), Tamil Nadu including Chennai (47.34 million) and Madhya Pradesh (46.29 million).



Graph 3-5 State-wise Broadband and Internet density (March-2020)
Data Source-TRAI reports

The state-wise broadband and internet (includes both narrowband and broadband) customer base growth (till March'20) in customer base (in percentage) as compared to March'15[23] is depicted below graphically. It can be seen that internet customer base grew from 104.78% (Kerala) to 192.96% (MP) as compared to status as of March'2015, whereas broadband witnessed a growth rate ranging from 316.59% (Delhi) to 1286.12% (Bihar). Assam, Bihar, MP, Orissa and UP grew by more than 800%.

[23] Telecom treats UP in UP(E) and UP(W), which has been merged as UP, for the sake of interpretation. Similarly, Mumbai and Maharashtra; West Bengal and Kolkata data have been clubbed.



Graph 3-6 % Growth of Internet and Broadband with March'15 as base year

Data Source- TRAI subscriber data reports

The internet density can be decided as 'number of Internet Subscribers per 100 population'. This gives a broad idea of population covered by internet services. The internet density data at March'15 (year in which SDGs were announced) and March'20 are given below-

Table 3-8 State-wise internet density[24]

Service Area	Internet Density March'20	Internet Density March'15	Internet Density (% Change)
Delhi	202.71	89.24	113.47
Himachal Pradesh	81.62	36.71	44.91
Maharashtra	74.69	33.16	41.53
Punjab	83.45	42.09	41.36
Andhra Pradesh	65.15	25.22	39.93

[24] TRAI Note- No. of total internet subscribers per 100 population is derived from the subscriber data provided by the operators and the population projections of the country, published by the Office of the Registrar General & Census Commissioner, India.

Service Area	Internet Density March'20	Internet Density March'15	Internet Density (% Change)
Kerala	75.01	36.44	38.57
Karnataka	69.06	32.5	36.56
Gujarat	64.77	30.93	33.84
Haryana	59.01	26.33	32.68
Tamil Nadu	66.53	34.14	32.39
Rajasthan	54.24	21.91	32.33
West Bengal	51.1	20.42	30.68
Jammu & Kashmir	56.43	27.27	29.16
Madhya Pradesh	43.26	16.24	27.02
Orissa	43.95	17.3	26.65
North East	51.99	25.87	26.12
Assam	41.06	17.05	24.01
UP	38.58	15.34	23.24
Bihar	30.35	12.19	18.16

Data source- TRAI reports for year 2015 and 2020

3.7 Status of India vis-a-vis Other Countries

Approximately 4.6 billion people worldwide today use the internet and transmit billions of gigabytes of data over the World Wide Web every day. Internet has not only connected the world, but also made national, social and economic boundaries insignificant. The broad statistics of worldwide internet users is given below-

Worldwide Internet users				
	2005	**2010**	**2017**	**2019**[a]
World population	6.5 billion	6.9 billion	7.4 billion	7.75 billion
Users worldwide	16%	30%	48%	53.6%
Users in the developing world	8%	21%	41.3%	47%
Users in the developed world	51%	67%	81%	86.6%

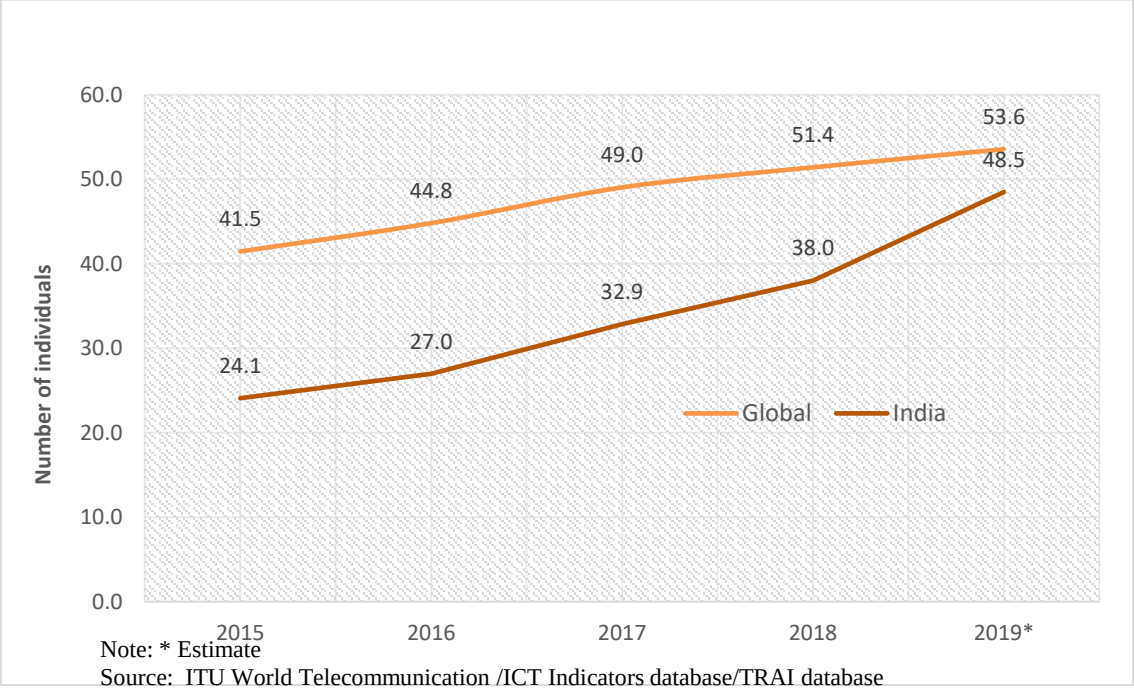
[a] Estimate.

Source: International Telecommunications Union

3.7.1 Global v/s India status

The internet has completely changed the way people communicate with each other globally. On the industry front, the internet has reshaped the corporate world, creating new technology giants that have successfully tapped into voids of demand the internet has made in its wake. The growth of the internet is taking place all over the world with the development and implementation of new technologies. The status of internet density

globally vis-à-vis in India is depicted below-



Note: * Estimate
Source: ITU World Telecommunication /ICT Indicators database/TRAI database

Graph 3-7 Numbers of individuals Globally using the Internet per 100 inhabitants

India's internet penetration is still counted as low tele density, especially compared to China or the Western world. The developed countries had good infrastructure and high tele-density, which supported faster growth of internet. Internet-density wise, India ranks at 110th position globally. The internet data of a few countries is given below-

Table 3-9 Top 20 countries with highest number of Internet users - 2020

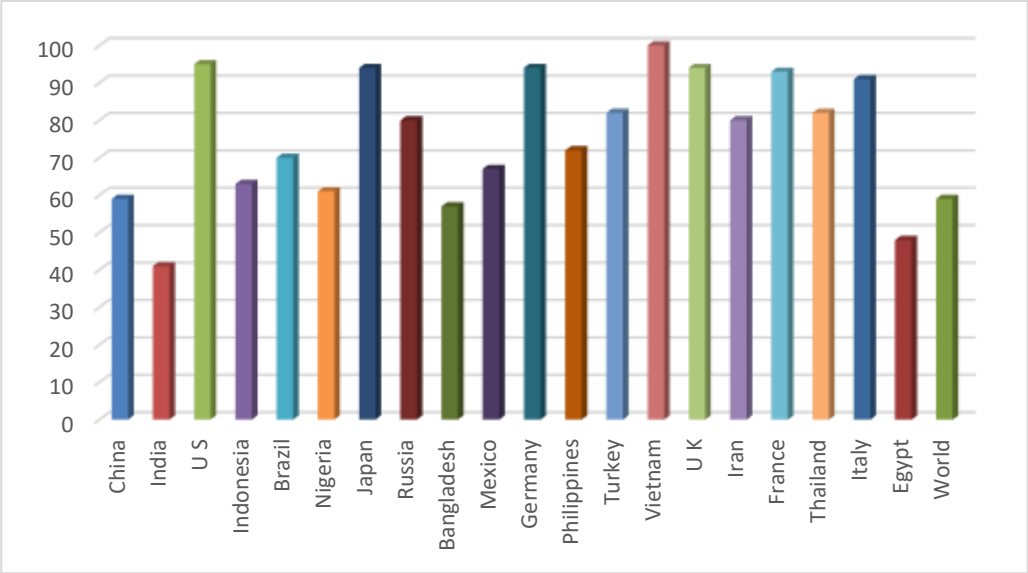
#	Country or Region	Internet Users 2020 Q1	Internet Users 2000 Q4	Population, 2020 Est.	% of 2020 Popln	Population 2000 Est.	Internet Growth 2000 - 2020
1	China	854,000,000	22,500,000	1,439,062,022	59	1,283,198,970	3,796%
2	India	560,000,000	5,000,000	1,368,737,513	41	1,053,050,912	11,200%
3	United States	313,322,868	95,354,000	331,002,651	95	281,982,778	328%
4	Indonesia	171,260,000	2,000,000	273,523,615	63	211,540,429	8,560 %
5	Brazil	149,057,635	5,000,000	212,392,717	70	175,287,587	2,980 %
6	Nigeria	126,078,999	200,000	206,139,589	61	123,486,615	63,000%
7	Japan	118,626,672	47,080,000	126,854,745	94	127,533,934	252 %
8	Russia	116,353,942	3,100,000	145,934,462	80	146,396,514	3,751 %

#	Country or Region	Internet Users 2020 Q1	Internet Users 2000 Q4	Population, 2020 Est.	% of 2020 Popln	Population 2000 Est.	Internet Growth 2000 - 2020
9	Bangladesh	94,199,000	100,000	164,689,383	57	131,581,243	94,199 %
10	Mexico	88,000,000	2,712,400	132,328,035	67	2,712,400	3,144 %
11	Germany	79,127,551	24,000,000	83,783,942	94	81,487,757	329 %
12	Philippines	79,000,000	2,000,000	109,581,078	72	77,991,569	3,950 %
13	Turkey	69,107,183	2,000,000	84,339,067	82	63,240,121	3,455 %
14	Vietnam	68,541,344	200,000	68,541,344	100	200,000	34,250 %
15	United Kingdom	63,544,106	15,400,000	67,886,011	94	58,950,848	413 %
16	Iran	67,602,731	250,000	83,992,949	80	66,131,854	27,040 %
17	France	60,421,689	8,500,000	65,273,511	93	59,608,201	710 %
18	Thailand	57,000,000	2,300,000	69,799,978	82	62,958,021	2,478 %
19	Italy	54,798,299	13,200,000	60,461,826	91	57,293,721	415 %
20	Egypt	49,231,493	450,000	102,334,404	48	69,905,988	10,940 %
TOP 20 Countries		3,241,273,512	251,346,400	5,233,377,837	62	62	1,289 %
Rest of the World		1,332,876,622	109,639,092	2,563,237,873	52	52	1,216 %
Total World		4,574,150,134	360,985,492	7,796,615,710	59	59	1,267 %

NOTES: (1) Top 20 Internet Countries Statistics were updated for Dec 31, 2019.
(2) Growth percentage represents the increase in the number of Internet users between the years 2000 and 2020.
(3) The most recent user information comes from data published by Facebook, International Telecommunications Union, official country telecom reports, and other trustworthy research sources.

Source- https://www.internetworldstats.com/top20.htm

Though India ranks 2nd worldwide (China being at the top), the % population having access to internet is still low, owing to its high population. This is depicted graphically below-



Graph 3-8 Percentage population of 20 highly populated countries having access to internet

Source: www.internetworldstats.com

Studies suggest that the age group between 20 and 39 years old constituted around 54 percent of the Indian internet users in early 2019. The lowest share was of people over the age of 40 years while the age group of 12 to 15 years made up about 14 percent share of the total internet users.

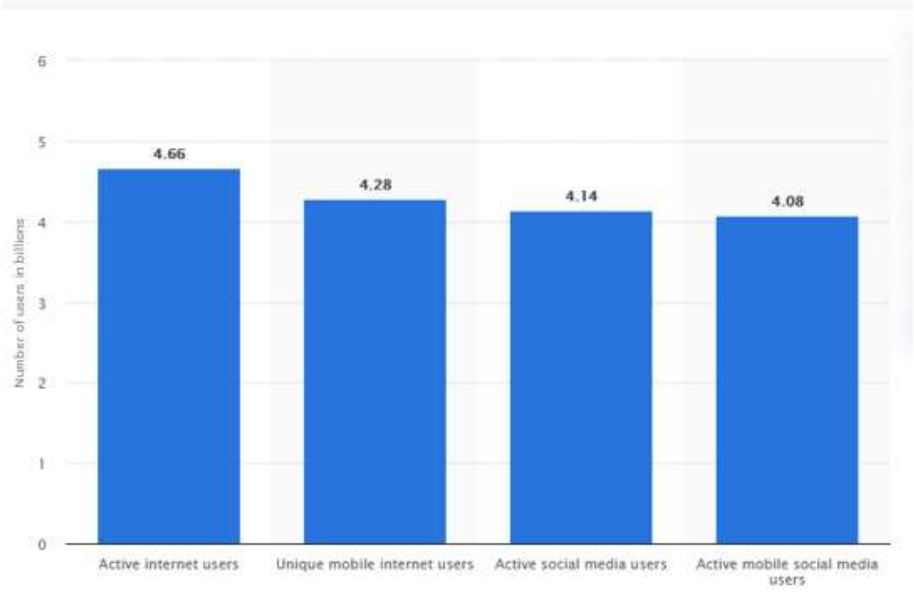


Figure 3.8 Global Digital population (July'20) (Billions)

Source- https://www.statista.com

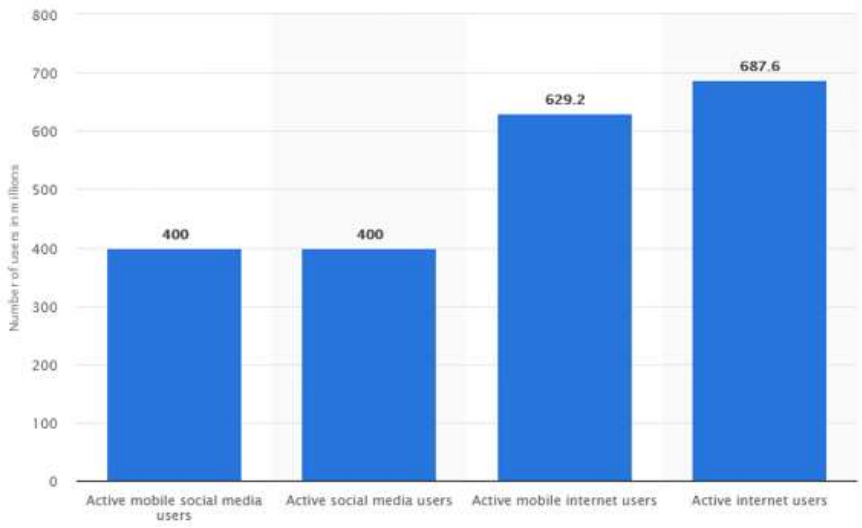


Figure 3.9 Digital population India (Jan'20) (Millions)

Source- https://www.internetworldstats.com

3.7.2 India v/s other Asian countries

India contributes to almost 25% of internet users of Asian counties. However, a dekko at number of Internet Subscribers per 100 population indicates India stands at 27th position.

Table 3-10 Asia Internet Use and Population Statistics

ASIA	Population (2020 Est.)	Internet Users, (Year 2000)	Internet Users 31-MAY-2020	Penetration % Population	Users % Asia
Afganistan	38,928,346	1,000	7,337,489	18.8 %	0.3 %
Armenia	2,963,243	30,000	2,126,716	71.8 %	0.1 %
Azerbaijan	10,139,177	12,000	7,991,630	78.8 %	0.3 %
Bangladesh	164,689,383	100,000	96,199,000	58.4 %	4.2 %
Bhutan	771,608	500	397,499	51.5 %	0.0 %
Brunei Darussulam	437,479	30,000	416,798	95.3 %	0.0 %
Cambodia	16,718,965	6,000	8,005,551	47.9 %	0.3 %
China *	1,439,323,776	22,500,000	854,000,000	59.3 %	37.1 %
Georgia	3,989,167	20,000	2,658,311	66.6 %	0.1 %
Hong Kong *	7,496,981	2,283,000	6,698,252	89.3 %	0.3 %
India	1,380,004,385	5,000,000	560,000,000	40.6 %	24.3%
Indonesia	273,523,615	2,000,000	171,260,000	62.6 %	7.4 %
Japan	126,476,461	47,080,000	118,626,672	93.8 %	5.2 %
Kazakhstan	18,776,707	70,000	14,669,853	78.1 %	0.6 %
Korea, North	25,778,816	--	20,000	0.1 %	0.0 %
Korea, South	51,269,185	19,040,000	49,234,329	96.0 %	2.1 %
Kyrgystan	6,524,195	51,600	2,493,400	38.2 %	0.1 %
Laos	7,064,242	6,000	3,056,000	42.0 %	0.1 %
Macao *	649,335	60,000	538,007	83.8 %	0.0 %
Malaysia	32,365,999	3,700,000	26,353,017	81.4 %	1.1 %
Maldives	540,544	6,000	370,000	68.4 %	0.0 %
Mongolia	3,278,290	30,000	2,233,000	68.1 %	0.1 %
Myanmar	54,409,800	1,000	22,200,000	40.8 %	1.0 %
Nepal	29,136,808	50,000	16,190,000	55.6 %	0.7 %
Pakistan	220,892,340	133,900	71,608,065	32.4 %	3.1 %
Philippines	109,581,078	2,000,000	79,000,000	72.1 %	3.4 %
Singapore	5,850,342	1,200,000	5,173,907	88.4 %	0.2 %
Sri Lanka	21,413,249	121,500	7,169,533	33.5 %	0.3 %
Taiwan	23,816,775	6,260,000	22,042,902	92.6 %	1.0 %
Tajikistan	9,537,645	2,000	3,013,256	31.6 %	0.1 %
Thailand	69,799,978	2,300,000	57,000,000	81.7 %	2.5 %
Timor-Leste	1,318,445	0	410,000	31.1 %	0.0 %
Turkmenistan	6,031,200	2,000	1,262,794	20.9 %	0.1 %
Uzbekistan	33,469,203	7,500	17,161,534	51.3 %	0.7 %
Vietnam	97,338,579	200,000	68,541,344	70.4 %	3.0 %
TOTAL ASIA	4,294,516,659	114,304,000	2,305,458,859	53.7 %	100%

NOTES: (1) The Asia Internet Statistics were updated for January 31, 2020. (2) The Facebook subscriber data were updated for Dec. 31, 2019. (3) CLICK on each country name to see detailed data for individual countries and regions. (4) The demographic (population) numbers are based mainly on data contained in United Nations Population Division and local official sources. (5) The usage numbers come from various sources, mainly from data

ASIA	Population (2020 Est.)	Internet Users, (Year 2000)	Internet Users 31-MAY-2020	Penetration % Population	Users % Asia
published by Facebook , ITU , and other trustworthy sources. (6) For navigation help, definitions and methodology, please see the site surfing guide. (7) Data may be cited, giving due credit and establishing an active link back to Internet World Stats. (*) China figures do not include SAR Hong Kong, SAR Macao nor Taiwan, which are reported separately for statistical purposes.					

Source- https://www.internetworldstats.com/

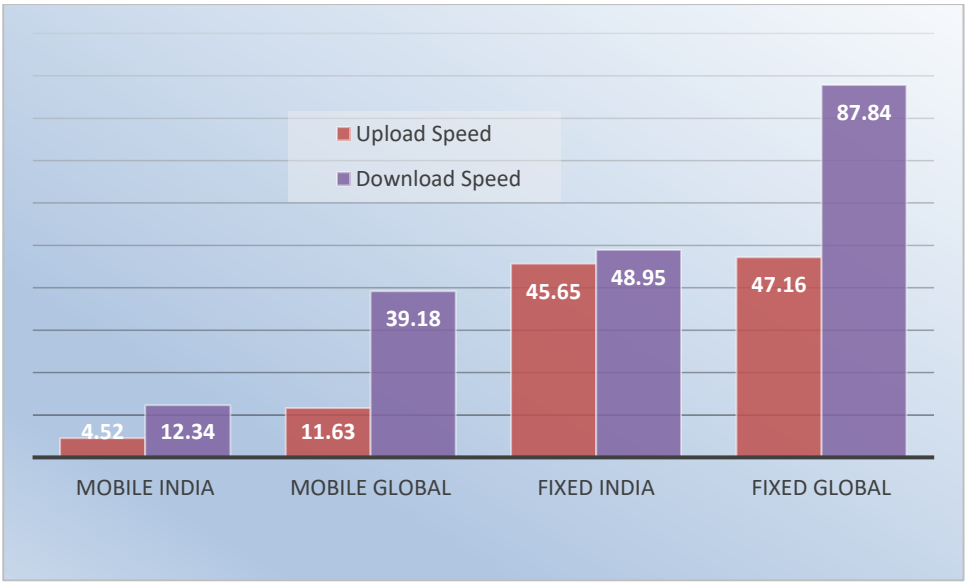
3.8 Global Internet Speed Index

There are many plate-forms offering internet speed test index. This section refers to the speed test provided by https://www.speedtest.net. The Speedtest Global Index compares internet speed data from around the world on monthly basis. Data for the Index comes from the hundreds of millions of tests taken by real people using Speedtest every month.

Internet measurements made with Speedtest occur at the times and in the places that are most relevant to the person taking the test. Each time a test is initiated, a snapshot of what the internet looks like in that place and time is recorded. When aggregated together, these individual experiences represent the typical internet performance for a given location.

Speedtest leverages a vast testing infrastructure with over 10,000 servers in more than 190 countries, ensuring users will always be able to test to a local server regardless of where they are located. From January 1, 2019 onward, countries must have at least 300 unique user test results for mobile or fixed broadband in the reported month to be included in the Index Results for mobile are based on all cellular technologies. Fixed broadband includes mobile WiFi results. Results are updated mid-month for the previous month.

A comparison of India internet speed with Global average is given below-



Graph 3-9 Average Internet Speed (Global Vs India, Oct'20)

Source- https://www.speedtest.net/global-index

As per October'20 index India stands at 66th and 131st position for fixed and mobile internet speed.

Summary

The seventeen SDGs have become *de-facto* international obligations and have potential to guide in domestic spending priorities of the countries till 2030, however not legally binding. The SDGs are expected to stimulate action over the next 15 years in areas of critical importance for humanity and the planet. The member countries are supposed to take ownership and establish a national framework for achieving these Goals and align its' own sustainable development plans, policies and programmes. The countries are expected to have follow-up and review at the national level regarding the progress made in implementing the goals and targets.

NITI Aayog developed the SDG India Index Baseline Report and an accompanying

Dashboard in December 2018 in collaboration with UN India. It not only presents a snapshot of progress at the national level but also comprehensively documents and measures the achievements made by States and UTs towards various SDG targets and also ranks them on a select set of indicators. The SDG India Index has enabled States and UTs to identify priority areas and benchmark their progress relative to others, thus promoting competition among them for improving performance.

The Covid-19 is likely to impact India's achievement. Impact of Covid-19 has not only been limited to society at large but the perspective of the economy both rural and urban also impacted adversely. The migrant workers who depend on daily earnings, barely have savings which they could spend during any emergency. Similar to migrant workers, gig workers, e.g., delivery boys, cab driver etc have been gone through a similar issue. In addition to adverse impact on the economy, the impact of Covid-19 on education has been cruel and its repercussions will be seen in the upcoming future. The World Bank, in its report titled 'Beaten or broken: Informality and Covid', has warned that there will be the lifelong impact of school closures on the productivity of this generation of students.

India stands at 117th position with a score of 61.9 amongst 166 countries with major challenges in many areas like Health, Gender equality, inequalities etc. The regional SDG index score is 77.2 against India's score of 61.9. Further, the Covid-19 may also affect India's position adversely. There are still 34 targets against which indicators are required to be assigned (table 3.2). Needless to state, India needs to put a lot of efforts and perform better.

The internet in India initially utilised dialup connectivity (now we call it a narrowband) which saw a boost in speed (or emergence of Broadband) with technological emergences like ADSL and 3G. Mobile technological developments like 4G gave a major thrust to

broadband growth and as seen from graph 1, broad took over narrowband in 2016-17, and by March'20, it became more than 92% of total internet connections in the country. Further, the urban sector saw a major growth (mainly because private sector found it commercially beneficial) and the rural sector, which houses around 67% of the population, saw a little growth. The rural broadband connections contribute only to around 38% of total broadband connections on the country.

Still, future appears very promising for India's Internet journey with new technologies like 5G, Artificial intelligence and machine learning to make high-speed internet access to all. The Covid pandemic has played a critical role in amplifying and hastening many of these changes in 2020.

4 Critique of Role of Broadband in Achieving SDGs

Broadband connectivity is capable of not only transforming individual human potential, but also develops knowledge economies for transformation in government services. Broadband brings digital transition across economic sectors, expand opportunities for enterprises and provide greater value for citizens and consumers. Broadband connectivity is also acknowledged as an enabler of efforts to achieve the UN SDGs.

Broadband accelerates the achievement of SDGs through following enablers:

Access to information and services

The cellular telecom networks (e.g., 3G and 4G) and other broadband connectivity enable access to information and services for individuals, rural and urban alike- thus enabling individual to access the welfare services run by state.

Connectivity between individuals and organizations

The broadband provides better connectivity between individuals, organizations and state functionaries which increases productivity and innovation across multiple sectors and communities. The broadband provides the real-time communications needed for rapid

scaling of critical services. This is evident specially during pandemic period.

Efficiency from improved productivity and resource efficiency

The increased access to information and communication enabled by broadband saves on travel and improves data collection efficiency. It also provides the efficient mechanism to collect large datasets which can be analysed to find opportunities for efficiencies and scale customized solutions. This also enables real-time information (via smartphones and devices connected to the Internet of Things) collection.

An analysis conducted by ITU reviewed the impact of broadband, on national economies. The analysis demonstrates that broadband has impact on economy of countries. The study indicates that globally an increase of 10 per cent in fixed broadband penetration yields an increase of 0.8 per cent in GDP, and an increase of 10 per cent in mobile broadband penetration yields an increase of 1.5 per cent in GDP.

4.1 Role of internet in the implementation of the SDGs

The Internet Society believes this will be especially important in five areas[25]:

1. Sustainable development policy- Internet and development stakeholders need to build a stronger and realistic understanding of ICTs' potential in difficult development contexts.
2. Implementing sustainable development- ICTs can support the delivery of every SDG and Goals can be translated into practical measures to support their implementation.

[25] The Internet and Sustainable Development (June 2015), Internet Society

3. Monitoring sustainable development- ICTs, by facilitating data-gathering and analysis of indicators adopted for every Goal and target, play a crucial role in monitoring progress towards sustainable development.

4. Leveraging big data for development- Data Analytics have potential to improve understanding of development environments, facilitate evidence-based policymaking and monitor development outcomes.

5. Sustainable multi-stakeholder approaches to developments- Private sector has predominant role in telecom. ICTs enable cooperation between government, business and other stakeholders to manage programmes.

4.2 Impact of Broadband on SDGs

A ubiquitous broadband connectivity is the critical enabler for an ecosystem which are important components of programmes aimed at attaining SDGs. The benefits of broadband as a tool for sustainable development are widely known. Universal connectivity offers a powerful platform to deliver essential services like e-governance, education, health, energy and financial inclusion and ensure that no-one is left behind.

An analysis conducted by ITU reviewed the impact of broadband, which indicated that, in the aggregate, mobile broadband appears to have a higher economic impact than fixed broadband, and that the impact is greater in less developed countries than in more developed countries. The study further suggested that globally an increase of 10 per cent in fixed broadband penetration yields an increase of 0.8 per cent in GDP, and an increase of 10 per cent in mobile broadband penetration yields an increase of 1.5 per cent in GDP. However, in more developed countries, the economic impact of fixed broadband is

greater than in less developed countries.[26]

By embracing broadband, governments are creating the foundations for unparalleled social and economic progress. Broadband connectivity is providing a basic building block in programmatic efforts in support of the SDGs. A research conducted based on multi-country demand-side surveys by Gallup and GSMA reveals that mobile phone ownership and internet access exhibit an improvement in people's lives.[27] The welfare benefits of broadband connectivity at the individual level are well established. It has been found that users in developing countries use mobile internet for communications and social networking than users in developed countries, whereas the latter use other services such as e-commerce and accessing health information and e-government services.[28]

4.3 Role of broadband in achieving SDGs

Broadband connectivity is critical for efforts to achieve the SDGs, providing a basic building block in programmatic efforts in support of the 17 goals and 169 targets. The enabling role of broadband on various SDGs is depicted below-

1. End Poverty

Improved broadband connectivity provides access to information on employment, health schemes and education, which will increase the chances that people can lift themselves out of poverty and also help ensure equal rights to economic resources and market insights that can benefit all. National Indicator 1.4.6= Number of mobile telephones as percentage

[26] The State of Broadband: Broadband as a Foundation for Sustainable Development, September 2019
[27] The Impact of Mobile on People's Happiness and Well-Being, Gallup and GSMA, 2018
[28] State of Mobile Internet Connectivity 2019, https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/07/GSMA-State-of-Mobile-Internet-Connectivity-Report-2019.pdf

of total population, is also related to telecom field.

The access to financial services like DBT has proven to be a pivotal step in helping people lead out of poverty. Studies suggest that an increase of 1 per cent of total telecom investment leads to a reduction of poverty rate (measured by per cent of population under US$1.90 per day) by 0.132 per cent point (PP). An increase of 1 per cent in mobile investment leads to a reduction of 0.0135 pp whereas for fixed telecom investment, it is 0.0045 pp[29].

2. Hunger & food security

The effective monitoring of state run food security schemes (for example-PDS) require a robust broadband infrastructure so that the benefits are reaped by needy and no pilferage takes place. The agriculture is becoming increasingly knowledge-intensive to feed a growing population. Broadband enables farmers improve crop yields through weather forecasts, training programmes, other online content tailored to their needs and knowledge transfer. It helps agriculture related business productivity through better access to market information. Digital infrastructure and Internet of Things (IoT) technologies can enhance agricultural sustainability and improve food security.

Studies suggest that an increase of 1% in total telecom infrastructure investment leads to a reduction in the percentage of undernourished people of 0.011 pp.[29]

No Food Waste initiative makes extensive use of broadband under which social start-take excess food from restaurants, parties, wedding parties, colleges etc and redistribute it to those in need and at risk of hunger — the homeless, poor and the elderly.

[29] Source- Frontier Economics analysis.

3. Health & well-being

A robust broadband infra-structure is an integral part of any healthcare ecosystem. Using broadband, the citizen can access health care services remotely regardless of their proximity to a healthcare centre. Health care workers can learn and prepare at a faster pace for disease outbreaks, identify patient symptoms, perform remote diagnostics, follow established treatment protocols, access expert support etc. It allows remote diagnostics, patient monitoring and providing payment options for health services.

The broadband facilitates emergency communication and broadcasting health related SOPs during health epidemics and enables users to access formal and informal health-related information via videos and mobile health applications. Online yoga classes and access to motivational videos also help improve mental and physical health. Studies have found that an increase of 1 percent in total telecom investment increases life expectancy by 0.0095 pp.[30]

Broadband also improves efficiencies in supply chain logistics, particularly for the distribution of medicine and medical equipment.

4. Education

Broadband enables students and teachers, especially those that are underserved and remote, to access information to support learning, online certification and student advisory services, etc. It also makes educational material available to the students. Using good broadband connectivity, students, teachers and institutions can interact and communicate

[30] Source- Frontier Economics analysis.

with each other to impart education. Digital learning/coaching has become fastest-growing industry.

Mobile devices with wireless broadband enable students to access learning resources anytime, anywhere. Mobile learning can help break down economic barriers, divides between rural and urban, as well as the gender divide.

5. Gender

Broadband empowers women and girls with access to information related to healthcare, nutrition, training, education, employment and markets etc. and thus provides opportunities for gender equality by enabling everyone to have access to the same online resources and opportunities. It provides women new opportunities for economic empowerment by creating business and employment, and also enables them to gain a stronger voice in their communities, their government and at the global level.

Increased broadband access for women and girls provides them tool to communicate with other women and communities, increases opportunities to assemble and access to online markets and services increase economic productivity of both women's market offerings and purchasing power. However, the gender gap in access to broadband is a hurdle into gender equality and gender empowerment and countries are required to enhance the use of enabling technology to promote the empowerment of women.

6. Water and Sanitation

The water management which includes measurement and monitoring of water supplies, necessary interventions, equitable and sustainable extension of water, sanitation and hygiene, requires an infrastructure built around broadband connectivity. This enable

governments to create a monitoring and evaluation frameworks to optimize operations and improve the quality of service.

The broadband along with other digital infrastructure, provides tools to efficiently manage and monitor water quality and consumption.

Figure 4.1 Telecom and SDGs

Source-ITU

7. Energy

Broadband enabled systems (eg smart grids, smart buildings, smart logistics and industrial processes) are helping to transform the world towards a more sustainable and energy efficient future. The broadband enabled technologies and processes have the potential

to play a significant role in significantly reducing global greenhouse gas emissions.

Smart meters provide household with a tool that improves awareness of energy usage. The sensors and control operated through broadband makes optimum usage of green energy sources.

8. Work & Economic Growth

Its an established fact that broadband is transforming the way that business is being done everywhere and creating new employment opportunities. It promotes economic development and empowers entrepreneurs and business leaders with the tools, skills and opportunities to stimulate and facilitate economic growth. Studies have found that an increase of 1 percent of total telecom investment leads to an increase in GDP of 0.09 pp.[29]

In addition to its direct economic contribution, broadband contributes to the SDG by allowing firms, especially micro, small and medium-sized enterprises (MSMEs), to become more efficient, access more customers and sell more in non-local markets, which creates jobs for local communities as well.

9. Infrastructure, Industrialization, Innovation

Broadband provides access to information for the management and optimization of important global and local infrastructure, such as water, power, transportation systems and communication networks. Connectivity between individuals and organizations is an essential enabler for innovation. Using broadband services, industry can improve productivity and use resources efficiently (e.g., Industrial Internet of Things, smart water and energy grids and advanced traffic management systems).

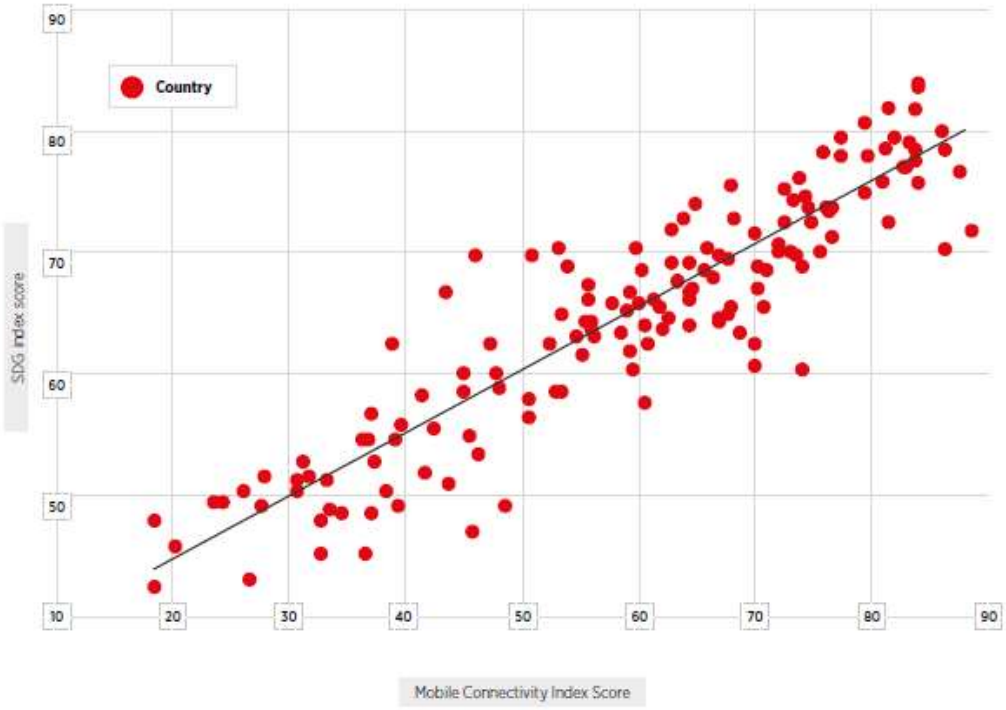


Figure 4.2 Relationship between SDG Index and Mobile Connectivity Index
Source GSMA Mobile Industry SDG Impact Report

'*ITU believes broadband must be considered essential infrastructure for the 21st-century due to its capacity to power industry and innovation. And ITU's role in the adopting of globally harmonized spectrum and standards is essential to facilitate the development of transformative digital infrastructure, such as 5G systems, that will drive scalable solutions to all 17 SDGs.*'[31]

Indian indicators for SDG, indicators 9.c.1 -Proportion of population covered by a mobile network, by technology and indicator 9.c.2 -No. of broadband subscribers per 10000 persons, are directly related to broadband.

10. Reduce inequality

Improved access to information and knowledge to disadvantaged segments of society

[31] https://www.itu.int/en/sustainable-world/

(persons with disabilities, women etc), the broadband helps to reduce inequality. However, due to the poor penetration of broadband among women (especially rural women), reducing inequalities is a challenge.

According to the researchers, investment in telecom improves social and development outcomes in a country. It facilitates digital inclusion by enabling access to information, services, social networks and marketplaces. The income inequality is reduced by broadband as it provides free access to knowledge and better work opportunities to remote areas. Telecom also contributes to economy by providing employment, thus bringing financial equalities.

Research has found that an increase of 1 percent in total telecom investment leads to as increase in the income share held by the lowest 10 percent of the 0.0013 pp and those of lowest 20 percent of 0.0027 pp[29].

11. Cities

More than half the world's population already living in urban areas and migration is continuing. The elements of smart cities like smart buildings, education, intelligent transport systems, health services, smart water and waste management, energy management etc requires a robust broadband infrastructure.

The connectivity between individuals and organizations improves productivity, management, and the economic activity of cities, making them more eco-friendly and sustainable. The citizen can participate in policy and decision-making processes. Cities having efficient resource and transport systems, improves the productivity of their residents.

12. Sustainable consumption & production

Broadband contributes to the SDG by enabling mechanisms for e-waste management, creating awareness programmes accessibility and by catalysing policy developments.

Broadband enabled smart metering, smart grids, reduced energy consumption etc have a positive impact on reducing our consumption. However, broadband system also consumes energy, which is optimised using a number of technological tools.

13. Climate Change

Broadband plays a critical role in collecting earth monitoring data, sharing climate and weather information, forecasting and early warning systems. It helps to prepare for and mitigate the effects of climate change through forecasting and early warning systems. It also enables build awareness among citizen and improve levels of preparation and resiliency.

Smart applications which provide green or efficient solutions for manufacturing, transport systems and infrastructure are fuelled by broadband, thus enable other sectors of the economy to reduce their greenhouse gas (GHG) emissions.

14. Oceans

Broadband supports technical platforms that act as channels to capture and enable access to information and data for improved monitoring and reporting which leads to increased accountability. Satellite-based monitoring delivers timely and accurate data on a global basis, while local sensors deliver on the spot updates in real-time, and are

transported using broadband networks to the relevant stack-holders.

15. Land

The sensors and IoTs used for monitoring of terrestrial ecosystems, desertification, water flows, climate parameters, wild-life etc make use of broadband systems. This helps in conservation and prevention of the loss of biodiversity. The Satellite-based monitoring data and local sensors' on the spot updates in real-time flow over broadband networks for further analysis.

16. Peace & Justice

Broadband is a crucial element in obtaining, communicating and transmitting accurate and timely information during disasters, enabling appropriate responses to be made. Broadband facilitates access to information and the right to free expression, while digital identity leverages mobile as a trusted and robust solution for the underserved. Governments and communities make use of digital infrastructure powered by broadband to strengthen the rule of law and promote the institutions of good governance.

Most of crisis management, humanitarian aid and peacebuilding, electoral monitoring etc are better managed with the use of broadband which increases transparency, empowers citizens, and helps to drive economic growth.

17. Partnership

Broadband enables effective collaboration between different industries and sectors as well as between public and private sectors. It provides an innovative and effective means of implementation in today's inter-connected world.

Broadband works as a catalyst to accelerate economic growth, social inclusion and environmental sustainability which are the three pillars of sustainable development. Paragraph 15 of the 2030 Agenda for Sustainable Development highlights that "*the spread of information and communication technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies…"*.

Table 4-1 Examples of Telecom interventions mapped to the SDGs

Area	SDG	Examples
Health, water, sanitation	SDG 3: Ensure healthy lives and promote well-being for all at all ages. SDG 6: Ensure availability and sustainable management of water and sanitation for all.	Sensor- and SMS-enabled village water pumps (Rwanda, Kenya); GSM-connected fridges for vaccines in the 'cold chain' (Global); sensor-enabled 'band aid' to monitor Ebola patients' data (W.Africa); water stream gauge with sensors to monitor river flow/depth (Honduras).
Agriculture & livelihoods	SDG 1: End poverty in all its forms. SDG 8: Promote sustained, inclusive & sustainable economic growth, full & productive employment & decent work for all. SDG 2: End hunger, achieve food security & improve nutrition & promote sustainable agriculture.	Connected micro-weather stations improving localized weather data and provision of crop failure insurance (Kenya); low-cost mobile-controlled micro irrigation pumps (India); soil-monitoring sensors used to improve tea plantations (Sri Lanka, Rwanda); RFID for tracking, theft prevention and vaccination of livestock (Botswana, Senegal & Namibia).
Education	SDG 4: Ensure inclusive and equitable quality education & promote lifelong learning opportunities for all.	Smart identity cards with biometric features for education (Nigeria); biometric clocking to improve teacher attendance (South Africa); Connected Schools Initiative (Spain). At Kenyatta University in Kenya, staff use identity cards to clock in/out of campus. Students use identity cards to clock in, borrow books & pay for food.

Area	SDG	Examples
Environment & Conservation	SDG 12: Ensure sustainable consumption and production patterns. SDG 13: Take urgent action to combat climate change and its impacts. SDG 14: Conserve and sustainably use the oceans, seas & marine resources for sustainable development. SDG 15: Protect & promote sustainable use of terrestrial ecosystems, manage forests, combat desertification, reverse land degradation & halt biodiversity loss.	Radio-based cloud-connected devices to identify and track the presence of illegal fishermen (Timor-Leste); air pollution sensors to monitor urban outdoor air pollution (Benin); acoustic sensors to monitor sea bird populations (global); sensors and connectivity to protect game park perimeters and track animals (Africa); connected unmanned aerial vehicles monitor national parks and connecting images from camera traps (UAE); acoustic sensors in tropical rainforests 'listening' for illegal logging (Indonesia).
Resiliency, Infrastructure & Energy	SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all. SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, & foster innovation. SDG 11: Make cities and settlements inclusive, safe, resilient & sustainable.	National Plan for Smart Cities (Spain). VimpelCom has enabled donations via SMS for people struck by natural disasters in Georgia and Tajikistan.
Governance & Human Rights	SDG 10: Reduce inequality within and among countries. SDG 16: Promote peaceful and inclusive societies for sustainable development, access to justice & accountable, inclusive institutions.	Retinal scans used for ATMs providing secure biometric cash assistance to displaced refugees (Jordan).
Cross-cutting	SDG 5: Achieve gender equality and empower all women and girls. SDG 17: Strengthen the MoI and revitalize the global partnership for sustainable development.	ICTs can be used to enable girls and women to learn more about their rights online and to acquire skills. VimpelCom runs an m-Literacy program aimed at empowering (digitally) illiterate women in rural areas of Pakistan.
Source: ITU & Cisco Systems.		

Summary

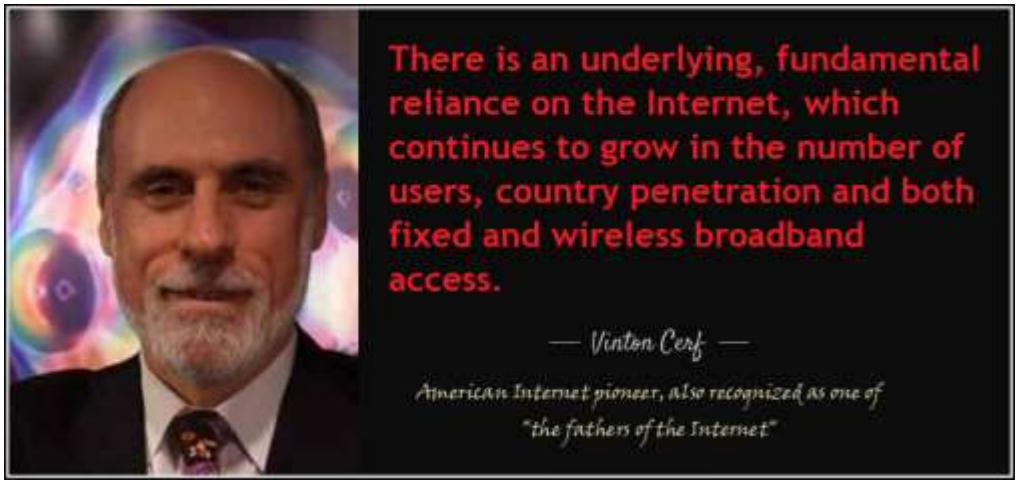
The SDGs have set us on an incredible path to solving the greatest challenges of our time. Broadband networks have the power to accelerate this journey in a way that no other technology can by enabling greater inclusion in vast cities and remote villages, transforming communities, delivering healthcare in ways never imagined, opening doors to education, employment and income opportunities, creating smarter cities, empowering people with the tools they need to thrive and driving a more sustainable planet.

The Global e-Sustainability Initiative (GeSI) argues that '*digital solutions from all areas of life can directly contribute to SDG achievements'* and emphasises that '*digital solutions are indispensable, they transform the world quickly, with attractive propositions to people and with a positive impact to achieve all of the SDGs*'[32].

The governments are creating the foundations for unprecedented global, social and economic progress by embracing broadband. Broadband networks will define India's future in many ways and will enable India to leapfrog ahead of many countries. Our global competitiveness depends on the widespread access and speed of broadband proliferation. India is on the brink of entering a new phase of growth, facilitated by the Government's ambitious and progressive programs on various walks of life, and, broadband can stimulate this growth significantly.

[32] Http://systemtransformation-sdg.gesi.org/, 2016

5 Findings and Conclusions



5.1 Introduction

This chapter covers about the role of broadband in achieving identified indicators of selected SDGs, responses of various officials dealing with SDGs and broadband for identifying the indicators and finally the study and recommendations for the improvement of broadband penetration across country. The officers dealing exclusively with telecom (including broadband) were requested to respond and provide their considered opinion on various measures required for the same.

The purpose of this study was to study the role of broadband in achieving SDGs. Due to paucity of the time available, the study was limited to two identified indicators of two selected SDGs. Further, the study was limited to two better performing states and two poor performing states. Study was also made about the regulatory framework for broadband, find the impediments in increase in penetration of broadband and also suggest way forward to improve the broadband acceleration.

5.2 Methodology

Two separate questionnaires were prepared using google forms and the respondents were asked to provide their responses online. The questionnaire related to identification of indicators was administered to senior government officials dealing with SDG and broadband implementation and monitoring. The second questionnaire related to improving broadband penetration was administered to senior government officials dealing with Policy, planning, implementing and maintenance of broadband services. Some respondents from private telecom companies dealing with broadband services were also administered the same. The questions were simple statements related to whether the broadband helps in achieving the mentioned indicators and opinions on factors impending broadband growth and possible policy measure. The participants were asked to indicate their opinions in form of negative or affirmative or in multiple choice.

5.3 Role of Broadband in achieving SDGs

5.3.1 Selection of SDGs

After thorough study of the literature, two SDGs were selected by the author, namely- SDG 1: No Poverty and SDG 8: Decent Work and Economic Growth. Poverty is a multi-dimension phenomenon, indicating the lack of income or access to resources. It also represents reduced opportunities for hunger & malnutrition, education, social discrimination and the inability to participate in decision-making processes. Eradicating poverty in all its forms remains one of the greatest challenges globally. This Goal has 7 targets and 21 indicators have been identified under National Indicator Framework, however, to monitor the progress of these targets and baseline data is available for 19 indicators[33].

[33] SDG Progress report 2020, ver 2.1

Table 5-1 List of Indicators for SDG-1

Target	National Indicator
1.1: By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day	1.1.1: Proportion of population living below the national poverty line.
	1.1.2: Poverty Gap Ratio
1.2: By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	National Indicator not yet evolved
1.3: Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable	1.3.1: Percentage of households with any usual member covered by a health scheme or health insurance
	1.3.2: Number of Beneficiaries under Integrated Child Development Scheme (ICDS)
	1.3.3: Proportion of the population (out of total eligible population) receiving social protection benefits under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)
	1.3.4: Number of Self Help Groups (SHGs) formed and provided bank credit linkage
	1.3.5: Proportion of the population (out of total eligible population) receiving social protection benefits under Maternity Benefit
	1.3.6: Number of senior citizens provided institutional assistance through Old Age Homes/Day Care Centres funded by the Government
1.4: By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	1.4.1: Proportion of population (Rural) living in households with access to Safe drinking water & Sanitation (Toilets)
	1.4.2: Proportion of population (Urban) living in households with access to Safe drinking water & Sanitation (Toilets)
	1.4.3: Proportion of population (Urban/Rural) living in households with access to Electricity
	1.4.4: Proportion of homeless population to total population
	1.4.5: Proportion of population having bank accounts
	1.4.6: Number of mobile telephones as percentage of total population
1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	1.5.1: Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population
	1.5.2: Proportion of States that adopt and implement local disaster risk reduction strategies in line with national disaster reduction strategies
1.a: Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions	1.a.1: Proportion of domestically generated resources allocated by the government (Central & State) directly to poverty reduction programmes
	1.a.2: Proportion of total government spending on essential services (education, health and social protection)
1.b: Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions	1.b.1: Proportion of budget earmarked under pro-poor gender specific budgeting.

(Source-MoSPI SDGs National Indicator Framework report)

The Goal 8 encourages sustained economic growth through technological innovation by achieving higher levels of productivity. Effective measures to eradicate forced labour, human trafficking and slavery by encouraging entrepreneurship and job creation are key to this Goal. This SDG aims to achieve full and productive employment, reduce the gender pay gap and promote safe and secure working environments for all women and men by 2030. There are 12 targets distributed in 32 indicators at national level to measure and monitor the progress of the goal. However, the data is available for 27 indicators[33] only.

Table 5-2 List of Indicators for SDG-8

Target	National Indicator
8.1: Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	8.1.1: Annual growth rate of GDP (adjusted to price changes) per capita
8.2: Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors.	8.2.1: Annual growth rate of GDP per employed person
	8.2.2: Total number of patents issued
	8.2.3: Annual growth in manufacturing sector
	8.2.4: Annual growth in agriculture sector
8.3: Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services	8.3.1: Proportion of unorganized employment in non-agricultural sectors
	8.3.2: Coverage under ESI and EPS
	8.3.3: Coverage of NPS
	8.3.4: No. of MSME units registered under the online Udyog Aadhaar registration.
	8.3.5: Number of start-ups recognized under Start-up India
	8.3.6: Total number of patents issued.
	8.3.7: Growth of Registered Micro, Small and Medium Size Enterprises
	8.3.8: Total loans outstanding to micro, small and medium enterprises
	8.3.9: Outstanding Credit to Micro, Small and Medium Enterprises
8.4: Improve progressively, through 2030, global resource efficiency in consumption and production and Endeavour to decouple economic growth from environmental	8.4.1: Renewable energy share in the total final energy mix
	8.4.2: Per capita fossil fuel consumption
degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead.	8.4.3: Proportion of waste recycled vs. waste generated
	8.4.4: Proportion of sewage recycled vs. sewage generated

Target	National Indicator
8.5: By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	8.5.1: Unemployment rate
	8.5.2: Workforce Participation Ratio (WPR) .
	8.5.3: Wages earned by malefemale in regular / casual employment
	8.5.4: Number of employed persons with disabilities in public services.
	8.5.5: Total population with disabilities covered under social protection schemes
	8.5.6: Share of unemployed persons in population aged 15-24 (percentage)
8.6: By 2020, substantially reduce the proportion of youth not in employment, education or training	8.6.1: Unemployment Rate (15 24 years)
	8.6.2: Proportion of youth (15-24 years) not in education, employment or training (NEET)
8.7: Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms	8.7.1: Total crimes relating to human trafficking
	8.7.2: Number of missing children
8.8: Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	8.8.1: Number of workers covered under Employees State Insurance (ESI) Act
	8.8.2: Number of migrant workers
	8.8.3: Number of accidents in factories.
	8.8.4: Employment generated under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)
8.9: By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products	8.9.1: Percentage change in number of tourists (domestic and foreign)
	8.9.2: Direct contribution of Tourism to total GDP and in growth rate
8.10: Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all	8.10.1: Indicator on Financial Inclusion
	8.10.2: Proportion of population having Bank accounts
	8.10.3: Number of banking outlets per 1,00,000 population
	8.10.4: Automated Teller Machines (ATMs) per 1,00,000 population
	8.10.5: No. of accounts with Nil/1-5/more than 5 transactions
8.a: Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-related Technical Assistance to Least Developed Countries	National Indicator not yet evolved
8.b: By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labour Organization	8.b.1: Number of man days created under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)

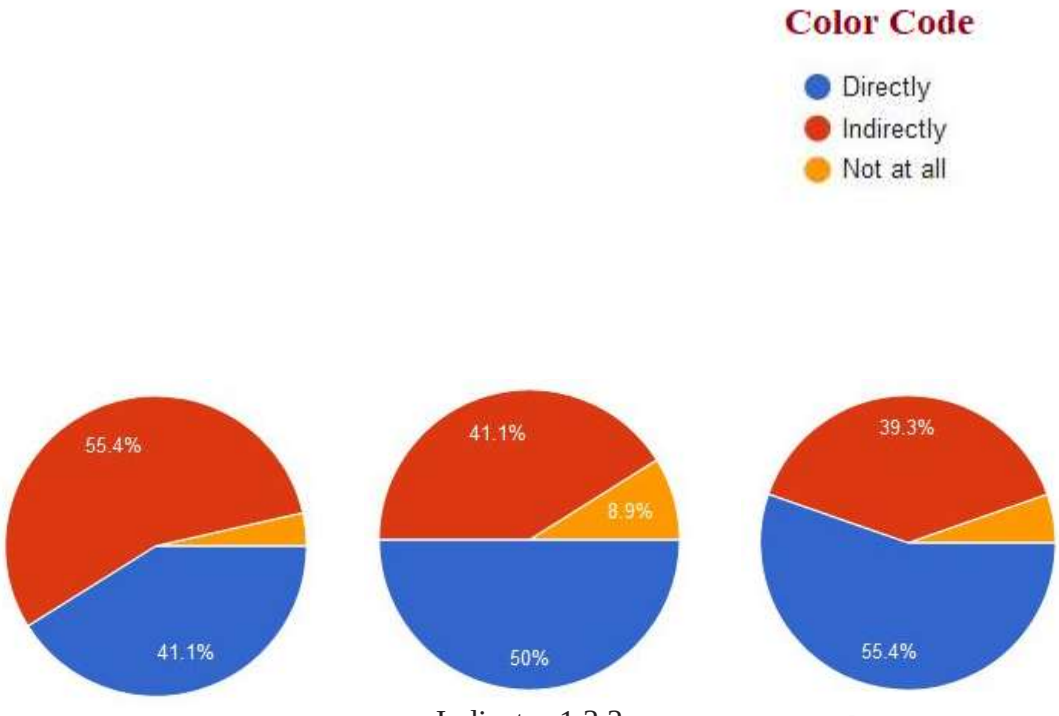
(Source-MoSPI SDGs National Indicator Framework report)

5.3.2 Identification of Indicators

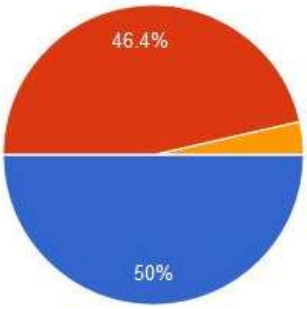
The author, with his background knowledge in the field of broadband, identified indicators 1.3.1, 1.3.3, 1.3.4, 1.3.5, 1.4.5, 1.a.2, 8.1.1, 8.2.2, 8.3.5, 8.5.1, 8.9.1 and 8.10.3 for seeking further opinions from officers dealing with SDGs and broadband to narrow down to two indicators. The officers were asked whether the broadband plays role in achieving the indicator and they were requested to choose either of 'Direct', 'Indirect' or 'Not at all'. The questionnaire in placed at annexure-2 and the responses received are in Annexure-3.

A total of 75 officers were targeted, however, the responses were received from 56 officers, covering a wide horizon of officers from NITI Aayog, MoSPI, MoC, State Planning/Statistical officers. As such, the sample represents a proper blend of officers involve in SDGs and Broadband.

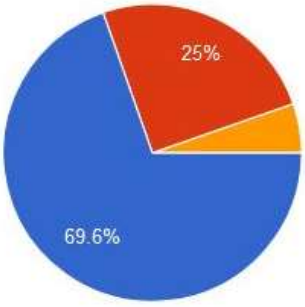
The responses as to how broadband helps in achieving mentioned 'indicators', are depicted below-



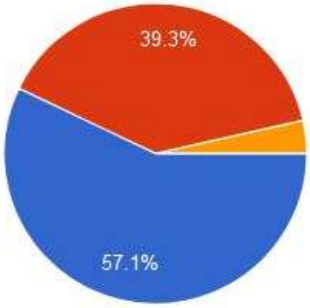
Indicator 1.3.1 Indicator 1.3.3 Indicator 1.3.4



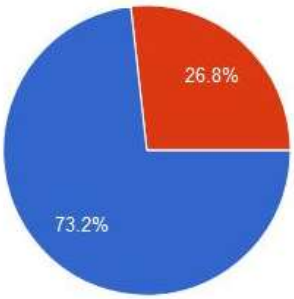
Indicator 1.3.5



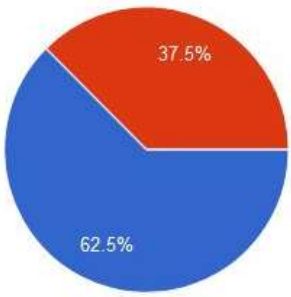
Indicator 1.4.5



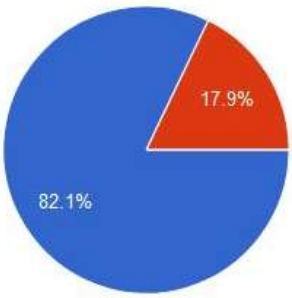
Indicator 1.a.2



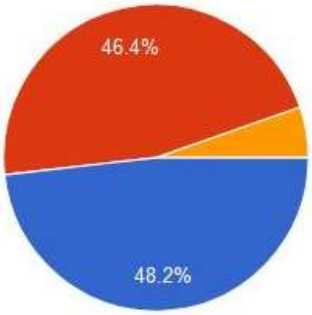
Indicator 8.1.1



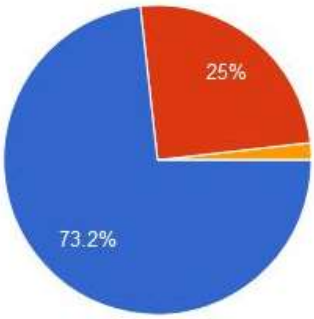
Indicator 8.2.2



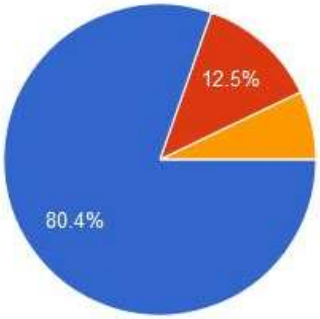
Indicator 8.3.5



Indicator 8.5.1



Indicator 8.9.1



Indicator 8.10.3

From the above responses, it is evident that most officers believe that broadband plays either a direct or indirect role in achieving SDGs. It is opined by most of officers that indicators 1.4.5 and 1.a.2 (of SDG-1) and indicators 8.3.5 and 8.10.3 (of SDG-8) are impacted positively by broadband.

5.3.3 Achievement of States of identified indicators

The SDG report-2020 (ver. 2.1) of NITI Aayog, has the latest data on indicator-wise achievements of states. The report does not have states-wise achievement of for

identified indicators 1.a.2 and for indicator 1.3.4 (with next highest votes), indicator 1.3.3 is selected for further analysis. Similarly, instead of indicator 8.3.5, indicator 8.9.1 is selected. The state-wise achievement for these finally identified indicators 1.3.3, 1.4.5, 8.3.5 and 8.10.3 are given in Annexure-4.

The broadband density data for three years are as given below in the table. It is worth to note that the TRAI releases data as per telecom service areas and not as per state boundaries. As such, Delhi Service area, apart from the State of Delhi, includes areas of Ghaziabad & Noida (UP) and Gurgaon & Faridabad (Haryana). Further, data/information for Andhra Pradesh includes Telengana, Madhya Pradesh includes Chhatishgarh, Bihar includes Jharkhand, Maharashtra includes Goa, Uttar Pradesh includes Uttarakhand, West Bengal includes Sikkim and North-East includes Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland & Tripura states.

Table 5-3 Broadband Density Report

Telecom Service Area	BB Density Mar'19	BB Density Mar'18	BB Density Mar'17
Andhra Pradesh	48.97	35.48	23.31
Assam	29.97	21.65	14.43
Bihar	23.28	14.42	8.45
Delhi	142.51	117.88	89.58
Gujarat	56.00	42.63	28.06
Haryana	46.96	27.84	23.97
Himachal Pradesh	63.71	86.14	32.47
Jammu & Kashmir	46.21	35.49	21.73
Karnataka	57.04	43.60	30.61
Kerala	61.70	48.85	34.67
Madhya Pradesh	32.76	19.47	13.92
Maharashtra	56.37	43.02	30.21
North East	41.16	31.65	20.27
Orissa	31.28	20.95	13.82
Punjab	67.86	51.35	36.85
Rajasthan	41.88	27.76	16.77
Tamil Nadu	56.68	46.24	31.52

Telecom Service Area	BB Density Mar'19	BB Density Mar'18	BB Density Mar'17
Uttar Pradesh	27.30	19.12	11.07
West Bengal	14.40	27.92	19.72
Total	**42.89**	**31.41**	**21.05**

(Data source- Yearly reports by TRAI)

Notes-

1. The North-Eastern states have not been included in the above data set as the TRAI provides the composite data for whole north-east zone.
2. indicators 1.a.2, 1.3.4 and 8.3.5 have been excluded as the NITI Aayog report does not have state-wise data.
3. Though Andhra Pradesh, Bihar, Jharkhand and Uttar Pradesh have been included in above study, the TRAI data for Andhra Pradesh includes Telengana, Bihar includes Jharkhand and Uttar Pradesh includes Uttarakhand.

The two best achieving and poor achieving states against these identified indicators are as below-

Indicator	Best performing State	2nd best performing State	Poor performing State	2nd poor performing State
1.3.3 MGNREGA (2018-19)	Himachal Pradesh (91.6%) Broadband ranking-3	Andhra Pradesh (91.4%) Broadband ranking-9	Jharkhand (75.4%) Broadband ranking-18	Punjab (76.1%) Broadband ranking-2
1.4.5 Number of accounts per 1,000 population (2017-18)	Delhi (2782.84) Broadband ranking-1	Tamil Nadu (2346.66) Broadband ranking-5	Bihar (1050.69) Broadband ranking-19	Uttar Pradesh (1247) Broadband ranking-18
8.9.1 Percentage change in number of tourists (2018 over 2017)	Uttar Pradesh (21.6%) Broadband ranking-18	Jammu and Kashmir (20.3%) Broadband ranking-9	Haryana (-20%) Broadband ranking-13	Himachal Pradesh (-16.1%) Broadband ranking-2
8.10.3 Banking outlets per 1,00,000 population (2018-19)	Himachal Pradesh (393) Broadband ranking-3	Odisha (290) Broadband ranking-15	Kerala (28.5) Broadband ranking-4	Tamil Nadu (90.2) Broadband ranking-6

5.3.4 Analysis of Broadband vs SDG achievement of States

The primary data used in the study come from 56 responses (out of 75 targeted), which is about 75 percent of the total respondents who were asked to opine. While evaluating data received through responses by sending questionnaire to targeted population, it is observed that most of the participants respond in a way establishing important role of broadband in achieving SDG indicators, directly and indirectly. Based on the demographics of 56 those who participated in the study, there is no reason to believe that those who did not participate in the survey instrument are different from those who did. Simple descriptive statistics were obtained from the data and are discussed in the following paragraphs.

The comparison of best performing and poor performing states with their broadband density data (for that particular year) has mix results. For example, two best performing states for indicator 1.3.3 (Persons provided employment as a percentage of persons who demanded employment under mahatma Gandhi National rural Employment Guarantee act (MGNREGA)) are also having high ranking in broadband density and the poor performing state of Jharkhand has poor ranking in broadband density, Punjab being an exception with good ranking in broadband density and poor performance against the indicator. Similarly, two best performing states of Delhi and Tamil Nadu for indicator 1.4.5 (Number of accounts (include deposit and credit accounts) of scheduled commercial banks per 1,000 population) also have high ranking in broadband density, and the poor performer states of Bihar and UP have poor ranking in broadband density. The achievement for indicator 8.9.1 (State/UT-wise percentage change in number of tourists during the reference year over previous year) does not commensurate with broadband density data. Same is true for indicator 8.10.3 (Number of banking outlets per 1,00,000 population) except for state of Himachal Pradesh, which has performed good

and also ranks good for broadband density.

A comparison of the ranking of states on SDG achievement and broadband density is shown below for year 2019.

Table 5-4 SDG vs Broadband ranking of States

State	SDG Rank (2019)	Broadband Density Rank (2019)
Kerala	1	4
Himachal Pradesh	2	3
Andhra Pradesh	3	9
Tamil Nadu	3	6
Telangana	3	9
Karnataka	6	5
Goa	7	*
Sikkim	7	*
Gujarat	9	8
Maharashtra	9	7
Uttarakhand	9	*
Punjab	12	2
Manipur	13	*
West Bengal	13	20
Madhya Pradesh	15	15
Odisha	15	16
Tripura	15	*
Haryana	18	10
Nagaland	18	*
Rajasthan	18	13
Chhattisgarh	21	*
Mizoram	21	*
Assam	23	17
Uttar Pradesh	23	18
Meghalaya	25	*
Arunachal Pradesh	26	*
Jharkhand	26	19
Bihar	28	19

* Data not published by TRAI separately for these states.

Data source: SDG- NITI Aayog, BB density-TRAI

The above table indicates a correlation between broadband density and SDG achievement, with Punjab and West Bengal being the exceptions. Punjab is ranking high

in broadband density but a poor performer for SDG, West Bengal being otherwise. It needs to be noted that the broadband density ranks up to 20 only as many states are clubbed in TRAI report (notes below table 5.3).

5.4 Improving penetration of Broadband

Telecommunication has emerged as a key driver of economic and social development during the last two decades, in an increasingly knowledge-driven globalised world where voice, video, data, internet and wideband multimedia services are indispensable.

COVID-19 pandemic has shown that the Government and private enterprises including common public are relying more on the use of broadband connectivity for interaction in comparison to physical travel. Post pandemic era, it is anticipated that, we will live in a world which facilitates socializing and economic activities with minimized human contact. The widespread availability and use of broadband have both economic and social benefits. The use of telecom and broadband connectivity will be important part of daily life.

Government of India has initiated many digital economy initiatives, which requires a robust, reliable, low latency, and high-speed broadband infrastructure for successful execution of them. Similarly, other advances like sensors networks, IoT, big data, machine learning, automation, Intelligent Transport Systems and AI also depend extensively on cloud services and broadband connectivity. A High-speed broadband infrastructure creates an enabling environment and builds foundation for technologies, applications, services and businesses to be developed.

5.4.1 Government initiatives to improve Broadband penetration

1. NDCP-2018 envisages broadband for all by 2022 and to propel India to the top 50 nations in the ICT Development Index of ITU from 134 in 2017. NDCP proposes to create robust digital communications infrastructure to promote '*Broadband for All'* as a part of the Connect India mission, together with ensuring service quality and environmental sustainability. Following goals relating to broadband have been laid down for 2022 under Connect India mission:

    i. Provide Universal broadband connectivity at 50 Mbps to every citizen

    ii. Provide One Gbps connectivity to all Gram Panchayats of India by 2020 and 10 Gbps by 2022,

    iii. Enable 100 Mbps broadband on demand to all key development institutions, including all educational institutions,

    iv. Enable fixed line broadband access to 50% of households.

2. Recently, the Government has approved schemes like fibre to all villages and PM-WANI project to extend the broadband access to commercially non-remunerative areas of the country. Other initiatives like BharatNet project, projects to improving telecom services in Andaman & Nicobar Islands (ANI) and Lakshadweep by laying under-sea OFC, scheme to improve telecom connectivity in Ladakh region etc are also being taken.

3. '*Fibre First Initiative'* under NDCP aims to facilitate a '*Fibre-to-the-tower'* programme to enable fiberisation of at least 60% of mobile telecom towers. Accordingly, to address the issues relating to RoW, the Government with the aim

of streamlining the process of RoW permissions, has notified the Indian Telegraph Right of Way (RoW) Rules[34] 2016 (the Rules). Its salient points include:

a) A single-window clearance mechanism for RoW permissions by all state Governments

b) One–time fee capped for telecom infrastructure installation

c) Time-bound clearances with deemed approvals

4. DoT, vide its references dated 26th April 2019, dated 8th May 2019 and 6th June 2019 requested TRAI to furnish its recommendations on various points like categories/speeds of broadband, infrastructure creation and on securing universal broadband access as provisioned in NDCP.

5.4.2 Finding challenges in increasing Broadband penetration and policy inputs

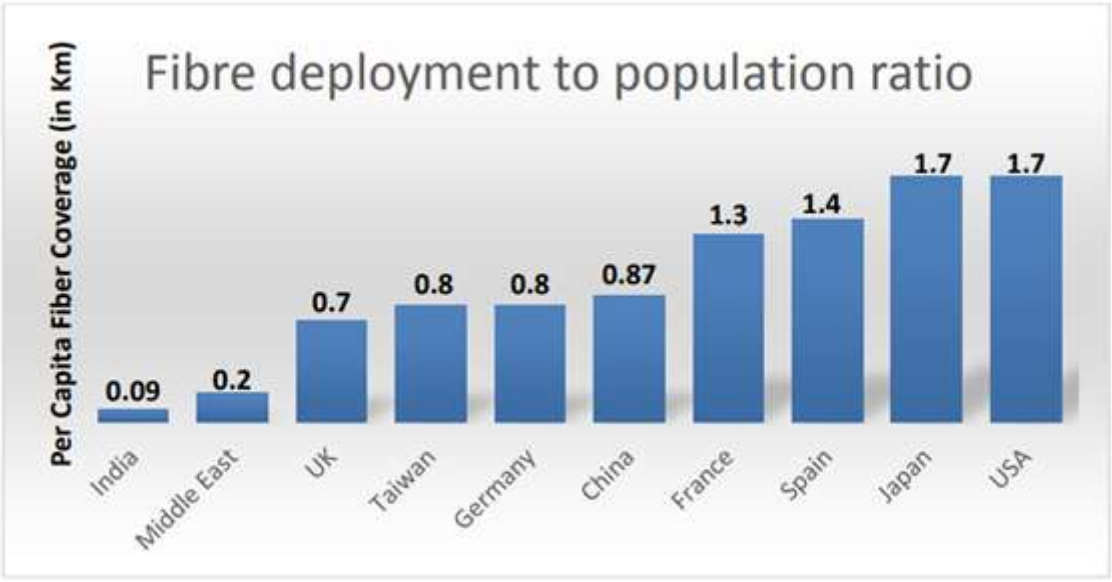
The telecommunication infrastructure is the foundation for any developing country in the race of digital transformation of the society, however, creating a robust broadband infrastructure is a capital intensive activity. For proliferation of broadband services and achieving the NDCP objective of broadband with a speed of 50 Mbps for all, significant amount of investment would be required in the field. It requires huge investments in the in various telecom infrastructure, like duct, fiberisation, Right of Way (RoW), Towers and spectrum (in case of wireless broadband) and time. For setting up a ubiquitous, secure, accessible, resilient and affordable Communications Infrastructure, prerequisite

[34] https://dot.gov.in/sites/default/files/ROW_2016.pdf?download=1

is to ensure easy availability of passive infrastructure.

Creating terrestrial fibre network for fixed wired and wireless broadband services comes with an inherent infrastructure expense based on a cost per kilometer that is difficult to scale while maintaining affordable prices for end users while connecting remote or rural communities.

Other challenge is investment at subscriber end on internet-enabled handsets. Though the subscription of mobile broadband has become cheaper, internet-enabled handsets are still unaffordable for masses, as the cost of these devices has not fallen significantly. This high cost remains a key barrier to mobile broadband adoption in low and middle income groups. As per TRAI, only 60% of mobile subscribers are having broadband connections.



Source: tele.net

Figure 5.1 Per capita fibre coverage

Apart from the issue of affordability of mobile broadband services and smartphones, the other challenges are as mentioned below-

- Unaffordability of handset and broadband charges, people below poverty line

(22% of population)

- Education factor of the subscriber including digital literacy.
- Availability of content and application in different vernacular languages
- Shared broadband connection (fixed line or mobile broadband) among different family members.

The author framed 20 questions covering the areas related to possible impediments, their causes and possible solutions from the service providers points as well from subscribers' perspective. The questionnaire, in the form of google form was circulated to around 150 officers/official involved in broadband policy planning, implementation and maintenance. Some of the officials from Private Telecom Service Providers who are having in broadband related assignment were also requested to respond. The questionnaire in placed at annexure-5.

5.5 Response Analysis

This section analyses the responses received on the impediments and possible policy suggestions for improving the broadband penetration Around 150 officers dealing with broadband policy planning, implementation and maintenance the broadband services were requested to provide their opinions. This also included officials from private telecom players involved in planning, implementation and maintenance the broadband/mobile services. Attempt was made to find the reasons and solutions from subscriber, policy and service providers' perspectives. A total of 91 officers/officials, from above segment covering almost all parts of the country, responded.

5.5.1 Issues pertaining to subscribers

1. As per latest TRAI report (Dec'2020)[35], there are 22.29 million fixed broadband subscribers (3%), whereas mobile based broadband subscribers are 724.46 million (97%) in addition to 0.65 million (0.08) fixed wireless subscribers. Presently only 60% of mobile subscribers use data services, obviously, if more mobile subscriber start using data services, the broadband density will increase steadily.

Therefore, the respondents were asked-

Q. Even though mobile broadband services are easily available and accessible, what could be the probable reasons that approximately 40% of total mobile subscribers do not access data services?

☐ Non-affordability of internet-enabled handsets,

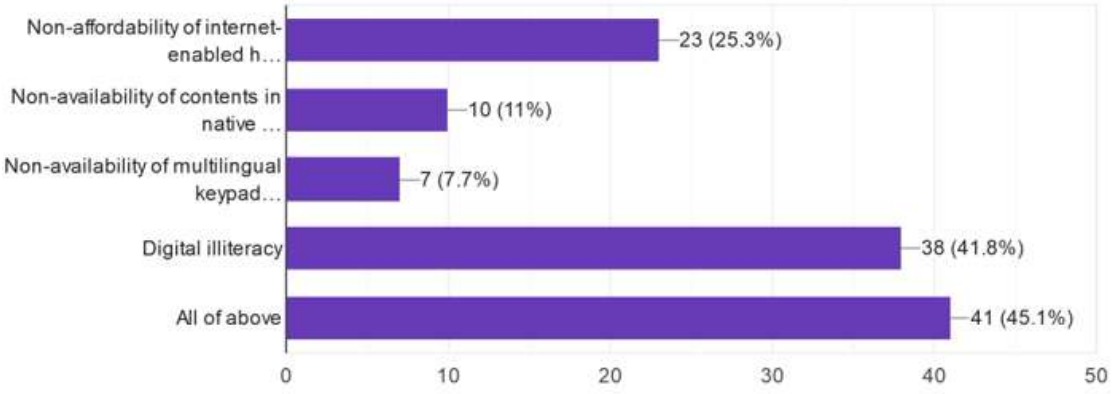
☐ Non-availability of contents in native languages

☐ Non-availability of multilingual keypads of mobile devices,

☐ Digital illiteracy

☐ All of above

And the respondents (as below) opined non-affordability of internet-enabled handsets and digital illiteracy major reasons among other issues.



[35] https://trai.gov.in/sites/default/files/PR_No.06of2021_0.pdf, accessed on 20.02.2021

2. As regards the fixed broadband service, the repondents were asked-

   Q. *Worldwide, fixed broadband services are considered reliable and capable of delivering higher speeds, still, why subscription rate for fixed broadband is so poor in India?*

   ☐ *The requirement is fulfilled by mobile data*

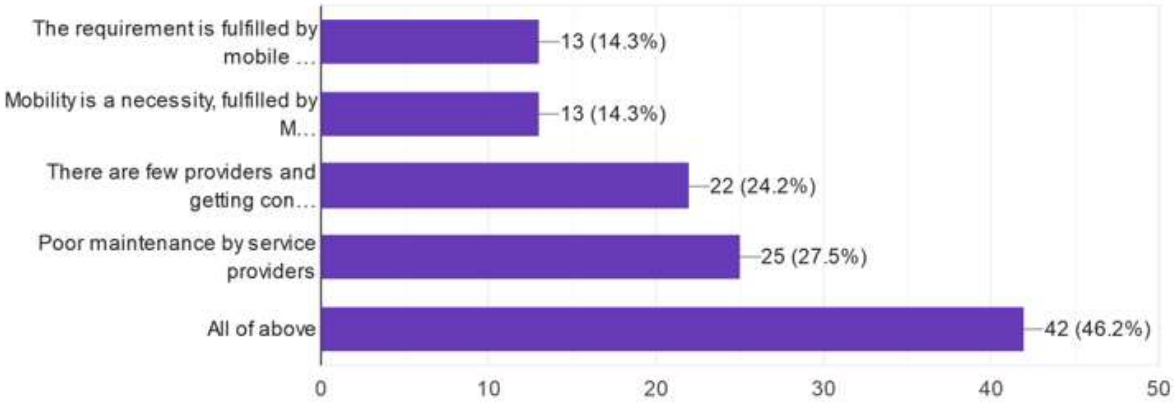
   ☐ *Mobility is a necessity, fulfilled by mobile*

   ☐ *There are few providers and getting connection is not easy*

   ☐ *Poor maintenance by service providers*

   ☐ *All of above*

The respondents opined that there are few providers and getting connection is not easy, and poor maintenance by service providers is also an issue-



3. India has only 2.93 million FTTH connections (Less than 15% of total wireline broadband connections) in comparison to over 350 million in China, though FTTH is considered as future-proof solution and it provides a Gbps speed with better latency[36] performance. The growth of FTTH broadband connections during the last 5 years is presented below-

[36] the time it takes for a small data set to be transmitted from your device to a server on the Internet and back to your device again.

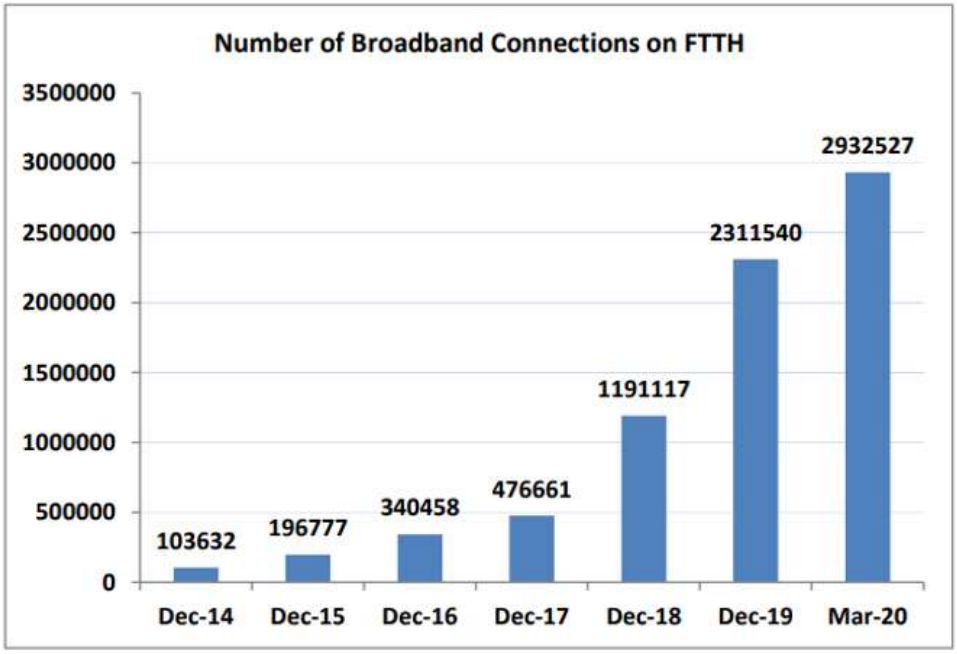


Figure 5.2 FTTH Broadband Connections Growth in Last 5 Years

Source- TRAI subscriber data report

Therefore, the respondents were requested to opine on the possible reasons by asking-

Q. What could be the factors attributable to the very poor penetration of FTTH services in India?

☐ Data requirement are fulfilled by mobile

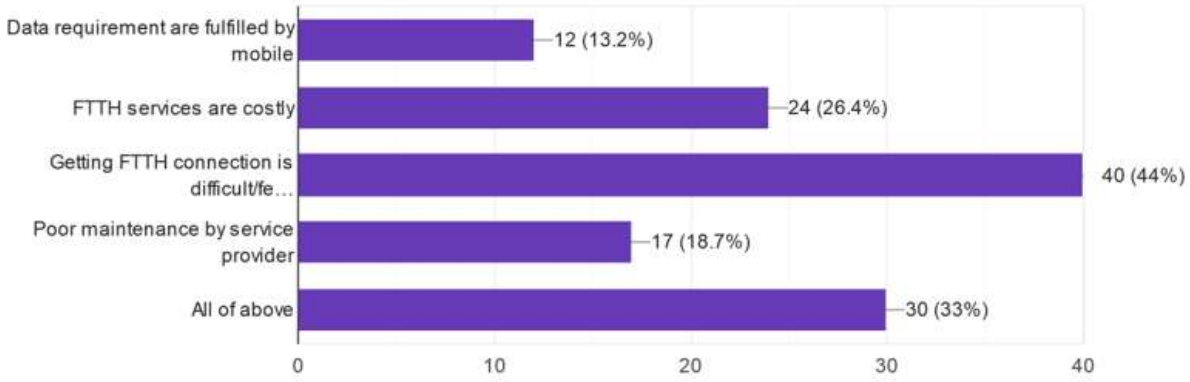
☐ FTTH services are costly

☐ Getting FTTH connection is difficult/few providers

☐ Poor maintenance by service provider

☐ All of above

The respondents felt that getting FTTH connection is difficult/few providers and FTTH services are costly, among other reasons.



4. Broadband speed must be above a certain threshold to access a particular type of applications such as real-time gaming, video conferencing or OTT services[37]. Therefore, the threshold speed (uplink or downlink) of required broadband varies for subscribers' utilisation requirements. Further, speed is perceived majorly as a quality parameter by a subscriber, though jitter[38] and latency also play an important role among quality parameters. In view of this, following two questions were asked-

   Q (a). Various applications such as video conferencing, real-time gaming, OTT services etc require different Broadband speeds. Do you think there is a need to define different categories of broadband like Basic, Superfast, Ultrafast etc (depending upon the speed) to give consumer a better and affordable choice?

   ☐Yes ☐ No ☐ Can't say

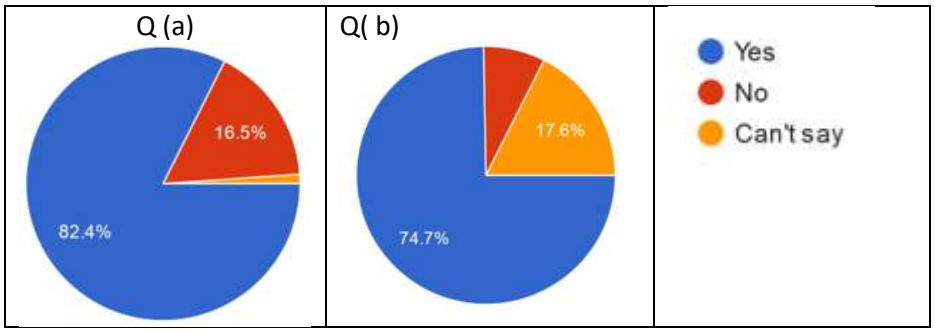
   Q (b). Speed is the single most important metric perceived as the 'quality' of broadband service by a consumer. Do you feel a need to introduce the speed measurement program in the country for better transparency?

   ☐Yes ☐ No ☐Existing speed test sites fulfil the need

[37] An over-the-top (OTT) media service is a streaming media service offered directly to viewers via the Internet. OTT bypasses cable, broadcast, and satellite television platforms, the companies that traditionally act as a controller or distributor of such content.

[38] Jitter is the variation in the time between data packets arriving, caused by network congestion or route changes. The longer data packets take to transmit, the more is the jitter, which affects audio/video quality. The standard jitter measurement is in milliseconds (ms).

Most respondents felt a need to define different broadband packages and a tool to ascertain speed (as below).



5.5.2 Issues concerning broadband service providers

India's telecom sector has been grappling with huge debts and some regulatory headwinds for the past few years, shutting down over ten telecom companies in the last few years. AGR dues of ₹1.3 lakh crore along with debt of over ₹5 lakh crore is outstanding against telecom companies. Telecom operators complain of high regulatory fees and spectrum pricing. Therefore, the respondents were requested to give their opinion on this aspect by asking following question-

Q. *What are the major hurdle in broadband acceleration in the country from service providers perspective-*

☐ *High license fee*

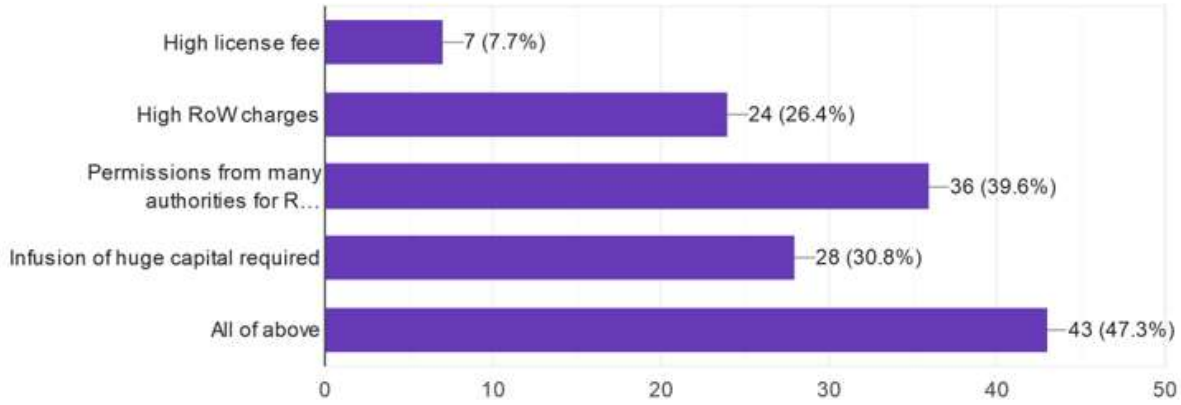
☐ *High RoW charges*

☐ *Permissions from many authorities for RoW/Tower*

☐ *Infusion of huge capital required*

☐ *All of above*

The respondents found permissions from many authorities for RoW/Tower, infusion of huge capital required and high RoW charges amongst other reasons.



Further, India ranked 129th among 138 nations[39] in terms of mobile broadband speed with average download speeds of 12.16 Mbps in case of mobile broadband. The highest mobile broadband speed experienced in South Korea is around 100Mbps. The combined performance of Core Network (CN) and Radio Access Network (RAN) decides the performance of mobile broadband. The availability of required access spectrum also plays an important role. Therefore, the respondents were asked following question.

Q. Average mobile broadband speed in India is much lower as compared to global average speed. What are the reasons for lower speed in India-

☐ insufficient number of sites,

☐ limited spectrum,

☐congestion in the user plane of individual radio sites,

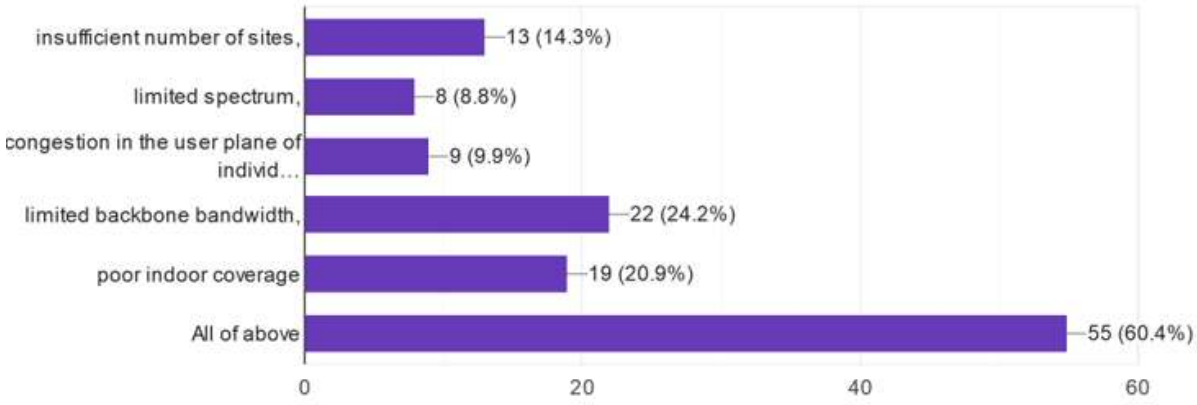
☐ limited backbone bandwidth,

☐ poor indoor coverage

☐ All of above

The main reasons attributed by the respondents included limited backbone bandwidth and poor indoor coverage.

[39] https://www.speedtest.net/global-index



Fixed Wireless Access (FWA) can provide an easier/cheaper solution to offer broadband connectivity in areas having poor wireline infrastructure. However, FWA requires line-of-sight access between the subscriber's location and the transmission tower and cannot be provided at sites obstructed by trees, buildings, hills etc. Rain, sandstorms or fog can also affect the quality of the service. In view of these issues, following question was asked-

Q. *While many developing countries are using Fixed Wireless Access (FWA) technology for provisioning of fixed broadband, why FWA has not become popular in India?*

☐ *High initial and maintenance cost*

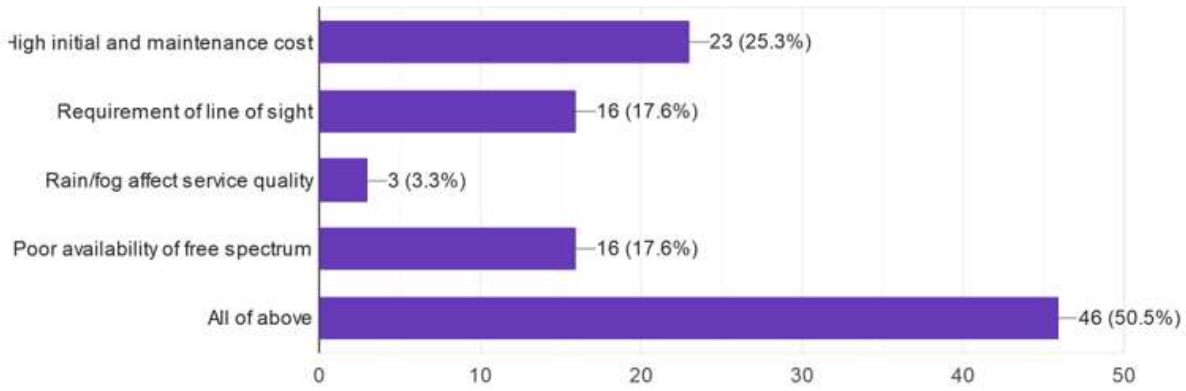
☐ *Requirement of line of sight*

☐ *Rain/fog affect service quality*

☐ *Poor availability of free spectrum*

☐ *All of above*

The respondents found high initial and maintenance cost, requirement of line of sight and poor availability of free spectrum as main constraints.



As described in para 5.4.1 (3), the government has notified Indian Telegraph Right of Way (RoW) Rules 2016. The RoW permission for laying fibre is required from various agencies like Local Bodies, Railways, Roadways and Highways, Forest departments, electricity distribution and transmission agencies etc. The hurdles and charges for getting the permission varies across various bodies and places. Therefore, next three questions were related to this aspect-

Q (a) What are the hurdles in getting RoW permissions-

☐ Permission from multiple agencies required,

☐ exorbitant and uneven charges,

☐ No specific time frame to give permission,

☐ all of above.

Q (b) Whether the Indian Telegraph Right of Way (RoW) Rules 2016 has enabled grant of RoW permissions in time at reasonable prices in a non-discriminatory manner?

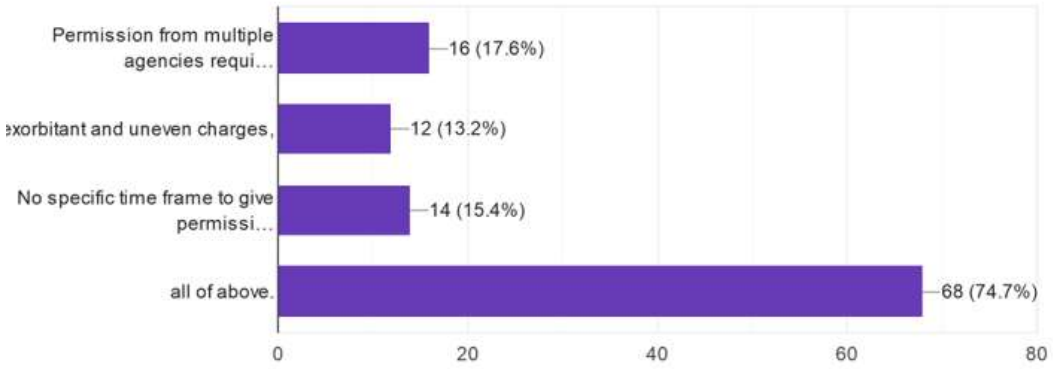
☐Yes ☐ No ☐ Can't say

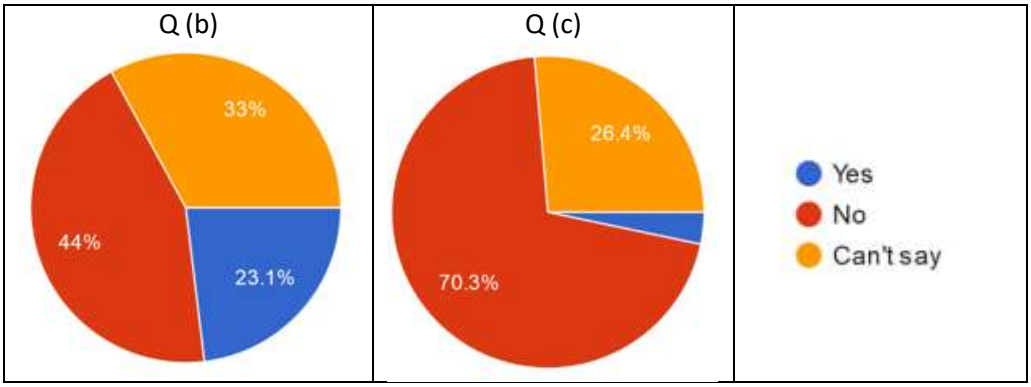
Q (c) Whether the RoW disputes under the Rules are getting resolved objectively and in a time-bound manner?

☐Yes ☐ No ☐ Can't say

The responses received are as below-

Q (a)





Most respondents opined that RoW permission is a hurdle and RoW Rules 2016 has neither enabled grant of RoW permissions in time at reasonable prices in a non-discriminatory manner, nor the disputes are getting resolved objectively and in a time-bound manner. One of the main reason for this is that most of the agencies required to provide RoW permissions are under state governments, that too under various ministries.

5.5.3 Policy related issues

The government of India has been constantly reviewing and revising its policy as per inputs from various sources to ensure improvement in telecom (including broadband)

density in the country. However, the review of policy, its amendment and issue of new guidelines is a regular requirement. Therefore, some questions covering the policy aspects were asked from the respondents. The first and foremost question was-

Q. *What steps should be taken by Government to facilitate Telecom Operators for increase in broadband penetration-*

☐ *Introduction of Floor Tariffs,*

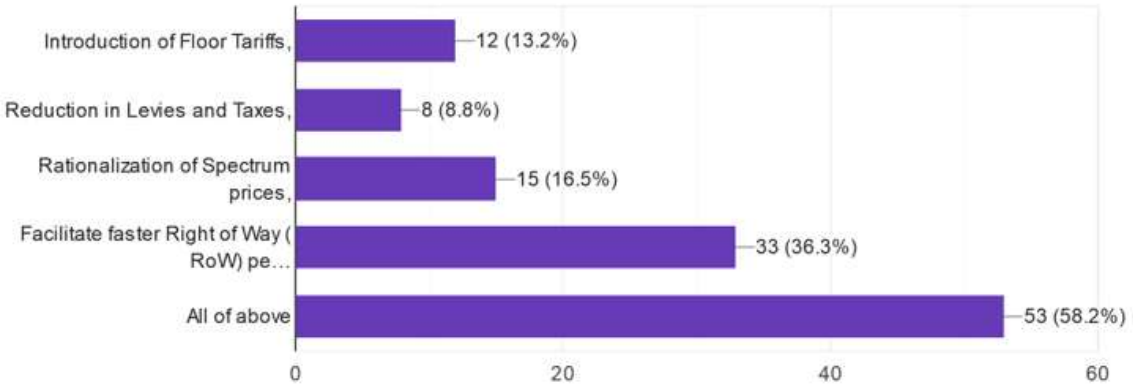
☐ *Reduction in Levies and Taxes,*

☐ *Rationalization of Spectrum prices,*

☐ *Facilitate faster Right of Way (RoW) permissions,*

☐ *All of above*

The respondents felt the need to facilitate faster RoW permissions and rationalisation of spectrum prices.



As obvious from the responses, the RoW is felt a big hurdle in laying OFC and putting tower, both essentially required for broadband. One possible solution could be creation of common ducts along the roads providing chambers/manholes at suitable intervals to lay the OFC. The telecom service provider can simply hire/lease a duct and lay its OFC, without excavate the road or street every time when new fibre cable is required to be laid, saving time and avoiding damage to roads. In view of this, the respondents were asked-

Q. *Is there a need to develop common ducts along the roads and streets for pulling*

OFC, which can be used by service providers on non-discriminatory manner, so as to address RoW permissions and reduce OFC laying costs?

☐Yes ☐ No ☐ Can't say

Around 98% of the respondents favoured to requirement of development of common ducts along the roads and streets.

Cross-sector collaboration either be in the beginning of the infrastructure development itself or at later stage can be made to create common infrastructure. Public utility companies like electricity and telecom, multiple telecom companies, water and telecom licensees etc can join hands to excavate in public RoW simultaneously. The next question addressed this aspect-

Q. *If you believe common ducts along the roads and streets for pulling OFC can resolve RoW issues, then who should develop it-*

☐ Private sector entities

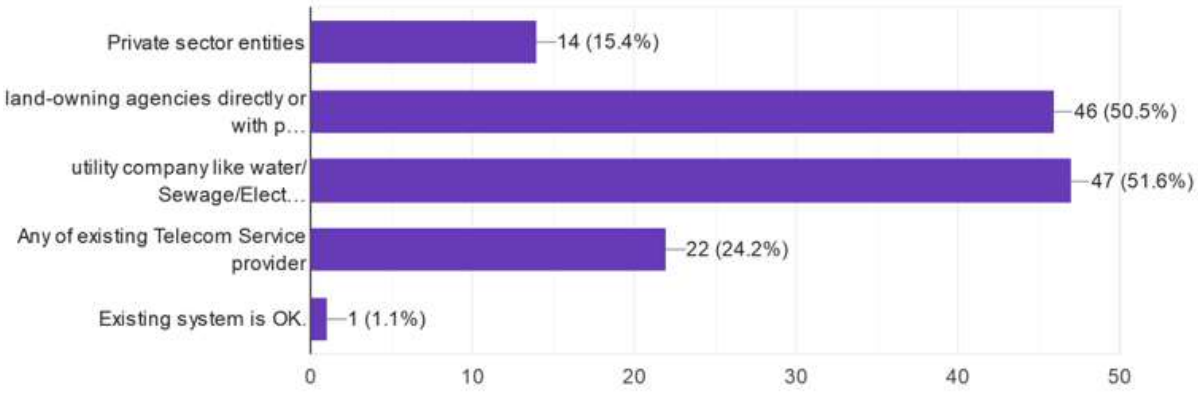
☐ land-owning agencies directly or with partners,

☐ utility company like water/Sewage/Electricity,

☐ Any of existing Telecom Service provider

☐ Existing system is OK.

Majority of the respondents opined that either land-owning agencies directly/ with partners or utility company like water/sewage/electricity may create common ducts.



Telecom sector is a capital intensive field and new methodologies need to be adopted to make the services viable for provider and affordable for subscriber. Infrastructure sharing can reduce capital and operational expenditures for the service providers. BEREC[40] report on infrastructure sharing[41] (2018) estimates various saving of infra sharing as below:

a. Passive infrastructure sharing cost savings: [16%–35%] CapEx, [16%–35%] OpEx;

b. Active infrastructure sharing (excl. spectrum) cost savings: [33%–35%] CapEx, [25%–33%] OpEx;

c. Active infrastructure sharing (incl. spectrum) cost savings: [33%–45%] CapEx, [30%–33%] OpEx;

Further, the cable TV operators have a vast network of OFC within towns. Many of the electricity companies have long distance OPGW[42] (OFC) along their power lines. The vast power line infrastructure within cities can also be utilised for laying overhead fibre

[40] The Body of European Regulators for Electronic Communications (BEREC), based in Riga (Latvia), is the regulating agency of the telecommunication market in the European Union.
[41] https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/8164-berec-report-on-infrastructure-sharing, assessed on 21-12-2020.
[42] An optical ground wire (also known as an OPGW or, in the IEEE standard, an optical fibre composite overhead ground wire) is a type of cable that is used in overhead power lines. Such cable combines the functions of grounding and communications.

infrastructure, thus reducing the laying cost, time and effort, apart from overcoming the RoW issues. Therefore, the next two question sough opinion on-

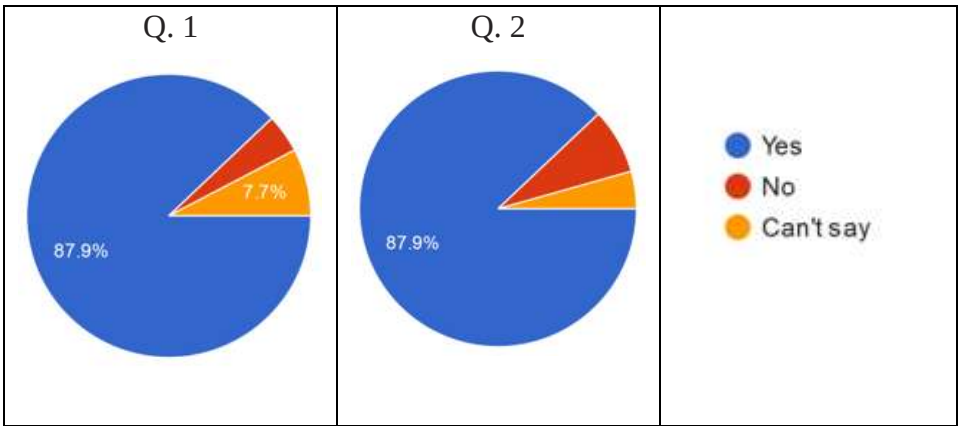
1. *Sharing of infrastructure not only reduces the cost but also results into a considerable reduction in service roll out time. Do you think, mandatory sharing of infra-structure can result into broadband penetration-*

   ☐*Yes* ☐ *No* ☐ *Can't say*

2. *Can leveraging the existing assets of the broadcasting (local cable operators' fibre network) and power sector (for overhead fibre) improve broadband penetration?*

   ☐*Yes* ☐ *No* ☐ *Can't say*

Around 88% of the respondents opined that mandatory sharing of infra-structure can result into broadband penetration. Further 88% of the respondents opined that existing assets of the broadcasting and power sector can be utilised to improve broadband penetration.



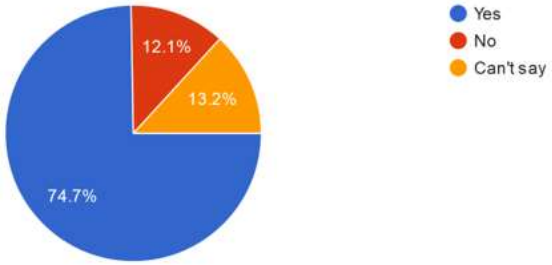
Consumer device plays an important role in the speed of data access, specially the two SIM slot mobile instruments, as the manufacturers limit the speed in second slot. In case of mobile services, handset device plays a major role in speed due to its design capabilities. In India, so far, there is no regulatory minimum performance/configuration

requirement. The next question addressed this aspect-

Q. *Presently there are a variety of consumer devices which are difficult compare for performance. Do you think, minimum standards for consumer devices available in the open market should be specified to improve the consumer experience?*

☐*Yes* ☐ *No* ☐ *Can't say*

Around 75% of the respondents opined for mandating the minimum standards for consumer devices available in the open market.



The core network design of service provider plays an important role in the delivery of quality broadband which is well within the control of service provider. The performance of core networks affects the performance of both fixed and mobile broadband. Another reasons of congestion, in case of mobile broadband, could be insufficient spectrum, few sites, poor backbone connectivity etc. Next two questions addressed this aspect-

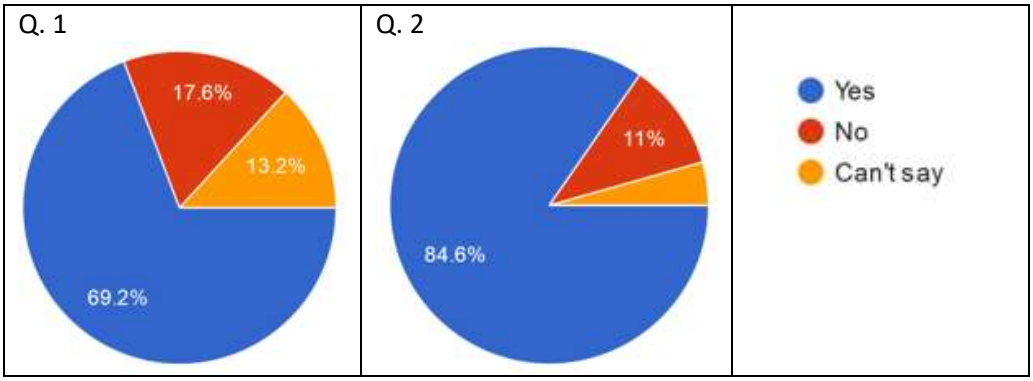
1. *Should it be mandated to mobile operators to declare parameters like actual congestion over the air interface, in the radio nodes and/or over the backhaul interfaces between RAN and CN, while reaching out to or enrolling a new customer?*

   ☐*Yes* ☐ *No* ☐ *Can't say*

2. *In order to give the customer a quality experience, do you think a need of any policy or regulatory intervention by way of mandating certain checks relating to contention ratio, latency and bandwidth utilisation in the core network of service provider?*

   ☐*Yes* ☐ *No* ☐ *Can't say*

Around 69% respondents opined for mandatory declaration of parameters affecting broadband experience and 85% opined for mandatory checks relating to contention ratio, latency and bandwidth utilisation in the core network of service provider.



India is a vast and diverse country, having hills, reserve forests, desserts etc (in addition to insurgency issues in some parts of the country) and covering it through fibre and mobile is a herculin and time consuming task requiring huge capital inflow. A diverse mix of service providers and innovative broadband technology platforms may accelerate broadband access across the nation. The emerging near orbit or non-geostationary orbit satellite technology could be a possible solution to address these issues. Therefore, the respondents were requested to provide opinion on-

Q. *Satellite technology provides ubiquitous connectivity across geography. Do you think India should bring in a policy to permit non-geostationary orbit (NGSO) satellites for broadband connectivity-*

☐*Yes* ☐ *No* ☐ *Can't say*

Around 70% of the respondents opined in favour of the suggestion.

The opinion expressed by various officers spread across various ministries/departments

involved in the implementation/monitoring of SDGs indicates that broadband penetration does affect achievement of certain indicators 'directly' and some other indicators 'indirectly'. There are only a few officers who opined for certain indicators that broadband penetration does not affect achievement of those indicators. However, as seen from responses (annexure-3), these officers have opined for most of the indicators that broadband does enable the achievement of indicators, directly or indirectly. The deliberation under para 5.3.4, wherein a comparative study of SDG ranking with BB density was made also indicates towards a correlation between them.

The responses received regarding the impediments and measures to improve the broadband penetration indicates that action at people (citizen), policy, legal framework and regulatory guidelines is required. The citizens need to be digitally empowered by way of digital literacy, local lingual content, informed choice of broadband plan, the informed network parameters and a minimum capable handset. The broadband service providers need to be facilitated by resolving spectrum related issues, resolution of RoW issues, making suitable policy changes for infra sharing and return on investment etc. The respondents have opined for the need to address RoW issues related to permissions and dispute settlement. Common ducts along roads, preferably either by land-owning agencies directly/ with partners or by utility company like water/sewage/electricity also need to be developed. It is essential that RoW permissions are granted expeditiously at reasonable prices and in a non-discriminatory manner by the concerned authority for the speedy rollout of passive infrastructure. There is need to find alternate approaches for creation of passive infrastructure items like duct space, OFC connectivity, towers etc and involve other players as well. The common duct would increase public safety, reduce traffic congestion and increase the infrastructure life spans, which are frequently damaged by frequent digging.

The telecom sector is a capital-intensive sector and infrastructure creation would require substantial investment. To cut the OPEX and CAPEX, mandatory sharing of infra-structure and utilisation of existing assets of the broadcasting and power sector need to be explored to ensure efficient use of the resources. This would improve affordability of broadband services by common public resulting into further demand.

There is a need to look for innovative approaches to increase broadband penetration and a policy related to NGSO satellites for broadband connectivity could be thought of. On the consumer side, thrust on greater digital literacy, affordable handsets, enhanced availability of vernacular content etc are required to increase the broadband subscription. The minimum standards for customer devices are required to be mandated to ensure a quality experience by user.

Majorly, the capital in telecom sector is infused by private players in India. The Government needs to support the efforts of private sector through facilitative policy environment. Issues concerning poor availability of free spectrum and rationalisation of spectrum prices needs to be addressed. The service providers may be mandated to declare parameters affecting broadband experience and mandatory checks relating to contention ratio, latency and bandwidth utilisation in the core network be carried out. This will bring trust and assurance on quality of services into the subscribers.

The respondents also opined that government should explore new technologies like NGSO satellite technology, for improving broadband penetration.

5.6 Conclusions

The progress towards SDGs had been uneven and more focused attention was needed in most areas before the COVID-19 outbreak. COVID-19 not only disrupted

implementation of many of the SDGs but also, in some cases, reversed the progress. All areas of the world, all segments of the population and all sectors of the economy have been affected by the pandemic. World's poorest and most vulnerable people are affected the most.

Broadband access has become a necessity and an equalizer for people in this pandemic time. A considerable increase in the dependence of individuals as well as enterprises on Work From Home (WFH), video conferences, social media, cloud services etc. has been observed. Individuals, institution, enterprises and governments increasingly rely on broadband for a number of services, from tele-education to tele-health. Governments and enterprises have become more dependent and require quality broadband services for routine and 'mission-mode' projects. A sound broadband infrastructure is required across country to bring people together and to implementation and monitoring of SDG achievements.

As such, after analysing the primary and secondary data, it can be concluded that broadband does facilitate achievement of certain indicators directly and for some indicator indirectly. The same has also been established by literature review. Still, mere increase of broadband penetration cannot guarantee the achievement of SDGs as a whole, since there must be some other parameters as well which affect the SDG achievement.

5.7 Recommendations

There are various factors related with subscribers, service provider and at policy level which impede the broadband growth. Following recommendations, relating to citizen facilitation, policy and service providers, are made to address the impediments in broadband spread and for improvement in broadband penetration-

(1) Programs to increase digital literacy among citizens need to be rolled out so that maximum customers become comfortable in using broadband services.

(2) The multi-lingual content availability and accessibility is must for driving the usage of broadband services. The Governments can promote development of multi-lingual content over the Internet.

(3) Consumer devices need to be standardized and certified so that quality of the same can be ensured for a common person.

(4) Different categories of broadband need to be defined in simple words so that layman can understand the difference and subscribe to appropriate services.

(5) TSPs should declare the performance parameters in public domain so that an informed decision can be made by individuals while subscribing to broadband services.

(6) Spectrum availability at reasonable prices should be increased to address supply side constraints of the wireless broadband. Availability of spectrum equivalent to global averages would help in improving the wireless broadband speed also.

(7) Roadmap for the spectrum auction should be declared in advance so that TSPs can plan network expansion with certain degree of certainty.

(8) To ensure efficient use of available spectrum with various Government agencies, periodic audit of the same is necessary. Underutilised spectrum can be re-farmed.

(9) Due to limited availability of fibre optic network in the country, spectrum for backhaul connectivity should be made available in sufficient quantity. It will help in increasing the availability of broadband services and improve quality of

broadband services.

(10) The Central Government has notified RoW Rules in year 2016 under the Indian Telegraph Act 1885. Implementation of the same at State and Local bodies level in letter and spirit should be expedited.

(11) Single-window clearance is must for RoW permission proposals at the level of Local Bodies, States, and the Central Government. permissions should be granted in time-bound manner so that TSPs can rollout the networks faster.

(12) An effective dispute resolution mechanism for RoW permissions need to be put in place.

(13) Just like Railways and Roads, common ducts must be laid and leased in non-discriminatory manner to TSPs for rolling out OFC network across the country. This will not only reduce the time to rollout but also increase affordability of broadband services. Local bodies may engage business partners on revenue sharing models for this.

(14) To increase the proliferation of fixed line broadband in the country, there is a need to mandate, just like electricity cables and water pipes, provisioning of OFC in the buildings. Further, city developers and builders should demarcate space within buildings and on rooftops for housing BB infrastructure and antenna. These areas should have uninterrupted power supply for reliable, always-on services.

(15) To improve the affordability of broadband services, active as well as passive infrastructure sharing should be encouraged. It will result in efficient utilisation of the available infrastructure.

(16) To increase the availability of fixed line broadband services across the country,

the licensing conditions need to be simplified so that, just like local cable operators mushroomed across the country, local ISPs also start providing broadband services.

(17) India, being a geographically diverse country, all emerging technologies must be encouraged for improving the availability of broadband services.

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7 Annexures

Annexure- 1 DoT Notification reg broadband definition

MINISTRY OF COMMUNICATIONS AND INFORMATION TECHNOLOGY

(Department of Telecommunications)

NOTIFICATION

New Delhi, the 18th July, 2013

S.O. No. 4-4/2009-Policy-I.—In supersession of the definition of Broadband contained in the Broadband Policy, 2004 and in consonance with point 1.5 of part IV(Strategies) contained in the National Telecom Policy-2012 and after consideration of the recommendation of the Telecom Regulatory Authority of India, the Central Government is pleased to revise the definition of Broadband as follows :—

"Broadband is a data connection that is able to support interactive services including Interest access and has the capability of the minimum download speed of 512 kbps to an individual subscriber from the point of presence (POP) of the service provider intending to provide Broadband service."

This notification shall come in to force with immediate effect.

V. UMASHANKAR, Jt. Secy.

Annexure- 2 Questionnaire for seeking response for selecting indicators.

Q4. Target 1.3 for SDG 'No Poverty' targets to- 'implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable'. The next four questions are in this reference-

Q4(a). Do you think availability of broadband facility helps in increase of 'percentage of households with any usual member covered by a health scheme or health insurance'? (indicator 1.3.1)

☐ Directly ☐ Indirectly ☐ Not at all

Q4(b). Do you think availability of broadband facility helps in increase of 'Proportion of the population (out of total eligible population) receiving social protection benefits under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)'? (indicator 1.3.3)

☐ Directly ☐ Indirectly ☐ Not at all

Q4(c). Do you think availability of broadband facility helps in increase of 'Number of Self Help Groups (SHGs) formed and provided bank credit linkage'? (indicator 1.3.4)

☐ Directly ☐ Indirectly ☐ Not at all

Q4(d). Do you think availability of broadband facility helps in increase of 'Proportion of the population (out of total eligible population) receiving social protection benefits under Maternity Benefit'? (indicator 1.3.5)

☐ Directly ☐ Indirectly ☐ Not at all

Q5. Target 1.4 for SDG 'No Poverty' targets that- 'By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance'. Do you think broadband helps in increase in 'Proportion of population having bank accounts'? (indicator 1.4.5)

☐ Directly ☐ Indirectly ☐ Not at all

Q6. Target 1.a for SDG 'No Poverty' targets to- 'Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions'. Do you think availability of broadband helps Government to increase 'Proportion of total government spending on essential services (education, health and social protection)'? (indicator 1.a.2)

☐ Directly ☐ Indirectly ☐ Not at all

Q7. Target 8.1.1 for SDG '**Decent work & economic growth'** aims to increase 'Annual growth rate of GDP (adjusted to price changes) per capita'. Does, in your opinion, growth in broadband availability helps in achieving the target? (indicator 8.1.1)

☐ Directly ☐ Indirectly ☐ Not at all

Q8. Target 8.2 for SDG '**Decent work & economic growth'** aims to- 'Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour intensive sectors'. Do you think availability of broadband helps in increase in 'Total number of patents issued (granted)'? (indicator 8.2.2)

☐ Directly ☐ Indirectly ☐ Not at all

Q9. Target 8.3 for SDG '**Decent work & economic growth'** aims to- 'Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-small - and medium-sized enterprises, including through access to financial services'. Do you think availability of broadband facility helps in increase in 'Number of start-ups recognized under Start-up India'? (indicator 8.3.5)

☐ Directly ☐ Indirectly ☐ Not at all

Q10. Target 8.5 for SDG '**Decent work & economic growth'** aims that- 'By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value'. Do you think that availability of broadband facility helps in **reduction** in 'Unemployment rate'? (indicator 8.5.1)

☐ Directly ☐ Indirectly ☐ Not at all

Q11. Target 8.9 for SDG '**Decent work & economic growth'** aims that- 'By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products'. Do you think that availability of broadband facility helps in increase in 'number of tourists (domestic and foreign) over previous years'? (indicator 8.9.1)

☐ Directly ☐ Indirectly ☐ Not at all

Q12. Target 8.10 for SDG '**Decent work & economic growth'** aims to- 'Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all'. Do you think that availability of broadband facility helps in increase in 'Number of banking outlets 1,00,000 population'? (indicator 8.10.3)

☐ Directly ☐ Indirectly ☐ Not at all

Annexure- 3 Response for selecting indicators.

Response no	Role of broadband in achieving indicator											
	1.3.1	1.3.3	1.3.4	1.3.5	1.4.5	1.a.2	8.1.1	8.2.2	8.3.5	8.5.1	8.9.1	8.10.3
1	Directly	Directly	Directly	Directly	Directly	Indirectly	Directly	Indirectly	Indirectly	Indirectly	Directly	Directly
2	Indirectly	Indirectly	Directly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
3	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
4	Directly	Directly	Indirectly	Directly	Directly	Indirectly	Directly	Directly	Directly	Indirectly	Directly	Indirectly
5	Indirectly	Directly	Directly	Directly	Indirectly	Directly	Directly	Directly	Indirectly	Directly	Indirectly	Directly
6	Indirectly	Indirectly	Directly	Directly	Indirectly	Indirectly	Directly	Indirectly	Directly	Indirectly	Indirectly	Directly
7	Indirectly	Indirectly	Indirectly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
8	Directly	Directly	Indirectly	Indirectly	Directly	Directly	Indirectly	Directly	Directly	Indirectly	Directly	Directly
9	Indirectly	Indirectly	Directly	Directly	Indirectly	Directly	Directly	Directly	Indirectly	Indirectly	Indirectly	Directly
10	Indirectly	Directly	Directly	Indirectly	Indirectly	Indirectly	Indirectly	Indirectly	Directly	Directly	Directly	Directly
11	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
12	Indirectly	Directly	Indirectly	Directly	Directly	Directly	Indirectly	Indirectly	Directly	Indirectly	Directly	Directly
13	Indirectly	Indirectly	Directly	Directly	Directly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly
14	Indirectly	Indirectly	Indirectly	Indirectly	Directly	Directly	Indirectly	Directly	Directly	Directly	Directly	Directly
15	Indirectly	Indirectly	Indirectly	Indirectly	Directly	Indirectly	Directly	Directly	Directly	Indirectly	Directly	Indirectly
16	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
17	Not at all	Not at all	Not at all	Not at all	Indirectly	Not at all	Directly	Directly	Directly	Not at all	Directly	Directly
18	Directly	Directly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Indirectly	Directly
19	Directly	Directly	Directly	Directly	Directly	Directly	Indirectly	Indirectly	Directly	Indirectly	Indirectly	Directly
20	Indirectly	Directly	Indirectly	Directly	Directly	Indirectly	Indirectly	Indirectly	Indirectly	Directly	Indirectly	Directly
21	Directly	Indirectly	Indirectly	Indirectly	Indirectly	Directly	Indirectly	Indirectly	Directly	Indirectly	Indirectly	Directly
22	Indirectly	Directly	Directly	Directly	Indirectly	Directly	Indirectly	Indirectly	Indirectly	Indirectly	Indirectly	Indirectly
23	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
24	Indirectly	Directly	Directly	Indirectly	Directly	Indirectly	Directly	Directly	Directly	Directly	Directly	Not at all
25	Indirectly	Not at all	Indirectly	Indirectly	Indirectly	Directly	Directly	Indirectly	Directly	Directly	Directly	Directly
26	Indirectly	Indirectly	Directly	Indirectly	Directly	Indirectly	Indirectly	Indirectly	Directly	Directly	Indirectly	Directly
27	Directly	Indirectly	Not at all	Indirectly	Not at all	Indirectly	Directly	Indirectly	Directly	Not at all	Not at all	Indirectly

28	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Indirectly	Indirectly	Directly	Indirectly
29	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
30	Indirectly	Directly	Directly	Indirectly	Directly	Indirectly	Indirectly	Indirectly	Directly	Indirectly	Directly	Directly
31	Not at all	Not at all	Not at all	Not at all	Indirectly	Indirectly	Directly	Directly	Directly	Indirectly	Directly	Not at all
32	Directly	Directly	Directly	Directly	Directly	Indirectly	Directly	Indirectly	Directly	Directly	Directly	Directly
33	Directly	Directly	Indirectly	Indirectly	Directly	Directly	Indirectly	Directly	Directly	Indirectly	Directly	Directly
34	Indirectly	Indirectly	Directly	Directly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
35	Indirectly	Directly	Indirectly	Indirectly	Directly	Indirectly	Indirectly	Indirectly	Directly	Indirectly	Directly	Not at all
36	Indirectly	Indirectly	Indirectly	Indirectly	Indirectly	Indirectly	Directly	Indirectly	Indirectly	Indirectly	Directly	Indirectly
37	Indirectly	Indirectly	Indirectly	Indirectly	Directly	Directly	Directly	Directly	Directly	Indirectly	Directly	Directly
38	Indirectly	Not at all	Indirectly	Indirectly	Not at all	Not at all	Indirectly	Indirectly	Indirectly	Indirectly	Indirectly	Directly
39	Directly	Indirectly	Directly	Directly	Indirectly	Directly	Indirectly	Indirectly	Directly	Indirectly	Directly	Directly
40	Indirectly	Directly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
41	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
42	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
43	Indirectly	Indirectly	Indirectly	Indirectly	Not at all	Indirectly	Directly	Indirectly	Indirectly	Indirectly	Indirectly	Directly
44	Indirectly	Indirectly	Directly	Indirectly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
45	Directly	Indirectly	Directly	Indirectly	Directly	Indirectly	Directly	Directly	Directly	Indirectly	Directly	Directly
46	Directly	Indirectly	Indirectly	Indirectly	Directly	Indirectly	Directly	Indirectly	Directly	Indirectly	Directly	Directly
47	Directly	Indirectly	Indirectly	Directly	Directly	Indirectly	Directly	Directly	Directly	Indirectly	Directly	Directly
48	Indirectly	Indirectly	Directly	Indirectly	Directly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly
49	Directly	Indirectly	Indirectly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
50	Directly	Indirectly	Directly	Indirectly	Directly	Indirectly	Indirectly	Indirectly	Directly	Indirectly	Directly	Indirectly
51	Directly	Indirectly	Indirectly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Indirectly	Directly
52	Indirectly	Directly	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Not at all	Directly	Directly
53	Directly	Not at all	Directly	Directly	Indirectly	Directly	Directly	Directly	Directly	Indirectly	Indirectly	Not at all
54	Indirectly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Directly
55	Indirectly	Directly	Directly	Indirectly	Directly	Indirectly	Directly	Directly	Indirectly	Indirectly	Directly	Directly
56	Directly	Directly	Directly	Directly	Directly	Directly	Directly	Indirectly	Directly	Directly	Indirectly	Directly

Annexure- 4 State-wise achievement for identified indicators.

Source: SDG Report-2020 (ver 2.1) NITI Aayog

Indicator 1.3.3: Persons provided employment as a percentage of persons who demanded employment under mahatma Gandhi National rural Employment Guarantee act (MGNREGA) (in percentage)				
State/UT	**2015-16**	**2016-17**	**2017-18**	**2018-19**
Andhra Pradesh	87.0	93.5	87.8	91.4
Arunachal Pradesh	92.5	96.8	85.6	93.4
Assam	89.0	86.1	87.0	87.2
Bihar	75.0	74.9	75.6	77.2
Chhattisgarh	73.7	76.3	77.3	79.9
Goa	98.7	99.3	98.1	87.2
Gujarat	83.2	78.4	80.9	83.0
Haryana	80.2	79.4	80.2	79.0
Himachal Pradesh	89.0	90.6	91.1	91.6
Jammu And Kashmir	88.4	86.6	86.8	87.3
Jharkhand	85.5	78.9	70.3	75.4
Karnataka	72.2	81.0	84.1	85.5
Kerala	89.3	89.4	88.0	89.3
Madhya Pradesh	86.0	77.3	79.7	78.1
Maharashtra	86.3	85.0	86.4	86.1
Manipur	98.1	98.8	96.5	95.5
Meghalaya	97.7	97.6	97.3	97.9
Mizoram	100.0	99.9	99.9	99.9
Nagaland	99.4	99.1	98.2	95.1
Odisha	84.3	80.8	84.8	85.8
Punjab	85.0	82.8	81.6	76.1
Rajasthan	85.5	86.0	85.1	83.2
Sikkim	95.4	95.5	94.2	93.1
Tamil Nadu	98.0	98.0	98.8	94.1
Telangana	79.4	84.2	77.1	84.5
Tripura	97.0	96.4	94.4	95.7
Uttar Pradesh	83.3	83.2	84.2	84.0
Uttarakhand	90.2	88.5	90.1	90.4
West Bengal	89.5	87.8	87.6	88.3
Andaman And Nicobar	95.8	98.4	92.5	84.8
Dadra and Nagar	-	-	-	-
Daman and Diu	-	-	-	-
Lakshadweep	89.4	100.0	56.1	91.2
Puducherry	83.9	84.5	83.8	84.5
all India	85.5	85.3	84.7	85.2

Indicator 1.4.5: Number of accounts (include deposit and credit accounts) of scheduled commercial banks per 1,000 population				
State/UT	**2015-16**	**2016-17**	**2017-18**	**2018-19**
Andhra Pradesh	1835.93	1953.23	2001.22	1761.81
Arunachal Pradesh	905.97	1030.62	1104.57	1037.47
Assam	1105.74	1321.55	1390.11	1204.52
Bihar	842.76	977.87	1050.69	5.20
Chhattisgarh	1154.41	1626.18	1383.48	1393.56
Goa	3845.71	3994.40	3980.26	563.40
Gujarat	1363.85	1489.00	1508.54	9.19
Haryana	1691.32	1839.13	1908.41	147.39
Himachal Pradesh	1724.67	1865.04	1942.50	7054.21
Jammu and Kashmir	1416.84	1559.36	1663.17	1002.80
Jharkhand	1084.93	1224.49	1308.14	3397.48
Karnataka	1790.32	1922.27	2000.84	1911.65
Kerala	2040.09	2112.28	2253.24	2099.68
Madhya Pradesh	1179.49	1291.09	1339.60	1295.33
Maharashtra	1651.20	1792.06	1898.84	47.64
Manipur	738.27	879.28	964.28	890.65
Meghalaya	820.71	921.33	940.40	887.76
Mizoram	1053.82	1211.36	1284.26	1196.05
Nagaland	628.61	708.37	741.89	693.13
Odisha	1251.99	1418.45	1501.03	1048.54
Punjab	1926.51	2098.93	2178.20	729.36
Rajasthan	1089.53	1180.11	1250.06	663.91
Sikkim	1454.64	1599.39	1639.32	94277.44
Tamil Nadu	2026.38	2154.07	2346.66	1.33
Telangana	1884.17	2126.97	2041.33	1837.97
Tripura	1564.49	1727.71	1820.82	1357.98
Uttar Pradesh	1130.60	1210.38	1247.00	87.25
Uttarakhand	1646.12	1797.78	1855.47	24444.99
West Bengal	1383.43	1569.37	1638.00	10.68
Andaman and Nicobar	1529.78	1603.04	1637.19	372161.75
Chandigarh	3636.02	3840.64	3883.22	50925.56
Dadra and Nagar Haveli	1615.43	1773.68	1630.78	188131.18
Daman and Diu	1606.16	1722.11	1647.94	500980.82
Delhi	2624.83	2772.71	2782.84	4674.42
Lakshadweep	1462.00	1336.39	1368.43	42250.01
Puducherry	2084.61	2174.33	2235.35	95255.43
all India (total)	1413.31	1549.71	1610.56	1490.66

Note- Due to 2018-19 data not being consistence, 2017-18 data is considered for analysis.

Indicator 8.9.1: State/UT-wise percentage change in number of tourists during the reference year over previous year (in %)			
State/UT	**2016 over 2015**	**2017 over 2016**	**2018 over 2017**
Andhra Pradesh	26.0	7.9	17.7
Arunachal Pradesh	9.7	15.0	15.3
Assam	-6.1	17.3	-3.0
Bihar	2.0	13.4	3.6
Chhattisgarh	-9.8	4.9	11.4
Goa	19.5	22.2	3.6
Gujarat	16.5	14.5	12.5
Haryana	0.2	-19.1	-20.5
Himachal Pradesh	5.2	6.2	-16.1
Jammu and Kashmir	3.0	51.0	20.3
Jharkhand	0.9	1.0	5.0
Karnataka	8.1	38.6	19.0
Kerala	5.7	10.9	5.9
Madhya Pradesh	92.4	-48.0	7.6
Maharashtra	12.4	2.5	0.0
Manipur	2.9	2.1	16.3
Meghalaya	10.6	19.5	21.3
Mizoram	1.2	1.1	12.5
Nagaland	-8.8	9.9	57.9
Odisha	9.0	9.2	8.6
Punjab	51.2	5.2	10.6
Rajasthan	17.3	10.5	9.4
Sikkim	9.4	75.2	5.1
Tamil Nadu	3.1	0.4	12.0
Telangana	0.7	-10.2	9.0
Tripura	2.4	-12.8	10.4
Uttar Pradesh	4.2	9.6	21.6
Uttarakhand	3.4	12.6	3.7
West Bengal	6.0	6.9	7.5
Andaman and Nicobar	28.5	21.8	5.4
Chandigarh	10.0	20.1	8.3
Dadra and Nagar Haveli	11.6	4.3	-0.8
Daman and Diu	4.4	3.8	4.7
Delhi	12.1	2.8	0.0
Lakshadweep	-48.6	-19.2	53.6
Puducherry	8.0	9.7	5.7
Total	12.7	2.7	12.1

Indicator 8.10.3: Number of banking outlets per 1,00,000 population				
State/UT	**2015-16**	**2016-17**	**2017-18**	**2018-19**
Andhra Pradesh	45.2	47.7	92.2	138.8
Arunachal Pradesh	164.8	161.6	321.4	476.6
Assam	66.8	66.7	131.3	195.1
Bihar	34.6	34.1	67.0	99.1
Chhattisgarh	61.3	70.5	116.5	171.2
Goa	30.8	22.4	52.7	74.5
Gujarat	40.2	38.6	77.1	113.6
Haryana	61.1	58.1	116.6	171.4
Himachal Pradesh	135.3	132.0	264.5	393.1
Jammu and Kashmir	60.0	59.7	118.2	176.0
Jharkhand	65.6	65.6	128.3	190.1
Karnataka	55.7	56.1	110.4	164.7
Kerala	8.4	10.2	18.5	28.5
Madhya Pradesh	63.8	63.2	124.2	183.9
Maharashtra	51.9	47.3	97.8	143.3
Manipur	72.7	72.2	142.7	212.1
Meghalaya	146.0	136.2	277.8	408.7
Mizoram	25.0	23.8	48.0	70.9
Nagaland	34.3	33.1	66.4	98.3
Odisha	96.9	98.1	193.7	290.1
Punjab	66.9	61.6	126.9	186.5
Rajasthan	56.9	69.2	123.6	189.4
Sikkim	182.5	181.6	358.7	532.9
Tamil Nadu	29.5	30.9	59.9	90.2
Telangana	28.3	27.5	55.2	81.9
Tripura	22.7	21.8	43.9	64.8
Uttar Pradesh	42.7	43.3	84.2	125.2
Uttarakhand	81.7	98.0	176.5	270.2
West Bengal	35.3	36.5	71.0	106.6
Andaman and Nicobar	125.1	124.7	248.0	370.2
Chandigarh	35.0	41.0	74.6	113.7
Dadra and Nagar Haveli	81.3	69.5	137.2	190.5
Daman and Diu	31.8	20.1	46.0	60.0
Delhi	97.0	96.4	187.7	276.7
Lakshadweep	0.0	0.0	0.0	0.0
Puducherry	6.5	7.1	13.1	19.6
all India (Total)	49.5	50.1	97.8	145.6

Annexure- 5 Questionnaire for seeking response regarding broadband.

3. Various applications such as video conferencing, real-time gaming, OTT services etc require different Broadband speeds. Do you think there is a need to define different categories of broadband like Basic, Superfast, Ultrafast etc (depending upon the speed) to give consumer a better and affordable choice?

   ☐Yes ☐ No ☐ Can't say

4. Speed is the single most important metric perceived as the 'quality' of broadband service by a consumer. Do you feel a need to introduce the speed measurement program in the country for better transparency?

   ☐Yes ☐ No ☐ Existing speed test sites fulfil the need

5. Worldwide, fixed broadband services are considered reliable and capable of delivering higher speeds, still, why subscription rate for fixed broadband is so poor in India?

   ☐ The requirement is fulfilled by mobile data

   ☐ Mobility is a necessity, fulfilled by mobile

   ☐ There are few providers and getting connection is not easy

   ☐ Poor maintenance by service providers

   ☐ All of above

6. Even though mobile broadband services are easily available and accessible, what could be the probable reasons that approximately 40% of total mobile subscribers do not access data services?

☐ Non-affordability of internet-enabled handsets,

☐ Non-availability of contents in native languages

☐ Non-availability of multilingual keypads of mobile devices,

☐ Digital illiteracy

☐ All of above

7. What could be the factors attributable to the very poor penetration of FTTH services in India?

   ☐ Data requirement are fulfilled by mobile

   ☐ FTTH services are costly

   ☐ Getting FTTH connection is difficult/few providers

   ☐ Poor maintenance by service provider

   ☐ All of above

8. What are the major hurdle in broadband acceleration in the country from service providers perspective-

   ☐ High license fee

   ☐ High RoW charges

   ☐ Permissions from many authorities for RoW/Tower

   ☐ Infusion of huge capital required

   ☐ All of above

9. While many developing countries are using Fixed Wireless Access (FWA) technology for provisioning of fixed broadband, why FWA has not become popular in India?

   ☐ High initial and maintenance cost

   ☐ Requirement of line of sight

   ☐ Rain/fog affect service quality

   ☐ Poor availability of free spectrum

   ☐ All of above

10. Whether the Indian Telegraph Right of Way (RoW) Rules 2016 has enabled grant of RoW permissions in time at reasonable prices in a non-discriminatory manner?

    ☐Yes ☐ No ☐ Can't say

11. What are the hurdles in getting RoW permissions-

    ☐ Permission from multiple agencies required,

    ☐ exorbitant and uneven charges,

    ☐ No specific time frame to give permission,

    ☐ all of above.

12. Whether the RoW disputes under the Rules are getting resolved objectively and in a time-bound manner?

    ☐Yes ☐ No ☐ Can't say

13. What steps should be taken by Government to facilitate Telecom Operators for increase in broadband penetration-

☐ Introduction of Floor Tariffs,

☐ Reduction in Levies and Taxes,

☐ Rationalization of Spectrum prices,

☐ Facilitate faster Right of Way (RoW) permissions,

☐ All of above

14. Average mobile broadband speed in India is much lower as compared to global average speed. What are the reasons for lower speed in India-

☐ insufficient number of sites,

☐ limited spectrum,

☐congestion in the user plane of individual radio sites,

☐ limited backbone bandwidth,

☐ poor indoor coverage

☐ All of above

15. Is there a need to develop common ducts along the roads and streets for pulling OFC, which can be used by service providers on non-discriminatory manner, so as to address RoW permissions and reduce OFC laying costs?

☐Yes ☐ No ☐ Can’t say

16. If you believe common ducts along the roads and streets for pulling OFC can resolve RoW issues, then who should develop it-

☐ Private sector entities

☐ land-owning agencies directly or with partners,

☐ utility company like water/Sewage/Electricity,

☐ Any of existing Telecom Service provider

☐ Existing system is OK.

17. Can leveraging the existing assets of the broadcasting (local cable operators' fibre network) and power sector (for overhead fibre) improve broadband penetration?

☐Yes ☐ No ☐ Can't say

18. Presently there are a variety of consumer devices which are difficult compare for performance. Do you think, minimum standards for consumer devices available in the open market should be specified to improve the consumer experience?

☐Yes ☐ No ☐ Can't say

19. In order to give the customer a quality experience, do you think a need of any policy or regulatory intervention by way of mandating certain checks relating to contention ratio, latency and bandwidth utilisation in the core network of service provider?

☐Yes ☐ No ☐ Can't say

20. Should it be mandated to mobile operators to declare parameters like actual congestion over the air interface, in the radio nodes and/or over the backhaul interfaces between RAN and CN, while reaching out to or enrolling a new customer?

☐Yes ☐ No ☐ Can’t say

21. Satellite technology provides ubiquitous connectivity across geography. Do you think India should bring in a policy to permit non-geostationary orbit (NGSO) satellites for broadband connectivity-

☐Yes ☐ No ☐ Can’t say

22. Sharing of infrastructure not only reduces the cost but also results into a considerable reduction in service roll out time. Do you think, mandatory sharing of infra-structure can result into broadband penetration-

☐Yes ☐ No ☐ Can’t say