ICT DEVELOPMENT INDEX (IDI) OF ITU: STRATEGY TO IMPROVE INDIA'S RANKING

Dissertation submitted to Indian Institute of Public Administration (IIPA) for the Master's Diploma in Public Administration (MDPA) in partial fulfilment of the requirement for the Advanced Professional Programme in Public Administration(APPPA)

by

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45th Advanced Professional Programme in Public Administration 2019-20

CERTIFICATE

I have the pleasure to certify that Shri Subhash Chand has pursued his research work and prepared the present dissertation titled "**ICT Development Index (IDI) of ITU: Strategy to improve India's ranking"** 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 monogram, dissertation or work which has previously formed the basis for the award of any degree, diploma or certificate of this institute without proper citation.

This is being submitted to the Indian Institute of Public Administration (IIPA) for the Master's Diploma in Public Administration (MDPA) in partial fulfilment of the requirement for the Advanced Professional Programme in Public Administration (APPPA).

I recommend that the dissertation of Shri Subhash Chand is worthy of consideration for the award of MDPA of IIPA.

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Date: March 2020 **(Subhash Chand)**

Place: New Delhi **Roll No. 4503**

DECLARATION

I, the undersigned, hereby declare that this dissertation titled "**ICT Development Index (IDI) of ITU: Strategy to improve India's ranking""** is my own work and that all the sources I have accessed or quoted have been indicated or acknowledged by means of completed references. The dissertation has not been submitted for any other degree /diploma or elsewhere.

(Subhash Chand)

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List of Abbreviations

AGR	Adjusted Gross Revenue
BIS	Bureau of Indian Standards
CSC	Common Service Centre
CT	Communication Technology
CDMA	Code Division Multiple Access
DID	Direct Inward Dialling
DOT	Department of Telecommunications
DSL	Digital Subscriber Line
EDS	Electronic Delivery Services
ETA	Equipment Type Approval
EVDO	Evolution Data Only
FTTH	Fibre To The Home
FTTB	Fibre To The Building
3G	3rd Generation
4G	4th Generation
5G	5th Generation
GCI	Global Connect Initiative
GDP	Gross Domestic Product

GIS	Geographic Information System
GPR	Government Process Reengineering
HSPA	High Speed Packet Access
ICT	Information and Communication Technology
IDI	ICT Development Index
IIB	International Internet Bandwidth
INSAT	Indian National Satellite System
IOT	Internet Of Things
IP	Internet Protocol / Infrastructure Providers
IPR	Intellectual Property Right
IR4.0	Industrial Revolution 4th Generation
IT	Information Technology
ITA	Indian Telegraph Act
ITES	Information Technology Enabled Services
ITU	International Telecommunication Union
KBPS	Kilo Bits Per Second
LF	License Fee
LSA	License Service Area
LTE	Long term Evolution

MBPS	Mega Bits Per second
Meity	Ministry of Electronics and Information Technology
MISR	Measuring the Information Society Report
MMP	Mission Mode project
MOC	Ministry Of Communications
M2M	Machine To Machine
NBC	National Building Code of India
NDCP	National Digital Communications Policy
NeGP	National e-Governance Plan
NGN	Next Generation Network
NOFN	National Optical Fibre Network
NPIT	National Policy on Information Technology
NTP	National Telecom Policy
OFC	Optical Fibre Cable
PPDR	Public Protection and Disaster Relief
PSU	Public Sector Undertaking
R&D	Research and Development
ROW	Right Of Way
SACFA	Standing Advisory Committee on Radio Frequency Allocation

SAT	Spectrum Advisory Team
SATCOM	Satellite Communication
SME	Small and Medium Enterprise
SPV	Special Purpose Vehicle
SUC	Spectrum Usage Charges
TRAI	Telecom Regulatory Authority of India
TSP	Telecom Service Provider
USOF	Universal Service Obligation Fund
VNO	Virtual Network Operator
VoIP	Voice over Internet Protocol
VSAT	Very Small Aperture Terminal
WCDMA	Wideband Code Division Multiple Access
WiFi	Wireless Fidelity
WiMax	World Wide Interoperability for Microwave Access
WPC	Wireless Planning and Coordination

Abstract

Purpose

ICT Development Index (IDI) of ITU is a global ICT index of a country issued by International Telecommunication Union (ITU). As per ITU's Measuring the Information Society Report(MISR)-2017, India's IDI rank is 134, among 176 countries. The low IDI rank reflects low level of Information and Communication Technology (ICT) infrastructure, adoption and low level of ICT usage in Indian industries, governance and by the citizens. Government of India sets a strategic policy goal, in National Digital Communications Policy (NDCP)-2018, to propel India's IDI ranking in top 50 by 2022.

So the purpose of this study is to analyse the IDI and it's indicators vis-a-vis higher IDI ranked countries, find the causes of low IDI score, examine government policies, schemes, challenges and suggest strategy to improve India's IDI ranking.

Problem

ICT Development Index (IDI) is published by International Telecommunication Union (ITU) based on internationally agreed Information and Communication Technology (ICT) indicators. IDI is a standard tool that governments, operators, development agencies, researchers and others can use to measure the digital divide and compare ICT performance within and across countries.

IDI is based on 11 ICT indicators, grouped in 3 clusters: ICT access, ICT use and ICT skills sub indices. For computation of the final Index, the ICT access and ICT usage sub-indices were each given a 40 per cent weighting, and the skills sub-index 20 per cent weighting. The final Index value was then computed by summation of the weighted sub-indices. As per ITU's Measuring the Information Society

Report(MISR)-2017, Iceland tops the IDI rankings with an IDI value of 8.98 followed by South Korea, Switzerland and Denmark. India ranks 134 with IDI value at 3.03 among 176 countries. But seeing the rapidly growing Indian economy, more than 1000 million mobile users, growing size of population and global status in IT/ITes, present ranking at 134 is not fair and needed huge improvement.

Methods

For this study, a flexible research design has been adopted using qualitative analysis. This study analyses the development of telecom access infrastructure, both fixed and mobile-cellular, in the country. Therefore, an exploratory approach has been taken in this research.

Both primary and secondary data sources are used for this study, which include-

i) Books, articles , research papers and journals ii) Analysis of NDCP-2108, National Policy on Information Technology(NPIT) -2012, Digital India Programme and data available with MeitY, DOT, TRAI, BBNL iii) MISR- 2017 of ITU and World Bank reports. iv) South Korean ICT promotion policies and other reports. v) Primary data obtained through survey questionnaire from representatives of DOT, TRAI, Telecom Service Providers (TSPs) and the users .The sample size consists of 100 respondents. The data so collected is analysed and presented in tabular forms and charts.

Results

The analysis of IDI and all its 11 indicators are done in light of MISR 2017 of ITU. India's comparison of IDI's indicators is done with higher IDI ranked countries like South Korea, Japan , Singapore, China, USA, United Kingdom and Germany. Case study of ICT development in South Korea is also conducted. India's present ICT

access infrastructure and future infrastructure requirements assessed and Inputs/suggestions through survey questionnaire have been collected, on indicators in IDI Access and use sub-indices.

On IDI indicators level, India legs far behind South Korea and other higher IDI countries on all 11 indicators. It is found that access infrastructure, both fixed and mobile, is lacking in pan- India coverage and quality of networks. Affordability of Computers and internet access to households is beyond the reach of large section of population. Internet speed is also a constraint due to availability of insufficient international Internet bandwidth. Training and awareness of internet in day to day life is also a big barrier for low internet use by individuals.

Conclusion

To increase India's IDI ranking, it is utmost important to establish a robust ICT access infrastructure, both fixed and mobile telecom networks. Low IDI value suggests that either the access to ICT infrastructure is not available or not affordable. Establishment of optical fibre based fixed telecom network and 3G, 4G and 5G mobile network on pan-India basis is the need of the country and its growing population. There is growing need for unrestricted, high international Internet bandwidth to users besides provisioning of computers/laptop/tablet and internet access to households at subsidized/ affordable rates.

Recommendations

Following recommendations are made to improve India's IDI ranking:

ICT access infrastructure: Investment in Fibre To The Home(FTTH) and Fibre To The Building (FTTB) for fixed and 3G, 4G and latest 5G mobile technologies for cellular networks; establishment of more number of cable landing stations for higher

International Internet Bandwidth(IIB); promotion of satellite based broadband coverage for remote and inaccessible areas.

ICT usage: Computer /laptop/tablet to be provided at subsidized cost ; delivery of content in local languages and free internet training for 100 million people.

Technology facilitation: Digitalization of contents like land records, public distribution system(PDS); Strengthening of Common Service Centres(CSCs) to provide e-Services and internet to rural people.

Financial sustainability: Use of solar power and separate electric feeder line to run telecom network; funding from Universal Service Obligation Fund (USOF) to make CSCs sustainable.

Policy framework: Reduction in Spectrum usage charges(SUC) and License fee (LF); facilitation of Right of Way (ROW) permissions; provision for Common Telecom Infrastructure (CTI) in National Building Code (NBC) ; Common Service Duct in cities for ICT access infrastructure ; Public Private Partnership(PPP) for next generation ICT infrastructure ; Strengthening of telecom PSUs; Budgetary provision for ICT Infrastructure promotion ; monetary and fiscal incentives for infrastructure providers.

Change management: Government to citizens(G2C) interaction should be web based; Officials to be equipped with tools like Personal Digital Assistants(PDAs).

Research and Development: Promotion of Research and Development (R&D) in ICT and innovative technology solutions.

Suggestions of the research work

1.Future research proposed, for in-depth comparative study of IDI, on all indicators including indicators in skills sub-index.

2. This research work may be forwarded to DOT, Ministry of Communications, for guiding in framing policies, promotion, partnership, coordination and execution.

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CHAPTER 1

INTRODUCTION

1.1 ICT and India

Various studies and initiatives have established the role of ICT in employment opportunities and inclusive growth. There is growing awareness that connectivity is foundational to the global development agenda. But despite momentum for universal internet access, a large size of the global population has never accessed the internet. There are gaps in connectivity mainly due to lack of effective policies, tools and investments. Bridging the gaps could help achieve the tremendous potential of these technologies and foster inclusive socio-economic growth. Government agencies, International organizations and ICT stakeholders around the world are spearheading initiatives, programmes and strategies to connect the left out about 1.5 billion people. Few such initiatives include :

i) UN Broadband Commission for Sustainable Development- Whose aim is to showcase and document the power of ICT and broadband-based technologies for sustainable development. In 2018, given the shift towards new UN development Agenda 2030 and new challenges of a digital world, the Commission re-evaluated and launched new framework of Targets 2025 in support of "Connecting the Other Half" of the world's population. These targets seek to expand broadband infrastructure and internet access and use by populations around the world, in support of achievement of the Sustainable Development Goals established by the United Nations.

ii) The Global Connect Initiative (GCI): a U.S. Department of State-led multi-stakeholder effort, which aims to bring 1.5 billion additional people online by 2020, aims to foster pro-market environments that encourage investment, innovation and

job creation. GCI calls on all stakeholders to do their part to expand access to the internet globally, whether they're governments creating and updating national broadband plans, multilateral development banks prioritizing connectivity in their programs, or the private sector providing innovative solutions to connecting people in remote areas.

iii) World Bank's Connecting for Inclusion: Broadband Access for All , initiative.

In the past two decades tremendous growth of ICT (Information and Communication Technology) and ITeS (IT enabled services) industry observed worldwide and India has an impressive mark in the world trade of ICT and ITeS. Indian ICT industry is a fast growing industry in terms of its annual growth in domestic market share, exports , offshore outsourcing and investment. The Indian ICT/ITeS is considered to be global powerhouse. The IT-ITeS industry revenue aggregate (exports + domestic) is expected to grow over 8 percent and projected to reach USD 164 billion in FY 2018-19 as compared to USD 151 billion in FY 2017-18(Meity: Annual Report 2018-19).

1.2 Internet and ICT

Today, Internet is pressing need of citizens as well as Government , through which government connects with the citizen to facilitate delivery of services in a transparent, efficient and in real time. Citizen also connects to the government in the form of submitting feedbacks and suggestions to government.

From e-commerce to e-learning, ICTs such as internet and other global telecommunication systems are conduits through which society is acted out. For this objective, Government of India initiated flagship Digital India Programme, with a vision to transform India into a digitally empowered society and knowledge economy.

The national level e-Governance programme called National e-Governance Plan (Ne-GP) was initiated in 2006. There were 31 Mission Mode Projects (MMPs) under National e-Governance Plan covering a wide range of domains, viz. agriculture, land records, health, education, passports, police, courts, municipalities, commercial taxes, treasuries etc. 24 Mission Mode Projects have been implemented and started delivering either full or partial range of envisaged services.

Considering the shortcomings in National e-Governance Plan that included lack of integration amongst government applications and databases, low degree of government process re-engineering, scope for leveraging emerging technologies like mobile, cloud etc, Government of India has approved the e-Kranti programme recently with the vision of "Transforming e-Governance for Transforming Governance". All new and on-going e-Governance projects as well as the existing projects, which are being revamped, should now follow the key principles of e-Kranti namely 'Transformation and not Translation', 'Integrated Services and not Individual Services', Government Process Reengineering (GPR) to be mandatory in every MMP', 'ICT Infrastructure on Demand', 'Cloud by Default', 'Mobile First', 'Fast Tracking Approvals', 'Mandating Standards and Protocols', 'Language Localization', 'National GIS (Geo-Spatial Information System)', 'Security and Electronic Data Preservation'. The portfolio of Mission Mode Projects has increased from 31 to 44 MMPs. Many new social sector projects namely Women and Child Development, Social Benefits, Financial Inclusion, Urban Governance, eBhasha etc have been added as new MMPs under e-Kranti.(source: Digital India) .

To provide ICT Access, a robust physical infrastructure is required to be set up. For Access across India, National Optical Fiber Network (NOFN) was created By Government of India on 25/10/211 to provide connectivity to 2,50,000 Gram

Panchayats in the country, with the aim to ensure broadband connectivity with adequate bandwidth. This is to be achieved utilizing the existing optical fiber of Bharat Sanchar Nigam Limited (BSNL) and extending it to the Gram Panchayats. A World Bank study has estimated that a 10% increase in broadband connectivity leads to 1.38% increase in Gross Domestic Product (GDP). Broadband is a tool for improving the lives of people by providing affordable and equitable access to information and knowledge. For individuals, broadband has direct impact on their day to day life style. It can contribute towards increased trade and employment avenues. Information and Communication Technologies (ICT) applications such as e-Commerce, e-Banking, e-Governance, e-Education and Tele-medicine require high speed Internet connectivity. NOFN will facilitate this.(Source : BBNL, a Govt. of India undertaking).

Many ICT based initiatives has taken place over the last decade with some positive effects .However benefits have not tickled down equitably, depriving the poor and marginalized groups of the society. The pan India effects are yet to be seen, as accessibility, affordability, sustainability of ICT services and attitudinal and institutional change remain fundamental issues.

1.3 National Digital Communications Policy – 2018

Post-liberalization of the Indian economy, the Indian telecom sector saw following policies :-

1. National Telecom Policy , 1994
2. National Telecom Policy , 1999
3. Broadband Policy, 2004
4. National Telecom Policy , 2012

5. National Digital Communication Policy-2018

National Digital Communications Policy-2018, is new policy approved by government of India, for the development of telecom sector. The National Digital Communications Policy-2018 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

Following Infrastructure goals are proposed to be achieved in NDCP-2018:

Connect India: Creating a Robust Digital Communication Infrastructure :

a. Provide Universal broadband connectivity at 50 Mega bits per second(Mbps) to every citizen
b. Provide 1 Giga Bits per seconds (Gbps) connectivity to all Gram Panchayats of India by 2020 and 10 Gbps by 2022
c. Enable 100 Mbps broadband on demand to all key development institutions; including all educational institutions
d. Enable fixed line broadband access to 50% of households
e. Achieve 'unique mobile subscriber density' of 55 by 2020 and 65 by 2022
f. Enable deployment of public Wi-Fi Hotspots; to reach 5 million by 2020 and 10 million by 2022

g. Ensure connectivity to all uncovered areas

1.4 ICT Development Index (IDI) of ITU

The disparity in access to Information and Communications Technologies (ICTs), often referred to as "digital divide", has received significant attention among policy makers and academics around the world. In particular, the need for continuous monitoring of the ICT adoption rates by communities in different economies has been one of the top priorities in various forums. In order to address this need, the International Telecommunication Union (ITU), a United Nations agency, proposed a single, comprehensive ICT Development Index (IDI) in 2009. IDI is designed to consolidate useful information from previous measurement indices. One of its main uses, as illustrated by ITU, is to measure the magnitude of the digital divide and how it is evolving over time.

Conceptual framework

The IDI is a composite index that combines 11 indicators into one benchmark measure that can be used to monitor and compare developments in ICTs between countries and over time. The IDI was developed by ITU in 2008 in response to ITU Member State's request to establish an overall ICT index, was first presented in Measuring the Information Society Report 2009 (ITU, 2009), and has been published annually since then.

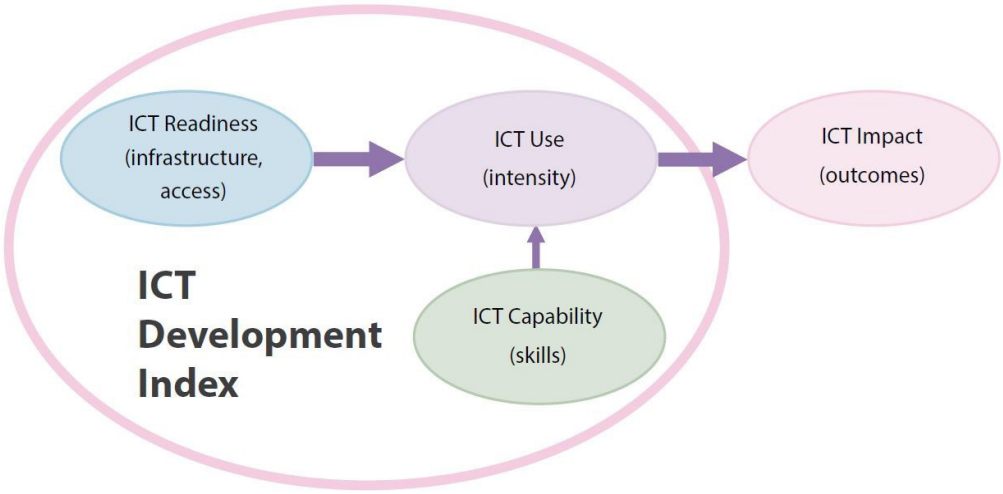
A three stage IDI evolved. Based on this conceptual framework, the IDI is divided into the following three sub-indices, which are illustrated, with their component indicators, in the chart :

Access sub-index**:** This sub-index captures ICT readiness, and includes five infrastructure and access indicators (fixed-telephone subscriptions, mobile-cellular telephone subscriptions, international Internet bandwidth per Internet user, households with a computer, and households with Internet access);

Use sub-index: This sub-index captures ICT intensity, and includes three intensity and usage indicators (individuals using the Internet, fixed-broadband subscriptions and mobile-broadband subscriptions);

Skills sub-index: This sub-index seeks to capture capabilities or skills that are important for ICTs. It includes three proxy indicators (mean years of schooling, gross secondary enrolment, and gross tertiary enrolment). As these are proxy indicators, rather than directly measuring ICT-related skills, the skills sub-index is given less weight in the computation of the IDI than the other two sub-indices

Chart 1.1: Three stages in the evolution towards an information society:



(Source: ITU, Measuring the Information Society Report volume1-2017)

There has been sustained growth in the availability of communications in the past decade, led by growth in mobile cellular telephony and, more recently, in mobile broadband. Growth in fixed and mobile-broadband infrastructure has stimulated Internet access and use. The number of mobile-cellular subscriptions worldwide now exceeds the global population, India is no exception to this. India has provided more than a billion mobile phones to its citizen. Although many individuals, still do not use a mobile phone .

Mobile-broadband subscription rates are much higher in developed countries in Europe and the Americas than other developing countries like India. Subscribers in developed countries also tend to benefit from higher bandwidth than those in developing countries. There are substantial digital divides between developed and developing countries. These divides are evident in Internet use as well as connectivity.

International Telecommunication Union (ITU) has been publishing report "Measuring the Information Society Report", of all countries on select indicators of ICT Development Index (IDI). It also demonstrates that there are still great disparities in ICT development between more and less connected countries which need to be addressed if inclusive information societies are to contribute to the achievement of sustainable development and other international goals. As per Measuring the Information Society Report , 2017 , India ranks 134 on overall IDI ranking, among 176 countries with scores- Access sub index: 3.6* (rank 137), Use sub index: 1.62*(rank 144)and Skill sub index: 4.73*(rank 121). Access sub index and Use sub index fair poorly not only in ranking on these parameters but scores as well.

(* These scores are out of 10).

This dissertation aims to study the ICT Development Index (IDI) of ITU , the select indicators of ICT access and ICT use , and analyse the same in light of Government policies, programs and regulations.

1.5 Statement of the problem:

ICT Development Index (IDI) is published by International Telecommunication Union (ITU) based on internationally agreed Information and Communication Technology (ICT) indicators. IDI is a standard tool that governments, operators, development agencies, researchers and others can use to measure the digital divide and compare ICT performance within and across countries. IDI is based on 11 ICT indicators, grouped in 3 clusters: ICT access , ICT use and ICT skills sub indices.

For computation of the final Index, the ICT access and ICT usage sub-indices were each given a 40 per cent weighting, and the skills sub-index (because it is based on proxy indicators) a 20 per cent weighting. The final Index value was then computed by summation of the weighted sub-indices. Sensitivity analysis is carried out to investigate the robustness of the Index results in terms of the relative position in the overall ranking, using different combinations of methods and techniques to compute the Index.

Iceland tops the IDI rankings with an IDI value of 8.98 followed by South Korea, Switzerland and Denmark. India ranks 134 with IDI value at 3.03 among 176 countries in 2017 .(ITU: Measuring the Information Society Report 2017). 134 is not a very good ranking considering the country's economic and IT status in the world.

Though India improved in IDI value by 0.38 (from2.65 in 2016 to 3.03 in 2017) and it now ranks 17th in terms of improvement in IDI value. But seeing the rapidly growing Indian economy, more than 1000 million mobile users, growing size of

population and global status in IT/ITes , present ranking at 134 is not fair and require huge improvement.

So , this study aims to analyse ICT Development Index (IDI) of ITU and indicators with regard to existing govt. policies, programmes and propose suggestions for improving India's IDI ranking.

1.6 Objectives of the study

1. To analyse indicators of ICT development index vis-à-vis countries with higher IDI score.
2. To analyse India's scores and positions of ICT Development Index and identify causes for low score.
3. To examine policies, schemes of government and challenges to improve India's ranking.
4. To suggest strategies to improve India's ranking

1.7 Rationale

Though India is one of the largest telecom market in terms of users, next only to China but rank below, at 134 on ICT Development Index, among 176 countries in 2017 report . Development of ICT is a global demand, lagging behind would be to the dis-advantage of individual, society and country creating regional and global disparities .

IDI is directly linked to ICT development and economic development in the country in general , society and individuals in particular. Therefore, it needs study of challenges and strategies to improve India's global IDI ranking, and raise the economic opportunity.

As per NDCP-2018, propelling India to the Top 50 Nations in the ICT Development Index of ITU from 134 in 2017 is one of the strategic goals to be accomplished by

2022. Not much research done in India on ICT development index so, this study will help policymakers in India to make policy decisions , strategies in improving IDI ranking.

1.8 Research Design

(i) For this study, a flexible research design has been adopted using qualitative analysis of the current situation. Starting from historical background and opening of telecom sector to private telecom service providers in 1994, this study discusses the development of telecom access infrastructure, both fixed and mobile-cellular, in the country. Therefore, an exploratory approach has been taken in this research.

(ii) The research design for this study shall comprise of (a) Analysis of primary data collected through questionnaire and (b) Analysis and correlation between secondary data collected from ITU, World Bank, TRAI, DOT, Ministry of Electronics & Information Technology etc.

1.9 Research Questions

1. What are indicators of ICT development index on which India fairs poorly vis-a-vis developed and developing countries ?
2. What are Government policies for ICT access ?
3. What are Government policies for ICT use ?
4. What are challenges before govt./ Telecom Service providers for improving ICT access and use ?
5. What strategies are needed to meet these challenges to improve ranking

1.10 Scope / limitation /delimitation

Due to logistics constraints including paucity of time and resources the scope of this study is limited to ICT Access and ICT Usage sub indices of IDI and important indicators covered in these only. Comparative analysis with some higher IDI countries and case study of a country having higher IDI is also being done. An idea for future research would be an in-depth comparative study of countries having higher IDI ranking, on all three sub-indices , including skills sub-index and its indicators.

1.11 Literature Review

Literature review is being carried out for study on IDI and its indicators. Literature reviewed are as below:

1. Rajat Kathuria and Mansi Kedia(2011) in newspaper article "Why India fares poorly in digital indices" observe that Mobile voice telephony, where most of India's success is resident, accounts for only 8% of the entire IDI. The rest of the index is largely built on broadband and Internet, including mobile broadband, and in the skills available to leverage availability of the network infrastructure. These skills include literacy rates and gross enrolment ratios in primary and secondary education. It is in broadband and the skills required to use it that India fares poorly, reinforcing the view that broadband infrastructure and its functionality needs to be improved on a war footing for India to boost its ranking in the global information society and, more importantly, to realise the potential social and economic impacts inherent in the broadband ecosystem

2. Anteneh Ayanso, Danny I. Cho and Kaveepan Lertwachara(2011) in their research "ICT Development Index and the Digital Divide" have observed ICT Profiles often exhibit groups of economies with relatively high local density, representing a group

of countries that are either advanced or behind in terms of ICT penetration and usage. Accordingly, clustering can be effectively used to find naturally occurring groups that correspond to the modality of the ICT data. Thus, the cluster-based methodology presented in this paper supplements the methodology used by ITU and allows further analysis using the individual components of the composite IDI index. future research will examine the global as well as regional digital divide using the three sub-indices (ICT Access, ICT Use, and ICT Skills) of the IDI in order to provide additional insight in terms of the three stages in the evolution towards an information society which represents the conceptual framework employed by ITU to describe the process countries are go through.

3. Gargi Banerjee (2014) in the review article "ICT Development in India : Current scenario" observed that in present era Information and Communication Technology (ICT) industry is contributing a lot into Indian national economy in various ways. Almost all the states in India are targeting this sector as a vehicle for economic development. From the study it is revealed that over the period of 1990-91 to 2006-07 there has been a huge development of ICT in India. There has been growth and investment in ICT and its components in India. To support ICT growth it is seen that there is enormous growth in the human capital development in different states of India. The growth of ICT has been indicators that for the development of exports and imports of the related items like hardware, software and engineering goods. The ICT development has made the rural people better informed about the market and the many Indian farmers are benefitted with the reach of ICT in the form of mobile phone or internet in the remote villages

4. Ani Wilson, Ugwunta David ,Eneje Beatrice and Okwo Mary (2014) in their research "How telecommunication development aids economic growth: Evidence

from ITU ICT Development Index (IDI) top five countries for African region" have observed that telecommunication development in Africa influences economic growth positively and significantly. This is because telecommunication development serves as a platform that boosts other economic activities in the region. The results concur with the theory that mobile phones in less developed economies are playing the same crucial role that fixed telephony played in the richer economies in the1970s and 1980s. Mobile phones substitute for fixed lines in poor countries, but complement fixed lines in rich countries, implying that they have stronger growth impact in poor countries. The contribution of mobile cellular phones to economic growth has been growing in Africa region, and the marginal impact of mobile telecommunication services is even greater in areas where fixed-line phones are rare such as in Nigeria, the fastest growing mobile telephone market.

5. Settapong Malisuwan, Dithdanai Milindavanij, Jesada Sivaraks and Noppadol Tiamnara (2015) , in their research "A modified model of ICT Development Index (IDI) for Thailand to achieve the ICT leader in ASEAN" have observed that After the first allocation of spectrum in the 2.1 GHz band in 2012 was successfully made, Thailand has experienced significant progresses in ICT development, especially positive effects on the overall economic benefits. The ITU MIS report 2015 identified that Thailand is one of the most dynamic countries in IDI ranking over the past five years, supported mainly by improvement in mobile broadband penetration. The next wave of 4G 1800MHz rolling out in Thailand will foster growth in the access and use of ICTs, which should in turn have a positive impact on short and long-term social and economic development.

1.12 Methods to be applied & data sources

Both primary and secondary data sources are used for this study, which include-

i) Books, articles and journals available on the subject.

ii) Data available with concerned Government departments and Ministries -Ministry of Electronics & Information Technology, DOT, TRAI, BBNL on policies, programmes, evaluation and progress reports on the subject.

iii) ITU and World Bank reports on the subject.

iv) South Korean ICT promotion policies; Cyber Korea 21 (1999), e-Korea (2002) and u-Korea (2005) and Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society 2016 and other reports..

v) Primary data obtained through survey questionnaire from representatives of Department of Telecommunications, TRAI, Telecom Service Providers (TSPs) and the users of telecom services .

The sample size consists of 100 respondents. The data so collected is analysed and presented in tabular forms, charts etc.

1.13 Chapterisation Scheme

The research study will be discussed as per chapterisation scheme given below:

Chapter 1: Introduction

Chapter 2: Analysis of Policies Regulating the Access

Chapter 3: Review and assessment of Infrastructure requirements

Chapter 4: Analysis of IDI indicators (Based on field data)

Chapter 5: Strategy to improve India's IDI ranking

Chapter 6: Conclusion and recommendations

CHAPTER 2

ANALYSIS OF POLICIES REGULATING THE ACCESS

2.1 Introduction

The Information and Communication Technology (ICT) is combination of two terms, Information Technology (IT) and Communication Technology (CT). Information Technology deals with Computing of Information whereas Communication is transmission of the information over a distance with the use of Internet. Communication has access component wherein end users are connected to communication network with the help of wire-line and/or wireless access technologies. End users may use landline phones , computers, mobile devices like mobile phones and mobile tabs etc. to connect to external world for voice and internet. Access part of any communication network plays key role in proliferation of information. IC and IT in ICT are inseparable in today's world. So, ICT has become vitally important both for individual citizens and governments to carry their day to day functions.

ITU in ICT Development Index (IDI) calculation has used parameters ; ICT Access, ICT Use and ICT Skills as sub indices with weightage for each sub indices and each component within sub indices.

Government of India came with policies for growth and development of telecommunications in the country since liberalization of telecom sector in 1994. Telecom Policies - National Telecom Policy, 1994, National Telecom Policy, 1999, Broadband Policy, 2004 and National Telecom Policy ,2012 contributed for the growth of telecom sector in India and played vital roles in catapulting India's position into one of the largest mobile user base. However accessibility and other challenges

remain concerns for Government and telecom service providers (TSPs).Therefore, in this chapter, we will analyse telecom policies for regulating access and use in the country.

2.2 National Digital Communications Policy (NDCP) – 2018

2.2.1 Preamble

2.2.1.1 **Access and role of Telecommunications**

Access is important part of any telecommunication network infrastructure for providing connectivity to its various geographical regions and citizens. Inadequate access or lack of it will pose developmental challenges of the region and the people of the area. The Government of India emphasised the importance and need for the state of the art telecommunications infrastructure and information as key drivers for socio-economic development of the country in the present knowledge intensive global scenario. Government has also recognised the role of telecom service providers (TSP) in the creation of telecommunication infrastructure. Thrust of various telecom policies has been for adoption of telecom technology that would offer viable options in overcoming developmental challenges in education, health, employment generation, financial inclusion and contribution to GDP of the country. Accordingly, comprehensive and forward looking telecommunications policy is pivotal for enabling the development of telecommunications.

2.2.1.2 **National Telecom Policy (NTP)-2012- Objectives and Achievements**

In 2012 , Government announced National Telecom Policy with certain objectives including providing reliable and affordable broadband on demand, increasing rural tele-density , recognize telecom as Infrastructure Sector , address the Right of Way (ROW) issues in setting up of telecom infrastructure, evolve a policy framework for

financing the sector consistent with long term sustainability, adoption of green policy in telecom and incentivise use of renewable energy sources for sustainability, recognize telecom as infrastructure sector to realize true potential of ICT for development, One Nation - One License across services and service areas, promote innovation, indigenous R&D and manufacturing, high speed and high quality broadband access to all village panchayats through a combination of technologies.

NTP 2012 laid special emphasis on providing reliable and affordable broadband access to rural and remote areas by combination of optical fibre, wireless, VSAT and other technologies. Optical fibre network laid up to the village panchayat level by funding from the Universal Service Obligation Fund (USOF), extension of optical fibre connectivity from village panchayats to all villages and habitations. Access to this Optical Fibre Network was open, non-discriminatory and technology neutral, promoting Fibre To The Home (FTTH) with enabling guidelines and policies, favouring fast transformation of cities and towns, cable TV networks to be optimally utilised for extending high quality broadband services in rural areas, stimulate the demand of broadband applications and services, work closely with Department of IT in the promotion of local content creation in regional languages which would enhance the investment in all-Internet Protocol (IP) networks including NGN, promote synergies between roll-out of broadband and various Government programs viz e-governance, e-panchayat, MNREGA, NKN, AADHAR, AAKASH tablet etc. and support from USO fund for telecom services, including converged communication services in commercially unviable rural and remote areas.

NTP 2012 announced a number of specific targets to be achieved by 2017 and 2020. As against NTP 2012 target of 175 million broadband connections by the year 2017 and 600 million by the year 2020 at minimum 2 Mbps download speed , Department

of Telecommunication (DOT) achieved 661.27 millions Broadband (≥ 512 Kbps download) connections . As against NTP 2012 target of rural tele-density (%) of 70 by the year 2017 and 100 by the year 2020. With regard to high speed and high quality broadband access to all village panchayats through a combination of technologies by the year 2014 and progressively to all villages and habitations by 2020, DOT achieved 1,34,736 Gram Panchayats (GPs) only out of approx 2,50,000 GPs in the country as on 31st January, 2020 (BharatNet Status Report,31st January 2020.

The demand for Telecommunication is in rural and remote areas which are left unconnected, whereas urban areas require quality of telecommunication services with adequate broadband speed. The Growth of telecommunication infrastructure with regard to accessibility, as was envisaged in NTP 2012 , could not be developed , in remote and rural areas, whereas in Urban areas, quality of service has been a big concern since telecommunication infrastructure has not been upgraded to meet the existing demand. On one hand the capital cost of infrastructure development is huge and maintaining the infrastructure is challenging and economically nonviable in the present telecom scenario where all big telecom service providers in the country are debt ridden and thin profitability adding to their woos.

The above concerns were viewed keenly as telecommunication development in the country is being affected.

2.2.1.3 **Need for a new telecom policy**

To achieve the unfulfilled objectives of NTP 2012 and latest developments in the telecom, IT, other sectors like automobiles and transport, media etc., it was envisaged by the government to accommodate markets and technologies and provide enabling environment for the telecom sector for the holistic development for future telecom

needs. The new telecom policy framework is required to facilitate India's vision of becoming IT hub and develop a world class telecom infrastructure cater to the need of the country and aspiration of it's growing population.

2.2.2 **Objectives , targets and strategies of National Digital Communications Policy (NDCP) 2018**

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.

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

1. **Connect India**: Creating Robust Digital Communications Infrastructure

To promote Broadband for All as a tool for socio-economic development, while ensuring service quality and environmental sustainability.

2. **Propel India**: Enabling Next Generation Technologies and Services through Investments, Innovation and IPR generation :

To harness the power of emerging digital technologies, including 5G, AI, IoT, Cloud and Big Data to enable provision of future ready products and services; and to

catalyse the fourth industrial revolution (Industry 4.0) by promoting Investments, Innovation and IPR.

3. **Secure India:** Ensuring Sovereignty, Safety and Security of Digital Communications

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

2.2.3 Policy framework

The policy framework must focus to create an enabling environment for continuous investments in telecom sector for deployment of telecom infrastructure and technology for catering to the demand and aspirations of the country and its citizens. Towards this objective, the NDCP 2018 policy framework would look at the telecom access infrastructure as follows:

- Mobile-cellular telephone service , Mobile broadband internet (with at least 3G, LTE/ WiMax mobile networks)
- Fixed telephone service, Fixed broadband internet
- Satellite based telephone and broadband internet service
- Others- Optical Fibre Cable (OFC) , WiFi
- International Connectivity for internet bandwidth

2.2.3.1 Access Infrastructure Provisioning

Following milestones set in NDCP 2018, aims to be achieved by 2022 :

a. Provide Universal broadband connectivity at 50Mbps to every citizen by 2022

b. Provide 1 Gbps connectivity to all Gram Panchayats of India by 2020 and 10 Gbps by 2022.

c. Enable 100 Mbps broadband on demand to all key development institutions; including all educational institutions.

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

e. Achieve 'unique mobile subscriber density' of 55 by 2020 and 65 by 2022.

f. Enable deployment of public Wi-Fi Hotspots; to reach 5 million by 2020 and 10 million by 2022.

g. Ensure connectivity to all uncovered areas.

2.2.3.1.1 **Mobile-cellular telephone service, Mobile broadband internet**

The mobile –cellular telephone service is basic need of the citizens in day to day activities. Seamless coverage and quality of service is foremost requirement for people on the movement. The policy intends to facilitate the establishment of mobile tower infrastructure by:

i. Extending incentives and exemptions for the construction of telecom towers.

ii. According accelerated Rights of Way permissions for telecom towers in Government premises.

iii. Promoting and incentivizing deployment of solar and green energy for telecom Towers.

iv. Facilitating Fibre-to-the-tower programme to enable fiberisation of at least 60% of telecom towers thereby accelerating migration to 4G/5G.

v. Leveraging existing assets of the broadcasting and power sector to improve connectivity, affordability and sustainability.

vi. Establishing Common Service Ducts and utility corridors in all new city and highway road projects, and related elements.

vii. Recognizing Spectrum as a key natural resource for public benefit to achieve India's socio-economic goals, ensure transparency in allocation and optimise availability and utilisation by:

(a) Developing a transparent, normative and fair policy for spectrum assignments and allocations.

(b) Making adequate spectrum available to be equipped for the new broadband era:

i. Identifying and making available new Spectrum bands for Access and Backhaul segments for timely deployment and growth of 5G networks.

ii. Making available harmonized and contiguous spectrum required for deployment of next generation access technologies

iii. Further liberalizing the spectrum sharing, leasing and trading regime

iv. Coordinating with Government departments for freeing underutilised/ substitutable spectrum, and its assignment along with unutilised spectrum for efficient and productive use

v. Optimal Pricing of Spectrum to ensure sustainable and affordable access to digital communications

vi. Simplifying the process of obtaining permissions from various agencies such as WPC and SACFA in order to promote efficiency

vii. Enabling Light Touch licensing/ de-licensing of spectrum for broadband proliferation

viii. Promoting the co-use/ secondary use of spectrum

ix. Constituting a Spectrum Advisory Team (SAT) consisting of experts, industry and academia to facilitate the identification of new bands,

applications and efficiency measures to catalyse innovation and efficient spectrum management

(c) Efficient spectrum utilisation and management:

i. Ensuring the optimum utilisation of spectrum by management of interference free spectrum and encouraging new technologies and consolidation

ii. Monitoring efficient utilization of spectrum by conducting systematic audits of the spectrum allocated to both commercial and government organizations

iii. Deploying dynamic database systems for allocation/ interference management

iv. Publishing annual spectrum utilization and availability roadmap for communication needs including those of aircraft and vessels

(d) Promoting Next Generation Access Technologies in India through the following actions:

i. Encouraging licensed service providers to utilise next generation access technologies to ensure cost optimization, service agility and new revenue streams

ii. Recognising mid-band spectrum, particularly the 3 GHz to 43GHz range, as central to India's strategy for Next-Generation Networks

iii. Promoting the effective utilisation of high capacity backhaul E-band (71-76/81-86 GHz) and V-band (57-64 MHz) spectrum in line with international best practices.

iv. Rationalizing annual royalty charges for microwave links for backhaul connectivity

v. By encouraging innovative approaches to infrastructure creation and access including through resale and Virtual Network Operators (VNO).

2.2.3.1.2 **Fixed telephone service, Fixed broadband internet**

Policy has vision to provide Fixed telephone and Fixed broadband internet connectivity to households and educational institutions. Implementing a 'Fibre First Initiative' to take fibre to the home, to enterprises and to key development institutions in Tier I, II and III towns and to rural clusters:

i. According Telecom Optic Fibre cables the status of Public utility

ii. Promoting collaboration models involving state, local bodies and private sector as necessary for provision of shared duct infrastructure in municipalities, rural areas and national highways.

iii. Leveraging existing assets of the broadcasting and power sector to improve connectivity, affordability and sustainability.

iv. Incentivising and promoting fibre connectivity for all new developmental construction.

v. By making requirement for telecom installations and the associated cabling and in-building solutions mandatory in all commercial, residential and office spaces by amending National Building Code of India (NBC), through Bureau of Indian Standards (BIS).

2.2.3.1.3 **Satellite based telephone and broadband internet service**

Satellite based communications play key role in connecting remote and inaccessible area round the clock. India being frontrunner in launching satellites, especially the communications satellites, could leverage satellite asset in the space. Satellite Communication Technologies in India will be strengthen by

(a) Reviewing the regulatory regime for satellite communication technologies, including:

Revising licensing and regulatory conditions that limit the use of satellite communications, such as speed barriers, band allocation, etc.

i. Simplifying compliance requirements for VSAT operators to ensure faster roll out

ii. Expanding scope of permissible services for the effective utilisation of High Throughput Satellite systems through appropriate licensing mechanism.

(b) Optimise Satellite communications technologies in India, by:

i. Reviewing SATCOM policy for communication services, along with Department of Space, to create a flexible, technology-neutral and competitive regime, keeping in view international developments and social and economic needs of the country

ii. Making available new spectrum bands (such as Ka Band) for satellite based commercial communication services.

iii. Rationalizing satellite transponder, spectrum charges and charges payable to WPC

iv. Assessing the bandwidth demands across various spectrum bands used for satellite communications, in consultation with stakeholders

v. Prioritising international engagement with ITU on spectrum management issues, including satellite communications in India.

(c) Develop an ecosystem for satellite communications in India, with focus on:

i. Streamlining administrative processes for assignment and allocations, clearances and permissions related to satellite communication systems

ii. Promoting local manufacturing and development of satellite communications related infrastructure through appropriate policies

iii. Promoting participation of private players, with due regard to national security and sovereignty

2.2.3.1.4 **Others - Optical Fibre Cable (OFC) , WiFi**

Establishing a 'National Broadband Mission – Rashtriya Broadband Abhiyan' to secure universal broadband access by

(a) Implementation of the following broadband initiatives, to be funded through USOF and Public Private Partnerships:

i. BharatNet – Providing 1 Gbps to Gram Panchayats upgradeable to 10 Gbps

ii. GramNet – Connecting all key rural development institutions with 10 Mbps upgradeable to 100 Mbps

iii. NagarNet – Establishing 1 Million public Wi-Fi Hotspots in urban areas

iv. Jan WiFi – Establishing 2 Million Wi-Fi Hotspots in rural areas

(b) Establishment of a National Digital Grid by:

i. Creating National Fibre Authority

ii. Establishing Common Service Ducts and utility corridors in all new city and highway road projects, and related elements.

ii. Creating a collaborative institutional mechanism between Centre, States and local bodies for common Rights of Way, standardisation of costs and timelines; and removal of barriers to approvals

iv. Facilitating development of Open Access Next Generation Networks.

(c) Creating a Broadband Readiness Index for States/ UTs to attract investments and address RoW challenges

(d) Encouraging investment in broadband infrastructure through fiscal incentives, including accelerated depreciation and tax incentives; and incentivizing fixed line broadband.

(e) By encouraging innovative approaches to infrastructure creation and access including through resale and Virtual Network Operators (VNO)

(f) Promoting broadband connectivity through innovative and alternative technologies

2.2.3.1.5 **International Connectivity for internet bandwidth**

International connectivity for internet bandwidth is an essential part of any internet network. Availability and affordability are the key aspects. Any constraint on internet bandwidth due to international connectivity is bound to reflect at the user end.

Policy intends to improve international connectivity and reduce the cost of international bandwidth by facilitating setting up of International Cable Landing Stations by rationalising access charges and removing regulatory hurdles; and by benchmarking international bandwidth to global trends; Encourage and facilitate sharing of active infrastructure by enhancing the scope of Infrastructure Providers (IP) and promoting and incentivizing deployment of common sharable, passive as well as active, infrastructure.

2.2.3.2 **Other Issues**

2.2.3.2.1 **Investment**

To enable the establishment of telecommunication infrastructure , investment of USD 100 Billion will be required in the Digital Communications Sector by 2022, reforming the licensing and regulatory regime to catalyse Investments and Innovation, and promote Ease of Doing Business by:

i. Reviewing of levies and fees including LF, SUC and the definition of AGR and rationalisation of Universal Service levy.

ii. Reviewing the concept of pass through charges to align the same with the principles of input line credit thereby avoiding double incidence of levies.

iii. Reviewing the rationalization of license fees on fixed line revenues to incentivise digital communications

iv. Rationalising taxes and levies on Digital Communications equipment, infrastructure and services

v. Enabling unbundling of different layers (e.g. infrastructure, network, services and applications layer) through differential licensing

vi. Promoting Open Public Wi-Fi access through Wi-Fi / Public Data Office, Aggregators and Public Data Offices

vii. Introducing various fiscal and non-fiscal benefits for development of telecom clusters around cable landing stations to foster innovation in Digital Communications Technologies

(c) Simplifying and facilitating Compliance Obligations by:

i. Reducing license and regulatory compliance requirements keeping in view best international practices

ii. Simplifying existing systems and procedures for grant of licenses, approvals, clearances, permissions and developing a comprehensive end-to-end online platform

iii. Specifying timelines within which various types of licenses, permissions and clearances shall be provided by the relevant administrative offices

iv. Improving the Terms and Conditions for 'Other Service Providers', including definitions, compliance requirements and restrictions on interconnectivity

v. forming the Guidelines for Mergers & Acquisitions, 2014 to enable simplification and fast tracking of approvals

vi. Reorganizing Wireless Planning and Coordination (WPC) Wing to facilitate Ease of Doing Business

vii. Reviewing the penalty provisions to ensure proportionality and reasonableness

viii. Creating a regime for fixed number portability to facilitate one nation – one number including portability of toll free number, Universal Access numbers and DID numbers

ix. Simplifying ETA (Equipment Type Approval) process for low powered (< 1 watt) radio devices

x. Simplifying import licensing requirements of Wireless Planning and Coordination (WPC) Wing

2.2.3.2.2 **Strengthening of Public Sector undertakings (PSUs)**

(a) Focus on building technical expertise and knowledge management for Public Sector Units, through the following initiatives:

i. Building internal capacity within PSU's to promote secure and efficient service delivery, infrastructure development and domestic manufacturing.

ii. Identifying and exploiting operational synergies in service provisioning, infrastructure creation, R&D, Standardization and manufacturing.

iii. Using the training infrastructure available with telecom PSUs for skill development

iv. Upgrading the manufacturing PSUs under DoT to effectively harness strategic and operational synergies

v. Facilitating technical up gradation of PSUs.

2.2.3.2.3 **Disaster management**

Developing a comprehensive plan for network preparedness, disaster response relief, restoration and reconstruction by

(a) Strengthening network resilience by:

i. Framing and enforcing standard operating procedures to be followed during disasters and natural calamities, including sectoral guidelines for disaster response and recovery applicable to various service providers

ii. Establishing institutional framework to promote monitoring of activities, rapid dissemination of early warning disaster notifications and better coordination and collaboration between relevant Ministries / Departments, including the National Disaster Management Authority of India

(b) Developing a Unified Emergency Response Mechanism by:

i. Creating an institutional framework with clearly defined roles and responsibilities, Standard Operating Procedures and technical guidelines

ii. Incorporating obligations under the license terms and conditions for implementation of Next Generation 112 services in all areas, based on geo location technologies, and provide online access to caller location and details to authorised central and state agencies

iii. Enforcing obligations of service providers to share infrastructure, and ensure interoperability in emergency situations in a network-agnostic, operator-agnostic and technology-agnostic manner.

(c) Enhancing the Public Protection and Disaster Relief (PPDR) plan for India by:

i. Facilitating the establishment of a Pan-India network for Public Protection and Disaster Relief (PPDR)

ii. Making necessary spectrum available for PPDR including by establishing INSAT satellite-based mobile communication systems

iii. Implementing global and regional harmonized spectrum Plans for PPDR

2.2.3.2.4 **Changes in legislation**

The Telecommunication sector in India is governed by Indian Telegraph Act, 1885 (ITA 1885) and Indian Wireless Act 1933. ITA 1885 need to be amended to tackle the new challenges in NDCP 2018.

2.3 National Policy on Information Technology (NPIT)- 2012

2.3.1 Preamble

2.3.2 Objectives of National Policy on Information Technology – 2012

1. To increase revenues of IT and ITES Industry from 100 Billion USD at present to 300 Billion USD by 2020 and expand exports from 69 Billion USD at present to 200 Billion USD by 2020.
2. To gain significant global market-share in emerging technologies and Services.
3. To promote innovation and R&D in cutting edge technologies and development of applications and solutions in areas like localization, location based services, mobile value added services, Cloud Computing, Social Media and Utility models.
4. To encourage adoption of ICTs in key economic and strategic sectors to improve their competitiveness and productivity.
5. To provide fiscal benefits to SMEs and Start-ups for adoption of IT in value creation
6. To create a pool of 10 million additional skilled manpower in ICT.
7. To make at least one individual in every household e-literate.
8. To provide for mandatory delivery of and affordable access to all public services in electronic mode.

9. To enhance transparency, accountability, efficiency, reliability and decentralization in Government and in particular, in delivery of public services.
10. To leverage ICT for key Social Sector initiatives like Education, Health, Rural Development and Financial Services to promote equity and quality.
11. To make India global hub for development of language technologies, to encourage and facilitate development of content accessible in all Indian languages and thereby help bridge the digital divide.
12. To enable access of content and ICT applications by differently-abled people to foster inclusive development.
13. To leverage ICT for expanding the workforce and enabling life-long learning.
14. To strengthen the Regulatory and Security Framework for ensuring a Secure and legally compliant Cyberspace ecosystem.
15. To adopt Open standards and promote open source and open technologies

2.3.3 Strategies of National Policy on Information Technology – 2012

Key strategies of National Policy on Information Technology – 2012 are as follows;-

2.3.3.1 **Human Resource Development**

1. To create necessary physical and institutional infrastructure for creating a pool of 10 million trained persons in IT sector by the year 2020 through formal and non formal sectors, with focus on skill development and expertise creation.
2. To set up Centres of Excellence in institutes of higher learning to promote high end research in specialized ICT areas and producing quality doctoral and postdoctoral level researchers.
3. To create a mechanism to ensure that at least one individual in every household is e-literate.

4. To create a framework to certify the level of applied knowledge and skills of personnel in specific areas of ICT.
5. To catalyse continuous updation of curriculum and syllabi at all levels to include the current developments and relevant knowledge of ICT as an integral part of the educational programmes.

2.3.3.2 **Creating an ecosystem for Internet and mobile driven Service Industry**

1. To leverage Internet and Web technologies for developing new products, technologies and businesses.
2. Enable seamless, ubiquitous, secure and personalized delivery of government and non-government services through Internet based and mobile based delivery of services throughout the country.
3. Foster an ecosystem for innovation in services by leveraging Aadhaar as well as financial and location-based services
4. To leverage mobile devices as instruments for enabling secure transactional services including financial services.
5. To promote development of an ecosystem for enabling innovation and entrepreneurship related to mobile Value added Services.

2.3.3.3 **Enabling Service Delivery through e-Governance**

1. To implement the National e-Governance Plan (NeGP) and mandate provision of all Government Services through Electronic mode within a fixed time frame by enactment of the Electronic Delivery of Services (EDS) Bill and through reengineering processes to enhance efficiencies of service delivery.
2. To mandate public procurement through electronic mode across all departments to enhance transparency and competition.

3. To set up a widespread network of Common Service Delivery Access points for enabling assisted access to electronic services.
4. To accelerate and standardize delivery of electronic services by providing Common Shareable Service Delivery Platforms by leveraging technologies like Cloud Computing.
5. To develop, adopt, evolve and notify standards for seamless interoperability of data and applications.
6. To promote open standards and open technologies.
7. To enhance institutional framework for Capacity Building Programme for imparting training across all levels.
8. To design and create a citizen engagement framework for utilization of social media by the government and its agencies.
9. To design and implement policy framework for placing data in public domain for use and value addition. 10. To promote Public Private Partnerships in e-Governance projects and facilitate flow of private sector financial and technical capabilities into the national e-governance effort especially in areas where viable investments are feasible.

2.3.3.4 **Promotion of Innovation and R&D in IT Sector**

1. To support SMEs and start-up companies to equip them for competitive environment through fiscal benefits, innovation fund and incubation facilities.
2. To create an Innovation Challenge Agenda to promote innovation in ICT sector.
3. To build R&D infrastructure and test facilities for development and adoption of emerging technologies like: Next Generation Computing Systems, High Performance Computing (HPC), Cloud Computing, GIS, Mobile

Technologies, Inter-operable Infrastructure for Small Financial Transactions, Switch, Language Technologies etc.

4. To incentivize innovation in public supported research.
5. To promote industry-academia collaborative R&D with emphasis on innovation, products, patents and IPs
6. To encourage adoption of ICT based Green technologies as well as to promote green technologies by making them competitive through appropriate fiscal & non-fiscal policies.
7. To strengthen the ecosystem for creation as well as protection of Intellectual Property.

2.4 **Digital India Programme**

Digital India is a flagship Government of India programme with a vision to transform India into a digitally empowered society and knowledge economy. It is an umbrella initiative covering a number of government agencies and departments and centred on three key areas: digital infrastructure as a utility for every citizen; governance and services on demand; and digital empowerment of citizens.

One of the key areas on which the vision of Digital India is centred is "digital infrastructure as a utility to every citizen" .A key component under this vision is high speed internet as a core utility to facilitate online delivery of various services. It is planned to set up enabling infrastructure for digital identity, financial inclusion and ensure easy availability of common services centres. It is also proposed to provide citizens with "digital lockers" which would be sharable private spaces on a public cloud, and where documents issued by Government departments and agencies could be stored for easy online access. It is also planned to ensure that the cyberspace is made safe and secure.

Governance and services on demand is another key vision area of Digital India. The National e-Governance Plan (NeGP) was approved in 2006 to take a holistic view of e-governance initiatives across the country, integrating them into a collective vision. Around this idea, a massive countrywide infrastructure reaching down to the remotest of villages is being developed, and large-scale digitization of records is taking place to enable easy and reliable access over the internet. The ultimate objective was to make all government services accessible to the common man in his locality, through common service delivery outlets, and ensure efficiency, transparency, and reliability of such services at affordable costs to realise the basic needs of the common man.

Digital empowerment of citizens is third key vision area of Digital India. Digital connectivity is a great leveller. Cutting across demographic and socio-economic segments, Indians are increasingly connecting and communicating with each other through mobile phones and computers riding on digital networks. The Digital India programme itself promises to transform India into a digitally empowered society by focusing on digital literacy, digital resources, and collaborative digital platforms. This also places emphasis on universal digital literacy and availability of digital resources/services in Indian languages.

2.5 **Analysis**

Substantial amount of telecommunication access infrastructure still need be established in the country though large number has already in place as far as tele-density is concerned. Telecom reforms initiated more than two decades ago has benefited the telecom sector and the country immensely. The new digital communications policy contemplated to meet the telecom infrastructure needs of the country with regard to increasing mobile geographical coverage and mobile subscriber density, broadband internet infrastructure provisioning, international

connectivity for internet bandwidth and investments and funding requirements thereof. Investment requirements to create country-wide huge telecom infrastructure, is also enormously large. To bring efficiency of economy, use of solar power and emerging technologies is also envisaged.

Provisioning of broadband connectivity to two and half lakh gram panchayats over Optical Fibre Cable (OFC) has been ambitious initiative under universal service obligation funding, helping people in rural and remote area to access and benefit various states and union Governments policies and schemes. Full roll out of this project, carried through Bharat Broadband network limited – a Special purpose vehicle (SPV) under Government of India, will enormously benefit in providing broadband connectivity to rural and remote areas in the country. It is concluded by saying that policies for proliferation and regulating access infrastructure are in place but implementation is the key , which depends on strategy and synergy of all stakeholders .

CHAPTER 3

REVIEW AND ASSESMENT OF INFRASTRUCTURE REQUIREMENTS

3.1 **Introduction:**

Infrastructure development is key for the development of ICT in any country. India is a country with very large population residing in rural areas. Providing fixed and mobile telephone and internet connectivity across the length and breadth of the country, is a huge challenge . India is geographically divided into 22 License Service Areas (LSAs) with more than 8 Telecom Service Providers (TSPs) providing fixed telephone, wireless mobile and internet services in the country. The number of telephone subscribers in India is 1,195.24 million , with overall tele-density of 90.52 , per 100 inhabitants, as on 30th September, 2019 . Telephone subscription in Urban areas at the 677.95 million, with tele-density at 160.63 whereas rural telephone subscription at 517.29 million ,with tele-density at 57.59, per 100 inhabitants, at the end of September, 2019 (TRAI Quarterly Performance Indicator Report, July-Sept'2019).

3.2 Present Status of Telecom Access Infrastructure:

Telecom access infrastructure status in the country is as below:

3.2.1 Fixed telephone service

There are over half a dozen fixed / wireline telephone service providers in the county namely ; BSNL, MTNL, Bharti, TATA Tele, Reliance Communications, Quadrant , Vodafone and Reliance Jio Infocomm Ltd. Total wireline subscription is 21.49 million, including 2.72 million in rural area, as on 30.09.2019. The trend in growth of wireline service is stagnant, with urban tele-density – 4.45 , rural tele-density-0.30 and overall tele-density of 1.63 (per 100 inhabitants).

Table: 3.1 Service Area wise Wireline Subscriber base & Net Additions(in million)

Service Area	Subscriber base June-2019	Subscriber base Sept-2019	Net Additions (June-Sept)-2019
Andhra Pradesh	1.37	1.38	0.005
Assam	0.11	0.11	0.004
Bihar	0.22	0.18	-0.034
Delhi	3.28	3.35	0.066
Gujarat	1.10	1.21	0.108
Haryana	0.26	0.26	-0.003
Himachal Pradesh	0.11	0.11	-0.004
Jammu & Kashmir	0.10	0.12	0.016
Karnataka	2.12	2.15	0.028
Kerala	1.85	1.83	-0.024
Madhya Pradesh	0.91	0.94	0.022
Maharashtra	1.47	1.44	-0.026
Mumbai	2.91	3.08	0.164
North East	0.10	0.10	0.000
Orissa	0.23	0.23	-0.001
Punjab	0.76	0.75	-0.002
Rajasthan	0.52	0.53	0.007
T.N. (incl. Chennai)	2.14	2.14	0.001
U.P.(E)	0.42	0.43	0.011

U.P.(W)	0.29	0.29	-0.002
Kolkata	0.69	0.70	0.004
West Bengal	0.20	0.19	-0.014
All India	**21.17**	**21.49**	**0.321**

(Source : TRAI Quarterly Performance Indicator Report, July-Sept 2019)

3.2.2 Mobile-cellular (Wireless) telephone Service

There are 6 wireless service providers in the county namely ; BSNL, MTNL, Bharti Airtel, Reliance Communications, Vodafone Idea Ltd, and Reliance Jio Infocomm Ltd. Total wireless subscription is 1173.75 million, with 514.56 million in rural area and 659.18 million in urban area, as on 30.09.2019. The overall tele-density of 88.90 (per 100 inhabitants) and Urban tele-density – 156.16 , Rural tele-density-57.28.Figures show multiple wireless subscriptions in urban areas whereas sizeable population is left without wireless connections in rural areas.

Table:3.2 Service Area wise Wireless Subscriber base & Net Additions(in million)

Service Area	Subscriber base June-2019	Subscriber base Sept-2019	Net Additions (June-Sept)-2019
Andhra Pradesh	86.97	87.59	0.62
Assam	23.54	24.04	0.50
Bihar	85.57	85.24	-0.33
Delhi	52.96	53.66	0.70
Gujarat	68.93	68.74	-0.18
Haryana	27.90	28.26	0.36
Himachal Pradesh	10.56	10.77	0.20

Jammu & Kashmir	11.48	11.34	-0.14
Karnataka	68.15	69.11	0.95
Kerala	44.27	44.89	0.62
Madhya Pradesh	75.40	75.42	0.02
Maharashtra	92.61	93.69	1.08
Mumbai	38.36	38.80	0.44
North East	12.04	12.30	0.26
Orissa	32.73	32.87	0.14
Punjab	39.32	40.07	0.75
Rajasthan	65.16	65.67	0.51
T.N. (incl. Chennai)	82.11	82.74	0.63
U.P.(E)	99.82	100.34	0.52
U.P.(W)	64.87	65.10	0.23
Kolkata	26.30	26.39	0.09
West Bengal	56.41	56.72	0.31
All India	**1165.46**	**1173.75**	**8.29**

(Source : TRAI Quarterly Performance Indicator Report, July-Sept 2019)

3.2.3 Internet service

Out of total 353 internet service providers, top 10 service providers together hold 99.51% of total internet subscriber base as 30.09.2019. Top 10 internet service providers are: Reliance Jio Infocomm Ltd, Bharti Airtel , Vodafone Idea Limited , BSNL, MTNL, Atria Convergence Technologies Pvt. Ltd., Hathway Cable & Datacom Pvt. Ltd., You Broadband India Pvt. Ltd , GTPL Broadband Pvt. Ltd. and Excitel Broadband Private Limited.

Total Internet subscription is 687.62 million, including 247.63 million in rural area, as on 30.09.2019. Out of 687.62 million, 22.26 million are wired internet subscriptions. Out of 687.62 million internet subscriptions, 625.42 million are broadband (Download Speed >=512 Kilo Bits Per Second) and 62.20 Million as narrowband(Download Speed <512 Kbps).

Table 3.3 Service Area wise number of Internet Subscribers at the end of September, 2019

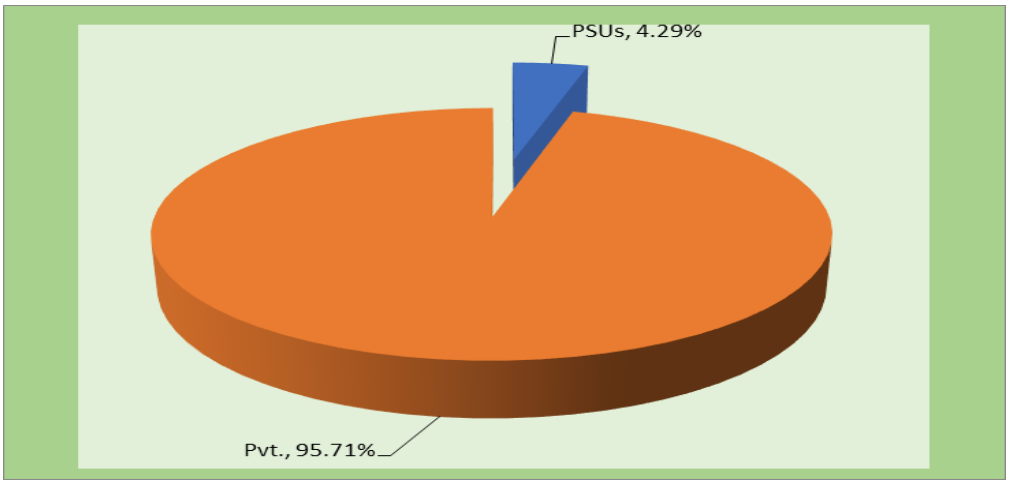
Service Area	Internet Subscribers (in million)			No. of Internet subscribers per 100 population		
	Rural	Urban	Total	Rural	Urban	Total
Andhra Pradesh	21.54	32.26	53.80	33.02	126.70	59.33
Assam	6.57	6.46	13.03	23.45	113.28	38.66
Bihar	25.37	18.52	43.88	20.60	92.99	30.68
Delhi	0.74	37.79	38.53	98.35	165.82	163.65
Gujarat	12.05	30.56	42.61	31.97	107.44	64.43
Haryana	6.16	9.87	16.02	34.41	90.09	55.55
Himachal Pradesh	3.41	2.19	5.60	53.34	245.68	76.85
Jammu & Kashmir	1.70	3.17	4.88	18.59	86.24	37.96
Karnataka	14.32	29.36	43.68	37.18	114.22	68.02
Kerala	10.27	15.70	25.97	37.69	171.21	71.30
Madhya Pradesh	17.06	27.38	44.44	21.82	89.85	40.90
Maharashtra	22.16	35.44	57.59			
Mumbai	1.37	27.60	28.97	36.84	99.38	68.01
North East	2.96	4.40	7.36	27.65	117.09	50.87

Orissa	10.51	7.10	17.62	29.54	88.37	40.37
Punjab	7.38	17.31	24.69	42.46	117.73	76.96
Rajasthan	17.23	21.98	39.21	29.82	118.15	51.34
T.N. (incl. Chennai)	13.49	34.97	48.46	50.74	76.31	66.92
U.P.(E)	23.91	25.60	49.51	20.09	83.47	34.89
U.P.(W)	13.23	21.39	34.62			
Kolkata	1.52	15.32	16.84	23.38	109.60	48.32
West Bengal	14.70	15.62	30.31			
All India	247.63	439.99	687.62	27.57	104.25	52.08

(Source : TRAI Quarterly Performance Indicator Report, July-Sept 2019)

The Overall Internet subscriptions, per 100 inhabitants, is 52.08 with urban Internet subscriptions – 104.25 and rural Internet subscriptions - 27.57, per 100 inhabitants. Internet market share of Public sector Undertakings (PSUs) and Private Internet service providers is 4.29% and 95.71% respectively.

Chart 3.1: Market share of PSUs and Private Internet Service



(Source : TRAI Quarterly Performance Indicator Report, July-Sept 2019)

3.2.4 VSAT service providers

Very Small Aperture Terminal (VSAT) is a satellite communications system that provide internet/ intranet connectivity to home and business users .Seven VSAT service providers provide VSAT connectivity in the country ; Hughes Communications Ltd., Bharti Airtel Ltd., Tatanet Services, HCL Comnet , BSNL , Infotel Satcom and Cloudcast Digital Ltd (eartwhile Planetcast Media Services Ltd).

The Number of VSAT subscribers working is 297,047, as on quarter ending September, 2019.

Chart 3.2 : Number of VSAT Subscribers & Rate of Growth (in percentage)

(Source : TRAI Quarterly Performance Indicator Report, July-Sept 2019)

3.2.5 International Internet Bandwidth

The term "international Internet bandwidth" refers to the total used capacity of international Internet bandwidth, in megabits per second (Mbit/s). Used international Internet bandwidth refers to the average usage of all international links, including

fibre optic cables, radio links and traffic processed by satellite ground stations and teleports to orbital satellites (expressed in Mbit/s)(Measuring the Information Society Report 2017 ,Vol-1).

The International Internet bandwidth owned by various service providers in the country is 12,328 Giga bits per second (Gbps) at the end quarter ending September, 2019 (TRAI Quarterly Performance Indicator Report, July-Sept 2019).

3.3 Role of Government in Infrastructure Development:

With the aim to provide broadband internet connectivity to rural areas in the country, Bharat Broadband Network Limited (BBNL) , a Special Purpose Vehicle (SPV), set up by the Government of India under the Administrative Ministry of Communication, Department of Telecommunications for the establishment, management and operation of National Optical Fibre Network (NOFN). BBNL has been incorporated on 25-02-2012 as a Public Sector Undertaking (PSU) / Company under the Companies Act, 1956, with the mission :-

1.To provide high speed digital connectivity to Rural India at affordable price.

2.To provide B2B services in a non-discriminatory manner.

3.To facilitate proliferation of broadband services in rural areas so as to foster socio-economic development in line with the vision of 'Digital India' programme which has been launched by government of India with the vision to transform India into a digitally empowered society and knowledge economy.

Progress under BharatNet Project :

No of Gram Panchayats (GPs) made Service Ready (On fibre & satellite) -1,34,736 GPs, as on 31st Jan.2020 (BharatNet Status Report , 31st January 2020)

BharatNet Usage Status as on 03-02-2020:

Wi-Fi operational in GPs: 18,037 GPs

No. of Wi-Fi Users: 12,91,780

Fibre to the Home (FTTH) connections on BharatNet :

FTTH connections taken by the States:38,833

(BharatNet Usage Status Report)

3.4 Analysis:

Exiting fixed, mobile, internet Infrastructure status is being analysed here. India has made significant progress in mobile access network during the last more than two decades since liberalisation of telecom sector in 1994.Internet connectivity also reached significant level and India is second largest internet user in the world. But fixed telephones and fixed broadband connectivity is very low in the country. More than 98 percent population do not have fixed telephone or fixed broadband.

Mobile subscription in urban area is 156.16, per 100 inhabitants where as in rural area mobile subscription is 57.28, pet 100 inhabitants. This clearly shows lack of pan-India mobile network coverage, especially in rural, remote , hilly and inaccessible areas. Quality of mobile network, with uninterrupted coverage and speed of internet data, is also a concern. 3G and 4G high speed mobile internet network coverage is limited to cities and commercially important towns only. Either quality, 3G/4G mobile network is not available or not affordable to people at large.

There is huge requirement of fixed and mobile telecom access infrastructure, both in coverage and quality in future. Establishment of access infrastructure is an economic opportunity for all stakeholders; Governments, service providers, businesses and citizens.

CHAPTER 4

ANALYSIS OF IDI INDICATORS (BASED ON FIELD DATA)

4.1 **IDI an Introduction**

The Measuring the Information Society Report, released by ITU, measures the ICT Development Index (IDI) of countries based on certain parameters. The conceptual framework of IDI focuses on the availability of ICT infrastructure such as access, level of ICT usage, and the skills to use ICTs effectively. Thus IDI includes 3 sub indices – ICT Access, ICT Use and ICT Skill. ITU issues ranking of economies or countries, based on IDI score, which is compiled based on weighted scores in sub-indices and indicators in each three sub indices . 176 economies are measured by ITU in the Measuring the Information Society Report 2017. IDI is a score of a country out of 10. ITU has released the Measuring the Information Society report,2017. ITU is expected to release its next report with some indicator refinements and inclusion of some more indicators as per latest developments in the field of ICT such as speed of broadband on fixed and mobile internet.

In this section, IDI sub-indices and indicators in the Measuring the Information Society Report ,2017 are being analysed.

4.1.1 **IDI indicators**

IDI is divided into 3 sub-indices and 11 indicators , which are described as below and illustrated, in the Table 4.1:

Access sub-index: This sub-index captures ICT readiness, and includes five infrastructure and access indicators (fixed-telephone subscriptions, mobile-cellular telephone subscriptions, international Internet band width per Internet user, households with a computer, and households with Internet access);

Use sub-index: This sub-index captures ICT intensity, and includes three intensity and usage indicators (individuals using the Internet, fixed-broadband subscriptions and mobile-broadband subscriptions);

Skills sub-index: This sub-index seeks to capture capabilities or skills that are important for ICTs. It includes three proxy indicators (mean years of schooling, gross secondary enrolment, and gross tertiary enrolment). As these are proxy indicators, rather than directly measuring ICT-related skills, the skills sub-index is given less weight in the computation of the IDI than the other two sub-indices.

Table 4.1: ICT Development Index – indicators, reference values and weights

Indicators	**Reference value**	**Weights (Indicators)**	**Weight (sub-indices)**
ICT Access			0.40
1.Fixed telephone subscriptions per 100 inhabitants	60	0.20	
2.Mobile-cellular telephone subscriptions per 100 inhabitants	120	0.20	
3.International internet bandwidth per internet user	2158212*	0.20	
4.Percentage of households with computer	100	0.20	
5.Percentage of households	100	0.20	

with internet access			
ICT Use			0.40
6.Percentage of individuals using internet	100	0.33	
7.Fixed broadband internet subscriptions per 100 inhabitants	60	0.33	
8.Active mobile broadband subscriptions per 100 inhabitants	100	0.33	
ICT Skills			0.20
9.Mean years of schooling	15	0.33	
10.Secondary gross enrolment ratio	100	0.33	
11.Tertiary gross enrolment ratio	100	0.33	

Note: * This corresponds to a log value of 6.33, which was used in the normalization step.

(Source: ITU, Measuring the Information Society Report volume1-2017)

4.1.2 **IDI Indicators - descriptions**

The meaning and description of the 11 indicators , included in the IDI , grouped by the three sub-indices: access, usage and skills are as follows :

a) ICT infrastructure and access indicators

Five indicators included in this group provide an indication of the available ICT infrastructure and individual's access to basic ICTs. Data for all these indicators are collected by ITU.

1. Fixed-telephone subscriptions per 100 inhabitants

The term "fixed-telephone subscriptions" refers to the sum of active analogue fixed-telephone lines, voice-over-Internet Protocol (VoIP) subscriptions, fixed wireless local loop subscriptions, Integrated Services Digital Network voice-channel equivalents and fixed public payphones. It includes all accesses over fixed infrastructure supporting voice telephony using copper wire, voice services using Internet Protocol (IP) delivered over fixed (wired)-broadband infrastructure (e.g. digital subscriber line (DSL), fibre optic), and voice services provided over coaxial-cable television networks (cable modem). It also includes fixed wireless local loop connections, defined as services provided by licensed fixed-line telephone operators that provide last-mile access to the subscriber using radio technology, where the call is then routed over a fixed-line telephone network (not a mobile- cellular network). VoIP refers to subscriptions that offer the ability to place and receive calls at any time and do not require a computer. VoIP is also known as voice-over-broadband (VoB), and includes subscriptions through fixed-wireless, DSL, cable, fibre optic and other fixed-broadband platforms that provide fixed telephony using IP.

2. Mobile-cellular telephone subscriptions per 100 inhabitants

The term "mobile-cellular telephone subscriptions" refers to the number of subscriptions to a public mobile-telephone service providing access to the public switched telephone network using cellular technology. It includes both the number of postpaid subscriptions and the number of active prepaid accounts (i.e. accounts that

have been active during the previous three months). It includes all mobile-cellular subscriptions that offer voice communications. It excludes subscriptions via data cards or USB modems, subscriptions to public mobile data services, private trunked mobile radio, telepoint, radio paging, machine-to-machine (M2M) and telemetry services.

3. International Internet bandwidth (bit/s) per Internet user

The term "international Internet bandwidth" refers to the total used capacity of international Internet bandwidth, in megabits per second (Mbit/s). Used international Internet bandwidth refers to the average usage of all international links, including fibre optic cables, radio links and traffic processed by satellite ground stations and teleports to orbital satellites (expressed in Mbit/s). All international links used by all types of operators –namely fixed, mobile and satellite operators –are taken into account. The average is calculated over the 12-month period of the reference year. For each individual international link, if the traffic is asymmetric, i.e. incoming traffic is not equal to outgoing traffic, then the higher value of the two is provided. The combined average usage of all international links can be reported as the sum of the average usage of each individual link. International Internet bandwidth (bit/s) per Internet user is calculated by converting to bits per second and dividing by the total number of Internet users.

4. **Percentage of households with a computer**

The term "computer" refers to a desktop computer, laptop (portable) computer, tablet or similar handheld computer. It does not include equipment with some embedded computing abilities, such as smart television sets, or devices with telephony as a main function, such as mobile phones or smartphones.

Household with a computer means that the computer is available for use by all members of the household at any time. The computer may or may not be owned by the household, but should be considered a household asset.

Data are obtained by countries through national household surveys and are either provided directly to ITU by national statistical offices (NSOs) or obtained by ITU through its own research, for example, from NSO websites. There are certain data-related limits to this indicator, insofar as estimates have to be calculated for many developing countries that do not yet collect ICT household statistics. Over time, as more data become available, the quality of the indicator will improve.

5. **Percentage of households with Internet access**

The Internet is a worldwide public computer network. It provides access to a number of communication services, including the World Wide Web, and carries e-mail, news, entertainment and data files, irrespective of the device used (not assumed to be only a computer; it may also be a mobile telephone, tablet, PDA, games machine, digital television, etc.). Access can be via a fixed or mobile network. Household with Internet access means that the Internet is available for use by all members of the household at any time.

Data are obtained by countries through national household surveys and are either provided directly to ITU by NSOs or obtained by ITU through its own research, for example from NSO websites. There are certain data-related limits to this indicator, insofar as estimates have to be calculated for many developing countries which do not yet collect ICT household statistics. Over time, as more data become available, the quality of the indicator will improve.

b) **ICT usage indicators**

The three indicators included in this group capture ICT intensity and usage. Data for all these indicators are collected by ITU.

1**. Percentage of individuals using the Internet**

The term "individuals using the Internet" refers to people who used the Internet from any location and for any purpose, irrespective of the device and network used, in the previous three months. Usage can be via a computer (i.e. desktop computer, laptop computer, tablet or similar handheld computer), mobile phone, games machine, digital television, etc.). Access can be via a fixed or mobile network.

Data are obtained by countries through national household surveys and are either provided directly to ITU by NSOs or obtained by ITU through its own research, for example, from NSO websites. There are certain data-related limits to this indicator, insofar as estimates have to be calculated for many developing countries which do not yet collect ICT household statistics. Over time, as more data become available, the quality of the indicator will improve.

2. **Fixed-broadband subscriptions per 100 inhabitants**

The term "fixed-broadband subscriptions" refers to fixed subscriptions for high-speed access to the public Internet (a Transmission Control Protocol (TCP)/IP connection) at downstream speeds equal to or higher than 256 kbit/s. This includes cable modem, DSL, fibre-to-the-home/building, other fixed (wired)-broadband subscriptions, satellite broadband and terrestrial fixed wireless broadband. The total is measured irrespective of the method of payment. It excludes subscriptions that have access to data communications (including the Internet) via mobile-cellular networks. It includes

fixed WiMAX and any other fixed wireless technologies, and both residential subscriptions and subscriptions for organizations.

3. **Active mobile-broadband subscriptions per 100 inhabitants**

The term "active mobile-broadband subscriptions" refers to the sum of data and voice mobile-broadband subscriptions and data-only mobile-broadband subscriptions to the public Internet. It covers subscriptions actually used to access the Internet at broadband speeds, not subscriptions with potential access, even though the latter may have broadband-enabled handsets. Subscriptions must include a recurring subscription fee to access the Internet or pass a usage requirement – users must have accessed the Internet in the previous three months. It includes subscriptions to mobile-broadband networks that provide download speeds of at least 256 kbit/s (e.g. WCDMA, HSPA, CDMA2000 1x EV-DO, WiMAX IEEE 802.16e and LTE), and excludes subscriptions that only have access to GPRS, EDGE and CDMA 1xRTT.

The term "data and voice mobile-broadband subscriptions" refers to subscriptions to mobile-broadband services that allow access to the open Internet via HTTP in which data services are contracted together with voice services (mobile voice and data plans) or as an add-on package to a voice plan. These are typically smartphone-based subscriptions with voice and data services used in the same terminal. Data and voice mobile-broadband subscriptions with specific recurring subscription fees for Internet access are included regardless of actual use. Prepaid and pay-per-use data and voice mobile-broadband subscriptions are only counted if they have been used to access the Internet in the previous three months. M2M subscriptions are excluded. The indicator includes subscriptions to mobile networks that provide download speeds of at least 256 kbit/s (e.g. WCDMA, HSPA, CDMA2000 1x EV-DO, WiMAX IEEE 802.16e

and LTE), and excludes lower-speed technologies such as GPRS, EDGE and CDMA 1xRTT.

The term "data-only mobile-broadband subscriptions" refers to subscriptions to mobile-broadband services that allow access to the open Internet via HTTP and that do not include voice services, i.e. subscriptions that offer mobile broadband as a standalone service, such as mobile-broadband subscriptions for data cards, modem/dongle and tablets. Data-only mobile-broadband subscriptions with recurring subscription fees are included regardless of actual use. Prepaid and pay-per-use data-only mobile-broadband subscriptions are only counted if they have been used to access the Internet in the previous three months. M2M subscriptions are excluded. The indicator includes subscriptions to mobile networks that provide download speeds of at least 256 kbit/s (e.g. WCDMA, HSPA, CDMA2000 1x EV-DO, WiMAX IEEE 802.16e and LTE), and excludes lower-speed technologies such as GPRS, EDGE and CDMA 1xRTT. It excludes data subscriptions that are contracted together with mobile voice services.

c) **ICT skills indicators**

The three indicators included in this group capture ICT skill. Data on gross secondary and tertiary enrolment ratios are collected by the United Nations Educational, Scientific and Cultural Organization Institute for Statistics (UIS).

1. **Mean years of schooling**

The term "mean years of schooling" is the average number of completed years of education of a country's population , excluding years spent repeating individual grades. It is estimated using the distribution of the population by age group and the

highest level of education attained in a given year, and time series data on the official duration of each level of education.

2. **Gross enrolment ratio (secondary and tertiary level)**

According to the UIS, the gross enrolment ratio is "the total enrolment in a specific level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in a given school-year."

This is all about 11 IDI indicators used by ITU in the Measuring the Information Society Report. In the next section we will analyse IDI, sub-indices and indicators values and rankings.

4.2 **India's IDI Indicators Analysis**

India's IDI ranking and value for 2016 and 2017 and ranking and values in access sub-index, use sub-index and skills sub-index during these years are being analysed.

India's IDI ranking in 2017 was 134 with IDI value of 3.03. There is improvement of 4 places in ranking and 0.38 points over the ranking and value in 2016.

IDI access sub-index ranking in 2017 was 137 with value of 3.60. There is improvement of 2 places in ranking and 0.36 points over the ranking and value in 2016.

IDI use sub-index ranking in 2017 was 144 with value of 1.62. There is drop of 2 places in ranking in spite of the improvement of 0.37 points over the value in 2016.

IDI skills sub-index ranking in 2017 was 121 with value of 4.73. There is improvement of 3 places in ranking and 0.44 points over the ranking and value in 2016.

The analysis is tabulated below:

Table 4.2 : India's IDI , Access , Use and Skills sub-indices ranking and values

IDI rankings and values ,2017 and 2016						
Sl. No	Country	Rank 2017	IDI 2017	Rank 2016	IDI 2016	Remarks
1.	India	134	3.03	138	2.65	Ranking is among 176 countries, score is out of 10.
IDI access sub-index rankings and values , 2017 and 2016						
Sl. No	Country	Rank in access sub-index 2017	IDI access sub-index 2017	Rank in access sub-index 2016	IDI access sub-index 2016	
1.	India	137	3.60	139	3.24	
IDI use sub-index rankings and values, 2017 and 2016						
Sl. No	Country	Rank in use sub-index 2017	IDI use sub-index 2017	Rank in use sub-index 2016	IDI use sub-index 2016	
1.	India	144	1.62	142	1.25	

IDI skills sub-index, rankings and values, 2017 and 2016						
Sl. No	Country	Rank in skills sub-index 2017	IDI skills sub-index 2017	Rank in skills sub-index 2016	IDI skills sub-index 2016	
1.	India	121	4.73	124	4.29	

(Data Source : ITU, Measuring the Information Society Report volume1-2017)

Improvements in the values of IDI , access sub-index, use sub-index and skills sub-index of 0.38,0.36,0.37 and 0.44 has resulted in marginal improvements of 4 places in IDI, 2 places in access sub-index and 3 places in skills sub-index and a drop of 2 places in use sub-index. This means that other countries have also made comparably significant progress on these indices. Analysis with some higher IDI countries will help understand the challenges further.

4.3 **IDI Comparisons with higher IDI ranked countries**

India's IDI comparisons with higher IDI ranking countries is necessary with a view to assess the variations and year on year trends. Comparison is being done on Overall IDI score and ranking, Access Sub-Index score and raking, Use Sub-index score and ranking, Skill sub-index score and ranking .

4.3.1 **IDI Comparison with IDI rankings and values**

India's IDI comparison with some countries having higher rank and higher IDI value is done in the table below. For comparison, size of GDP and IDI ranking is taken as criteria. South Korea, Japan, Singapore, China , USA, United Kingdom and Germany have been selected for comparison based on above criteria.

Table 4.3: IDI Comparison - rankings and values

Sl. No	Country	Rank 2017	IDI 2017	Rank 2016	IDI 2016
1.	**South Korea**	**2**	**8.85**	**1**	**8.80**
2.	Japan	10	8.43	11	8.32
3.	Singapore	18	8.05	20	7.85
4.	**China**	**80**	**5.60**	**83**	**5.17**
5.	USA	16	8.18	15	8.13
6.	United Kingdom	5	8.65	5	8.53
7.	Germany	12	8.39	13	8.20
8.	**India**	**134**	**3.03**	**138**	**2.65**

(Data Source : ITU, Measuring the Information Society Report volume1-2017)

South Korea has IDI ranking of 2 with IDI score of 8.85 in 2017 report whereas it was at rank1 with IDI score of 8.80 in 2016 report. The IDI score shows overall very high level of ICT penetration in South Korea. United States, the world's largest economy has the IDI ranking of 16 with IDI score 8.18 in 2017 report whereas it was at rank 15 with IDI score of 8.13 in 2016. The world's second largest economy , China, stood at IDI ranking of 80 with IDI score of 5.60 in 2017 report whereas it was at rank 83 with IDI score of 5.17 in 2016. South Korea , Japan , Singapore , China USA, United Kingdom and Germany all the seven countries have very High IDI values. The high IDI values in these seven countries reflect high level of ICT access infrastructure, high level of ICT usage and high level of ICT skills.

In case of India, IDI raking of 134 with IDI score of 3.03 in 2017 report is an improvement over IDI ranking of 138 with IDI score of 2.65 in 2016 report, but comparative IDI values reflect a lot required to be done to increase penetration of ICT in the country and improving the IDI ranking anywhere close to these seven country.

4.3.2.1 **IDI Comparison with Access sub-index rankings and values**

Access sub index has 0.4 (40 percent) weightage in IDI. India's comparison with countries having higher IDI Access sub-index rank and value is done in the table below.

Table 4.4 : IDI Comparison-Access sub-index rankings and values

Sl. No	Country	Rank in access sub-index 2017	IDI access sub-index 2017	Rank in access sub-index 2016	IDI access sub-index 2016
1.	**South Korea**	**7**	**8.85**	**7**	**8.90**
2.	Japan	9	8.80	9	8.73
3.	Singapore	12	8.61	12	8.56
4.	**China**	**89**	**5.58**	**90**	**5.37**
5.	USA	17	8.27	17	8.18
6.	United Kingdom	4	9.15	4	9.12
7.	Germany	6	8.93	5	8.97
8.	**India**	**137**	**3.60**	**139**	**3.24**

(Data Source : ITU, Measuring the Information Society Report volume1-2017)

South Korea , Japan, Singapore USA, united Kingdom, Germany have ranking ranging from 4-17 with score raging from 8.27- 9.15 in the report 2017. In case of China this score is 5.58. The countries with High value of access sub-index show that ICT Access infrastructure in these countries is well developed. India's ranking is 137 with score at 3.60.This indicates a lot required to be done to establish ICT access infrastructure in India to get anywhere close to these countries .

4.3.2.2 **IDI Comparison with Access Indicators values**

Further analysis at the level of IDI Access indicators , under Access sub-index , will help understand the real picture. There are five IDI Access indicators, details as per para 4.1.1 of this chapter. Table below depicts analysis at the level of access indicators.

Table 4.5: IDI Comparison-Access Indicators values

Sl. No	Country	Fixed-telephone subscriptions per100 inhabitants		Mobile-cellular subscriptions per 100 inhabitants		International Internet bandwidth Bit/s per Internet user		Percentage of households with computer		Percentage of households with Internet	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1.	**South Korea**	**58.1**	**56.1**	**118.5**	**122.7**	**46,894**	**54,252**	**77.1**	**75.3**	**98.8**	**99.2**
2.	Japan	50.2	50.6	126.5	129.8	64,180	83,010	79.7	81.0	97.2	97.2
3.	Singapore	35.9	35.0	146.5	146.9	765,829	982,923	87.0	86.6	88.2	91.1

4.	**China**	**16.5**	**14.7**	**92.2**	**96.9**	**6,530**	**14,699**	**49.6**	**52.5**	**54.2**	**55.5**
5.	USA	38.4	37.1	117.6	127.2	99,011	126,545	86.8	87.0	81.5	84.0
6.	United Kingdom	52.0	52.2	124.1	122.3	374,554	449,137	89.9	89.8	91.3	91.3
7.	Germany	54.9	53.7	116.7	114.5	91,443	107,489	91.0	91.4	90.3	90.8
8.	**India**	**2.0**	**1.9**	**78.1**	**87.0**	**5,725**	**15,956**	**14.1**	**15.2**	**20.0**	**22.6**

Note : values in 2015 and 2016 are taken for IDI measurements in 2016 and 2017 respectively.

(Data Source : ITU, Measuring the Information Society Report volume1-2017)

Fixed-telephone subscriptions per 100 inhabitants-South Korea, Japan, United Kingdom and Germany have more than 50 percent fixed telephone penetration and Singapore and USA have more than 35 percent and China is about 15 percent. In case of India fixed telephone subscription is about 2 percent. Comparatively India is far behind these country in terms of penetration of fixed telephones.

Mobile-cellular subscriptions per 100 inhabitants- This figure is more than 100 percent in all these countries and India too has a comparable percentage of about 80 percent.

International Internet bandwidth Bit/s per Internet user- India has about 16000 Bit/s IIB in 2016, about three fold jump with its previous figure in 2015. But if we compare this figure with 54252 Bits/s for South Korea ,64180 Bits/s for Japan, 107,489 Bits/s

for Germany, 99,011 Bits/s for USA, 374,554 Bits/s for United Kingdom and 982,923 Bits/s for Singapore then India's IIB figure is very small.

Percentage of households with computer- More than 75 percent house-holds in South Korea, Japan, Singapore, USA, United Kingdom and Germany and more 50 percent in China have Computers whereas in India about 15 percent house-holds only own the computers. India is far behind these counties on this indicator.

Percentage of households with Internet- More than 85 percent house-holds in South Korea, Japan, Singapore, USA, United Kingdom and Germany and more 55 percent households in China have internet whereas in India about 20 percent households only have internet.

Analysis clearly shows a wide gaps in all these access indicators values in case of India vis-a vis countries having very high values. The higher values of access indicators in South Korea , Japan, Singapore , United Kingdom, Germany , USA and China show that the ICT access infrastructure in these counties is highly developed.

4.3.3.1 **IDI Comparison with Use sub-index rankings and values**

Use sub index has with 0.4 (40 percent) weightage in IDI, as detailed in para 4.1.1 of this report . India's comparison with countries having higher IDI use sub-index rank and value is done in the table below

Table 4.6: IDI Comparison-Use sub-index rankings and values

Sl. No	Country	Rank in use sub-index 2017	IDI use sub-index 2017	Rank in use sub-index 2016	IDI use sub-index 2016
1.	**South Korea**	**4**	**8.71**	**4**	**8.56**

2.	Japan	11	8.15	10	8.07
3.	Singapore	24	7.45	21	7.44
4.	**China**	**69**	**5.27**	**71**	**4.63**
5.	USA	20	7.67	18	7.56
6.	United Kingdom	7	8.38	8	8.13
7.	Germany	18	7.77	23	7.35
8.	**India**	**144**	**1.62**	**142**	**1.25**

(Data Source : ITU, Measuring the Information Society Report volume1-2017)

The value of use sub-index ranges from 5.27 – 8.71 in the report 2017 , in case of all 7 countries mentioned in the table ; China, Singapore, Japan, South Korea, Germany, USA and United Kingdom. In case of South Korea, Japan and United Kingdom score is more than 8. India stands at a value of 1.62 with ranking of 144 in the eport, 2017. The High score of use sub-index in these countries reflect that percentage of individuals using internet, fixed broadband internet subscriptions per 100 inhabitants and active mobile broadband subscriptions per 100 inhabitants are very high. Whereas India's value of 1.62 on use sub-index is very low in comparison to South Korea's value of 8.71 and even China's value of 5.27.

4.3.3.2 **IDI Comparison with Use Indicators values**

Further analysis at the level of use indicators, under use sub-index , will help understand the real picture. Table below depicts analysis at the level of use indicators.

Table 4.7: IDI Comparison-Use Indicators values

Sl. No	Country	Percentage of individuals using the Internet		Fixed-broadband subscriptions per 100 inhabitants		Active mobile-broadband subscriptions per 100 inhabitants	
		2015	2016	2015	2016	2015	2016
1.	**South Korea**	**89.6**	**92.7**	**40.2**	**41.1**	**109.7**	**111.5**
2.	Japan	91.1	92.0	30.7	31.5	128.3	131.9
3.	Singapore	79.0	81.0	26.5	25.4	143.2	144.6
4.	**China**	**50.3**	**53.2**	**19.8**	**22.9**	**55.5**	**66.8**
5.	USA	74.6	76.2	31.4	32.4	115.5	120.0
6.	United Kingdom	92.0	94.8	38.6	39.2	87.5	91.4
7.	Germany	87.6	89.6	37.2	38.1	70.8	80.2
8.	**India**	**26.0**	**29.5**	**1.3**	**1.4**	**9.4**	**16.8**

Note : values in 2015 and 2016 are taken for IDI measurements in 2016 and 2017 respectively.

(Data Source : ITU, Measuring the Information Society Report volume1-2017)

Percentage of individuals using the Internet – As per the report , more than 80 percent in South Korea, Japan, Singapore, USA, United Kingdom, Germany and more than 50 percent in China are using internet whereas about 30 percent individuals only are using internet in India.

Fixed-broadband subscriptions per 100 inhabitants- more than 41 percent in South Korea and more than 30 percent in Japan, USA, United Kingdom ,Germany and about 25 percent in Singapore and China are having fixed broad subscriptions whereas less than 1.5 percent inhabitants only are having fixed broadband subscriptions in India. Comparatively, India is far behind any of these counties in terms of fixed broadband penetration.

Active mobile-broadband subscriptions per 100 inhabitants- more than 100 percent in South Korea, Japan, Singapore, USA, and more than 80 percent in United Kingdom, Germany and more than 65 percent in China are having active mobile-broadband subscriptions whereas about 16 percent inhabitants only are having active mobile-broadband subscriptions in India.

India's values of all three use indicators are far below values of these indicators in comparison to all the seven countries in the table. A lot need to be done on establishment of fixed broadband and mobile broadband infrastructure in India.

4.3.4.1 **IDI Comparison with Skills sub-index rankings and values**

IDI Skills sub-index has 0.2 (20 percent) weightage , as detailed in para 4.1.1 of this report . India's comparison with countries having higher IDI skills sub-index rank and value is done in the table below.

Table 4.8 IDI Comparison-Skills sub-index rankings and values

Sl. No	Country	Rank in Skills sub-index 2017	IDI Skills sub-index 2017	Rank in Skills sub-index 2016	IDI Skills sub-index 2016
1.	**South Korea**	**2**	**9.15**	**3**	**9.08**
2.	Japan	30	8.22	35	7.97
3.	Singapore	37	8.14	56	7.27
4.	**China**	**81**	**6.28**	**93**	**5.89**
5.	USA	3	9.05	1	9.18
6.	United Kingdom	33	8.17	29	8.18
7.	Germany	17	8.58	23	8.36
8.	**India**	**121**	**4.73**	**124**	**4.29**

(Data Source : ITU, Measuring the Information Society Report volume1-2017)

IDI skills sub-index reflects indicators -mean year of schooling , secondary and tertiary gross enrolments. Higher the value of these skill sub-index, higher the value of indicators it comprises. India stands at skills sub-index value of 4.73 vis-à-vis 9.15 value of South Korea and score of 6.28 for China as per report of 2017.

4.3.4.2 IDI Comparison with Skills Indicators

Further analysis at the level of skills indicators , under skills sub-index , will help understand the clear picture. Table below depicts analysis at the level of skills indicators.

Table 4.9: IDI Comparison-Skills Indicators values

Sl. No	Country	Gross enrolment ratio				Mean years of schooling	
		Secondary		Tertiary			
		2015	2016	2015	2016	2015	2016
1.	**South Korea**	**97.7**	**97.7**	**95.3**	**95.3**	**11.9**	**12.2**
2.	Japan	101.9	101.7	62.4	63.4	11.5	12.5
3.	Singapore	97.2	97.2	43.8	69.8	11.6	11.6
4.	**China**	**96.2**	**94.3**	**30.2**	**43.4**	**7.5**	**7.6**
5.	USA	95.9	97.6	88.8	85.8	13.6	13.2
6.	United Kingdom	124.4	127.8	56.9	56.5	13.3	13.3
7.	Germany	102.5	102.7	61.1	68.3	13.5	13.2
8.	**India**	**68.9**	**74.3**	**23.9**	**25.5**	**5.4**	**6.3**

Note : values in 2015 and 2016 are taken for IDI measurements in 2016 and 2017 respectively.

(Data Source : ITU, Measuring the Information Society Report volume1-2017)

Secondary gross enrolment ratio- this ratio is more than 90 percent for South Korea, Japan, Singapore, China, USA, United Kingdom and Germany whereas India has this ratio about 75 percent.

Tertiary gross enrolment ratio- more than 80 percent in case of South Korea and USA , more than 55 percent in case of Japan, Singapore , United kingdom, Germany and about 45 percent in case of China whereas tertiary gross enrolment ratio for India is about 25 percent. There is wide gap between India and all these high indicator value countries.

Mean years of schooling- more than 12 years in case of South Korea, Japan, Singapore, USA, United Kingdom, Germany and about 7 years in case of China whereas mean year of schooling in case of India is about 6 years.

India fares well in skills sub-index (score-4.73) as compare to its access sub-index (score – 3.60) and use sub-index (score-1.62). However the weightage of skills sub-index is 0.2 only as compare to access and use sub-indices of 0.4 each or 0.8 cumulatively.

This study paper is limited to study and analysis of Access and Use sub-indices only keeping in view the time constraint and high weightage of Access and Use sub-indices and indicators therein. Among the seven countries which have higher IDI ranking, South Korea is top IDI ranked country and improved IDI value and maintained top position year on year. The study of South Korean ICT model would help in framing policies and execution practices for improvement of ICT infrastructure and usage in the country.

4.4 **Analysis of IDI - Case study of South Korea**

Among the highest IDI ranking and value countries, South Korea is consistently positioned at top of the ranking either at position 1 or position 2 in the global IDI

ranking of ITU. Study of South Korea's IDI indicators and policies and practices adopted for promoting ICT will be discussed in this section. Source of study for analysis are Measuring the Information Society Report (MISR) -2017 of ITU and South Korean Government policies and plans.

4.4.1 **Mobile and fixed services**

The Government of South Korea has promoted the sector through ongoing strategies to ensure that the country is a broadband leader. Consumers, competitive markets and strong links between the research community, hardware manufacturers and service providers facilitated this status.

Mobile services: The country has a sophisticated mobile market and has been a leader in deploying the latest technologies. There are three operators. SK Telecom is the market leader, followed by the incumbent Korea Telecom (KT) and LG U+. 4G mobile technology, Long Term Evolution (LTE) was launched as far back as 2011. There is virtually nationwide LTE population coverage, and approximately 80 per cent of the country's mobile connections are through LTE. In 2017, 93 per cent of the population used smartphones to access the Internet. With tri-band carrier aggregation of LTE-Advanced, the country has the fastest mobile network service available globally – four times faster than standard LTE. 5G mobile technology has been commercially launched in South Korea in 2019.

Fixed services: The incumbent Korea Telecom (KT), privatized between 1993 and 2002, is the market leader in fixed-telephone services. In terms of fixed broadband, KT is also the market leader. Other leading fixed-broadband stakeholders include SKT and LGU+, while other operators, mainly cable TV companies, make up around 15 per cent of the market. Over 90 per cent of households have access to 1 Gbps

service. Several fixed broadband technologies are in use, including xDSL and hybrid fibre-coaxial, but most operators are migrating to Fibre ToThe Home (FTTH), which accounted for 74 per cent of subscriptions in 2016. This includes redistribution through in-building LANs owing to the high proportion of multilevel housing units in the country. There are several nationwide fibre-optic backbones operated by telecommunication companies, Internet providers and the electric power utility. The country's strategic location between China and Japan facilitates access to over a dozen regional and international submarine cables providing high international internet bandwidth.

4.4.2 **South Korean Government policies promoting ICT**

The Government of South Korea framed policies with time-bound targets and goals promoting ICTs as a strategic tool for national development, such as Cyber Korea 21 (1999), e-Korea (2002) and u-Korea (2005) for establishment of world class ICT infrastructure**.** These typically called for coordination between government, businesses and research communities. In 2016, the Government of South Korea released the Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society. The plan describes how the country will react to the fourth industrial revolution characterized by the cloud, big data, mobile services and the Internet of Things.

The Korea Communications Commission (KCC) was founded in 2008 to handle regulatory and other issues related to the convergence of broadcasting and telecommunications. The Telecommunications Business Act of 1995 and its amendments are the main legislation covering regulation of the sector.

4.4.2.1 Cyber Korea 21 (1999-2002) and Growth of ICT infrastructure in Korea

The Korean government, in the middle of 1990s, has established two master plans for the development of the information society, the first Master Plan for Informatization Promotion in 1996 and the Cyber Korea 21 plan in 1999. Through these plans, the government has brought Korea one step closer to the realization of the information society with the construction of an advanced information infrastructure.

As per e-Korea Vision 2006 plan, key achievements of Cyber Korea 21 are highlighted as below:

- High-speed telecommunications networks were constructed to enable the citizens of Korea to have high-speed access to the broadband internet services throughout the nation. As of the end of 2001, the number of internet users totalled 24.38 million, where 7.81 million households had high-speed access to broadband Internet services.
- Informatization of the overall administrative processes in the government has increased not only administrative efficiency but has also established a solid foundation for the e-Government. Informatization of customs services has shortened the processing time (for exports, from more than a day to less than 2 minutes; for imports, from more than 2 days to less than 2 and half hours), and has reduced logistic costs by at least 500 billion won a year.
- The application of information technologies has spread to major manufacturing industries such as steel, electronics, ship-building, automobile and textiles in order to reduce costs and to enhance national performance. Size of the e- commerce market in South Korea grown to 88.5 trillion won in 2001 after Cyber Korea 21 as compare to 0.05 trillion won in 1998, a year prior to Cyber Korea 21.

Key factors for success of Cyber Korea 21 plan :

1. Establishment of a comprehensive informatization promotion framework and system :
    - The Framework Act on Informatization Promotion was enacted in 1995
    - Informatization Planning Office and Informatization Promotion Fund were established in 1996
    - Informatization Promotion Committee was established in 1996 and IT Strategy Meeting was organized in 1998.

In order to implement these action plans, the Korean government has formed a close partnership with the private sector.

2. The nationwide PSTN constructed in 1980's and the information systems built as a part of National Computerization Project were upgraded and integrated into the information infrastructure.
3. The government made initial investments in CDMA technology and promoted market competition in broadband and mobile telecommunication services in order to stimulate private sector investments.
4. The e-literacy training programs, partnership between the government and the private sector, contributed to the rapid rise of the internet population in Korea during 1999-2001.

4.4.2.2 e-Korea 2002 (2002-2006)

Although Korea made huge progress in ICT infrastructure establishment up to 2002 but many new challenges like digital divide as a new social problem , e-governance, cyber security and international export competitiveness has also cropped up by this time. To deal with new challenges, Government of South Korea , in the year 2002 , came with e-KOREA VISION 2006, The Third Master Plan for Informatization Promotion (2002~2006).The third Master Plan for Informatization Promotion through

e-KOREA VISION 2006 provides the blueprints for building the information society of the future , making Korea a global leader of the information age in the 21st century. Key feature are summarized as below:

Objectives and missions :

1. To maximize the ability of all citizens to utilize information and communication technologies in order to actively participate in the information society by providing the opportunity for all citizens to have access to Internet service and establishing a lifelong education system through online learning, all citizens will be able to nurture their creativity and to improve their ability to use information and communication technologies. As a result, all citizens will be able to participate in the information society as "prosumers" of information, their ability to utilize IT will lead to the creation of added value in all aspects of society and to the enhancement of quality of life.

   (*The prosumer of information is one who is both a producer and consumer of information)

2. To strengthen global competitiveness of the economy by promoting informatization in all industries Government plans to strengthen the global competitiveness of existing manufacturing and service industries and to build a foundation for fostering new high-tech industries based on exiting world class information infrastructure. As the IT industry is becoming an industry which strengthens the competitiveness of other industries, the productivity of existing manufacturing and service industries is expected to be further enhanced.

3. To realize a smart government structure with high transparency and productivity through informatization efforts. The government plans to enhance the transparency and productivity of all public administration processes as well as to

provide prompt and reliable civil services through the use of information and communication technologies. More online public services in the areas of education, culture and social welfare will be offered to South Korean citizens in order to enhance quality of life.

4. To facilitate continued economic growth by promoting the IT industry and advancing the information infrastructure The government will construct the next generation network with fixed and wireless access which will provide high quality broadband multimedia services at reason-able cost to anyone, anywhere in Korea. The government will provide the necessary support for new strategic IT products, develop core technologies, establish new creative industries and provide support for market entry overseas in order to become a global leader in information technology.

5. To become a leader in the global information society by taking a major role in International cooperation between Korea, China and Japan in the area of information technology , provides an opportunity for Korea to take a leading role in the world market. Korea plans to lead regional cooperation in IT among Asian countries by establishing a promotion system for the information culture in the Asia-Pacific region.

6. Promoting National Informatization-due to high costs and low returns, telecommunications service providers are not willing to expand broadband networks to rural areas. To resolve this problem, the government will provide an incentive to service providers so that remote areas such as rural areas, islands, and mountainous regions will have comparable information accessibility as larger cities.

- The government is now supporting the establishment of free internet facilities at community centers for low income areas and remote regions such as

islands. At the end of 2002, all towns and villages will have at least one center offering free internet access.

- The government is also providing support to the development of the telecommunications services and terminals especially for the handicapped. In particular, the government is developing ways to provide information access services at low cost for children of low income families as well as orphans.
- By introducing real time classes linking various schools online, the government will try to improve the quality of public education. Through the various methods of PCs and digital TVs, the government plans to stimulate "online learning at home" which will enable the sharing of digital learning materials between schools and homes.
- The government will build a world-class information infrastructure for all schools in Korea. By 2006, the average number of the students to one PC will fall below 5, and the average transmission speed of internet access will be upgraded to a minimum of 2Mbps.

7. Promoting Industrial Informatization- to stimulate activity in B2B e-commerce, the government has recognized the need for improving the logistics and online payment systems. Furthermore, to enhance the efficiency of international trade, the government will develop a paperless e-trade system, networking all companies in Korea to the internet, expanding the bases of e-business throughout the country.
    - To this end, the government will provide the necessary support for internet access of SMEs. Networking SMEs will promote the formation of independent markets for SMEs and productive e-businesses.
    - In addition, the government will provide aid to SMEs without sufficient funding and technologies to adopt IT through the integrated services by ASPs

(Application Service Providers), as well as fulfil the informatization needs of 30,000 SMEs. The government will construct a network for a comprehensive e-business support system and provide services in concentrated industrial complexes.

8. Promoting Informatization in the Public Sector-The government will expand online services to include all civil services, so that citizens do not need to visit public offices in person in order to handle various civil affairs. The government will expand the "single-window" services in phases by linking and integrating online civil services, currently provided by each ministry. Under the single-window services, citizens can deal with civil affairs through a single channel. The government will expand online civil services to private areas where public interests are important, as well as public corporations.
9. Advancing towards the Next Generation Telecommunications Infrastructure-
    - Expanding the broadband telecommunications networks for the realization of universal access to the broadband internet with a minimum transmission speed of 1 Mbps by 2005.
    - Distributing digital televisions to more than 50% of the total households in Korea until 2006, are the objective in this direction.

4.4.2.3 **u-Korea Master plan 2005 (2006-2015)**

U-Korea master plan was conceived in the year 2005 to be implemented between 2006- 2015. Under this plan South Korean government envisioned to create Smart Cities or U-Cities, of future which will be designed, built and operate on robust ICT infrastructure already established. U-City is a 21st century futurist city which enables urban functions and services such as administration, traffic, crime prevention, fire prevention and home-networking of residential places, fusing high-tech infrastructure

and ubiquitous information available into the urban area. Ubiquitous means 'existing anywhere' and is an environment where the user can access the network everywhere and without being aware of the computer/network.

U-city is a uniquely Korean idea. Korea has used its high speed CDMA and mobile technologies to connect radio-frequency identification, or RFID, smart cards and sensor-based devices. Information is gathered, in real time, from all these devices installed ubiquitously, and processed at back end to provide services to the city dwellers. It all starts with a resident's smart-card house key. The same key can be used to get on the subway, pay a parking meter, see a movie, borrow a free public bicycle and so on. Existing and new U-cities have come up in Korea on public private partnership model.

The main goal of u- Korea 2005 plan is creation of the society in which all people would be able to take advantage of safe, ubiquitous society, 4U: Universal, Usable, Unisonous, Upgraded by the way of progress in five main areas (government, land, economy, social environment, individual life), along with optimalization of four main driving forces (globalization, industrial infrastructure, social infrastructure, technological development)(NISA: Korea Informatized progress and status overview 2007)

4.4.2.4 Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society:

The South Korean government has been taking crucial steps to thoroughly prepare for the coming Fourth Industrial Revolution (IR 4.0), such as fostering entrepreneurial spirit and boldness in Korean society, identifying and proactively supporting promising technologies, and developing creative work forces. In an attempt to secure

a leadership position in the unfolding revolution and expedite the realization of an intelligent information society in Korea, the Government of South Korea announced the "Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society" in December 2016.

The Master plan focuses on Internet of Things (IoTs) as source of data generation, data management though blockchain technology, Big Data for data analysis, Artificial Intelligence (AI) and 5G (Fifth Generation) Mobile Network infrastructure to accelerate the Fourth Industrial Revolution.

The plan document stressed that for the successful implementation of this Master Plan, the currently flourishing public private partnership in ICT is key to achieve the massive transformation and innovation required in all economic, social, and other related systems of the Korean nation.

For success of this plan Government of Korea stressed to increase budgetary allocation for R&D activity in Intelligent IT. The Korean Government's R&D budget for Intelligent IT in 2016, which includes investment in intelligent software, basic technologies, and human resources development, accounts for only 0.7 percent of the overall national R&D budget (KRW 134.8 billion out of KRW 19 trillion).

4.4.3 Analysis of South Korea's ICT success

South Korea attained global leadership in ICT infrastructure establishment, adoption and promotion thanks to robust Government policy initiatives and effective implementations by government, business and research communities with time-bound targets. It has not only maintained top IDI position but improved IDI values year on year since inception in 2009. India can learn a lot from South Korea's practices adopted to improve IDI ranking. Some takeaways are listed below:-

4.4.3.1 Through Cyber Korea 21 (1999), e-Korea (2002) and u-Korea (2005) plans, Korea came one step closer to a knowledge-based society with the construction of an advanced information infrastructure, the introduction of various information systems in public services and in the private sector, as well as growth in the overall IT industry. It is also notable that the Informatization Promotion Fund (1996) created the system of letting the profits from ICT fields be reallocated into ICT sector and enabled focused investment in ICT. Also, new financing methods –'invest first, settle later', and matching deposits – attracted private sector investments, utilizing government resources as seed money. This can be interpreted as a PPP-based funding mechanism, even though other forms of PPP model, such as privately-funded e-government projects, are hardly to find in the country. In summary, Korea was able to be equipped with the necessary laws, fund, organizations and programs for a jump-start in ICT.

4.4.3.2 The 10-year, 3-stage Korea Information Infrastructure (KII) Plan was established in 1995, lifting up Korea to one of the most advanced countries in the world in terms of ICT infrastructure. By 2000, fiber optic networks in 144 regions nationwide were completed, and 1,400 rural areas had access to broadband networks. This paved a physical infrastructure for the e-government projects in the early 2000s. A total of 31,632 governmental organizations such as central and local administrative offices, educational- and research institutes and medical institutions use KII network at a discounted price.

4.4.3.3 It needs to be mentioned that Korea has a geographic and demographic advantage in jump-starting a broadband powerhouse: The high degree in population density and urbanization combined with the unique housing patterns - apartment complexes and community housing account for 60% all housing in the country – are

conducive to economies of scale and thereby the deployment of more cost effective ICT infrastructure.

4.4.3.4 The government has opened the broadband Internet service market without regulation or controls over licensing and pricing. This approach with minimal regulatory measures in the market has encouraged facility-based competition among service providers. Increased competition put downward pressure on tariffs, which in turn, created more demand. The government worked closely with the private sector, encouraging investment and formulating development strategies that deeply relied on competition. Due to this competitive market environment, service providers had to maintain low tariff, and as low tariff created still more demand, a virtuous cycle in the broadband Internet service was formed.

4.4.3.5 A distinctive characteristic of the intervention, is that the government played a complementary role as supporter or enabler of the ICT development, not any more as replacement for the private sector, inducing infrastructure/ R&D investments and establishing ICT-friendly environment. This massive, but sophisticated intervention is regarded, in large, successful and effective.

4.4.3.6 While trying to expand the supply in ICT through building ICT infrastructure nationwide and developing high-end technologies, the government also came up with strategies for the other side of broadband equation - demand creation. The ambitious plan of “ICT training for 10 million people” is one of the most notable initiatives among others, to raise awareness on internet services for Teachers and students, farmers, fishermen, Labor workers, housewives, Soldiers, Public officials, disabled and elderly, prisoners.

4.4.3.7 Korea has a high rate of literacy and school enrollment , which are essential prerequisites for the widespread adoption of ICT. Moreover, a large consumer base of technology-savvy Koreans actually helped the rapid deployment of Internet and various new digital services.

4.5 **Analysis of IDI indicators based on Survey (Field Data)**

IDI includes 11 indicators in access, use and skills sub-indices. This study conducted field survey related to IDI Indicators in Access and Use sub-indices only.

Primary data has been collected through survey by designing a relevant questionnaire as per annexure attached. Target population to whom questionnaire was sent includes officers in Department of Telecom, TRAI, Telecom Service Providers (TSPs), academia and others. Objective is to include target population as wide as possible including the policy makers, regulators, service providers, academia and users to encompass the total domain. Questionnaire was sent to 100 respondents and responses are received from all 100 respondents.

Basic data about respondents

Respondents -100

Responses received-100

Gender- Male- 75, Female -25

Age: 18-25 yrs : 20 respondents,

26-40 yrs: 21 respondents,

40-50 yrs: 41 respondents,

> 50 yrs (respondents-18)

Qualification:

Graduate- 48 respondents

Post Graduate- 50 respondents

Doctorate & other -2 respondents

Occupation: Government Service -66 respondents

Private Service- 10 respondents

Others -24 respondents.

The responses received are tabulated as below:

Table 4.10 Survey Questions and Responses

Q, No.	Details of Question	Response (Percentage)
1.	**Do you have a fixed telephone connection?**	
1.	Yes	64%
2.	No	36%
2.	**Fixed telephone subscriptions per 100 inhabitants in the country is very low as compared to Mobile-cellular telephone subscriptions. It is due to lack of fixed telephone network connectivity.** **Do you think Fixed telephone connectivity needs to be promoted, in the country?**	
1.	Yes	69%
2.	No	23%
3.	Can't say	8%
3.	**Fibre To The Home (FTTH) is one of the most reliable ways to provide Fixed telephone connectivity, especially Fixed Broadband Internet Connectivity. But it is relatively expensive and time taking to establish FTTH connectivity as compared to a mobile-cellular connectivity.** **Do you think FTTH infrastructure connectivity**	

	in Cities/town and villages need to be promoted and incentivized?	
1.	Yes, FTTH infrastructure once laid, will cater for all telephone / Broadband needs in future.	61%
2.	Yes selectively, FTTH infrastructure laying in commercially important Cities /Town and upto gram panchayat need be promoted and incentivized.	34%
3.	No	2%
4.	Can't say	3%
4.	**Do you agree that Bharat broadband Network Ltd (BBNL), a SPV to connect all gram panchayats on Optical fibre cable (OFC),would help provide broadband connectivity to rural households as well?**	
1.	Agree to a large extent	45%
2.	Agree to some extent	46%
3.	Not at all	5%
4.	Can't say	4%
5.	**Mobile networks connectivity, especially 3G and long-term evolution (LTE/ WiMax), is required for mobile broadband internet. Large sections of population, especially in sub-urban, rural and remote areas , still do not have access to the mobile network.** **In your opinion, what could be the bottleneck(s) for expansion of mobile network coverage in the country ?**	
1.	Mobile Network laying is cost/capital intensive and has long gestation period.	17%
2.	Technology for mobile network is changing every 3-5 years, before service providers start reaping benefits, new technology arrive.	33%
3.	Lack of sufficient R&D for telecom technology	16%

	development in the country , so dependent on Import of technology which also results in foreign exchange outflow.	
4.	Mobile service providers in the country are debt ridden and Non-performing Assets (NPAs) of banks further deter investments in infrastructure in Indian telecom sector.	24%
5.	None of the above	10%
6.	**Observing the enormous growth potential of data , how to expand the mobile network connectivity in the country to cover every household with internet access ?**	
1.	facilitating the import of cheaper mobile technologies- 3G/4G or even 5G in future.	20%
2.	Providing spectrum at reasonable rates and incentivizing those service providers rolling outing faster network.	40%
3.	Penalizing the service providers delaying roll out of network.	3%
4.	Incentivizing domestic production of mobile technologies , 3G/4G or even 5G	14%
5.	Strengthening the Public Sector Units (PSUs), BSNL, MTNL, ITIs, to play key role in establishing mobile networks.	20%
6.	None of the above	3%
7.	**International Internet Bandwidth (IIB), is key for broadband internet speed at user's end. It is observed that most of the users , irrespective of service providers, face problems in getting broadband speed. Also, IIB in India is far less than the global trends.** **Do you think, International Internet Bandwidth needs to be enhanced by establishing more cable landing stations and/or subsidizing access charges ?**	
1.	Yes, more cable landing stations and subsidizing access	43%

	charges.	
2.	Yes, more cable landing stations without subsidizing access charges.	39%
3.	No	3%
4.	Can't say	15%
8.	**Do you agree that Government should provide computer or tablet or similar handheld computer free of cost or at subsidised cost to every household in the country to promote use of internet in every household ?**	
1.	Agree to large extent.	20%
2.	Agree to some extent	38%
3.	Disagree	42%
9.	**What do you think that some specific provisions in policy framework of India required, to promote Internet access and usability ?** **Please Give your suggestions:**	
	_____Suggestions _____	

(Source : Author)

Question-wise responses from respondents are listed , with analysis, as below:

Q.1: **Do you have a fixed telephone connection?**

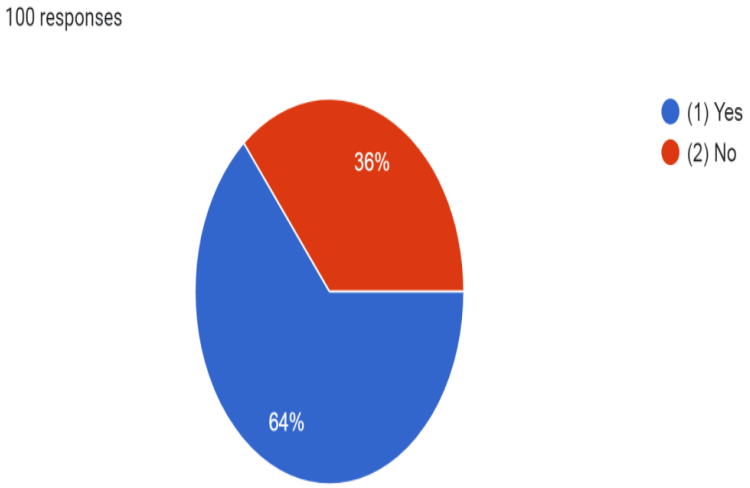


Chart 4.1: Fixed telephone connection availability with respondents

(Source : Questionnaire responses)

Out of total 100 respondents, 64, two third, said they are having fixed telephone connection and 36 reported having no fixed connection.

Q.2: **Fixed telephone subscriptions per 100 inhabitants in the country is very low as compared to Mobile-cellular telephone subscriptions. It is due to lack of fixed telephone network connectivity.**

Do you think Fixed telephone connectivity needs to be promoted, in the country?

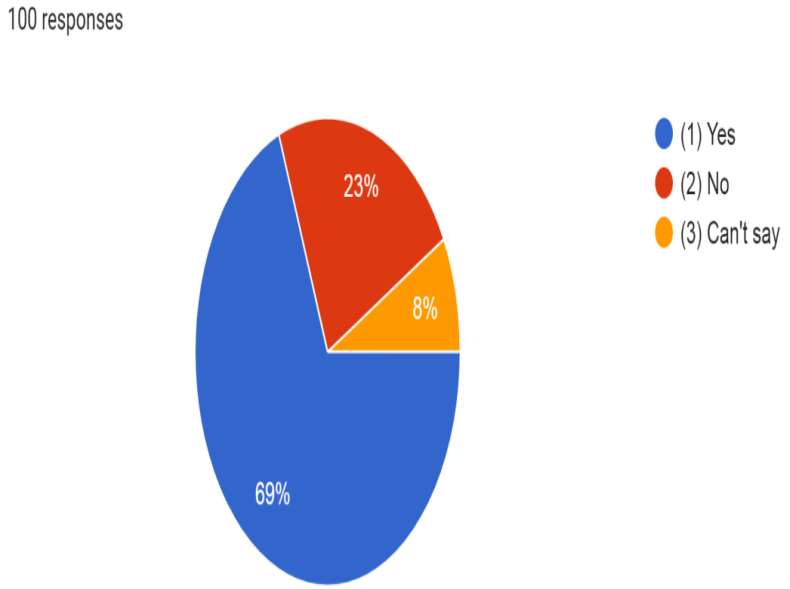


Chart 4.2: Fixed telephone connectivity promotion

(Source : Questionnaire responses)

Out of 100 respondents, only 23 are not in favour of promoting fixed telephone connectivity whereas majority 69 have views in favour of promotion whereas 8 respondents don't have view for or against promotion of fixed telephone connectivity.

Q.3: **Fibre To The Home (FTTH) is one of the most reliable ways to provide Fixed telephone connectivity, especially Fixed Broadband Internet Connectivity. But it is relatively expensive and time taking to establish FTTH connectivity as compared to a mobile-cellular connectivity.**

Do you think FTTH infrastructure connectivity in Cities/town and villages need to be promoted and incentivized?

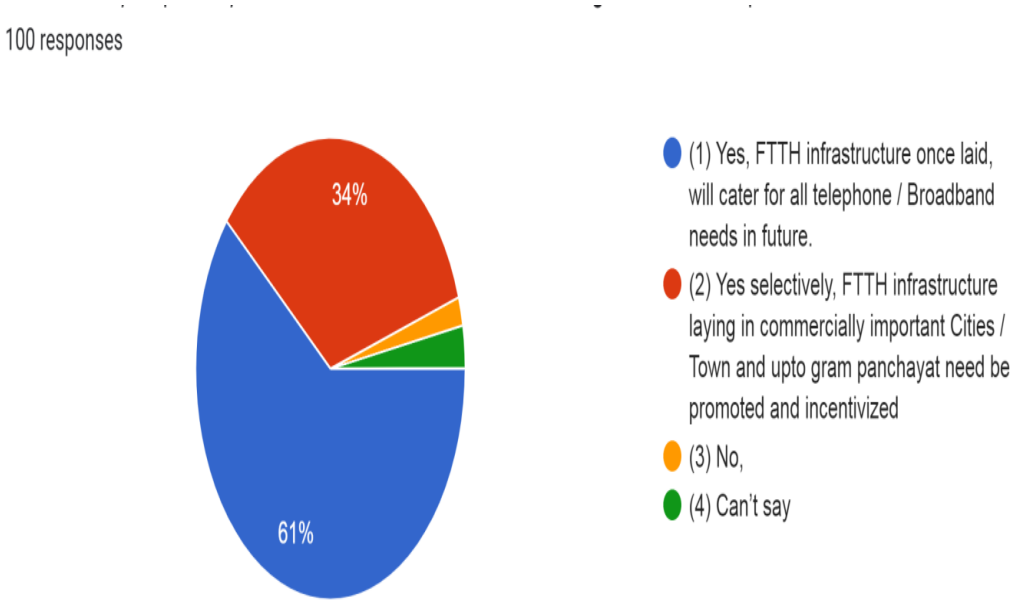


Chart 4.3: Fixed broadband promotion on Fibre To The Home (FTTH)

(Source : Questionnaire responses)

Out of 100 respondents, only 2 respondents are not favouring promotion of FTTH and 3 respondents don't have view for or against FTTH promotion whereas majority of 95 respondents are either in favour of pan-India or selective promotion and incentivising FTTH in commercially important cities/town upto gram panchayat level for telephone and fixed broadband internet connectivity.

Q.4: **Do you agree that Bharat broadband Network Ltd (BBNL), a SPV to connect all gram panchayats on Optical fibre cable (OFC),would help provide broadband connectivity to rural households as well?**

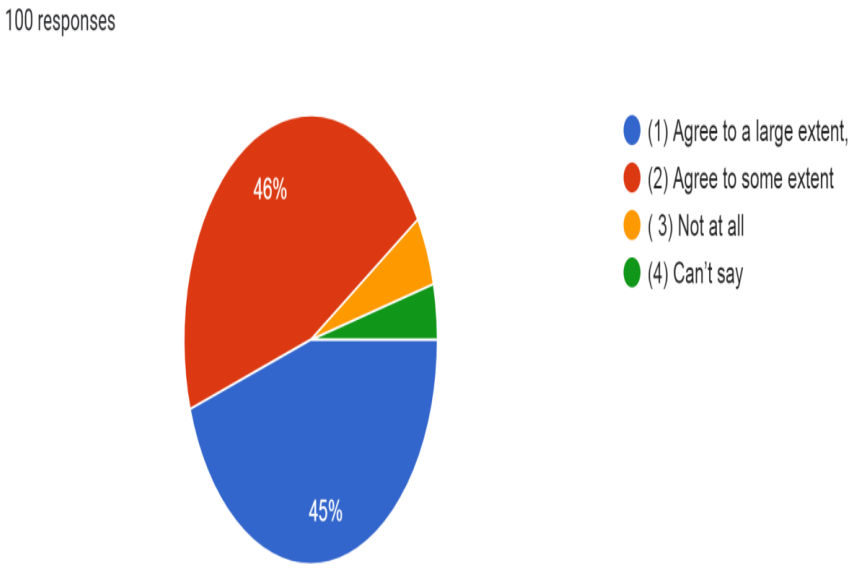


Chart 4.4: Fixed Broadband connectivity to rural Households through BBNL

Source : Questionnaire responses

Out of 100 respondents , 5 don't agree that BBNL can provide broadband to rural households , 4 respondents have no view , whereas majority 91 respondents either fully agree or agree to some extent that BBNL would help provide broadband connectivity to rural households. BBNL aims to reach OFC upto 250000 gram panchayats in the country. More than 1 lakh gram panchayats already connected on OFC. Fixed telephone and fixed broadband connectivity to households in villages can be provided on FTTH at some incremental cost, if BBNL is mandated to do so. Also , wireless broadband connectivity on WiFi can also be installed.

Q.5: **Mobile networks connectivity, especially 3G and long-term evolution (LTE/ WiMax), is required for mobile broadband internet. Large sections of population, especially in sub-urban, rural and remote areas, still do not have access to the mobile network.**

In your opinion, what could be the bottleneck(s) for expansion of mobile network coverage in the country?

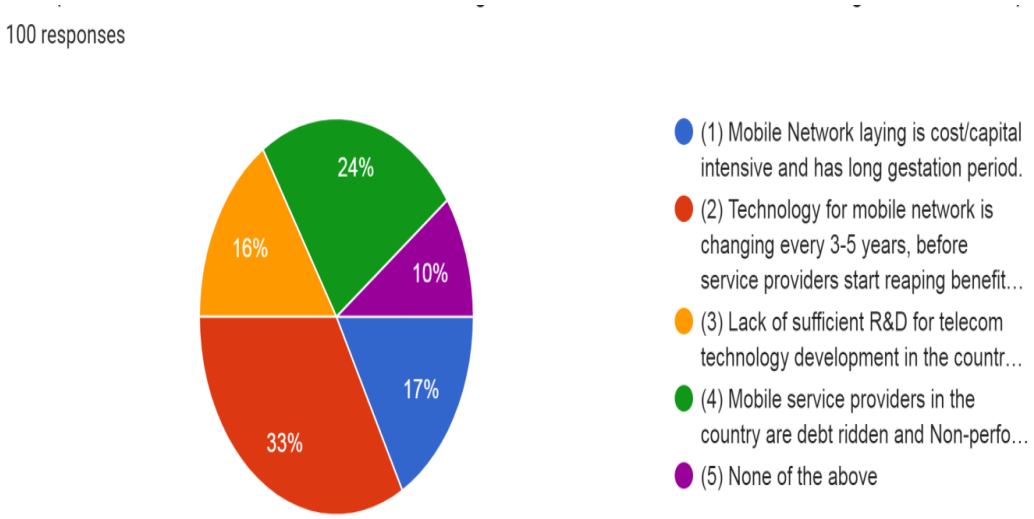


Chart 4.5 : Bottlenecks for Mobile coverage and network quality

(Source : Questionnaire responses)

Out of 100 respondents, 90 respondents opine that for Large sections of population, especially in sub-urban, rural and remote areas, still do not have access to 3G (LTE/WiMax) mobile network due to flowing reasons :

1. Mobile Network laying is cost/capital intensive and has long gestation period.
2. Technology for mobile network is changing every 3-5 years, before service providers start reaping benefits, new technology arrive.

3. Lack of sufficient R&D for telecom technology development in the country , so dependent on Import of technology which also results in foreign exchange outflow.
4. Mobile service providers in the country are debt ridden and Non-performing Assets (NPAs) of banks further deter investments in infrastructure in Indian telecom sector.

Q.6: **Observing the enormous growth potential of data , how to expand the mobile network connectivity in the country to cover every household with internet access ?**

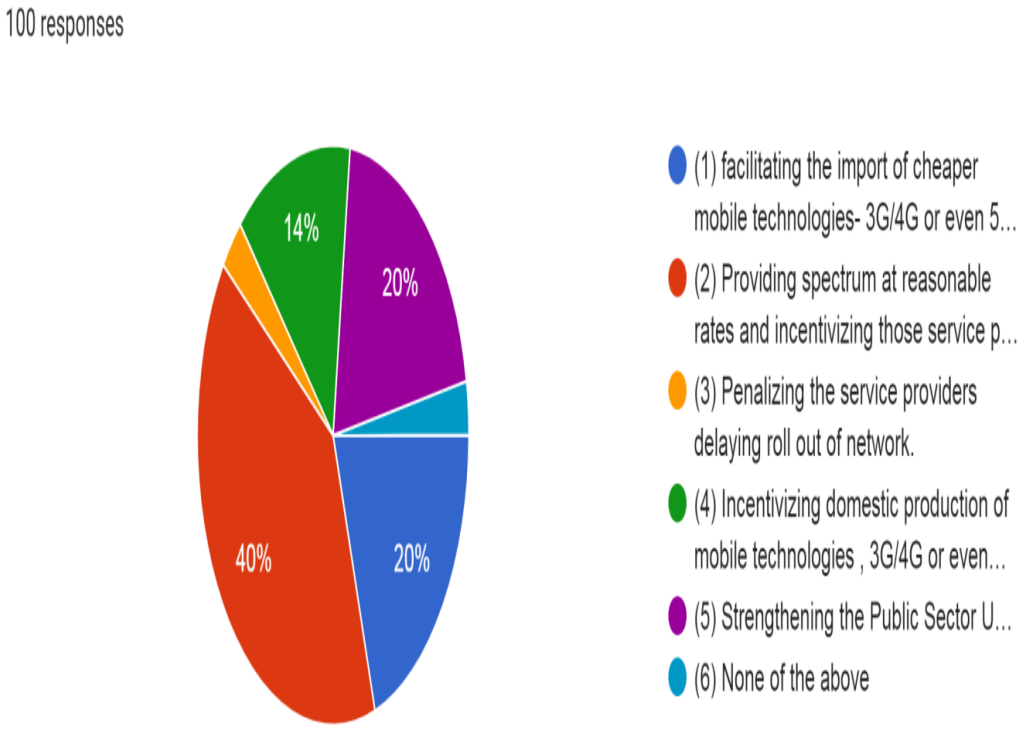


Chart 4.6 : Expansion of mobile network and internet access to households

(Source : Questionnaire responses)

Out of 100 respondents, 94 respondents ascertain following reasons for expanding the mobile network connectivity in the country to cover every household with internet access :

1. Facilitating the import of cheaper mobile technologies- 3G/4G or even 5G in future .

2. Providing spectrum at reasonable rates and incentivizing those service providers rolling outing faster network.

3. Incentivizing domestic production of mobile technologies, 3G/4G or even 5G.

4. Strengthening the Public Sector Units (PSUs), BSNL, MTNL, ITIs, to play key role in establishing mobile networks.

Q.7: **International Internet Bandwidth(IIB), is key for broadband internet speed at user's end. It is observed that most of the users , irrespective of service providers, face problems in getting broadband speed. Also, IIB in India is far less than the global trends.**

Do you think, International Internet Bandwidth needs to be enhanced by establishing more cable landing stations and/or subsidizing access charges ?

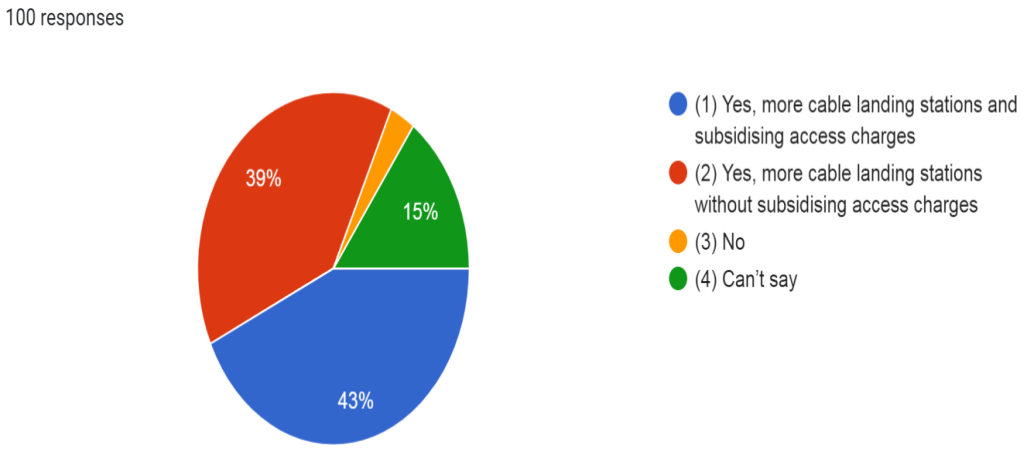


Chart 4.7 : Expansion of International Internet Bandwidth (IIB) through promotion of cable landing stations

(Source : Questionnaire responses)

Out of 100 respondents, 82 respondents opined that , International Internet Bandwidth needs to be enhanced by establishing more cable landing stations either by subsidizing access charges or without subsidizing access charges to provide IIB to users at par with global trends. 15 respondents cant say anything and 3 respondents don't agree for establishing more cable landing stations.

Q.8 **Do you agree that Government should provide computer or tablet or similar handheld computer free of cost or at subsidised cost to every household in the country to promote use of internet in every household?**

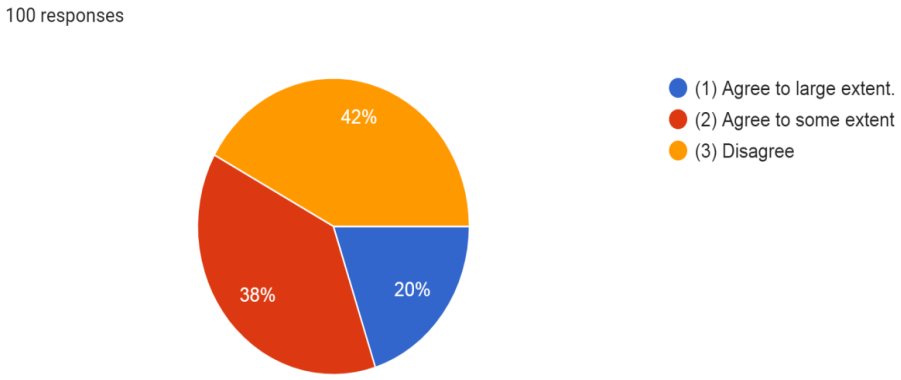


Chart 4.8 : Provision of computer to households for promoting use of internet

(Source : Questionnaire responses)

Out of 100 respondents, 58 respondents agree that Government should provide computer or tablet or similar handheld computer free of cost or at subsidised cost to every household in the country to promote use of internet in every household. 42 respondents disagree for free or subsidized provisioning of computer or tablet or similar handheld computer to households.

Question 9) What do you think that some specific provisions in policy framework of India required, to promote Internet access and usability?

Suggestions, as received, are listed as below:

1. Setting an upper bar on the price of data that can be charged by any telecom provider. Cheaper spectrum to private TSPs and free to PSU TSPs. Better IIB is required.

2. A strong home grown R&D is the need of the hour. Telecom space has become a playground for few equipment providers and this situation is posing dependency risks. Besides a fair and consistent policy will definitely encourage investment in this now parched sector.

3. Road restoration charges should be nil for OFC cable laying and increased Fibrization

4. Free right of way (ROW) for OFC laying.

5. Successful implementation of BharatNet project.

6. Development of NTIPRIT into a world class telecom academy having state of art labs, and indigenous technology and innovations.

7. Rolling out faster service, and educating rural and urban India about quality contents available on internet, and help them to share their own content and knowledge on net.

8. Rural infrastructure may be supported from USO fund.

9. Just need to do nothing. Keep away from directing telcos ,charge less for license and spectrum charges one time floor rate for allocation of spectrum should be minimal. Telecom should not be seen as money spinner for govt but looked as enabler for development of nation.

10, 1) Ease ROW permission, 2) Implement National Building Code in all states, 3) Fiberisation of towers, 4) Common duct usage policy

11. High Quality standards like good speed of broadband , fault free service, lower tariff for poor persons, good quality mobile at very less price for poor persons, etc

12. Need to advancement of tech accessibility must be in urban as well as rural.

13. 1. FTTH Technology but the fibre should be of good quality. 2. Wimax Technology, but for this the equipment should be of good quality with sufficient number of black holes to cover the large area with sufficient speed

14. Infrastructure building for telecom as a national resource & promotion of infrastructure sharing.

15. Public wi fi is required at free of cost

16. 1.Use of IT as a subject in schools from 6th class onwards 2.promoting landline internet connections specially in rural areas . They should have internet study centres in government schools wherein evening classes can be held 3. Computers at some subsidized rates for the children to learn computer and use internet.

17.There should be market driven mechanism to promote internet access through wi fi hot spots so that anyone can get the same easily.

18. DoT imposes a number of levies on TSPs along with auctioning the spectrum at astronomical prices. This makes the provisioning of telecom services costly for TSPs. There is an urgent need to rationalize this and reducing the input cost for TSPs.

19.Govt. should act in a way to facilitate and remove the difficulties of private companies coming forward. There should be entry level relations for new entrants. Government should set up a robust, effective and efficient grievance handling system

20. Availability of Infra with proper service quality. Govt should focus on facilitating service as per need to customers

21.India as a county is lacking proper and reasonable infrastructure for education due to which use of internet in large section of society is not being used for commercial purpose. This could be a major bottleneck for limited use of internet in

the country. In fact, in order to promote internet to rural household there is a need for simultaneous infrastructure for reliable public education system so that internet could become a tool for development for not only individual user but as a society as well.

22. Instead of spending about Rs.50,000 cr public money in Bharatnet project, which could so far provide operations in few Gram Panchayats, the money could be utilized by incentivising Telecom Service providers and getting the work implemented by them. In such case, the TSP will own their network and provide village connectivity at discounted rates and this will connect all the villages with telecom services quickly.

23. Spectrum rates should be more reasonable. PSUs can setup infra in remote and rural areas overlooking the profit margin.

24. Current policy framework is sufficient.

25. Govt should make policy for provide accessibility by covering every village and highways in the country without making a business model for private operators, which works on the model of profitability only. It should be responsibility of each telecom operator to provide internet services at the remote places also ,where there is no profit to them. There should be social obligation on telecom service providers to provide service in poor rural area also.

26. Ensure free Accessibility of broadband to every student.

27.It is estimated that there are 27,721 inhabited villages (as per the Census 2011) in the country, which are not covered by mobile services. The reasons for not having mobile services in these villages include, inter-alia, remote & tough terrains, areas diversely located with scattered population and commercially non-viable operations. Mobile coverage in these villages is being provided by the

Government and Telecom Service Providers in phased manner. Internet is also being accessed mainly through mobile wireless 2G, 3G and 4G technologies. In the National Digital Communications policy issued by the Government in 2018 ,necessary provisions already made for provisioning of Broadband for all. However the implementation part needs to be done in time-bound manner.

28. Policy frameworks for digital India, NDCP , national broadband mission , etc are sufficient policy enablers are a here in our country. Data policy is at final stage any time it will come. Only implementation of these policy is key.

29. Right of Way (ROW) issues must be sorted out with state governments.

30. Availability of content in local/ vernacular language and digital literacy should be promoted.

31. Educating people is really important regarding the benefits of technology and how to use it. It is also important to make it affordable and keep updating the technology so that the implementation doesn't loose its way after some years.

32. Telecommunication infrastructure needs to be strengthened with large coverage of BTS towers.

33. Utilisation of USOF in increasing mobile broadband in rural areas

34. Govt. to ensure right amount of time goes on internet otherwise country will become addict.

35.1. Reduction in licensee fee/USOF levy of TSP depending on the extent of 4G network coverage at village level. Waiver in USOF levy for TSPs who provide 4G in all villages with sufficient QoS 2. Promotion of R&D for developing technologies which can operate reliably within the limitations in rural areas of India 3. Improving power supply in villages

36. Optical fibre cable is the carrier for high speed internet in the access network as well as in the backbone transmission. A policy should be made such that the operators can lay ofc without much difficulty. The common duct along the National Highway, State Highway, and so on should be made available. Any part of city plan , road connectivity should have a plan for telecom connectivity as a component. Applications for laying ofc and approval should be made online.

37. Lower costs

38. The Government should make the policy to develop the telecom network to cover full urban & rural areas by each service provider.

39.The net neutrality policy requires a change since irrespective of type of traffic, all are treated equal in network which is causing a bottleneck for quality usage of bandwidth

40. Specific provisions in policy framework are obviously required to ensure proper internet access to each and every one at reasonable cost with certain restrictions to check spread of hatred in society. Access of internet for antinational activities must be strictly watched through special features.

41.Nationalisation of fiber assets and setting up an Authority to oversee optimum utilization of existing resources and creation of last mile network for end to end readiness so that a robust digital infrastructure is created till each home

42. The spectrum should not be considered just as a source of revenue, but it should be used as a tool for promoting social and economic goods. While deciding the reserve of prices of spectrum ,the ancillary and secondary effect on Economy should also be considered. Also, having fibre connection to the buildings in metro areas should be made mandatory to give No-objection certificate for construction of buildings and high rise apartments on the same line as it is done for fire, water

and electricity. The sub-contractualisation and leasing of commercial spaces for exclusive service by a service provider needs to be strictly monitored.

43.There are already many policies but problem is in its implementation only. Service providers are taking money for providing 4G speed but it is worst than 2G in past. Service providers should tell areas specifically where they are providing 4/3/2G services.

44. The PSUs should provide the internet access at very cheap rates and should help the TSPs in deploying the fibre network, towers, and other telecom network at subsidized rates. Also the RoW charges should be reduced

45. Making Basic services of Government online, providing Infra and digital literacy programs.

46. Better network and connectivity required at remote areas. India is still lacking to provide good education to every citizen. Good education should be free in India. Unemployment problem should be eradicated , which requires lots of home work

47.Promotion of new technologies like 5G in access and optical fiber in front and backhaul, as these have the potential to offer services at cheaper cost due to efficiency in spectrum usage and network operations at the same time these support large bandwidth.

48. Better and more focused use of USOF

49.Internet usage depends on access and agriculture industry being the backbone of the nation is one of the few industries which dont have much of work online . Promoting internet activity in this sector would immensely help internet usage in rural areas of the country

50. Competition among firms need to be increased and more companies to be inducted for efficiency, price reasonability. Monopoly of few firms like Jio needs to be addressed. BSNL need to be strengthened.

51.Future technologies for provisioning of Broadband services , content and applications should be user friendly and useful. The improvement of index can be a secondary target. The primary target should be the welfare of the citizens.

52. Like Education for all, Internet for all may be made a fundamental right.

53. Tariff transparency required. The plans should be linear with specified unit price for speech and data. The complex tariff structure has led to fall of so many telecom companies. The over competition has killed the telecom industry. There should be limit on telecom companies can take debt.

54.Penal provisions for not providing International Internet bandwidth. Spectrum at reasonable price and faster rollout of services. Safeguard against cyber frauds and threats.

55. Right of Way for telecom network needs to be simplified, Sharing of Infrastructure needs to be simplified & promoted and regulated by one independent authority. Promotion for the equipment manufacturing is required.

56. More and more services should be bought online. Online payment should be given incentive.

57. All the telecom service providers are incurring huge losses hence government need to work on this. Frame policies so that profitability can be increased so that these companies can invest in expanding the network infrastructure to provide internet access and increase usability.

58.Govt should incentivise the TSPs for providing mobile coverage in uncovered villages and make it mandatory to cover some specified uncovered villages.

59.USO fund collection should be stopped / reduced, as USOF has not provided desired results.

To sum up the suggestions; Right of Way (ROW) issues, R&D in India for telecom, reduction in Spectrum usage charges (SUC) , reduction in License Fee (LF), OFC provisions in National Building Code (NBC), Proliferation of FTTH, free of cost WiFi to users, provisioning of computer at Subsidized cost to the students, Internet education in schools, availability of Content in local languages, 4G mobile coverage upto village level , strengthening of PSUs , Promotion of 5G and successful implementation of BBNL project in gram panchayats and time bound execution of infrastructure projects are suggestions given by respondents. Which indicates growing concern for coverage and quality of both fixed and mobile infrastructure on pan-India basis . Also, importance and awareness for internet and provisioning of computer/ laptops at subsidized prices are some key suggestions.

From the above analysis in this chapter, it is amply clear that investment in infrastructure is key with ease of execution and operation of the same. Affordability of services, both fixed and mobile broadband internet, and devices to access the internet services like computer, laptop, tablet are made available at reasonable and affordable prices. With this in place, training and awareness will play catalytic role for the proliferation of ICT across the country.

CHAPTER 5

STRETEGY TO IMPROVE INDIA'S IDI RANKING

5.1 Introduction

ICT Development Index (IDI) of International Telecommunication Union (ITU) is a country-wise ICT value and ranking on global level. Through various IDI sub-indices , the country's Access infrastructure for making ICT available to its population , participation of its society through use of ICT and though skill sub-index it measures the skill : primary , secondary and tertiary education for level of population to adapt ICT by a country's population. IDI is a broad ICT measurement internationally on 11 indicators through which, level of ICT penetration and adoption is measured in a country.

On one hand IDI opens up investment opportunities for global equipment manufacturers to invest in providing Access infrastructure for ICT , on the other hand its an opportunity for a country to attract multinational companies to invest in capital and technology and create new job opportunities and contribution in the Gross Domestic Product (GDP) in the economy. Ambitious 5 trillion dollar Indian economy by 2024, dream of Indian Government, has huge investment potential in all sectors of economy and telecom sector will play pivotal role. Enhanced adaptation of ICT provides efficiency and productivity in all sectors of economy, helping exports and provide flexibility of work to employees and improving health of citizens by reducing working hours. High IDI value countries like South Korea, Japan, Singapore, United Kingdom , USA are testimony to the increased use of ICT and accruing all round benefits to its population, businesses and the economy.

The Indian economy has been graduating towards digital economy by increasing use of digital payments, e-commerce, e-Governance, Big data, Internet of Things (IOTs),

Artificial Intelligence (AI), Cloud Computing, Industrial Revolution (IR) 4.0 to mention a few. India has large , billion plus population and demographic dividend to reap benefits of enhanced ICT adaptation by it's population. The population of India is not only a consumer power house of content but huge creator of the content as well. With improvements in India's IDI ranking from current position, one can imagine the opportunities available ,to all sections of the society, business communities and the country. In the next section , we will discuss constraints in improving India's IDI ranking.

5.2 **Constraints in improving India's IDI ranking**

5.2.1 **Infrastructure constraints**

Fixed telephone subscriptions per 100 inhabitants , mobile-cellular telephone subscriptions per 100 inhabitants , international internet bandwidth per internet user, households with computer and internet access are the indicators of ICT access sub-index and individuals using internet, fixed broadband subscriptions per 100 inhabitants and active mobile broadband subscriptions per 100 inhabitants are indicators of ICT usage sub-index. Indicators in access and usage have been analysed in chapter 4 of this study paper. In this section we will discuss constraints. Following constraints , indicator-wise, are discussed below :

5.2.1.1 Fixed telephone subscriptions per 100 inhabitants in India was 1.9, as per ITU -2017 report, whereas in case of South Korea this figure was 56.1 during the same period. This means, more than 98 percent Indians do not have access to fixed telephone connectivity. Whereas in South Korea more than 50 percent population have access to fixed telephone connectivity.

Status of fixed broadband subscription also is not very encouraging in the country. Fixed broadband connectivity is established on fixed telephone lines providing both

voice and broadband internet services to users. Fixed broadband subscriptions per 100 inhabitants in India was 1.4 , as per ITU -2017 report, whereas this figure was 41.1 in case of South Korea during the corresponding period.

The growth of fixed telephone connectivity is stagnant in the country. Fixed telephone service is provided mainly by BSNL and MTNL , two uublic sector undertakings of Government of India, with very little contribution from private fixed telephone service providers like Bharti, TATA Tele, Reliance Comm, Quadrant , Vodafone and Reliance Jio**.** Since same fixed telephone infrastructure is used for providing fixed broadband so growth of fixed broadband is also low. Fixed telephone network infrastructure was established by BSNL and MTNL on legacy copper cable, which is very costly and laying the infrastructure on copper cable requires long period, perhaps years. Most of the private telecom service providers started fixed telephone services in selectively lucrative urban pockets only and applied higher tariff on users so growth remain limited , unlike mobile telephony. After the arrival of private service providers in mobile telephony, profitability of BSNL to lay fixed service network also impacted the investment into fixed telephone and fixed broadband segment. On one hand private service providers wanted quick profit from their investments and invested in establishing mobile network instead. So **lack of investments from private telecom service providers** was a big issues for the growth of fixed telephony and fixed broadband, whereas huge investments should have been encouraged into this segment of telecommunication infrastructure in India, as was done by South Korea in mid 90's.

Another key constraint , for laying fixed telephone and fixed broadband network specially in cities and towns ; laying cable along the roads, streets, multi-storey buildings ; telecom service providers face **problems in getting Right of Way**

(ROW) permissions from Municipalities ,Development Authorities, Builders of multi storey apartments , Residential Welfare Associations (RWAs) which causes cost overrun and delay in rolling out of the network and discourages investments into fixed telephone service and fixed broadband network.

5.2.1.2 Mobile-cellular telephone subscriptions per 100 inhabitants in India was 87, as per ITU -2017 report, whereas in case of South Korea this figure was 122.7 during the same period. India made huge progress in establishing and provisioning of mobile network and private telecom service provides contribution is more than 90 percent in mobile telephone subscriptions.

Active mobile broadband subscriptions per 100 inhabitants in India was 16.8, as per ITU-2017 report, whereas in case of South Korea this figure was 111.5, during the same period. This is huge difference.

Investment in mobile network infrastructure like 3G and 4G in India was required to give a boost to mobile broadband in the country. 3G and 4G networks were laid only in selected urban and commercially important pockets as profitability was concern and network usage tariffs were set high by private telecom service providers making 3G, 4G mobile broadband un-affordable to large sections of the population. Telecom PSUs , BSNL and MTNL , were not having sufficient capitals with them to invest in pan-India 3G network in the country. BSNL and MTNL were not having spectrum for establishing 4G mobile network, as hefty spectrum charges ware beyond their paying capacity. **Huge investments for establishing pan-India 3G and 4G technology mobile network was the requirement and making the same affordable to consumers across the country was constraint.**

For establishing a pan-India mobile network, mobile towers and equipments are required to be installed in cities, town, villages, remote and hilly areas, across state

and national highways. **Telecom service providers face problems in getting Right of Way (ROW) permission from multiple agencies like Municipalities , Development Authorities, Forest department, State and National Highway Authorities, Railways Authority and village panchayat.** This not only causes delay in according permissions from these multiple agencies for establishing mobile network but discourages the telecom service providers to invest in establishing good quality mobile network in rural, remote, hilly and uncovered areas.

Frequency spectrum to operate mobile service is a key constraint. For High quality mobile telephony and mobile broadband, sufficient frequency spectrum is required. As spectrum is a scarce resource, it gets divided into the number of operators providing mobile services in each License Service Area (LSA). Some big mobile service providers face spectrum shortage to provide good quality mobile service whereas small service providers are having spare spectrum and not able to use their spectrum. **Efficiency of spectrum usage is a constraint.**

To run mobile services, telecom service providers pay license fee and buy spectrum from Government of India. Spectrum is distributed to the TSPs through an auction process. The highest bidder in each License Service Area (LSA) gets the spectrum and other service providers pay the spectrum charges in the LSA equal to highest bidder in auction process. This cost of spectrum is sufficiently large part of the mobile network investment of any mobile service provider. The mobile service providers take loans from the banks , on high interest rates, to pay for spectrum charges and having limitation of funds on investment in equipments for quality network establishment. **Higher Spectrum Usage Charges (SUC) and license fee is a constraint for investment in quality pan-India mobile network establishment.**

5.2.1.3 International Internet Bandwidth (IIB) per internet user in India was 15,956 Bits/second, as per ITU -2017 report, whereas in case of South Korea this figure was 54,252 Bits/second during the same period. It means Indian internet users had restriction at internet speed due to low IIB available. It might have affected various internet dependant activities like e-commerce, e-Governance, e-payments in various parts of the country.

For large IIB, investment in establishing more cable landing stations with regulation and proliferation of competition among existing IIB providers had been the requirement.

5.2.1.4 Percentage of households with computer and households with internet access are two important indicators from ICT access sub-index. Percentage of households with computer , India stand at 15.2 percent , as per ITU -2017 report, whereas for South Korea this figure is 75.3 percent, during the corresponding period.

Regarding percentage of households with internet access , India stand at 22.6 percent , as per ITU -2017 report, whereas for South Korea this figure is 99.2 percent, during the same period.

The low figure suggests that very few Indian households afford to have computer, whereas 3 out of 4 households in South Korea can afford computer. Behind low score for India , two factors contributed ; **low household income levels and high cost of computers**. Similarly Low score on households with internet access in India, suggest low internet accessibility to households. This, too, has two factors responsible ; lack of geographical coverage of internet network and higher usage cost wherever network is available to make **internet availability and affordability** as big constraint for households. Due to low GDP per capita, affordability of computer and high speed internet connection is a big concern for large sections of the Indian population.

India's GDP Per Capita is 2010 US dollar, far below South Korean GDP per Capita of 31,362.8 US dollar (GDP per capita : World Bank Report 2018).

5.2.1.5 Percentage of individuals using internet is indicator of usage sub-index. India stand at figure of 29.5 percent of individuals using internet, as per ITU-2017 report, whereas South Korea is at 92.7 percent, during the same period. Low percentage of individual internet users in India raises the question on availability and affordability of internet to rural, remote and inaccessible areas and lower levels of skills to use internet are the constraints.

5.2.2 **Other constraints**

5.2.2.1 **Power supply constraint**

Availability of electric power supply on 24*7 basis is a constraint to power the active telecom infrastructure like telephone exchanges, Base Transceiver Station (BTS) mobile towers and charging laptop / mobile phones in India especially in rural , remote and hilly areas.

5.2.2.2 **Literacy barriers**

Illiteracy is a big barrier for ICT usage for large sections of the population. About 25 percent of the Indian population do not have the reading and writing skills that is necessary for functioning in everyday life. Adult literacy rate in India , percentage of people ages 15 and above, was 74 percent in 2018 (Adult literacy rate: World Bank Report 2018).

5.2.2.3 **Local content**

Information is an essential tool for the creation of knowledge. However , not enough attention is paid while determining what content is desired by the people who have low income, who live in rural areas, have limited education or belonging to members of racial or ethnic communities. Employment, education health, social and economic

development related information, culturally appropriate information in local languages are not available which act as barriers for internet use by people. People want information on local communities- like job listing including entry level skills, local housing listing , community information on neighbourhood events, local school, day care, after school programs and activities at the level of local council. All in one site that offer games, downloadable information, music , video, tips and training are not readily available. Lack of cultural diversity in the available content becomes a constraint for internet use by the people.

5.2.2.4 **Research and Development in technology**

Research and development in technology is another important area where country specific technology solutions can be made available at affordable prices and bridging the gaps between haves and have-nots. Low level of R&D in the country, make India dependent on technology imports to fulfil its telecommunication needs.

5.3 **Steps to improve India's IDI ranking**

5.3.1 For India to improve its IDI ranking, all infrastructural and others constraints need to be removed as a strategic national objective. To achieve success in removing constraints and facilitate the growth and proliferation of ICT infrastructure in the country, a cohesive approach aligning all stakeholders in synergy is the key. Policies alone can not act as enabler unless and until there exists executions challenges. To overcome the challenges, all stakeholders; Both Centre and state Governments, Telecom service providers, Equipment manufacturers, Research and Development communities and public as users need to come together as an alliance to work in unison for creating a robust world class ICT infrastructure in the country.

5.3.2 Fixed telephone subscriptions and Fixed broadband penetration in the country is low, primarily due to lack of investments in fixed line telecom infrastructure by

public sector undertakings, BSNL and MTNL, and the private telecom service providers. Fixed telephones were used for voice telephony using copper cable by erstwhile Department of Telecom (DOT) and later BSNL on pan-India basis except Mumbai and Delhi where this was responsibility of MTNL. Long period of time required for fixed infrastructure laying and higher cost of fixed line equipments have been deterrents for investments in fixed telephony by private service providers after opening of telecom sector to private players in 1994. Even for BSNL and MTNL to maintain fixed telephony copper cable network required huge manpower so fixed telephony became economically nonviable after proliferation and competition from mobile telephony in the country. However, fixed telephony and fixed broadband , using optical fibre cable (OFC) has become operational in the country by BSNL and MTNL and private operator like Bharti but OFC reach remain confined to metro or few selected commercial cities only. This new OFC based fixed telephony, used for high speed broadband also, faced same problem while laying the OFC network in the cities.

Investments in OFC based fixed telephone and fixed broadband networks is necessary to provide broadband connectivity to household, industries , Government agencies and individuals as it's the most reliable source of voice and broadband connectivity. Considering the long term importance and requirement of broadband, all developed countries like USA, UK, Japan and South Korea have established OFC based robust fixed line infrastructure. Following steps would help growth of fixed line telephony and fixed broadband on OFC in India :

- Right of Way (ROW) permissions to lay OFC cable across roads, streets in the cities and town need to be provided timely without loss of time. For all ROW permissions from multiple agencies like municipality, development authority

etc in a city, a single window concept to be applied throughout the state to bring efficiency and transparency for granting ROW permissions.

- All multi-storey building, especially new construction, in cities and towns have to ensure fibre connectivity from telecom service providers (TSP) or infrastructure providers (IP) on non discriminatory and sharing basis as a Common Telecom Infrastructure (CTI). Provision in National Building Code (NBC) 2016 needs to be enforced for issuing completion certificate to the builders.
- Common service ducts are laid in cities in highly urbanized countries like South Korea, Japan, UK, USA and other developed countries for electricity, gas pipelines , water pipes and telecom infrastructures etc., to avoid frequent digging of roads.

  Common Service Ducts in cities and towns for laying duct once only by a single agency like municipality or development authority, need to be explored to obviate frequent needs for cable laying and ROW permission by telecom service providers. Replication of successful common duct model in all cities and towns, will help build up of low cost ICT infrastructure for making smart cities and low cost internet services to the users. This will also solve maintenance issues.
- Monetary and fiscal incentives to promote establishment of OFC based infrastructure are needed to attract investments from infrastructure providers.

5.3.3 Mobile-cellular telephone subscriptions and active mobile broadband depend on mobile network's geographical connectivity , quality and affordability for the users. Following steps would help growth of quality mobile network and mobile broadband in the country:

- Right of Way (ROW) permission from multiple agencies like Municipalities , Development Authorities, Forest department, State and National Highway Authorities, Railways Authority and village panchayat to be accorded on priority without loss of time for erecting mobile tower network and associated infrastructure.
- Mobile towers erection on Government lands, buildings, schools and hospitals need to be permitted on subsidized or zero rent with preference to give connectivity to these locations.
- All multi-storey residential and commercial buildings, especially new construction, in cities and towns have to ensure mobile tower and in-building solutions (IBS) from telecom service providers (TSP) or infrastructure providers (IP) on non discriminatory and sharing basis as a common telecom infrastructure (CTI). Provision in National Building Code (NBC) 2016 needs to be enforced for issuing completion certificate to the builders.
- Frequency Spectrum is required for mobile-cellular services. A telecom service provider , after obtaining license to establish and operate telecom services, need to have spectrum for services to operate. Government Of India, ,through Department of Telecom, do auctioning of spectrum as per category of each of the 22 license service areas (LSAs) in the country. Highest bidder gets the spectrum and other bidders have to pay spectrum charges equivalent to highest bidder in an LSA. TSPs have to invest huge money in spectrum purchase and left with fewer options to invest in equipment for good coverage and quality. The 2015 spectrum auction in the 800 MHz, 900 MHz, 1800 MHz and 2100 MHz bands, the Government realized a total of Rs 109,874 Crores against the approved reserve price of Rs 80,277 Crores (One

year of Activities and Achievements 2014-15 : Department of Telecommunications).

Telecom service providers , in future, would be facing difficulty in buying 700 MHz, 800 MHz, 900 MHz, 1800 MHz and 3300-3600 MHz bands to be auctioned as 5G bands, if reserve prices are kept high.

Spectrum usage charges (SUC) should be kept reasonably low to help telecom service providers save on expenditure cost on spectrum and invest into expansion of network coverage and quality of service in remote , rural and inaccessible areas. Also, spectrum being scarce resource, efficient use of spectrum need to be made by all telecom service providers by allowing spectrum sharing, trading and harmonisation and deploying technology like software defined cognitive radio in the mobile networks.

- License fee (LF) is charged by Government for issuing a license to a telecom service provider for a particular period, in years, as per license service area for establishment and operation of telecom services. Licence fee is levied annually at 8% of the Adjusted Gross Revenue (AGR) of a company (TSP)., Rs 57,006 Crores was collected by Government of India from telecom service providers as license fee during the last 5 year period 2014-2019. Telecom service providers, having differing view on definition of AGR , are underreporting the AGR figures resulting in loss of license fee to the Government. CAG in its audit report found underreporting in AGR by 6 main TSPs; Idea, Airtel, Vodafone, Reliance, Aircel, Tata for the period 2006-07 to 2009-10. DOT has to issue demand note of Rs 61523.46 Crores for recovery of license fee due to underreporting (Annual report 2018-19 : Department of Telecommunications).

Any reduction in license fee from current 8% of AGR and simplification of AGR guidelines will help TSPs reinvest the saved money in the sector for coverage and quality of the telecom network. Also, it will help reduce litigations in future and develop synergy between government and TSPs to investment in the strategic telecom sector.

5.3.4 International Internet Bandwidth (IIB) per internet user can be made available and affordable to the users by installing more number of cable landing stations and creating competition among them . Currently there are 15 cable landing stations in 5 cities across India, in Mumbai, Chennai, Cochin, Tuticorin and Trivandrum. Along with number of subsea cables, there needs to be a healthy multi-provider play in the market that generates the dynamics of progressive price decline, without the perils of monopoly, duopoly or even oligopoly. Of the 20 subsea cables, 11 subsea cables are landing with and controlled by two providers - Tata Communications and Airtel. While Tata Communications lands 7 subsea cables, Airtel lands 4 . Reliance Jio has control over 3 subsea cables ,Global Cloud Xchange also controls 2 subsea cables, The rest, including Vodafone , Sify and BSNL have control on 1 subsea cable each(Status of cable landing stations in India).

Establishment of more cable landing stations for present and future needs, will bring down prices of IIB through competition and help users get higher broadband speed.

Government also needs to create regulatory framework for installation of cable landing stations and creating competition among them for making IIB available at affordable prices to the users.

5.3.5 Percentage of household with computer and household with internet access, is essential to promote use of internet at the level of households. Family members in a

household are at liberty to use internet on 24*7 basis. Any time during the day , any family member can access internet to use e-commerce, contacting Government agencies, play online games or children doing their home works. In South Korea , Children are encouraged to do home works on internet. Internet access can be provided with OFC and mobile connectivity but computer , laptop or tablet are still beyond the reach of large percentage of population specially in rural areas and urban poor. Following steps will help household to own computer, laptop and tablet:

- Low cost domestic production of computer, laptop, tablet under make in India programme.
- Promoting bundled schemes, Internet plus laptop/tablet, by Internet Service Providers (ISP) .
- Subsidizing the cost of computer, laptop, tablet to economically weaker sections of the society, women, students, physically handicapped persons.
- Credit/ loans from banks , at subsidized interest rates , without any collateral guarantee
- Import duty reduction on computer, laptop, tablet.

5.3.6 Percentage of individuals using internet also depends on the skill of the person who intends to use internet. Large percentage of population not using internet is either due to lack of skills to use internet and/or required content not available in local language. Following steps would help improve internet usage by individuals:

- Free internet training and awareness at community centres, village panchayats and common service centres (CSCs) in villages . For promotion of use of internet in rural areas , CSCs to act as cyber café for rural public free of charge upto certain usage, and on subsidized charges afterwards to make

broadband internet available, affordable and sustainable for public living in rural areas

- Internet training of teachers and students of all government and private schools.
- Free internet training of urban population in schools for housewives, labourers, senior citizens etc after school hours in afternoon/evening.
- Disseminating awareness and importance of internet in daily life through mass media, social media, cable tv. to generate interest for internet among population.
- Content creation, digitalization of all contents like land records, public distribution system , all centre and state government schemes in local languages .

5.3.7 Financial sustainability of running telecom services can be ensured by following steps :

- Long term sustainability of services through CSCs and Internet service providers in rural, remote, hilly and inaccessible areas through funding from Universal Service Obligation Fund (USOF) is the way forward till services in these areas become self sustainable.
- Promotion and use of solar panels as power source to run telecom services on 24*7 basis especially in the rural, remote, hilly and inaccessible areas is needed for operation and sustainability of services.
- Use of separate feeder line from power utility to mobile BTS towers to reduce cost and dependence on engine alternators to run round the clock mobile services in urban areas.

5.3.8 **Future ICT infrastructure proliferation**

- Public Private Partnership and coordination between businesses and research community is another important area for the proliferation and development of ICT infrastructure for the future technologies ; 5G , Internet of Things (IOTs), Big data, Artificial Intelligence necessary for Industrial Revolution (IR) 4.0 , Virtual Reality (VR), Augmented Reality (AR) for 4k Digital video games.
- Strengthening of public sector undertakings ; BSNL, MTNL for pan-India coverage for fixed, mobile telephone and internet services with the deployment of optical fibre and latest mobile technology like 4G and 5G in future. Role of BBNL in rural areas need to be extended to provide fibre and WiFi broadband connectivity to rural households. For equipment manufacturing, Indian Telephone Industries (ITIs) need to be strengthened to act as catalyst for domestic manufacturing of low cost mobile switches, equipments, broadband network equipments ,fibre optic cables, personal computers , laptops and mobile phones. Role of Centre for Development of Telematics (C DOT) , needs to be extended to the coverage of R&D for the entire telecom domain to facilitate development and production of country specific telecom solutions.
- Provision in budget for ICT infrastructure promotion and mass awareness program and research and development need to be made both by central and state governments.
- Use of ICT tools to be promoted like Personal Digital Assistant (PDA) by government staff dealing in public utility services; Bus conductors, Train Ticket Examiners (TTE), Electricity meter readers in Electric supplies and all banks and financial organizations .

- All Government and citizens interaction should be web based to improve delivery of services based on feedback to serve the citizens the way they need to be served.

IDI is very important index and achieving value comparable to developed countries, requires lot of investments in ICT infrastructure, use of innovative technological and sociological tools to create reliable and high quality, both fixed and mobile, commercial and sustainable network for offering relevant services to the population. Besides policies, execution level commitments are required from all stakeholders; Governments, service providers, research communities and citizens etc. to achieve goals in time bound manner.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

Information and Communication Technology (ICT) is an important tool in 21st century, which if applied universally may help mitigate all the inequalities in the world. India with more than 1300 million population stand to gain tremendously with its myriad number of applications in health, education, employment, social welfare, security and all other sectors of economy. The low ICT Development Index (IDI) ranking and value suggest that India need to put huge investment in ICT infrastructure building and promote use for its billion plus population. Availability, affordability and sustainability of fixed, mobile high speed broadband internet services are the key for the success of making India an ICT society. Policy needs to be framed in sync with new and innovative futuristic technologies well in advance so that adaptation and benefits are easily transmitted to the citizens. South Korea is an example before the world and India can take few lessons to improve its IDI ranking.

While providing universal access is a prerequisite, ICT based solutions have to be holistically designed to fulfil the objectives and needs of all users, including students, government officials, specially-abled (divyang) persons, women ,senior citizens , poor both in urban and rural areas. The tools and kits to access internet need to be customized and made affordable and the contents need to be made available in local languages to promote its use by the population. More awareness, for wide acceptance, will have to be created about ICT and its usage among citizens. More usage of ICT by citizens will not only help bring efficiency and increase productivity but also help increase in income , productive use of time and removing inequalities. South Korea took advantage of the fact in making its citizen aware about importance of ICT in

their lives and help making an advanced ICT society in the world, through mass training program like ICT training for 10 million people in late 90s .

Promotion of ICT infrastructure for ubiquitous access is very much modern day requirement and so is it usage for making India a developed ICT society. The IDI value and ranking is just a reflection of the level of development of the country's ICT access infrastructure and level of ICT usage and skills of its citizens. It also reflects the level of technological modernization of the various industrial and social sectors of the country and its society. Higher the IDI value and ranking of a country, higher is the level of ICT adoption in its economy and by its citizens. India's low IDI value and ranking reflect lower level of ICT adoption , in most sectors of the economy and its society. Increasing ICT access and usage not only will increase India's IDI ranking but inbuilt benefits of ICT will bound to reach all sections of society bridging gaps between haves and have nots. In the survey also, respondents underlined the need for establishment of robust ICT access infrastructure and emphasized enhanced use of internet by citizens in their day to day activities. Some very good and practical suggestions have been given by the respondents. We can also learn from policies, programs, promotions and execution practices adopted by high IDI ranking countries especially South Korea. Much of the course would depend on the initiatives taken by governments, both central and state governments, private telecom service providers, NGOs to establish the ICT infrastructure and promote use of ICT.

Recommendations:

ICT access infrastructure:

- In order to increase fixed telephony and fixed broadband, Fibre To The Home (FTTH) and Fibre To The Building (FTTB) in rural and urban areas need to be established as long term ICT infrastructure requirements. This requires promotion of investments in FTTH/FTTB infrastructure from telecom PSUs (BSNL/MTNL/BBNL), private telecom service providers and internet service providers.
- In order to increase mobile telephony and mobile broadband, 3rd Generation (3G) ,4th Generation (4G) and latest 5th Generation (5G) mobile technology deployment for pan-India mobile network connectivity is of utmost need. Investments from PSUs (BSNL/MTNL/BBNL), private telecom service providers needs to be promoted.
- To fill the connectivity gap, broadband network connectivity to remote, hilly and inaccessible areas of the country, especially north eastern states, needs to be provided though satellite at affordable prices.
- Establishment of more number of cable landing stations for provisioning of higher International Internet Bandwidth (IIB) to both the commercial and the retail users is needed. Government needs to create regulatory framework conducive for installation of cable landing stations and competitiveness among them for making IIB available at affordable prices to the users.

ICT usage:

- Provisioning of Computer / laptop/ tablet to households at affordable prices is another big requirement for usage of internet by family members in rural and urban areas. Government policy intervention for low cost domestic production of Computer / laptop/ tablet and import duty reduction on these electronic items, bundled schemes by Internet Service Providers (ISP) may act as catalyst for the proliferation of ICT usage.
- For promoting internet use by people , nation-wide trainings and mass awareness programmes for disseminating internet benefits are needed to be launched specially for teachers, students, government officials, specially-abled (divyang) persons, housewives , senior citizens , prisoners , poor both in urban and rural areas.

  Free "internet training for 100 million people" program may be launched similar to South Korean training program. School infrastructure in evening and private training institutions may supplement this effort.
- For applications to be used widely, delivery of contents need to be in local languages and of user's needs.

Technology facilitation:

- Digitalization of all contents like land records, public distribution system, all centre and state government schemes and availability to users in local languages will help citizens and promote internet use.
- Common Service Centres (CSCs) need to be strengthened to act as one stop shop for provisioning of online Government services (e-Services) and internet training programs in rural areas. For promotion of use of internet in rural

areas, CSCs to act as cyber café or internet community centres for rural public free of charge upto certain usage, say 500 MB, in a month and on subsidized charges afterwards to make broadband internet available, affordable and sustainable for public living in rural areas.

Financial sustainability:

- Long term sustainability of services through CSCs and Internet service providers is another key factors in rural, remote, hilly and inaccessible areas. Sustainability of services through funding from Universal Service Obligation Fund (USOF) is the way forward till services in these areas become self sustainable.
- Use of solar panels as power source to run telecom services on 24*7 basis especially in the rural, remote, hilly and inaccessible areas is needed for operation and sustainability of services.
- Use of separate feeder line from power utility to mobile BTS towers to reduce cost and dependence on engine alternators to run round the clock mobile services in urban areas.

Policy Framework:

- Spectrum usage charges (SUC) for provisioning of mobile and internet services should be reasonably low to help service providers save on expenditure and invest into expansion of network coverage and quality of service in remote , rural , inaccessible and non remunerative areas.
- Spectrum being scarce resource, efficient use of spectrum need to be made by all telecom service providers by allowing spectrum sharing, trading and

harmonisation and deploying technology like software defined cognitive radio in the mobile networks.. Necessary modifications in License conditions need to be made.

- License fee (LF) charges as percentage of Adjusted Gross Revenue (AGR) needs to be reduced. Also, definition of AGR needs to be revisited and reframed suiting to the requirement of the telecom infrastructure development in the country.
- Right of Way (ROW) permissions for laying Optical Fibre Cable (OFC) in urban area, along state and national highways, along railway track need to be facilitated to reduce delay in telecom network laying. There is need to frame common laws both by state and centre Governments and single window facility , for granting ROW permissions to service providers, to help early roll out of telecom networks.
- National Building Code (NBC), for regulating the building construction activities, need amendment to include mandatory provision for Common Telecom Infrastructure (CTI) for high speed broadband with speed 1Gbps and above on Fibre to The Building (FTTB) and Mobile tower , In-Building Solutions (IBS) on non discriminatory and sharing basis. This telecom infrastructure provision needs to be enforced on builders, before issuing completion certificate.
- Common Service Duct construction in cities and towns, need to be explored to obviate frequent need for road digging for OFC infrastructure laying and for ROW permissions by telecom service providers and infrastructure providers. Successful implementation of common service duct model will help build up

of low cost ICT infrastructure for making smart cities and low cost broadband internet services to the users, besides solving the maintenance issues.

- Public Private Partnership and coordination between businesses and research community is another important area for the proliferation and development of ICT infrastructure for the future technologies ; 5G , Internet of Things (IOTs), Big data, Artificial Intelligence necessary for Industrial Revolution (IR) 4.0 , Virtual Reality (VR), Augmented Reality (AR) for 4k Digital video games.
- Strengthening of public sector undertakings ; BSNL, MTNL for pan-India coverage for fixed, mobile telephone and internet services with the deployment of optical fibre and latest mobile technology like 4G and 5G in future. Role of BBNL in rural areas need to be extended to provide fibre and WiFi broadband connectivity to rural households. For equipment manufacturing, Indian Telephone Industries (ITIs) need to be strengthened to act as catalyst for domestic manufacturing of low cost mobile switches equipments, broadband network equipments ,fibre optic cables, personal computers , laptops and mobile phones. Role of Centre for Development of Telematics (C-DOT) , need to be extended to the coverage of R&D for the entire telecom domain to facilitate development and production of country specific telecom solutions.
- Provision in budget for ICT infrastructure development, research and development and mass ICT awareness program need to be made both by central and state Governments.
- Monetary and fiscal incentives to promote establishment of OFC based ICT infrastructure are needed to attract investments from infrastructure providers.

Experience sharing:

- G2C (Government to Citizen) like municipal services, healthcare, law and order, utility bill payment etc., need to be accorded high priority.
- Experience sharing on pan India basis is crucial to replicate successful applications.

Change management:

- Tools like Personal Digital Assistant (PDA) need to be provided to government staff dealing in public utility services; Bus conductors, Train Ticket Examiners (TTE), Electricity meter readers in Electric supplies and all banks and financial organizations.
- All Government and citizens interaction should be web based to improve delivery of services based on feedback to serve the citizens the way they need to be served.

Research and Development:

- Research and Development (R&D) in ICT is the need of the country to keep its industry ahead in global competitiveness and its citizen receptive to change in technology. R&D will not only help develop ICT ecosystem in the country and create new employments but also save foreign exchange outflow due to imports of ICT equipments. R&D on public private partnership model need also be explored to invite and promote new ideas and innovations.
- Innovative technology solutions, suited to India's varied geography and regions, can be developed and deployed like internet through WiFi in public places in urban areas and increasing rural internet connectivity.

APPENDIX-1

Survey Questionnaire

A.

1. Name of the respondent….

2. Gender (Male/ Female)……

3. Age (18-25, 26-40,40-50 & > 50 years)…..

4.Qualification(Graduate, PG, Doctorate, Others) …..

5.Occupation (Govt Service, Private Service, Others) ……

B.

Q.1 : Do you have a fixed telephone connection?

(1) Yes

(2) No

Q.2: Fixed telephone subscriptions per 100 inhabitants in the country is very low as compared to Mobile-cellular telephone subscriptions. It is due to lack of fixed telephone network connectivity.

Do you think Fixed telephone connectivity needs to be promoted, in the country?

(1) Yes

(2) No

(3) Can't say

Q.3: Fibre To The Home (FTTH) is one of the most reliable ways to provide Fixed telephone connectivity, especially Fixed Broadband Internet Connectivity. But it is

relatively expensive and time taking to establish FTTH connectivity as compared to a mobile-cellular connectivity.

Do you think FTTH infrastructure connectivity in Cities/town and villages need to be promoted and incentivized?

(1)Yes, FTTH infrastructure once laid, will cater for all telephone / Broadband needs in future.

(2) Yes selectively, FTTH infrastructure laying in commercially important Cities /Town and upto gram panchayat need be promoted and incentivized.

(3) No,

(4) Can't say

Q.4: Do you agree that Bharat broadband Network Ltd (BBNL), a SPV to connect all gram panchayats on Optical fibre cable (OFC),would help provide broadband connectivity to rural households as well?

(1) Agree to a large extent,

(2) Agree to some extent

(3) Not at all

(4) Can't say

Q.5: Mobile networks connectivity, especially 3G and long-term evolution (LTE/ WiMax), is required for mobile broadband internet. Large sections of population, especially in sub-urban, rural and remote areas , still do not have access to the mobile network.

In your opinion, what could be the bottleneck(s) for expansion of mobile network coverage in the country ?

(1) Mobile Network laying is cost/capital intensive and has long gestation period.

(2) Technology for mobile network is changing every 3-5 years, before service providers start reaping benefits, new technology arrive.

(3) Lack of sufficient R&D for telecom technology development in the country , so dependent on Import of technology which also results in foreign exchange outflow.

(4) Mobile service providers in the country are debt ridden and Non-performing Assests (NPAs) of banks further deter investments in infrastructure in Indian telecom sector.

(5) None of the above

Q.6: Observing the enormous growth potential of data , how to expand the mobile network connectivity in the country to cover every household with internet access ?

(1) facilitating the import of cheaper mobile technologies- 3G/4G or even 5G in future .

(2) Providing spectrum at reasonable rates and incentivizing those service providers rolling outing faster network.

(3) Penalizing the service providers delaying roll out of network.

(4) Incentivizing domestic production of mobile technologies , 3G/4G or even 5G.

(5) Strengthening the Public Sector Units (PSUs), BSNL, MTNL, ITIs, to play key role in establishing mobile networks.

(6) None of the above

Q.7: International Internet Bandwidth(IIB), is key for broadband internet speed at user's end. It is observed that most of the users , irrespective of service providers, face problems in getting broadband speed. Also, IIB in India is far less than the global trends.

Do you think, International Internet Bandwidth needs to be enhanced by establishing more cable landing stations and/or subsidizing access charges ?

(1) Yes, more cable landing stations and subsidizing access charges

(2) Yes, more cable landing stations without subsidizing access charges

(3) No

(4) Can't say

Q.8 : Do you agree that Government should provide computer or tablet or similar handheld computer free of cost or at subsidised cost to every household in the country to promote use of internet in every household ?

(1) Agree to large extent.

(2) Agree to some extent

(3) Disagree

Q.9: What do you think that some specific provisions in policy framework of India required, to promote Internet access and usability ?

Please give your suggestions:

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