GOVERNMENT OF KERALA
KERALA STATE PLANNING BOARD

FOURTEENTH FIVE-YEAR PLAN
(2022-2027)

WORKING GROUP ON
INFORMATION TECHNOLOGY

REPORT

Industry and Infrastructure Division
March 2022

FOREWORD

Kerala is currently the only State in India to formulate and implement Five-Year Plans. The Government of Kerala believes that the planning process is important for promoting economic growth and ensuring social justice in the State. A significant feature of the process of formulation of Plans in the State is its participatory and inclusive nature.

In September 2021, the State Planning Board initiated a programme of consultation and discussion for the formulation of the 14th Five-Year Plan. The State Planning Board constituted 44 Working Groups, with more than 1200 members in order to gain expert opinion on range of social economic issue pertinent to the plan. The members of the Working Groups represented a wide spectrum of society and includes scholars, administrators, social and political activists and other experts. Members of the Working Groups contributed their specialized knowledge in different sectors, best practices in the fields, issues of concern, and future strategies required in these sectors. The Report of each Working Group reflects the collective views of the members of the Group and the content of each Report will contribute to the formulation of the 14th Five-Year Plan. Each Report has been finalized after several rounds of discussions and consultations held between September and December 2021.

This document is the Report of the Working Group on "Information Technology". The Chairperson of the Working Group is Shri. Biswanath Sinha IAS, Additional Chief Secretary to Govt, Electronics and Information Technology Department. The Co-Chairpersons of Working Group were Dr. Saji Gopinath, Vice-Chancellor, Kerala University of Digital Sciences, Innovation and Technology, Sri. John M Thomas, Chief Executive Officer, IT Parks, Kerala, Prof. S M Sameer, Professor, NIT Kozhikode and Shri. Snehil Kumar Singh IAS, Director, IT Mission. Shri. V. Namasivayam, Member of the State Planning Board co-ordinated the activities of the Working Group. Shri. Joy N.R, Chief, Industry & Infrastructure Division was the Convenor of the Working Group and Shri. Tomy Joseph, Deputy Director, Industry & Infrastructure Division was Co-Convenor. The terms of reference of Working Group and its members are in Appendix I of the Report

Member Secretary

PREFACE

Kerala, the Indian State with highest Human Development Index, was one of the forerunners in the development of Electronics and IT industry in the country. The State Public Sector Unit Keltron was a leader in electronics manufacturing in the country during 1980's. The State also established country's first and largest IT space- Technopark- way back in 1990. The State has a vibrant FOSS community and also considered as a leader in e-governance and technology enabled citizen centric service delivery systems.

During the 13th Five-year Plan, State could develop an ecosystem conducive to development of technology startups which made it as the Top Performer State in State Startup Ranking conducted by Government of India during 2018 and 2019. Despite these early strides, the State could not capitalize much on the booming IT and Electronics industry in the country. With State contributing only a very small portion to the IT and Electronics industry today, there is a need to reinvent the sector considering the opportunities that are emerging in these sectors. There is a need for Kerala to push the boundaries further by adopting "digital" means in various walks of life effectively, to regain the leadership role in the emerging world of digital revolution.

As 14th Five-year plan is formulated with a vision of ushering in an inclusive economic growth for the State by applying science, technology and modern skills for sustainable growth of various sectors of the economy, the sunrise sectors of Electronics and IT industry will be playing a crucial role in this transformation. In order to chart out a plan of development of the sector, a Working Group was formed with eminent members from government, academia and industry by Planning Board. This report presents the recommendations of this working group which outlines a comprehensive approach for the development of the sector during the 14th Five Year Plan. The working group consists of 3 subgroups focussing on three specific aspects namely i) Industry investment and capacity building; ii) Information technology start-ups and iii) Communication and Internet infrastructure.

(1) Dr. Saji Gopinath, Vice-Chancellor,
    Kerala University of Digital Sciences,
    Innovation and Technology,
(2) Sri. John M Thomas, CEO, IT Parks, Kerala
(3) Prof. S M Sameer, Professor, NIT Kozhikode
(4) Sri. Snehil Kumar Singh IAS, Director, IT Mission.

Sri. Biswanath Sinha IAS
Additional Chief Secretary
Electronics & I T Department

State Planning Board

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State Planning Board

Abbreviations

BPL	Below Poverty Line
CAGR	Compound Annual Growth Rate
CDAC	Centre for Development of Advanced Computing
COE	Centre of Excellence
CUSAT	Cochin University of Science and Technology
DPIIT	Department for Promotion of Industry and Internal Trade
GDP	Gross Domestic Product
GIS	Global Information System
GOI	Government of India
GOK	Government of Kerala
ICFOSS	International Centre for Free and Open Source Software
IOT	Internet of Things
ISRO	Indian Space Research Organization
IT	Information Technology
KFC	Kerala Financial Corporation
KFON	Kerala Fibre Optic Networks
KKEM	Kerala Knowledge Economic Mission
KSIDC	Kerala State Industrial Development Corporation Limited
KTU	Kerala Technical University
MNC	Multi National Company
MSME	Micro, Small and Medium Enterprises
NEDF	North East Development Fund
PPP	Public Private Participation
SDPK	Skill Delivery Platform Kerala
TBI	Technology Business Incubator
TRAI	Telecom Regulatory Authority of India
USD	US Dollar
UNESCO	United Nations Educational, Scientific and Cultural Organization

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SUMMARY

As Fourteenth Five Year Plan is formulated with a vision of ushering in an inclusive economic growth for the State by applying science, technology and modern skills for sustainable growth of various sectors of the economy, the sunrise sectors of Electronics and IT industry will be playing a crucial role in this transformation. With State contributing only a very small portion to the IT and Electronics industry today, there is a need to reinvent the sector considering the opportunities that are emerging in these sectors. There is a need for Kerala to push the boundaries further by adopting ":digital" means in various walks of life effectively, to regain the leadership role in the emerging world of digital revolution. In order to chart out a plan of development of the sector a working group was formed with eminent members from government, academia and industry. The working group consists of 3 subgroups focusing on three specific aspects namely (1) Industry Investment and capacity building (ii) Information technology startups and (iii) communication and internet infrastructure. The three subcommittees of the working group have worked on specific aspects of development.

Kerala is envisioned as a leading digital destination of the future. A strong innovation ecosystem, IT clusters of product development, availability of electronics manufacturing facilities, creating centres of excellences and innovations, strong R&D linkages between industry and academia, creating seamless digital connectivity throughout the State, creating opportunities by brain gain and attracting the best human talents are essential for the realization of Kerala as the leading digital destination. The reach of capacity building should be, inclusive to the changing needs and nature of the society. The access to cloud computing and product testing infrastructure could be provided at subsidized rates to encourage entrepreneurs, students and innovators to develop various data intelligence innovations. The State could envision setting up specialized fabs that focus on specific domains like sensors memories on displays. Development of carbon neutral IT solutions important aspect in the future society.

Startups are economic entities that leverages on knowledge and innovation to create value resulting in exponential growth within a short period of time. As most of the startups depends on technology to build scalable business models, the conventional factors of production like land, labour, capital are of significant and the intellectual property that drives innovation become the key for their growth. During the State startup Ranking 2019, a few areas of improvement of Kerala has been identified. The committee examined the focus of the startup and unicorns, product maturing and quality of startup products, issues regarding funding and investment, support to startups other than IT product startups, capacity building within government for promotion of startups and women led startups and suggested measures to address these issues.

The committee on communication and internet infrastructure examined the issues and challenges related to Telecommunication and internet. The wired connectivity in terms of Broadband based and Fibre based connections have increased in the urban areas . The

rules pertaining to clearances and permissions need to be made completely online and there should be a time limit to the possible approval on rejection of the application. The use of 5G is still under testing and can open doors for development of new technologies and use cases for changing the lives of the citizens. The Tribal colonies and all remote communities in the State need to be provided internet connectivity. The committee also suggests that the BPL families in each of the villages should be provided internet connectivity.

CHAPTER I
INTRODUCTION

Information Technology continues to be a sunrise sector for India. Contributing almost 10% of GDP, the sector was witnessing a CAGR of 8% employing close to 4.4 Mn people. The Indian IT-BPM sector is the world leader with around 55% of global share and Indian companies have established more than 1000 global delivery centers in 80+ countries. It is expected that the growth in IT sector to continue further as the world is rapidly undergoing a digital transformation to meet the challenges of restricted mobility posed by the pandemic. Several studies have indicated that Indian IT sector may grow to around USD 350Bn by 2025 from the current level of USD 191 Bn (2019-20), making it one of the fastest growing sector of the economy

Even though Kerala has the right ingredients for the growth of IT industry, its performance lags when compared to the neighbouring states like Karnataka, Tamil Nadu and Telengana. Kerala has an IT service export of around Rs 25,000 Cr and employs around 150,000 people. Even though the IT work force in Kerala accounts only for around 3% of total workforce, the people from Kerala accounts close to 15% of human resources in IT industry, as a large number of IT professionals from Kerala works in the major IT hubs in the country like Bangalore, Hyderabad and NCR.

Similar trend is visible in the hardware side of digital industry also. India is estimated to have a market of around USD 350+ Bn in electronics by 2025, growing more substantially from the current level of USD 75 Bn. The imports which accounts for around 50% of current market is also expected to reduce to 30% by that time due to aggressive policy push on electronics manufacturing for increasing self-reliance. Electronics industry currently contributes to 3.3% of GDP and is growing at a CAGR of 14%, making it a key growth driver for the economy. Even though Kerala was an early mover in electronics industry with the establishment of the benchmark public sector undertaking M/s Keltron in late 70's, which crafted a unique de-centralised model of development, the state could not kept in pace with the fast development in the sector during 1990's and 2000's. With the presence of national agencies like ISRO, CDAC etc. and with emergence of demand in sectors like space, electric mobility etc., there is a huge potential for development of electronics industry from the state in the near future.

India today boasts of having the third largest startup system in the world. Rapid growth of startups both in number and valuation is visible across various states in India and the latest report of Niti Ayog places Kerala as one among the 6 fastest growing startup locations in the country. The 100th Unicorn of the country was borne out of Kerala and thanks to favourable policy measures, several start-ups from the State are currently at high growth trajectory. As startups play a key role in development of Electronics and It sector in the country, the State's focus on supporting fast growing startups through multiple policy interventions will be significant in creating a vibrant inclusive startup ecosystem.

Communication technologies are undergoing rapid transformation in the recent years.

The migration from 3G to 4G technologies have made significant improvement in the mobile connectivity and brought in significant speed in high volume data transfer. As a State Kerala is one of the regions with highest mobile penetration. Through the ambitious KFON project, Kerala is becoming is the State with highest coverage of high speed fiber connectivity. As country is advancing into the new regime of 5G communication technology, these infrastructure can be leveraged to make Kerala as the State with highest availability of 5G networks. Realsing this, Government of Kerala in the budget of 2022 has announced several measures to drive Kerala into leadership position in 5G. It is expected that through proactive measures and policies, the 14th Five year plan can focus on realising this goal of making Kerala as a hub of development of industries and startups that leverage on 5G technologies

The IT and electronics sector are undergoing significant changes all around the world. With the emergence of fourth industrial revolution characterized by convergence of digital, physical and biological world, the world is witnessing a digital revolution driven by host of new technologies like Artificial Intelligence, Data Analytics, Blockchains, quantum computing etc. The key aspect of emergence of these digital technologies is their ubiquitous nature and the pervasive impact they have on multiple sectors of the economy. These technologies, if used properly can make radical positive transformation on the society, addressing several hitherto unaddressed problems hampering the human development. These technologies can play a vital role in attaining the Sustainable Development Goals and as a State having highest Human Development Index, Kerala could be the forerunner of adoption of digital technologies for societal good.

From the above discussions, it is clear that adoption of a comprehensive digital strategy will be highly beneficial for Kerala in its next stage of development and growth. Realizing this, the working group on IT and Electronics put forth two broad recommendations. On the one hand the State has to harness the burgeoning opportunities in both IT and electronic sector both in terms of production, entrepreneurship and employment while on the other hand, State should adopt the technologies in various sectors of the economy to bring in a more equitable inclusive growth. This will hasten the State's stride towards evolving as a true knowledge society, which as UNESCO (2005) defined is an equitable and democratic society where creation and dissemination of knowledge shall be used for human wellbeing.

The three sub committees of the Working group has worked on specific aspects of this development. These are outlined in the Chapter 3,4 and 5.

CHAPTER 2
REVIEW OF INFORMATION TECHNOLOGY
SECTOR DURING 13TH PLAN

Information and Communication Technology sector has been playing an important role in the development of the State, since the 9th Five Year Plan. Realising its potential and critical importance, the State Government has made earnest efforts to create a sound and world class infrastructure for the sector and to develop the State's digital technology capacities and resources. This has enabled the State to be at the forefront in implementing information and communication technology projects, e-governance initiatives, e-literacy programmes and in the creation of basic IT infrastructure facilities.

Approach for 13th Five Year Plan

- *Employment Creation:* - Creation of more employment opportunities through generating one lakh jobs during XIII Plan.
- *Human Resources:* - Making available trained human resources through ensuring skill development activities in all educational institutions.
- *Startups:* - Development of an eco-system for startups through the promotion of constant innovation through new startups and thereby developing new products and services.
- *Development Missions:* - Enabling IT for the management and monitoring of the activities of the 4 Missions of the Government.
- *Public access:* - Public access to high speed digital services by providing Wi-Fi hotspots.
- *Data Platform:* - Integration of wide variety of data of Government departments, agencies and institutions on a single platform.

Vision

The vision of the sector is to establish Kerala as a knowledge-powered digital society by 2020 through application of digital technologies within the governing principles of freedom, inclusion, transparency, safety, and security.

Goals
Kerala State IT Mission.

1. Enable a harmonised, interoperable, interconnected, and integrated government.
2. World class infrastructure, integrated e-service architecture, digital citizenship.

IT parks. Establish Kerala as a preferred IT hub for emerging technologies

Kerala Startup Mission

1. To be a leading knowledge start-up ecosystem in India.
2. Creating a sustainable and inclusive ecosystem for developing knowledge based start-ups through multiple interventions.

IIITM-K.
1. To be an iconic knowledge institution focusing on emerging technologies.
2. To develop as a sustainable institution with national repute and global recognition.

ICFOSS. Leverage FOSS for enhancement of quality of life of the people through development of inclusive and assistive technologies.

KSITIL. Transform KSITIL into a top-class agency for development of physical and electronic Infrastructure required for IT sector.

Hardware Mission. Act as a single point of contact for international connects and enable growth of electronics and hardware industry in the State.

New initiatives of 13th Plan
- Skill Delivery Platform Kerala. Skill Delivery Platform Kerala is one of the major initiatives taken up in the 13th Plan help the engineering colleges in the State to improve the employability skills. This platform links engineering colleges in the State with IT parks via tele- presence network connecting 150 hi-tech classrooms to deliver skills training to approximately 50,000 students in a year.
- Kerala Fibre Optic Network (K-FON) is a State-wide optical fibre network for providing high-speed internet connectivity to about 30,000 Government and educational institutions (Track 1) and offer free internet to 20 lakh economically backward families and internet services at a lower rate for others (Track 2). Government has accorded Administrative Sanction for the implementation of K-FON project for an estimated cost of ₹1,028.20 crore. Later, revised Administrative Sanction was issued for an estimated cost of ₹1,548.08 crore. It has been decided to implement Track 1 with KIIFB assistance. A new joint venture company (KFON Limited) was formed in the share holding pattern of 49:49:2 in favour of KSEBL, KSITIL and GoK respectively as the SPV for the project. First phase of the project was launched done on February 18, 2021. The project is scheduled to be completed by April 30, 2022.
- Digital University. On January18,2020,the Government of Kerala upgraded IIITM-K to make the Kerala University of Digital Sciences, Innovation and Technology. The University started functioning from the new campus of IIITM-K in Technocity and the new building was inaugurated in February 2021.

IT Policy 2017
The IT policy announced by the government in 2017 aims to generate projects which will mould Kerala into knowledge based society. The main objective of the policy is to establish Kerala as a leading IT destination and generate direct and indirect employment opportunities in the sector, build necessary technological infrastructure for creation of an environment favourable to ICT development, enhance the necessary human capital required to both produce and use innovative technologies through education and skill building and establish Kerala as an IT industry destination by attracting investments from within and outside Kerala. The policy aims to:

- Establish Kerala as a preferred IT and ITeS hub and leverage ICT to contribute significantly to GDP and employment.

- Create schemes to attract the global IT players to the parks.
- Create 1 crore sq. feet built up space and provide 2.5 lakh employment.
- Utilize the capabilities of corporative and the capital from NRIs to develop the parks
- Maintain a steady annual growth of exports in IT and ITeS service and products.
- Create a science and technology driven eco system for research and development and innovation.
- Increase the quality and competitiveness of small and medium IT enterprise and connect them to the international market.
- Foster technology entrepreneurship culture and create a sustainable start up ecosystem by creating technology hubs.
- Provide inclusive, affordable and accessible electronic service delivery system for public services.
- Ensure universal open access to data, information and knowledge resources in a digital domain.
- Make the State 100 per cent e-literate and utilize ICT in all walks of life to ensure equitable and inclusive development of the society.
- Give special emphasis to promote research and development in Malayalam language computing and develop tools for the same.
- Develop a talent pool within the State in skills for sunrise industries and human resources capabilities for emerging and futuristic technologies.
- Make IIITM-K and ICFOSS as centres of excellence for research and development and studies in IT sector.
- Strengthen IT @ school.
- Create a safe framework for digital living in terms of cyber security, privacy and freedom of internet conduct training and awareness programmes and promote electronic transactions.
- Leverage IT in the day to day operations and in the delivery of services in hospitals.
- Adopt open source and open technologies in public domain and promote the same in SMEs and industry.
- Manufacturing of electronics goods/components will be made possible among all including house wives.
- Strengthen the operation of Kenton so as to regain the prominence it had in the past.
- Research and development institutions shall be established in the area of convergence of IT and bio technology and technologies shall be utilized to improve the quality of exports in fruits and vegetables, fish and spices from Kerala.
- Create an infrastructure to enable women to work in the IT sector ensuring them safe transportation and secure environment at the work place.

Impact of Covid-19 on IT sector

The impact of Covid-19 on the IT sector and the response measures by the sector to the pandemic has been very significant. Due to unprecedented spread of Covid-19 pandemic, daily business operations, project deliveries, and revenue streams of majority of the IT companies have been affected. The companies have opted for Work From Home for all

the employees from the end of March 2020 because of lockdown and containment zone restrictions. The past one and a half years has been critical for most of the business units as they had a challenge of setting up hardware and software systems.

The revenue losses incurred by the firms are mainly because of losses arising from existing projects put on hold, existing projects being cancelled and project in pipeline being cancelled, Internet connectivity, followed by power disruptions, security threads, and hardware issues are the major issues in 'Work From Home' mode. There were issues related to clients meetings and client visits getting cancelled.

Performance of IT Sector in Kerala

- According to the ICUBE 2020 report Kerala's internet penetration is third in the country (59%). Maharashtra (61%) ,Goa (60%) is number one and two
- Kerala is the first State to make Internet Access a Basic Right. Kerala Fibre Optic Network (K-FON) project was initiated by Government of Kerala for providing free internet connectivity to 20 lakhs economically backward households.
- The E district Kerala, a lighthouse project in India, has touched the 4 crore mark with respect to issuing various certificates to the citizens through Akshya Centres.
- The revamped Kerala Spatial Data Infrastructure Portal was launched in 2017 by the Hon'ble Chief Secretary. Kerala become the first State in the country to start Geo Tagging of Government Offices. KSDI has more than 300 beneficiaries including users from 39 Government Departments.
- Public Wi-Fi project established 2,000 Wi-Fi hotspots across the State to provide free internet to the people. The hotspots locations have been identified by the district administration, it includes bus stands, tourist places, parks, public places, janasevanakendras, and government offices. In addition Public Wi Fi facility has also been made available in 222 fishing villages along the Kerala coast.
- About 190 lakh sq.ft built up space, ₹4,982.1 crore investment, ₹20,623.6 crore turnover and 1,00,558 employment created through 825 companies operating in the three IT Parks.
- 2,692 Akshaya Centres are functioning across the State giving employment to 7,816 persons.
- Under the banner of Kerala Start Up Mission and several of its sector-specific partner organisations, there are presently more than 2,200 registered start-ups, more than 4 lakh square feet of incubation space and more than 230 Innovation and Entrepreneurship Development Cells.
- Kerala ranked as the top performing State in Department for promotion of Industry and Internal Trade's (DPIIT's) State Startup ranking.
- Availability of Resources for Startups is more than ₹1,000 crore through Fund of Fund Scheme.
- IIITM-K established 10 Research Centres, 65 Research papers published in National/ International Journals.
- Completed ten GIS based web application/portal projects for various Departments and six other projects are under development stage.

- Three Android based GIS mobile applications has been developed and deployed.
- Conducted various GIS based workshops for Government Departments, Schools, Universities and Colleges in addition to provisioning of internship facility for students.

Table 1 Financial Performance of IT sector from 2017-18 to 2021-22

13th Plan - Agency wise Plan Outlay and Expenditure in IT Sector   Rs in Crore

Sl. No Agency		Annual Plan 2017-18		Annual Plan 2018-19		Annual Plan 2019-20		Annual Plan 2020-21		Annual Plan 2021-22	
		Outlay	Exp.	Outlay	Exp.	Outlay	Exp.	Outlay	Exp.	Outlay	Exp.
1	Kerala State IT Mission	147.48	43.33	147.48	105.86	144.14	65.85	124.14	87.43	125.13	91.17
2	Technopark	84	67.65	84	23.46	84	.50	2	1.75	24.05	21.00
3	Infopark	67.05	66.01	67.05	37.01	67.05	20.00	10	6.00	35.55	34.55
4	Cyberpark	25.69	33.07	25.69	5.81	22.69	0.58	0.01	0	12.37	0
5	Digital University	-	-	-	-	-	-	-	-	24	14
6	IIITMK	52	52	65.5	6.98	15.5	7.75	64.2	64.19	20	20
7	Kerala Startup Mission	79.99	31	80	44.2	80	44.68	73.5	52.19	68.75	55.77
8	Kerala State IT Infrastructure Limited (KSITIL)	55.6	20.3	52.37	25	148	48.12	212.75	102.29	201.90	87.50
9	IIITK. Kottayam	22.5	22.5	24.5	6.25	_	_	_	_	_	_
10	C-Dit	10	5	6	6	7	0	6	6.44	6	4.60
11	ICFOSS	5	5	5	7.5	6	5	7.5	4.75	7.5	6.00
12	Hardware Mission	_	_	30	10.19	_	_	_	_	24	14
Total		549.31	345.86	587.59	278.26	574.38	199.15	500.1	325.04	525.25	334.59

Source: Plan Space and Accounts

Performance of IT sector Agencies

The agencies involved in the implementation and promotion of Information Technology in the State are Kerala State Information Technology Mission (KSITM), Indian Institute of Information Technology and Management–Kerala (IIITM–K), International Centre for Free and Open Source Software (ICFOSS), Technopark, Infopark, Cyberpark, Kerala State Information Technology Infrastructures Limited (KSITIL), Kerala Start Up Mission (KSUM), Indian Institute of Information Technology and Management- Kerala(IIITM-K) and Centre for Development of Imaging Technology(C-DIT).

1.Kerala State Information Technology Mission (KSITM)

Kerala State IT Mission is an autonomous nodal IT implementation agency of the Department of Information Technology, Government of Kerala which provides managerial and technical support to various initiatives of the Department. KSITM performs diverse roles including enactment of ICT related policies, development of guidelines and standards for e-governance, ICT facilitation for the Government entities, provide end to end support and guidance to State Departments in digitisation efforts, act as a bridge between

Government and industry, undertake Capacity Building initiatives and bridge the digital divide, establish and sustain common IT Infrastructure, and take up various e-Governance initiatives. The main activity is delivering the best of the digital services to the citizens keeping in mind "Citizen First" approach. As a result of these proactive policies and projects, Kerala achieved major progress in the transformational journey towards "Digital State".

Some of the remarkable achievements are shown below.
- Kerala declared as the 1st digital State in the country by GoI in 2016
- Hi-Speed Rural Broadband Network was first commissioned in India at Idukki
- First State in the country to issue over 4 crore e-Certificates.
- 100 per cent of the Grama Panchayats are connected through optical fibre network

Key activities of KSITM
Kerala has been a forerunner in e-governance and mobile governance by promoting and developing core infrastructure and e-literacy programmes.

- **K-Fi/Public Wi-Fi:** K-Fi is a free Wi-Fi project that aims to establish 2,000 Wi-Fi hotspots across the State to provide free internet to the people. The hotspots locations have been identified by the district administration which includes bus stands, tourist places, parks, public places, janasevanakendras and government offices. In addition Public WI FI facility has also been made available in 222 fishing villages along the Kerala coast.
- **E-Office** aims to conduct office procedures electronically thereby transforming Government offices to paperless offices and bringing out the benefits of digital communication that ultimately leads to faster decision making. E-office has been implemented in all departments in Secretariat, 66 Directorates/Commissionerate/other Government offices, all Collectorates, 17 Sub-Collectorates/RDOs. The Government has decided to roll out e-office up to grassroot level in Taluks and Village Offices in coming years.
- **Core infrastructure** for e-governance in the State consists of Kerala State Wide Area Network (KSWAN), Secretariat wide Area Network (SECWAN), State Data Centre and State Service Delivery Gate way (SSDG). KSWAN is the backbone of the State Information Infrastructure (SII), connecting all districts, 152 Blocks Panchayats, and 63 Mini Civil Stations/ revenue towers across the State. Around 4,000 offices of Government Departments are connected to KSWAN through Wireless and a larger number through leased lines and LAN. KSWAN aims to establish a state-of-the-art Optical Fibre Connection (OFC) based network architecture in the Government Secretariat with a vision to improve the quality and availability of ITeS at its administrative headquarters. State Data Centres (SDCs) are at the heart of e-governance framework of the State, hosting various applications and websites of the Government entities and provisioning associated services.
- **e-District**, a State Mission Mode project under National e-Governance Plan, targets delivery of high volume citizen services provided by the district administration, at Taluk or Village level, through back-end computerisation to enable online availability of these services through Common Service Centres (CSC) and State portal. Some of the

major services availed through e-district project are:

- Implemented 25 Revenue Certificate Services across the State
- RTI and Public Grievance Services
- Online utility bill payment systems enabled in e-District portal
- Various services of other Departments are also online/getting integrated with the e-District Portal

- **M-Keralam**, the unified mobile application which will bring together all the services rendered by different Government Departments under one umbrella. Currently, the app is providing 101 services of 18 Departments of the State.
- e-Government Procurement (e-GP) is being implemented in the State, 54 Government Departments and 335 PSUs/Autonomous Bodies/Government agencies are utilising the common e-Procurement system.
- **Friends Janaseva Kendras** have been established in all the 14 district headquarters. In 2018-19, an amount of ₹148.1 crores revenue for the Government was collected. The Government is also planning to make all services currently available through Akshaya also to be made available to Friends without service charges. It is a single window 'no queue' integrated remittance centre, where the citizens have the opportunity to pay all taxes and other dues to the Government, under one roof, at no extra cost. On an average, 1,000-1,050 people visit each centre every day. A new software with enhanced features for FREES (FRIENDS Re-engineered Enterprise Enabled System), was developed and introduced in FRIENDS Janasevana Kendram.
- **Akshaya** is an innovative project launched on November 18, 2002 to bridge the digital divide. It works on public private participation mode. In the initial stages, the objective of the project was to make at least one person in a family e-literate. Gradually focus of Akshaya shifted to citizen service centric mode.
- 2,692 Akshaya Centres are functioning across the State giving employment to 7,816 persons.
- More than 1,700 Akshaya Centre act as banking Kiosks for different banks.
- 5.5 million citizens got enrolled under UID through Akshaya Centers.
- Enrolment under UID through Akshaya is 92.7 per cent against the national average of 62 per cent. Akshaya is also a premier agency in UID enrolment having generated 75 per cent of total UIDs in Kerala.

Table 2 The details of Akshaya centres in Kerala

Year	No of Akshaya Centres (nos)	No of person employed (nos)	Turnover (Rs crore)
2016	2628	7476	46.1
2017	2679	7774	65.3
2018	2906	7942	73.6
2019	2716	7577	43.4
2020	2692	7816	41.9

- **Kerala State Spatial Data Infrastructure (KSDI)** is a mechanism to provide geo-spatial data sharing at all levels of Government, the commercial sector, the non-profit sector, and academia.

The major achievements of the project are as follows.
- KSDI Geo Portal is upgraded using Erdas Apollo 2016 webserver with new features
- KSDI collected data from 20 departments with more than 400 layers in various file formats and after quality checking, uploaded 59 seamless layers.
- Presently, KSDI has more than 300 beneficiaries including users from 39 Government Departments.

Government of Kerala was assigned as the State registrar for Aadhaar enrolment by UIDAI. Electronics and IT Department of Kerala was approved as the nodal Department and KSITM was approved as the nodal agency for Aadhaar enrolment in the State. In addition, UIDAI has approved KSITM as the Authentication User Agency and e-KYC User Agency. Aadhaar based services like Digilocker are also being rolled out to departments. At present, there are about 900 Permanent Enrolment Centres, 500 Child Enrolment Centres and 1,450 Update Centres by Akshaya CSCs to facilitate Aadhaar Enrolment and changes to details in Aadhaar.

A State Level Workshop on **DigiLocker** was conducted by Kerala State IT Mission with the support of National e-Governance Divison, (NeGD) of Ministry of Electronics and Information Technology MeitY for "**Achieving Paperless Governance and Rapid Implementation of DigiLocker".**

2. Indian Institute of Information Technology and Management - Kerala (IIITM-K)
The Indian Institute of Information Technology and Management – Kerala was set up in 2000 as a premier institution of excellence in Science, Technology and Management. It emphasises quality education to students and develops professionals and leaders of high calibre imbued with values of entrepreneurship, ethics and social responsibility. The institute focuses on education, research, development and training in basic and applied information technology and management.

IIITM-K is the implementing agency for the various e-governance initiatives for Govt of Kerala and Govt. of India. It co-ordinates national and international conferences and workshops to provide opportunity to students to interact with world class experts and researchers.

There are four specialised Post Graduate Programmes (M.Sc.) being offered by the Institute in Computer Science with specialisation in Cyber Security, Machine Intelligence, Data Analytics, and Geospatial Analytics. Along with the above four specialised courses, the Institute also offers M.Phil Ecological Informatics, M.Phil Computer Science, and PG Diploma in E-Governance. The M.Phil and MSc degree are awarded by Cochin University of Science and Technology (CUSAT) and post graduate diploma by Directorate of Technical Education, GoK. The Pass outs from IIITM-K hold commendable positions in internationally reputed IT companies such as JFWTC General Electric, Accenture, Amdocs, Siemens

Ernst and Young, ARS Software, Allianz Cornhill, IBM, IBS, Infosys, Tata Elxsi, Tata Consultancy Services, UST Global Technology, and Wipro.

The new campus of the Institute at Technocity is in completion phase and shall facilitate and promote studies, research and incubation in Information Technology and its application domains. The fully completed campus would have total built up area of 48,161 sq metre. 95 per cent of works in Academic block and hostel building are completed. It is expected that the functioning of IIITM-K will shift from Technopark to new campus in 2020.

3. Digital University

On 18.01.2022, the Government of Kerala upgraded IIITM-K to make the Kerala University of Digital Sciences, Innovation and Technology. The University started functioning from the new campus of IIITM-K in Technocity and the new building was inaugurated in February2021.The University is envisaged to become a unique centre of excellence of global repute by conducting education, research and extension activities in areas of digital technologies, science and humanities. The University is aiming to create capacity building in masters and doctorate programmes in the areas of artificial intelligence and natural language processing, internet of things, electronic systems and automation, imaging technologies, data analytics and big data, cyber security, block chain, ecological informatics and geo spatial analytics. The University will start schools in the areas of computer science and engineering, digital sciences, electronics systems and automation, informatics, digital humanities and liberal arts. The new University will initially create about 200 job opportunities in academic and research level.

4.Technopark

Technopark was set up as an autonomous organisation fully owned by Government of Kerala to create global standard infrastructure and to provide support required for development of information technology industries. It was formally inaugurated on November 18, 1995. Since then Technopark has been growing steadily both in size and employees strength.

With the commissioning of Phase III, Technopark will become the largest IT Park in India with 380 acres of land and 9.7million sq.ft built up area. The Park is now home to nearly 460 companies, employing more than 63,000 IT/ITeS professionals.

With the launch of Technocity project in Kazhakuttam, the largest integrated IT Township in 424 acres of land, the Kazhakuttam- Kovalam (NH 66) has become the first IT Corridor in Kerala. Technopark has charted out an ambitious target of creating 50,000 new jobs by 2021.

Table 3 Physical achievements of Technopark

Particulars	Achievements 2017-18	Achievements 2018-19	Achievements 2019-20	Achievements 2020-21
Total turnover (₹crore.)	14,000	14,000	15,000	15,000
Total export (₹crore)	6,450	7,000	7,350	#
Total investment (₹crore)	4,970	4,979	4,979	5,309

Total Employment (Nos)	56,000	60,000	62,000	63,000
No of Companies (Nos)	400	410	450	460
Total land (Acres)	662.54	662.54	662.54	662.54
Total built up space (Lakh sq.ft).	89	97	101	103

Source: Technopark
Note: # Audited data yet to receive.

Technopark currently owns 20 IT buildings within the campus. The built up space in the Technopark has increased from 88.81 lakh sq feet in 2017-18 to 102.7 lakh sq. ft in 2020-21. Out of which Technopark has created 34.81 lakh sq.ft area for industrial modules and total built up space completed by companies is 75.7 lakh sq.ft.

5 .Infopark

Infopark, Kochi is the second largest IT hub in Kerala with spokes at Cherthala and Thrissur. The objective of Infopark is creation of state-of-the-art infrastructure facilities such as space for IT/ITeS companies, supply of power, water and connectivity. Since its inception in 2004, Infopark and its co-developers created over 9 million sq.ft. built up space and have provided employment to over 53,000 IT Professionals through 420 IT companies who have taken space in its Parks.

Infopark has 5 campuses which is spread over 323 acres under various phases of development. In case of Infopark TBC, a built up partly fitted space of 25,845 sq.ft at Kaloor International Stadium was taken over from KSITM in the year 2013. Infopark undertook necessary balance fit outs, modifications/rectifications in the fitted out space and now the facility is mainly used for providing office space for startup companies.

Table 4 Physical achievements of Infopark

Particulars	Achievements 2018-19	Achievements 2019-20	Achievements 2020-21
Total turnover (₹crore.)	4,500	5,200	5,700
Total Employment (Nos)	40,000	47,000	53,000
No of Companies (Nos)	392	427	420
Total land (Acres)	323	323	323
Total built up space (Million sq.ft).	9.0	10.2	10.2

Source: Infopark

6.Cyberpark

Cyberpark was established on the lines of Technopark in Trivandrum and Infopark in Kochi based on a hub and spoke model. It was set up to bridge the IT infrastructure gap along the west coast starting from Kochi to Kasaragod. The objective of Cyberpark is to provide cost effective and top of the line infrastructure to the IT/ITeS investors and thereby encourage, promote and boost the export of software/software services and to create employment

opportunities in Malabar region. It is the responsibility of Cyberpark to interface between Government and Industry interact with potential investors, strengthening the IT/ ITes base, holding promotional campaigns, develop human resources for IT and ITeS. Kerla State IT Infrastructure Limited (KSITIL) holds the ownership of the entire area of 43 acres of land at Kozhikode Cyberpark.

Major achievements of Cyber Park are:-

*   3 lakh sq.ft built up space with 62 percentage occupancy. Currently 52 companies are operational in SEZ.
*   Earmarked a built up space of 12,391 sq.ft for non- SEZ IT operations. Half of the space is currently allocated to startup companies working under KSUM.
*   Created around 917 direct employment.
*   Export revenue have been reported to be in the tune of ₹26.17 crores.

Table 5 Major Physical achievements of Cyberpark

Particulars	Achievements 2018-19	Achievements 2019-20	Achievements 2020-21	Achievements 2021-22 (Up to Sep 2021)
Total turnover (₹crore.)	8.14	14.75	26.16	14.09
Total export (₹crore)	8.14	14.75	26.16	14.09
Total investment (₹crore)	0.74	1.35	2.47	1.93
Total Employment (Nos)	487	607	764	917
No of Companies (Nos)	23	46	52	52
Total land (Acres)	43	43	43	43
Total built up space (lakh sq.ft).	3.0	3.0	3.0	3.0

Source: Cyberpark

7. Kerala State IT Infrastructure Ltd (KSITIL)

KSITIL is a public limited company formed for the creation of the infrastructure for IT/ ITeS in the State. The company leverages the valuable land assets owned by the Government and through viable financial models, generates funds for building the IT Infrastructure in the State in a Private Public Participation model.

The business model of the company is to acquire land and develop basic infrastructure facilities such as electricity, water, road, and compound wall in the area, obtain SEZ status and other such Government approvals that may be required and then allot land to private developers for development of either IT SEZ or IT parks.

Major projects of KSITIL are Kozhikode IT Park, Kannur IT Park, Kasaragod IT Park, Kollam IT Park, Koratty IT Park, Cherthala IT Park, Ambalapuzha IT Park, Infocity Pala, IIIT-Kerala and Technolodges.

Some of the major projects of KSITIL are as follows:

1. **Skill Delivery Project, Kerala:** SDPK is a prestigious project assigned to KSITIL by

Government of Kerala. The objective of the project is to bridge the gap between students and industry. SDPK consists of a virtual platform with teleconferencing system being installed in all the 150 engineering colleges and 3 studios, which are being setup as part of the project. System Integration works in 74 class rooms across Kerala and 3 studios in Technopark, Infopark and NIT Calicut has been completed.

2. **Kerala Fibre Optic Network (K-FON)**: K-FON is a State-wide optical fibre network for providing high-speed internet connectivity to about 30,000 Government and educational institutions (Track 1) and offer free internet to 20 lakh economically backward families and internet services at a lower rate for others (Track 2). Government has accorded Administrative Sanction for the implementation of K-FON project for an estimated cost of ₹1,028.20 crore. Later, revised Administrative Sanction was issued for an estimated cost of ₹1,548.08 crore. It has been decided to implement Track 1 with KIIFB assistance. A new joint venture company (KFON Limited) was formed in the share holding pattern of 49:49:2 in favour of KSEBL, KSITIL, and GoK respectively as the SPV for the project. First phase of the project was launched on February 18, 2021. The project is scheduled to be completed by April 30, 2022.

3. **Construction of IT building at Technocity:** As part of development of Technocity, GoK decided to construct the first IT building at Technocity with a built up area of 2 lakh square feet. For this, KSITIL is assigned as SPV and the funding agency is KIIFB. The total project cost is ₹105 crore. 85 percent of physical works has been completed.

4. **Building 1 at Technology Innovation Zone, Kalamassery:** As part of startup ecosystem creation in Kerala, the Government of Kerala has announced the construction of 3.4 lakh square feet building at Kochi Innovation Zone. Accordingly, Government has accorded Administrative Sanction for ₹215.26 crore with financial assistance from KIIFB. KSITIL is designated as the SPV for the execution of the project. The works includes construction of three buildings and associated supporting infrastructure works. 35 percent of physical works has been completed

5. **Village Knowledge Centres works at Dharmadam LAC and Thalipparambu LAC**: KSITIL was engaged as the implementing agency for the construction of Village Knowledge Centres at Kannur. Total estimated cost was ₹5.61 crore. NABARD has sanctioned a loan of ₹5.33 crore. The work involves the construction of Village Knowledge Centre buildings using Glass Fibre Reinforced Concreate (GFRC) panel in 15 panchayat locations. 70 percent of physical work have been completed for Village Knowledge Centres at Dharmadom LAC and 55 percentage of physical works completed for Village Knowledge Centres at Thaliparambu LAC.

6. **Space Park:** Kerala Space Park is one of the ambitious initiatives of the Government of Kerala to make Kerala a production hub for aerospace products and services. Government of Kerala appointed KSITIL as the nodal agency of the project. KSITIL has prepared DPR and submitted to Government for approval. The plan focuses mainly to establish aerospace industrial units within the allotted 20 acres of land.

8 .International Centre for Free and Open Source Software (ICFOSS)
Government of Kerala established ICFOSS as an international centre in collaboration with

Free Software Organisations in India and abroad to promote development and application of free software and free knowledge. It is a nodal agency in all matters relating to free and open source software including consultancy, research and development, academics, studies and service, training, publishing, certification, and international co-operation and collaboration. ICFOSS has carried out so many FOSS-based Training programmes, Workshops, Seminars, Research Programmes, Projects, Malayalam Computing activities, Student Internships and projects, Summer Camps, Faculty Development Programmes, and Fellowship programmes.

The major activities of ICFOSS are the following:
- 20 faculty development programmes for teachers in which 600 teachers participated, 25 student training programmes in which 750 students participated, 6 training programmes for Professionals and SMEs in which 200 persons participated, 10 Scilab training programmes in which 300 students and teachers participated, Student project works, Internships, and Fellowship programmes are conducted.
- Launched Assistive Technology products such as T- Slide Mouse, Flip-Mouse and on-Screen Malayalam Keyboard
- FOSS cell co-ordinators meet up has been conducted and 45 co-ordinators attended.
- Training to Government Employees on FOSS Solutions and Malayalam Computing in 62 batches and 1700 employees participated
- International conference Swathanthra 2017 in which 300 students and professionals participated

9. Kerala Startup Mission (KSUM)
Kerala Startup Mission (KSUM) is the nodal agency of Government of Kerala for implementing the entrepreneurship development and incubation activities in the State. Kerala Start up Mission, formerly known as 'Technopark Technology Business Incubator' is India's first successful non- academic business incubator. It started operations in 2007.

The objective of the Mission is to identify and develop entrepreneurial talents among youth and students in Kerala, address the technology based entrepreneurship development requirements in the traditional sectors of Kerala, build appropriate training programmes suitable for Kerala's socio-economic culture, identify market niche for technology products and services, interfacing and networking among academic, and R&D institutions, industries, and financial institutions, and establishing a platform for speedy commercialisation of the technologies developed in the institutes to reach the end-users.

Under the banner of KSUM and several of its sector-specific partner organisations, there are presently more than 3,143 registered start-ups, more than 4 lakh sq.ft. of incubation space, more than 230 Innovation and Entrepreneurship Development Cells (IEDC), all of which are evenly distributed across various districts and cities such as Kochi, Trivandrum and Calicut. Many of these facilities also house advanced labs that focus on sectors such as hardware, biotechnology, electronics and advanced computing.

Achievements of KSUM
- Kerala ranked as the top performing State in DPIIT's State Startup ranking.

- Home to one of India's largest innovation hub of 1.8 lakh sq.ft - the Integrated Startup Complex
- Established centers of excellence in AR/VR with global tech giant Unity
- Established the BRINC Hardware Accelerator and XR Accelerator in collaboration with Unity
- Incubation infrastructure for niche sectors such as cancer research, spacetech, biotech
- Established Space Technology Application Development Ecosystem (STADE)
- Establishing Super Fab Lab at Kochi
- Conducted 32 fab workshops imparting digital fabrication expertise to more than 250 participants.
- 47 funded Startups in the State, out of which 13 are funded in 2019.
- 316 start ups build through IEDCs.
- More than 40 incubatorsand 4 accelerators in the State.
- 13 per cent Women Startups in Kerala, 30 Women Startups registered with KSUM
- Conducted 187 boot camps in Colleges.
- Distributed 50 Startup Box to startups/incubators.
- 10,000 Raspberry Pi kits distributed.
- 2 Silicon Valley Visit and support to 17 startups for intellectual visit.
- Established 2 Fab labs and 20 mini fab labs.
- Conducted 1 Fab Academy Courses.
- Seed support to 26 Startups.
- Supported 35 startups under Performance Linked Support Scheme and 21 startups for Patent Support Scheme, Released patent support to 5 startups
- Established 24 new Incubation and Entrepreneurship Development Cells (IEDC)
- Conducted IEDC summit connecting 2,700+ students/nodal officers
- Associated with 3 paid delegations with a participant size of 24 under International Entrepreneurial Exchange Programme
- Conducted one Fab Academy Program with a participant size of 14
- Under Start up Leadership Academy and Training programme, conducted 1 Management Development Programme, 9 Entrepreneurship Awareness Camps with ICT, 4 IEDC Co-ordinator's meet, 1 Product Design and Development Workshop for nodal officers and students, 5 programmes for faculties, 5 community development partners for delivering entrepreneurship/technical workshops for students/start-ups, 7 Let's Talk – Future Tech workshops for start ups
- Established Incubation Centre at Kasaragod under Open Innovation Collaboration Space
- KSUM launched a Water Innovation Zone with Kerala Water Authority with the objective of identifying and promoting Startups working on products which will assist KWA. Manhole cleaning robot by Genrobotics was the first project selected.
- Supported KRIBS – BIONEST, biotechnology incubator supported by DBT and RGCB, Kannur Technolodge, Piravom Technolodge and Muvattupuzha Tehnolodges and support was given to Nasscom 10K Warehouse and IAMAI Mobile 10X Incubator

- Conducted 64 hackathons, makeathons, 1,092 startup events at IEDCs and 3 Seeding Kerala Events
- Supported 62 start ups for national level event participation
- 13 Business Promotion Events held at Kerala
- Developed Technology Commercialisation Platform
- Conducted Future Sparks Programme at Kasaragod
- Maker Village, the largest electronic hardware incubator in the country is a joint initiative of Ministry of Electronics and Information Technology (MeitY), Government of India and Government of Kerala with KSUM as the leading partner and IIITMK, Thiruvananthapuram as the implementation agency.

10. Centre for Development of Imaging Technology (C-DIT)

C-DIT has been functioning as an Information and Communication Technologies (ICT) solutions provider in the Government sector.

The major programmes undertaken by C-DIT are:
- Reorganisation of Chief Minister's Public Grievance Redressal system and Distress Relief Fund assistance mechanism into an integrated online portal www.cmo.kerala.gov.in
- Design and development of software for conducting online examination and on screen evaluation of written answer sheets for Kerala Public Service Commission
- Digitisation of old manuscripts and documents for State Archives and Registration departments
- Design, hosting and maintenance of over 200 Government websites and social media platforms MIS/ERP systems for various Government departments
- In the wake of the recent flood disaster in the State, C-DIT maintains the online fund collection portal for State Government which is developed and deployed last year during flood disaster in the State.
- Carried out Hologram embedded Tax Label Production for Kerala State Beverages Corporation for affixing in Indian Made Foreign Liquor bottles. Besides, hologram embedded security documents such as RC Book, driving license were also supplied to Motor Vehicles Department.
- The Security Design Lab set up at Lottery Directorate for the designing of lottery tickets incorporating security features, and security forensic for preventing counterfeit is being managed by the technical support of C-DIT.
- As a cross border security measure, the project of fixing high security-registration boards for sea going vessels have been taken up for the Fisheries Department
- Successfully carried out Facility Management System for all the RT offices under Motor Vehicles Department.
- Completed online examination Software for Entrance Examination Commissionerate, online quiz platform for KSACS, Janajagratha portal for PRD, and 'Koode' the portal for the Covid- 19 affected patients.
- Produced of 246 episodes of pre-school learning video lessons for Women and Child

Development Department in the context of Covid-19 pandemic and subsequent closure of Anganwadies in the State.

- Facilitated Nammal Namukkai under Rebuild Kerala Initiative and Transgender Advocacy Campaign. Creative support offered for the Break the Chain Campaign to prevent spread of Covid-19 pandemic.

- Animation video production series for Sampushtakeralam for Women and Child Development Department, Navakeralam weekly television show, sign language bulletin, TV news monitoring project, social medial campaign of Haritha Keralam Mission, Rebuild Kerala Initiative, GST, Food Safety Commissionerate, Suchitwa Mission, and Arogyakeralam, live streaming of various programmes of Chief Minister and other Ministers, technical support for the various projects of KIIFB, K-DISK, and KSFE Pravasi Chitty, and technical facilitation of Chief Minister's Public Grievance Redressal System are the major other projects of C-DIT.

CHAPTER 3
INDUSTRY INVESTMENT AND CAPACITY BUILDING

Kerala as a society has thrived to grow in the principle of inclusivity and equality as primary drivers. In modern context, this sets in very well with the ambitious targets worldwide to build a modern Society 5.0. Society 5.0 is predecessor to the information society (Society 4.0), industrial society (Society 3.0), agricultural society (Society 2.0), and hunting society (Society 1.0). By definition, Society 5.0 is "A human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space." Through the aim to build such a society, the state which has already achieved high literacy rates, having India's first IT park, and one of the early electronics manufacturing industries, envisions to be a fully digital enabled state. It is not unrealistic for Kerala to become the top 20 digital destinations in the world and be in the top 5 in India in the next 5 years.

Creating a knowledge driven economy that is performance driven yet balancing the social wellbeing of the society at large, requires continued support for relearning and adapting to emerging technologies. The IT jobs of the future would imbibe creativity, innovation and having foresight to reimagine the application and use of high end technologies. Enabling such an environment not only requires creating an innovation ecosystem to support present industries but also supporting those for the future. Creating centres of excellence and new centres of learning throughout the state is essential to widen the adoption, use and reach of innovative digital technologies for social good. This section on capacity building puts a forward thinking approach to marry the present needs with that of the future IT landscape for Kerala.

The impact of climate change can be seen throughout the world. In the recent past, Kerala had to deal with disaster management as a key area of policy development. Creating digital solutions to cut carbon emission, and becoming a climate responsible state is in alignment with the long standing cultural relation the people of Kerala hold with its diverse flora and fauna. Kerala can show a way forward to future generations, by providing innovative IT solutions to combat climate change. Further, this idea can support the promotion of a range of traditional industries from handloom to that of creating modern manufacturing units.

Bringing e-Governance as part of skilling and capacity building requires developing frameworks for training personnel at all levels. Just like training for new skills, training for maintaining the changing e-Governance solutions are equally important. The effectiveness of e-Governance solutions becomes only reliable when the citizens are well aware of the functionality and use of such solutions.

Through this focus on capacity building, Kerala is envisioned as a leading digital destination of the future. The synchronization of various sectors to bring digital transformation across the state is essential for building the aforementioned Society 5.0. A strong innovation ecosystem, IT clusters of product development, availability of electronics manufacturing facilities, creating centers of excellences and innovations, strong R&D linkages between

industry and academia, creating seamless digital connectivity throughout the state, creating opportunities by brain gain and attracting the best of human talents are essential for the realisation of Kerala as the leading digital destination.

Skilling in an Inclusive Society

The reach of capacity building should be inclusive to the changing needs and nature of the society. Increase in digital divides in the community can do harm and could have a long term social negative impact on how future industries are shaped in the state.

1. **Reducing the digital divide:** The pandemic highlighted the importance of having access to digital technologies, in rural and urban areas. The pandemic affected everyone from students to working professionals. To ensure equality in digital society it becomes essential to make the widespread availability of good communication infrastructure, access to internet, access to computers and access to trained teachers at affordable costs to the citizens.

2. **Train the trainers:** Inclusivity requires the trainers to be aware of the challenges in handling crises. Teachers are often untrained and traumatized as a result of the crisis. Proper training and early awareness provides an opportunity for teachers to ensure accessibility for all learners according to their needs.

3. **Diversity and differences:** Professional skilling requires to be made accessible to all sections of the society. Persons with disabilities are likely to face increased risks and suffer even more of a disadvantage in terms of access to aid (including food, water, shelter), precisely because they are unable to physically access food distribution points, water points, sanitation facilities, schools, and so on. The differently abled and disabled individuals, as well as those in socially vulnerable situations would need to be given special attention.

4. **Digitally enabled state:** Kerala can aim to see itself within the top 5 digitally enabled states in the next 5 years. Including innovation as the core of skilling programs are essential to build a digitally enabled state. To build society 5.0, it is required to balance economic advancement by solving social problems by a system that highly integrates cyberspace and physical space, where innovation becomes a key driver. This requires developing high end digital infrastructure for the future, including high speed and reach of the internet, creating test beds for driving innovation and creating launch pads to bring in investors.

Becoming a Digital destination

It is envisioned to make Kerala the most favoured digital destination of high tech industries in India. It is recommended to create an ecosystem whereby Kerala becomes a top 20 digital destination in the world, and top 5 in India.

Digital innovation labs could be set up throughout the state, to drive grassroot innovations. Innovators from all walks of life could be encouraged to work in digital innovation labs, and get the necessary help to realise their ideas.

The access to Cloud computing and product testing infrastructure could be provided at

subsidized rates to encourage entrepreneurs, students and innovators to develop various data intelligence innovations. Such infrastructure could be developed in a public private partnership model, whereby the industries can directly support innovations from its ideation stages.

The Kerala state can be a leader in digital education, empowering the school education sector to higher education. This requires the widespread use and research on innovative pedagogies at various levels of training. The use of artificial intelligence, virtual reality, robotics, and electronics technologies can enable and improve the effectiveness of a wide range of teaching and learning techniques such as flipped learning, project based learning, problem based learning and research led learning.

To take strides in digital technologies, it's also important to build the related semiconductor industry. The state could envision setting up specialised fabs that focus on specific domains, like sensors, memories or displays. Such fabs are relatively less expensive than having multi-billion dollar general purpose foundries. The chip fabrication is capital intensive, however, it is an essential requirement to ensure indigenisation of developing high quality electronics products.

Development of carbon neutral IT solutions are an important aspect in the future society. Given the growing scientific evidence that climate change is real, and it will be having significant impact in the future, it is important to adopt a carbon neutral approach in creating products and services. Cross-disciplinary innovations are required to address the growing challenges of domain specific issues in creating carbon neutral products. Almost every product today uses one form of digital technology, which makes it important for the product developers to be aware and be trained on compliance issues and global regulatory requirements of reducing carbon emissions.

Future IT professionals
Information Technology (IT) - encompasses a broader definition of a variety of technologies (including sensors, electronics and computing) involved in creating, storing and processing information for meaningful tasks and applications.

The future IT professionals are expected to have a growth mindset, which can be summarized into following six traits:
a) **Ambitious -** they will be driven by a purpose to use IT to solve or address an issue that an individual, Government, a firm or society faces
b) **Bold -** willing to re-imagine the current reality using the technology that is available or technology that could be created
c) **Capable -** knowing the skills they need to acquire and knowing where you acquire these skills just in time for when they are needed
d) **Determined -** whilst everyone wants projects to run smoothly, the ever-increasing complexity of technology means that problems are inevitable. Having the trait of being determined and drawing on a trusted network allows the future IT professional
e) **Entrepreneurial** - being visionary in seeing the possibilities of future technology and developing communities that will collaborate with them materialising their vision

f) **Foresighted** - having due care and attention for the impacts of actions both in technology and business with emphasis on sustainability (business, personal, team, business, environment)

Creating an innovation ecosystem around this sector will be a promising opportunity for the development, nurturing and alignment of sustainable startups in the state.

Common infrastructure facilities

Some of the emerging areas where India, Kerala State could emerge as the leading global destination are fabless design centers, embedded architecture, Embedded Systems Design, VLSI design capabilities etc. Hence, it is suggested that Centers of Excellence for common core infrastructure facilities be established in key locations on a PPP model led by the Industry and supported by the government up to 49% of the capex and operational expenses that can help IT companies train people to develop skills, ideate, prototype and test solutions in a low cost and time efficient manner. Such a facility to be operational as a commercial enterprise could be housed in academic institution campuses to take advantage of the faculty available and could be used by the entrepreneurs and the academic institutions as Digital Innovation Labs in the state. Some examples of the common infrastructures incorporated in Centers of Excellences include:

1. **Common computing infrastructure** - have low cost sharable HPC facilities with GPU, and FPGA server nodes
2. **IoT/5G product test facility** - aim for setting up facilities to cater high frequency testing
3. **Embedded electronics design labs for entrepreneurs**- common labs that offers a range of EDA softwares
4. **Sensor fab, devices and 3D printing** - setting up clean room facilities, to experiment on emerging devices and indegenious sensors
5. **PCB manufacturing units** - create lab unit that is capable of manufacturing multilayer PCB board, including testing as well as assembly
6. **Green IT and sustainable future** - create labs for studying applications of green energy in IT
7. **Common digital libraries** - create a common library infrastructure for engaging professionals in lifelong learning

Criteria for setting up centres of excellence
1. The CoE should necessarily have participation of Industry, academia and Start ups
2. Upto 49% of the cost (Capex and Opex) to be supported by Government and balance 51% by Industry- Academia consortium
3. There will be a nominal fees to access the laboratories and managed by the Industry
4. The funds to be allocated for the CoE would be linked to engagement with Startups and a definitive proto type to be developed within three years
5. Notwithstanding points 1-4, support any specialized CoE's funded by central, state and industry through specific schemes/programs of the government.
6. COE should build interfaces with the Industry and build appropriate internship program

7. Government to consider reimbursement upto 50% of the cost of the Internship fees to the Industry to build industry skills amongst the students

Horizontal domains

There are cross disciplinary themes that are emerging and relevant for the next decade.

1. Artificial intelligence/ Data Science - algorithms and hardware, edge AI computing, Machine learning, big data etc
2. Internet of Everything/IoT and Cyber-Physical Systems - smart manufacturing, intelligent systems, sensors, 5G communications, digital health
3. Cyber security and Blockchains- algorithms, cryptography, data security, cryptanalysis, law enforcement, trust, privacy
4. Unconventional computing - neuromorphic architectures, analog computing, distributed computing, DNA computing
5. Quantum computing - emerging technologies, quantum hardware, algorithms, quantum cryptography, quantum imaging, quantum ML
6. Intelligent automation and additive manufacturing - industry 4.0, society 5.0, industrial robotics, mass customisations, virtual reality, gaming
7. Cloud / SaaS - distributed computing, storage, cloud computing, deep learning.

Vertical domains

These verticals focus on application areas that could use multiple horizontal domains to implement.

1. Digital Health - developing technologies and solutions for easy, accessible and affordable high quality health care.
2. Change management in IT industries - pandemic induced challenges, market changes, work style changes
3. E-governance - developing technologies and solutions for efficient governance
4. Futuristic IT education - identify newer ways to educate youth for being industry ready

Collaborations with other departments

Departments like Agriculture, Health, Coir, Education, Industry and digital manufacturing should come together to solve grand challenges for the future. When the companies move from the startup phase towards scaleup, they require manufacturing support that requires the support of industrial parks. The collaborations with the industries department in setting up electronics and IT product manufacturing units will be essential. It is recommended to set up industries liasioning units within each IT park to support the activities of growing companies. The units can act as an interface to get all the necessary information and bureaucratic support with a single window clearance to set up or get access to manufacturing units.

Grand Challenges

Programs can be envisioned to support long term vision
1. Clean and sustainable world - how IT solutions can create a sustainable future, reduce

pollutions, improve energy usage and production, reach targets of zero emission

2. Digital health for better quality of life - the acquisition, management, and use of information in health - can greatly enhance the quality and efficiency of medical care and the response to widespread public health emergencies. Help in the search for new medicines and treatments.

3. Technologies for social good - how societies can be made better with IT technologies. New ways of social interaction and connecting the society at large. Way to implement transparency, better governance and citizen participation

4. Improve IT reach and influence of infrastructure - ways to help improve the quality of IT infrastructure and digital readiness across the state

5. Disaster Management: Kerala needs ability to predict and manage natural disasters that has become high these years – Technology plays a huge role in both the prediction and management of natural disasters. Building specialisation centres to promote skills and capacity on Data analytics, IOT, GIS systems , Disaster Management supply chains etc will be needed. Large scale Tech enabled platforms to run awareness sessions to both citizens and volunteers are to be enabled as a regular mechanism. Information updates on ecologically sensitive zones, potential disaster zones etc could be provided to citizens through the same arrangements

Role of universities

Universities have an important role to play in the development of innovation and development of the high tech industry in the state. The major roles of universities include:

1. **Research and development:** The universities are places where the next breakthroughs in fundamental research occur. However, research that does target the light of practical use is not effective use of taxpayers money. The industry can contribute to the university R&D programs by offering the challenges for researchers to investigate, and also take part in funded research. The universities in the state should aim to extend the boundaries of fundamental research to more towards applied research that can have immediate impact in the society and industry at large.

2. **Creating creative minds:** The higher goal of university in today's society is to create a culture of innovation among the students. The universities should be a place to experiment new ideas, discover and invent the future. Towards this the curriculum of the universities should reflect high academic standards and rigor. The students should be made to think beyond grades and studies made activity driven.

3. **Technology transfers:** The universities should add technology transfer to create new products and industries as one of the primary objectives. To help this, faculty should be encouraged to develop companies and products with students, and make it legal for such faculty to take on multiple roles. The employment restriction in taking multiple roles should be abolished. Greater flexibility should be provided to both students and faculty in engaging outside projects that benefit the society at large.

4. **Professional conduct:** It is expected that any innovative work environment will involve developing conflicts of interest between students and faculty. Mechanisms should

be put in place within the universities to manage conflicts of interests and conflicts of commitment. The students and faculty should be made aware of professional codes of conduct, and practice them on a daily basis.

5. **Community involvement:** It is essential to provide a holistic education connecting technology with that of society. The student involvement in community development could be seen as an important aspect of universities. While there are several programs such as NSS, they are not technology intensive, and do not translate to students translating their knowledge to socially relevant problems. Programs and curriculum can be designed to instill thoughts of collective growth and community development.

6. **Mainstreaming Skilling through formal diploma and certification programmes:** IT and allied industry will require advanced skilling of professionals on a continuous basis depending on the changing demands in the industry. Universities can design such courses and award formal diplomas/certificates thus enabling life-long learning of mid-career professionals.

Schemes for promoting research
1. Research fellowships
Innovation is increasingly becoming an important driver of economic growth. Significant investment in R&D, both public and private, is important to create a culture of innovation. But unfortunately, India's expenditure in R&D is low compared to other competing economies.

The report on R&D Expenditure Ecosystem in India, published by the Economic Advisory Council to the Prime Minister, estimates that India spends only 0.6 - 0.7% of GDP on R&D activities, while countries like the US, China, Israel and Korea spend between 2.1% and 4.2 %. Further, it also points out that the Government & Public sector contribute the lion share of this, accounting for about 60% of the total R&D expenditure whereas the private sector contributes only around 40%.

In this context, it is important to recognise that while industry would invest in R&D projects as required in the market, the high-level of risk involved in funding long term research, disincentives companies to commit large capital to such R&D initiatives.

Further, today, cross-industry collaboration is driving innovation. Collaboration between companies from different sectors and research institutions is often necessary to develop innovative products. However, there are no incentives for these entities to come together.

Clusters of Innovation (CoI) program: To address these gaps, we suggest that the Government of Kerala consider adopting a Clusters of Innovation (CoI) program that can encourage companies, think tanks and academic/research institutions to undertake joint R&D projects and co-create innovative technologies and products. The primary intent of this program is to catalyze cross industry partnership to build technology leadership in certain pre identified focus areas. Under this program, the Government will incentivise industry led consortiums that intend to undertake joint R&D projects by providing matching grants. A government agency, through a committee of experts, will evaluate the

project proposals from consortia, for funding support. This will accelerate objective-driven and ambitious cross-industry and academia partnerships to build & monetize IPs, boost economic growth, promote industrial competitiveness and optimize investment impact and align Industry-academia collaboration and Industry Ph.D. funding programs to these technological innovation

Some of the recommended technical/ business areas for consideration would include Mobility, Energy, Digital Health and Care and Advance Manufacturing and support the concept Make India for India and World through India Stack/ Platformization strategy; create and implement India AIoT stack to facilitate IoT innovation across verticals and perhaps around 5G & Fabless design centers for India.

2. Industry fellowship

The wealth of a nation is determined by the technical scholars that produce it. Kerala has always been known as the cultural and arts capital of the world because of its richness in the number of scholars available in the area. In the Techade (Technology in a Decade) era, there is a similar need to create a wealth of Technology scholars from the state who will guide cutting edge technology solutions for the country. We also have the twin challenge of making our Technology University as a world class one. Unfortunately, as a country, the number of people pursuing higher education in Masters level, P.hD level in advanced technologies (say Aircraft Engine, Battery technologies, Electric Vehicle, Hydrogen energy, Advanced Manufacturing etc) are not high and those pursuing such courses are not suited for industry. There are several reasons for the same, one of them being appropriate scholarship and other being availability of Industry projects for testing in real life adoption.

CM Fellowship program: Considering the gap in Industry Academia collaboration, it is proposed to announce a CM Fellowship program of giving grant (upto 50% of the total costs) to Doctoral/ Postdoctoral scholars in few select areas and perhaps around 40- 50 per year to make their salaries nearly on par with the Industry leaders in the space. A virtual fellowship team could be formed and incentivized to solve critical problems thus raising the scientific temper in the country.

3. Fellowships for industry mentors and scientists

To promote industry engagement and promote scientific temper in the state, specific schemes can be created to fund the visits of industry fellows and scientists to work across the universities and research labs. Every year, upto 20 chair positions can be funded by the government. These chairs shall receive salaries at par with industry and shall be responsible to set up a large research and development program within the host institution. Such chairs could be provided with funds for hiring industry fellows, PhD students and Postdocs. Such a scheme can be initiated to hire the best talent from around the world, and focus on niche topics that will reflect breakthroughs in the years to come.

Skilling for e-Governance

1. Continuing education and re-skilling: Creating awareness and professional development programs for practitioners in local governing bodies of the state government.

This can be led by larger digital transformation programs coordinated by digital university Kerala.

2. Higher education: Creating newer research programs including PhD programs and master programs focussed on various emerging issues of e-governance with respect to newer trends and society 5.0 challenges.

3. E-governance undergraduate specializations: Introducing dedicated subjects and minor specializations in e-governance in undergraduate engineering and science education to empower the graduates to better prepare for future e-governance jobs. KTU can lead in this development.

4. Reskilling, maintenance training and citizen outreach: It is of primary importance that the end user of the e-Governance platforms are aware of the various functionalities and uses. Outreach programs to educate and train the users at large from varied backgrounds is widely required to improve the effectiveness of e-Governance services. In addition, there is a continued need to train the personnel for maintenance of e-Governance platforms that keep improving over the period of time. There would also need train manpower to handle legacy systems and those that require continued updates.

Enhancing the capabilities of Educational institutions

Skills and Knowledge are inseparable assets of every youngster and the next five years should focus on investments meant for creating responsible and talented youths for the future. Following areas could be considered for investments in the next five year planning

1. Augmenting Higher education Institutions as Skill Delivery Centres: By enhancing the infrastructure facilities to Industry-standard and by suitably enabling the faculty members on Industrial domain skills, higher education institutions could productively augment their facilities and human resources for providing skills and knowledge, which will be beneficial for students, faculty, and institution. With the blended learning infrastructure additions and Centres of Excellence, the skill centers in higher education institutions can produce substantial value to their stakeholders. Usage of Skills delivery platform Kerala (SDPK) , a unique project connecting 100+ Engineering and polytechnic in the state through a high-end telepresence network, is ready for usage. The facility could be effectively used for augmenting the skilling capabilities of Higher education institutions

2. Blended Learning infrastructure in Educational Institutions: With the world seeing pandemics such as COVID, the new world order will necessitate the augmentation of classrooms with blended learning infrastructure, where classes could be delivered over both physical and virtual modes. Government shall make investments in implementing such capabilities in the educational institutions – Learning Management, Virtual classroom equipment, Virtual classroom studios, Connectivity, computing infrastructure and digital learning contents created/introduced at the educational institution level and/or at Department / University level.

3. Upgrading the Labs in Technical, Higher Education, and Research Institutions: To meet the requirements of the industry, the labs in Higher education Institutions would

need an upgrade of the equipment. A comprehensive audit on the lab equipment to assess industry readiness will help reform the quality of the technical educational experience for the students. The faculty members and instructors should be suitably trained on the usage of modern equipment. These labs could not only be used for teaching and learning activities but be used for the creation of a prototype or MVP for educational Startups or innovation centres.

4. Industry, Academia and local community Collaboration: Newer models of Industry academia collaboration are emerging where Industry supported collaboration platforms are emerging in the market. Tapping into such platforms, and/or creation of similar collaboration spaces, where teachers, students, industry experts, and local communities can seamlessly collaborate using technology, needs to be promoted. Such collaboration platforms are required to be rigorously audited from time to time for improving overall objectives of outcome-based education. Through such spaces, Industry problems and societal problems could be solved by the students and teachers, thereby improving the quality of education and also enabling the future workforce with the real-life challenges

5. Student Gigs: Gig (Freelance) economy is an emerging trend in the workplace all across the world and Kerala will also be soon embracing such models in a big way. To prepare students for such new work models, enabling student participation in Gig platforms and Gig economic activities while they are studying, shall be a focus area for educational institutions. Investments in training and enablement (creating local gig work / assignment) needs to be considered as part of the plans.

6. Skill program accreditations: Skill program accreditation body may be formed under department of electronics and IT to annually monitor, rate and approve skill based IT programs offered by industries and institutions. Currently, skills based programs are unregulated and do not follow international quality standards or rigour. There is a growing need to bring in quality evaluations of programs and courses offered through online/mobile applications, industries and institutions offering certifications or tutoring or short-term programs.

Skills development in Business Domains of high potential growth
With the advent of Technology in multiple Industry verticals, the next level Kerala advantage would be on building a strong Knowledge Industry by twinning the Technology domains, Functional Domain and our Strength. Attached following are the areas that would help Kerala to grow into the top positions

1. Medical Devices industry domain: with the plans to make Kerala a hub in the Medical devices Market, there will be huge demand for technical skills in the operations and usage of medical devices domain. The ITI and polytechnics and skills provider networks in the state may be augmented with such skills development programmes. Typically, establishment of such market domains will lead to colocation of Industrial R & D Centre in the locations – Knowledge capabilities in Engineering and Technology institutions will need to be strengthened to develop deep knowledge in such domains

2. FinTech Industry: Non-Banking Financial Services is a key Industry sector in Kerala

and it can take a leadership role in this domain. Building Skill centres in Financial Services and creating a talent pool in this domain alongside technology areas such as AI and Blockchain can make Kerala a unique place for fulfilling the NBFC needs of the state and outside. Kerala could become the talent hub for such domains in the next five years

3. Space Tech Domain: With Indian Space industry opening up for private entities and Kerala gearing up to build its own space cluster, skills at across the layers of space tech industry will be in high demand in future – GIS, imaging technology, AI/ML, Mechatronics, Robotics, Hi-Tech Engineering are likely to find talent crunch locally . Partnering with IIST and establishing Space-Tech skill network across the Science and Engineering Institution will be an important area for Kerala's industry growth

4. Creative industry: The relatively high creativity quotient of Keralites are documented in history (artists like Raja Ravi Varma). With the advent of digital media , Kerala has a great potential in exponentially growing its capabilities in this domain. Investments in educational institutions and development of 'creative spaces' with various elements of creative industry (AR/VR labs, studios etc) can significantly improve the talent in creative space, thereby attracting new generation companies to the state.

5. Transportation, e-mobility and automotive industry: Transportation and automotive industry is one of the growing industries in the world. The means of transportation in the next decade would require changes keeping in mind the climate change and carbon footprints. Innovative solutions to reduce the reliance on fossil fuels and move towards carbon neutral e-mobility solutions will be evidential.

Kerala Knowledge Economy Mission and its roles in Aggregation and Creation of Jobs
Kerala Knowledge Economy Mission (KKEM) is created as a mission mode programme with an ambitious target of providing jobs/work to 20 Lakh youths in the state. The programme has multiple layers of jobseeker mobilisation, jobseeker training/mentoring, and connecting them to the jobs/work across various sectors in the world. The major thrust is on connecting new job seekers, career break women, and individuals who lost their jobs due to various reasons, to knowledge industry jobs and work.

Training and capacity building is a key activity under the initiative and the model is to leverage the existing strengths of educational institutions and Training Service Providers (TSPs) for augmenting the talent of the youths of Kerala. This initiative could be a major opportunity for creating a large talent pipeline in the state and thereby attracting more job opportunities to the state. Clear mechanisms to collaborate and obtain buy-in from the industry fraternity will be key to bringing success for the initiative. With the IT/ITES industry poised to grow faster than all other industry segments, large opportunities exist for Kerala to make it a hub for Digital Talent and thereby attracting large IT/ITES requirements to Kerala

Product Development through Open Source Movements
Open Software: In the changing times, where digital divides are increasing, it's important to make new technologies accessible for all. Open source movements in software had

promoted the growth of technologies and helped both students and professionals to grow much faster in career. Many startups today make use of various open source technologies, which otherwise would have them spend millions of dollars. ICFOSS could take the lead in developing open source technologies in association with students and startups, looking at the needs presented in the community.

Open Hardware: Hardware development is globally seen in early stages of open source movement. While board-level schematic designs are made available through open hardware movements, the majority of hardware product development do not use open hardware solutions. Open hardware is not a trivial issue, and would require a significant amount of university research. Digital University Kerala could take a leading role in developing open source technologies for hardware and integrated chip development, where researchers and engineers can help provide open source solutions that are otherwise very expensive for the students, and startups to obtain.

Open Designs: There is also a need to make many fields in technology and engineering, where digital technologies can help make designs open. For example, open source designs can include a design of a new turbine or that of an electrical controller which usually gets patented, with many implementation details kept closed. Open source documentation of the design could be encouraged in the universities and made publicly available. The universities such as KTU and CUSAT could take a lead in creating an environment for promoting open source designs in technology and engineering among undergraduate engineering/technology students.

Entrepreneurship training

The existing infrastructure should be expanded to provide practical training in a wide range of IT domains.

1. Training by incubators: Special schemes can be envisioned for training the entrepreneurs. The specific schemes for IT incubators under Kerala Startup Mission can be expanded for software based entrepreneurs, and Maker Village can be used for extending the support for hardware entrepreneurs.
2. Training by colleges: The incubators in the colleges can be offered specific funds to develop industry immersion programs to cultivate the growth of entrepreneurship thinking among undergraduate students.
3. Training by universities: The universities in the state can help develop curriculum and e-learning resources for inculcating entrepreneurship thinking among staff and students.
4. Training by companies: The companies could offer a range of industrial training and internship programs in partnership with universities to train the students and staff in entrepreneurship.

All such training programs should be subjected to rigorous peer-review and program accreditation on an annual basis. State-wide lists are to be maintained indicating their accreditation status for such programs so as to meet global standards and to ensure the best experience to the trainees. The training programs should be outcome driven and that reflect the industry needs.

CHAPTER 4
INFORMATION TECHNOLOGY –START UPS

Startups are economic entities that are working towards innovation, development or improvement of products/processes/ services and/or have a scalable business model with a high potential of employment generation or wealth creation . India is considered as a hotbed of startups with more than 65,000 startups registered with Department of Industrial Promotion and Internal Trade, Government of India. Kerala is considered to be a forerunner of Startup Movement in the country accounting of around 10% of the country's registered startups. Over 6500 startups from Kerala are registered with DPIIT, of which around 4000 are registered with Kerala Startup Mission, the apex body under Department of Electronics and IT for promotion of technology startups. Even though the startups can and do exist in different fields of economic activities, technology plays an important role in ensuring scalability and contribute towards their non-linear growth. This section is to assess the current status of Technology Startups and to suggest policy measures to enhance their growth in the next plan period. Specifically, the group deliberated on following terms of references

1. Review the growth and achievement of Start-ups in Kerala in the IT sector and assess the adequacies of national and state programs to continuously support the start-ups
2. Evaluate the functioning of the Incubation Centres and propose improvement to facilitate creating a robust start-up support system with appropriate linkages to research and finance
3. Propose policy changes and institutional arrangements for building a technology-driven start-up ecosystem and encouragement of women entrepreneurs
4. Propose policy changes to encourage and deepen the technology-driven start-up ecosystem in the industrial and information technology sectors in Kerala

This report presents the summary of the deliberations and recommendations of the sub-group on each of the above items

Review of the growth of startups and assessment of National and State Programs for supporting Startups

Startups are economic entities that leverages on knowledge and innovation to create value resulting in exponential growth within a very short period of time. As most of the startups depends on technology to build scalable business models, the conventional factors of production like land, labour, capital etc. are of significant and the intellectual property that drives innovation become the key for their growth. For a State like Kerala, which has limited availability of land and other conventional factors of production, it is natural that Startups provides an appropriate alternate model for industrial development. Realizing the potential of stratups to drive economic development of the State, Kerala had taken proactive steps in promotion of Startups in the State. National Institute of Technology Calicut was one of the first Institutions in the country to set up a technology business incubator (TBI)

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[1]*What qualifies as a startup? Startup India website startupindia.gov.in*

to support startups and the first non-academic TBI was set up by Technopark, Trivandrum way back in 2004 itself. The first TBI in PPP mode, Startup Village, was also set up by Technopark along with a successful startup from Kerala -Mobme- in 2012 in Kochi and this led to accelerated growth of startup movement in the State. Kerala was the first State to declare a State Startup Policy in 2014 which was later mimicked by various other States in the country. During 2015, Government of India has announced Startup India, under Department for Promotion of Industries and Internal Trade (DPIIT), as the focal body for promotion of Startups in the country. Same year, Government of Kerala also designated Technopark Technology Incubator as an independent society and apex body for promotion of Startups in the State and rechristened same as Kerala Startup Mission, reflecting the larger role of the agency to create a technology startup ecosystem in the State.

Ever since its inception in 2015, Kerala Startup Mission (KSUM) was actively involved in the development of startups in Kerala and in 2017, the Government has announced a comprehensive policy for promotion of technology innovation and entrepreneurship as part of the IT policy 2017. This policy provides guidelines for comprehensive development of startups in the State and it has reflected in 20 times growth of startups during past 5 years. From around 300 startups in 2017, the number of startups grew in excess of 6000 by the end of 2021 accounting for around 10% of startups in the country, which was duly acknowledged by Niti Ayog in its latest report by recognizing Kerala as one among the 5 regions in the country having the fastest growth in Startups

The development of startup ecosystem in Kerala is different most of the other fast-growing regions in the country like Bengaluru, Mumbai, NCR Region, Hyderabad, Pune etc. While private sector and MNC played the pivotal role in energizing and growing the startup ecosystem in those cities, it was the Government which provided key impetus for the Startup growth in Kerala. Some of these measures include creation of nearly half a million sqft of plug and play infrastructure in various locations in Kerala like Trivandrum, Kochi, Kozhikode, Kannur, Palakkad etc. and creating and/or supporting over 47 incubators and 4 accelerators, directly supporting startups through innovation grants, low cost debt funds and channelising angel funds for their development. The comprehensive model of Startup development provided by Kerala has been well acknowledged across the country with Government of India recognizing Kerala as a TOP PERFORMER in all the State Startup Ranking conducted by them so far . Internationally World Incubation Summit in 2019 recognised Kerala Startup Mission as the World's best Public Funded accelerator.

The key areas of strength of Kerala Startup ecosystem is the availability of high-quality infrastructure facility and proactive support from Government for development of Startups. Rather than a "outside-in" approach, Kerala followed a ground up "inside-out" approach for growing startups through a comprehensive 5 prong strategy which was spelt out in the IT policy 2017 . These 5 elements that contributes to the development of ecosystem include

In 2018 Kerala was ranked among Top 5 States while in 2019 ranking State was ranked among Top 3 States

i. Promotion of a Culture of Innovation and Entrepreneurship
ii. Enhancing Knowledge, Skills and Supporting ideation of innovative startups
iii. Incubation and Acceleration of Technology Startups
iv. Funding and Value Creation for high growth Startups
v. Achieving sustainability through support for Enterprise Development and Growth

Kerala Startup Mission and various incubators in the State conducts several programs to promote innovation and culture of entrepreneurship among various sections of the society. Creation of Innovation and Entrepreneurship Development Cells in various Colleges, supporting Young Innovator Program, focused events like Idea fest, innovation week etc. are some of the activities that help promote the culture of innovation among the masses. To complement these evangelization activities, several training and capacity building activities in the modern technologies are being implemented by the nodal agency. Kerala has world's second largest Fab Lab established in association with MIT, USA which supports digital fabrication efforts and early prototyping of startups. In addition to this, low cost manufacturing infrastructure for developing high quality products are being established by KSUM at different locations in the State. Software bank for high end computing needs of startups are also established. In addition programs in digital fabrication, blockchain, AVR, data analytics etc, are also being offered to enhance capacity building of Startups. The startups and potential innovators are continuously exposed to problems of industry and government so that new innovative products with high market potential can be developed by them. Early stage startups are provided with incubation support to develop their ideas into full-fledged commercial products through incubators and accelerators, established throughout the State. In addition to physical space, these incubators provide technology support, business connect, mentoring support etc. Kerala has also devised a comprehensive funding scheme to support startups at various stages of its growth. A small idea grant of upto Rs 2 lakhs is available for converting idea to prototype and a scale up grant upto Rs 7 lakhs is provided to convert the same into a viable product. For products with high IP / research content, a research grant of upto Rs 30 Lakhs is provided by Kerala Startup Mission. KSUM and other funding agencies like KSIDC, KFC etc. provide loans ranging from Rs 15 lakhs to Rs 500 lakhs to support the accelerated growth of Startups. In addition to this, Kerala has created an innovative Fund of Fund of fund model through which it made over Rs 1000 Crores of early stage equity funding available to fast growth startups having high value creation potential. Kerala also provide subsidized spaces for startups which attains traction and growth in IT and Industry parks to ensure their sustainable growth during their scale up stage. Rent subsidy, international market connect programs and IP filing support etc, are some of the measures provided to support enhanced growth and sustainability of the Startups

All the above measures have resulted in creating a robust ecosystem for supporting early-stage native startups in the State. Presence of over 300 IEDC cells in colleges has increased awareness amongst students and resulted in a large number of startups coming out of educational institutions. The support mechanisms provided by Government have also

helped in lowering the mortality of startups with only less than 30% of startups fail in the State. While the proactive measures of the Government and the comprehensive model for ecosystem development has resulted in creation of a large number of startups from the State, the State still lacks presence of Unicorns and high value startups. The startups in Kerala are more profit oriented than value based and, in this regard, they resemble MSME rather than typical startups else where in the world. Startups requiring high level of investment and having aggressive growth plans often leave the State once they reach a stage of maturity. Lack of a vibrant corporate players, startup investment ecosystem and presence of a market validation mechanism, still continues as major lacuna in the system and have to be addressed to ensure the next stage of growth. Moreover, even though there are over 6000 startups, only very few startups are there with strong IP and research capabilities. Similarly, the issues of inclusivity in gender is also currently poor in startups. There is also a need to enhance social (impact) startups that contribute to Sustainable Development Goals and overall development of the Society.

During the State Startup Ranking 2019, a few areas of improvement for Kerala has been identified. Along with this, the committee examined the experiences of other national international ecosystems and identified following gaps in the Kerala ecosystem. Some of the measures to address the same are also listed below

i. Focus of the Startup ecosystem
Kerala Startup Ecosystem provides only limited support outside IT Product Start-ups

This could be addressed through following solutions/ policy perspectives
1. Establishing focused accelerators and incubators for non-IT Start-ups in areas such as AgriTech, HealthTech, EduTech, Tourism, Ayurveda, Genomics etc. where Kerala has some existing strength. Involving reputed research, business and commercial entities in these areas for providing functional and business expertise/support to make this effective
2. Promote Digital transformation of non-IT MSME to help them compete globally. Given the fact that Kerala's MSME's are largely conventional, the digital transformation would enable them to compete globally and scale. Linkage between the MSME and Startup needs to be promoted as part of the policy

ii. Lack of High Value Startups and Unicorns
Kerala as a state have been successful in evangelizing concept of entrepreneurship and startups among students and other stakeholders. This is reflected in the large number of startups currently registered from karela. However, success or graduation rate of start-ups need to improve. Kerala is home to roughly 6000 start-ups, of which about 4000 are registered with KSUM. However, the state is yet to create a unicorn or major success story from this cohort.

Solution Ideas/Policy Perspectives to address this issue:
• Identifying of good quality start-ups and providing them with stronger support and management guidance is crucial. KSUM should develop measurement frameworks,

processes, and expert capacity towards this purpose. The frameworks and processes should support early identification of high potential start-ups, enable early state course correction for start-ups, as well as counsel out ideas that lack merit early, without sinking lot of time or investment.

- KSUM also needs to develop and onboard a network of full time and part time technical experts/product managers/business advisors with global exposure. These experts will complement the above-mentioned frameworks and processes, as well as help mature organisational capabilities, governance, product innovation etc. and enable start-ups to deliver global quality products and offerings.

- There is also a need to Invest in curated mentor network. Identify part time mentors (founders, retired business leaders etc.) willing to work with start-ups on pro-bono or sweat equity basis. KSUM to have dedicated professionals to curate and develop such mentor network in multiple verticals of interest. KSUM is already doing this in Fail fast or Succeed (FFS) program, but this needs to be scaled up and match making process (between mentors and startups) need to be improved by dedicated professional support from KSUM.

- Facilitate broader market access for Kerala Start-ups. Currently Start-ups are predominantly Kerala focused. This should be broadened to National & International level via market access partnerships. One way is to have a formal program for international market ambassadors leveraging NRKs/diaspora. KSUM to have a formal drive/program to build a network of market access ambassadors (invite Applications, Screen, Curate by geography/sectors, program launch, bootcamp etc.). Currently this is happening on an ad-hoc basis, but KSUM should institutionalise this and run it as a well-designed program with dedicated professional staff coordinating the program and ensuring smooth engagement between the network and start-ups.

iii. Product Maturity and Quality of Startup Products

Even though bulk of Kerala's start-ups are in IT product space, they lack of product sophistication and entrepreneurs often exhibit herd mentality with focus on limited use cases and limited understanding of customer/market needs. This is affecting the market readiness of many products (especially in national and international markets)

This could be addressed through following solutions/ policy perspectives

- To aid in product design Kerala has already invested in Design and Prototyping including Fab Labs. We need to extent it to soft capabilities and design specific training in areas such as design thinking, customer experience optimisation, conducting customer workshops and focus groups, requirements elicitation techniques etc. Identifying trainers in these areas, developing user experience labs etc. are necessary first steps.

- Establish incubators/accelerators with vertical or horizontal focus to develop start-ups with specialised/niche expertise and resultant products/services. To set up such focused incubators KSUM to work with established centres of expertise/research/knowledge in the state. KSUM can be the umbrella organisation which brings in part of the budget, VC connects, market access programs, and expertise in setting up incubators/accelera-

tors and partner organisations would bring in functional/sector expertise and business knowledge as applicable. Such incubators to be established in emerging technology areas like

1. Cloud Computing
2. Big Data and AI
3. IOT and Connected Technologies (like connected cars, smart cities etc.)
4. Cyber Security
5. Augmented/Virtual Reality

Similarly following industry verticals relevant to Kerala may be given renewed focus
1. AgriTech/Food Tech/ Spice Tech
2. Health tech/ AyurTech / Genomics
3. Edutech
4. Tourism Tech
5. Space and Defence Technologies

There is a need to incentivise IP/Patents creation by start-ups more aggressively. E.g. Certain grants/loans available to only IP based start-ups.

- There is a need to aggressively identify Industry immersion opportunities (symbiotic relationships, vertical integration opportunities etc.) for start-ups via KSUM. Established businesses may have a problem, a start-up can solve cost effectively and this will help start-ups to mature their products to solve real world problems. KSUM could broker such B2B connects based on a well-established business network.

iv. Issues regarding Funding and Investment

As discussed earlier, Kerala has early funding avenues for the Startups. KSUM itself provides grants and loans up to Rs. 30 Lakhs for start-ups. However, there is no mechanism to provide bridge funding to start-ups in the range of 30 lakhs - 2 Crore. Typically, Angel investors fills this gap in a successful ecosystem. This is a weak area of the Kerala Ecosystem. Funding delays is also an issue affecting survival of start-ups.

This could be addressed through following solutions/ policy perspectives
- Strengthening bridge funding via KFC, KSIDC etc. with startup loan targets for those entities.
- Develop stronger angel networks and HNI connects with more purposeful initiatives from KSUM, involving diaspora and other pan India angel networks.
- Create a special Startup bridge fund arm under KSUM to provide funding up to the tune of Rs.2 CR in the form of Equity/Debt Financing/Convertible Notes etc. This arm should be set up as a commercially viable entity (without any grants) with expertise in evaluating and funding start-ups. Funding should be based on stringent criteria and company/project viability assessment. This arm should be able to sustain itself over the long term based on proceeds from eventual exits, sale of equities or payback on debt instruments. This body should have expertise in areas such as financial analysis, firm valuation, business analysis etc. to make appropriate funding decisions, manag-

ing the overall portfolio risk. The successful model of North East Development Fund (NEDF) could be adopted as a model while designing such a funding mechanism

v. Support to Startups other than IT product startups

As such startup policies and schemes are only supporting IT product startups. KSUM provide little support to service companies and non-IT product companies. The other agencies which support such entities are oriented more towards asset heavy business and is not much of formal support is available for the growth such companies in Kerala

This could be addressed through the following solutions/ policy perspectives

- Expand focus to service start-ups- offering support to start-ups providing IT or non-IT services in B2B or B2C model. The functional and business knowledge gained from services will also help spawn more product start-ups in Kerala.

vi. Capacity Building within Government for Promotion of Startups

As discussed earlier, in contrast to other popular locations of startup growth in India and abroad, the role of Government (KSUM) in promoting startups is extremely crucial in Kerala. Lack of professional industries to support startups is a major limitation in the system which needs to be filled by KSUM. However at present the Bandwidth and capability available in Kerala Startup Mission to give tailored support and guidance to individual start-ups is limited and needs to be enhanced

Solution Ideas/Policy Perspectives:

- Increase professional depth and breadth of KSUM staff– recruit venture catalysts, experienced managers and specialised mentors on full time scale of pay roles guide and mentor start-ups. This should include general management, technical, functional, finance, and functional experts, who are willing to give back to society.
- There is a need to invest in developing a professional services capability in KSUM with the intent of making it financially independent in 5 years (for administrative costs). This includes project management and program management capabilities that can be offered for a professional fee at both at a national and international level for providing services relevant to Startup ecosystem (running hackathons, incubators, engaging start-ups to deliver projects etc.). These services are in high demand with the global focus on start-ups. This will help Kerala's start-ups in general, in the form of better support and reduce the administrative overhead on Govt.

vii. Issues of Inclusivity : very few women led startups

Despite having a large proportion of women in S&T education, the number of women led startups are very few at around 10-12% in Kerala. This is an important area that needs attention

Some of the methods to address the same could be

- Provide grants to social enterprises that run structured programs to train and empower women towards establishing micro enterprises of their own
- Provide subsidies or special incentives to women led startups in targeted industries
- Institutionalize recognitions and awards for successful women led startups

Review of Incubation Centres

Incubation Centres are units that provide handholding support to early stage entrepreneurs to develop and scale up their production. Kerala has around 47 incubators in addition to various tinkering units (ATAL Tinkering labs) in schools and a few themes focused accelerators. The various incubation centres can be divided under following categories

- Academic Incubators funded by GOI: NITC, IIMK, TIMED, Engineering Colleges etc.
- Academic Incubators funded by GOK: KSIDC, KSUM
- Government Incubators : KSUM- General & Specialised
- Accelerators: Specialised accelerators and Centres of Excellence like Maker village
- Tinkering Labs, IEDCs, early incubators
- Innovation Support Schemes: YIP, IIIC etc.
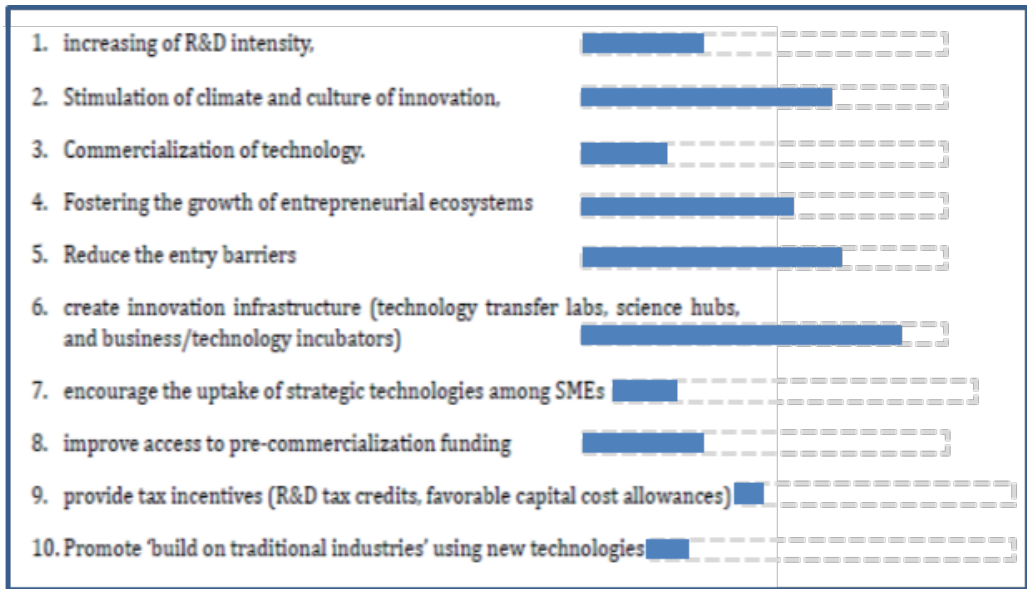- Rural incubators – Technolodges supported by KSITL

In all these incubators, Government provide direct support in terms of Capital or operational support or indirect support to startups operating from them through training, capacity building, funding etc.

While these incubators provide support to early-stage startups, a major limitation in Kerala ecosystem is the lack of corporate incubators which provide direct market connect to enable validation and scaling up of products. Similarly, other than incubators promoted by Rubber Research Institute and Sri Chitra Thirunal Institute of Medical Science and Technology, no major R&D institution also has set up impactful incubators so far. Thus, the next stage of growth startup ecosystem should focus on promotion of Research Incubators that provide translational research support for Technologies and IPs developed in the laboratories and research centres to help develop the research-intensive start-ups from Kerala. It is also pertinent to note that the share of patents in Startup ecosystem in Kerala is only 1.8% compared Karanatka which hold 24.3% of patents amongst startups in India

Policy Changes

Kerala already has a comprehensive policy for promotion of technology startups. Some of the areas of improvement in the policy is already presented in the earlier sections. To understand the areas which require improvement, performance on Kerala on various elements for developing a technology entrepreneurship ecosystem is assessed and is presented in the figure 1.

Figure 1 Various elements for developing a technology entrepreneurship ecosystem

1. increasing of R&D intensity,
2. Stimulation of climate and culture of innovation,
3. Commercialization of technology.
4. Fostering the growth of entrepreneurial ecosystems
5. Reduce the entry barriers
6. create innovation infrastructure (technology transfer labs, science hubs, and business/technology incubators)
7. encourage the uptake of strategic technologies among SMEs
8. improve access to pre-commercialization funding
9. provide tax incentives (R&D tax credits, favorable capital cost allowances)
10. Promote 'build on traditional industries' using new technologies

As seen from the figure, the existing policy framework was successful in creating innovation infrastructure and to stimulate the climate and culture of innovation. There is a need to have policy measures to support other elements like Increasing R&D intensity, technology commecialisation (technology incubation), creating tied ups with SMEs, enhance pre-commercialisation funding (in the range f Rs 30 lakh-Rs 3 Crores) and provide fiscal support or production incentives. It is also important to explore the possibility of usng technology to build further on traditional industries to achieve a more vibrant and inclusive ecosystem

CHAPTER 5
COMMUNICATION AND INTERNET INFRASTRUCTURE

Kerala is moving as a digital economy. The communication and Internet infrastructure is going to be the enabling agent in the future to establish the next era of growth.

Terms of Reference
1. Benchmark Kerala with other leading States on availability, access and quality of communication and internet infrastructure. Evaluate the progress of the State-driven as well as market -led (private sector) infrastructure creation
2. Estimate the investments required to create a national best communication and internet infrastructure keeping in view the ambitions of Digital Transformation Mision timelines
3. Assess the access levels of BPL and other vulnerable population for this critical infrastructure and propose program and policies to provide free access Kerala is having one of the highest penetration of Internet in the country, even more so than the national average. It is due to various factors such as demand, high population density and also telecom infrastructure build up. Due to High literacy in the state, there has been fairly easier acceptance of technology and the push from the Government for digitising records, and government processes.

The use of Internet and telecommunication has also been growing with the advent of 3G and 4G data infrastructure. The use of wireless communications is far higher than the wired communication across the State. The other distinction which is vital for understanding of the communication and internet infrastructure is divide of the Rural and Urban users. Kerala has round 44% of total subscribers coming from the Rural population. It is vital to understand this since it has direct implications on the expansion of the growth of users and also penetration of the Internet infrastructure.

Kerala and Country
The data from the TRAI - The Indian Telecom Service performance indicators (January-March 2021) gives important insights from the perspective of the country and performance of the State. (Annexure I)

Important Observation points:
1. Kerala Rate of growth of total subscribers is only 0.15% against the national average of 2.33%
2. Out of total subscribers Kerala has 44.32% subscribers coming from rural areas against the national average of 44.74%.
3. Kerala has one of the highest Tele-density of 129.47% against the national tele-density of 88.17%
4. In terms of wireless scubscribers the growth in Kerala is only a meagre 0.36% against the national average of 2.36%

It would be essential to understand the above observation points in relation to the geographic and the socio-cultural aspects of the State of Kerala

There is a stagnation in terms of new subscribers, this could be the already high tele-density in the State. This is established by the fact that Kerala has total of 46.1 million total subscribers.

The rural and urban spread of the subscribers is fairly uniform in the state, with the share of rural subscribers coming at par with the National average.

Kerala tele-density of 129.47% tells that the penetration of use of communication devices, internet has reached optimum levels spread. There are not major differences of users in terms of rural and urban population divide.

Challenges for Tele-communications

Even though there has been high tele-density in Kerala, it doesn't imply that the quality of the connectivity is at par with what is required for bringing in the next digital revolution. At present there are various pockets of colonies where the Communication networks has not been established for high end data exchange. There are pockets of areas where the wireless connectivity is not at par with the 4G or 3G speeds. This puts a major limitations on the possible expansions of markets and economy in terms of data exchanges.

The pockets of land not having telecom connectivity in terms of Mobile coverage are still a major concern along with pockets of land in urban areas where the quality of coverage has still not reached 4G standards.

The wired connectivity in terms of Broadband based and Fibre based connections have increased in the urban areas and local operators have taken these connections to further many households.

NEXT- Generation Connectivity

The future of connevtivty is based on Optical Fibre cabling and 5G infrastructure. The expansion of next generation connectivity can only be established if the State creates conducive and simpler mechanism for private and state players to establish Optical fibres and telecom infrastructure.

Kerala's present system of Single Window clearance system needs further refinement and to make it trule easier for businesses to setup infrastructure. Present, the telecom providers have to give a proposal for laying of OFC cabling to the Goverment and then through a physicall process, a Government order is issued. The entire process has to be made online and simpler for management and regulation.

The establishment of Telecom towers is the next target for the expansion of the communication infrastructure. The telecom infrastructure has to be approved by the local self governments and has to be in tandem with the Building rules established by the State.

According to the 'Making India 5G Ready' report developed in August 2018, by the 5G High-Level forum constituted by DoT:

"5G will require massive addition of both above and below the ground infrastructure, both in

passive and active categories. These include backhaul radios, antennas, towers, street furniture, and ducts, etc. In the long term, 5G infrastructure densification can exceed 1,000 Base Stations per Sq. Km."

The challenges on both the above issues can be summarised as follows:

Legal Issues

The government regulatory function should be limited to giving permissions for the infrastructure of OFC and Telecom towers.

The rules pertaining to clearances and permissions need to be made completely online and there should be a time limit to the possible approval or rejection of the application

The permissions should be truly single window and the applicant for setting up of new towers or OFC should not be going to multiple agencies for getting a permission

Socio-Cultural Issues

In terms of expansion of 4G to 5G the telecom infrastructure would be expanded almost 100 times the present. This can only be done with the support of the citizens and creating demand for higher speeds of connectivity.

The mis-information on part of telecom towers need to be dispensed with and clear science based information needs to be told to the factions of society having fear towards the telecom towers in terms of EMF radiation and alleged health affects of living near the Telecom towers.

Technical Issues

The expansion of the telecom infrastructure would be based on the use cases of the established new connectivity avenues.

The use of 5G is still under testing and can open doors for development of new technologies and use cases for changing the lives of the citizens.

The expansion and provisioning of higher connectivity speeds would allow the private and public sector to use and establish new applications and physical devices for use of public.

There has to be established take-up of the new technology from the private sector as well as citizens.

Government should incentivise companies working in the sector and ensure that the take up of the established products is by the government and other private companies alike.

The incentivising structure could be based not just on monetary compensations and supports but also on take ups and integration with the existing public infrastructure such as use of KFON network and also government buildings

Providing Connectivity to untouched and BPL areas

The Government has already provisioned various schemes for providing internet for the public use. The Public use internet scheme need to be expanded for covering the colonies/locations that do not have multiple TSP and ISPs providing cheap internet connections.

1. The Tribal colonies in the states need to be ensured to be provided internet connectivity.
2. The BPL families in each of the villages should be provided internet connectivity.

The identification of the families eligible for the free internet connectivity should be prepared at the local self government level.

The eligible list of beneficiaries should be verified by the District Collectors. The free internet connection should be provided at the state level and the finalisation of the prices and agency should be done at state level.

CHAPTER 6
MAJOR CHALLENGES/ISSUES

Industry Investment and Capacity Building

1. Programs can be envisioned to support long term vision.

1. Clean and sustainable world-how IT solutions can create a sustainable future, reduce pollutions, improve energy usage and production and reach targets of zero emission.
2. Digital health for better quality of life-the acquisition, management, and use of information in health can greatly enhance the quality and efficiency of medical care and the response to widespread public health emergencies.
3. Technologies for social good-how societies can be made better with IT Technologies. New ways of social interaction and connecting the society at large
4. Improve IT reach and influence of infrastructure- ways to help improve the quality of IT infrastructure and digital readiness across the State.
5. Disaster Management-Kerala needs ability to predict and manage natural disasters that has become high these years-Technology plays a huge role in both the prediction and management of natural disasters. Building specialization centres to promote skills and capacity on Data Analytics, IOT, GIS systems, Disaster Management supply chains etc will be needed.

II. Information Technology startups

1. Focus of the startup ecosystem-Kerala startup ecosystem provides only limited support outside IT product startups.
2. Lack of High value startups and Unicorns-Kerla as a State have been successful in evangelizing concept of entrepreneurship and startups among students and other stakeholders. This is reflected in the large number of startups currently registered from Kerala. However success on graduation rate of startups needs to improve. Kerala is home to roughly 6000 startups, of which about 4000 are registered with KSUM. However the State is yet to create a unicorn or major success story from this cohort.
3. Product Maturity and quality of startup products-Even though bulk of Kerala's startups are in IT product space, they lack of product sophistication and entrepreneurs often exhibit herd mentality with focus on limited use cases and limited understanding of customer/market needs. This is affecting the market readiness of many products.
4. Issues regarding funding and investment-Kerala has early funding avenues for the startups. KSUM itself provides grants and loans up to Rs 30 lakh for startups. However there is no mechanism to provide bridge funding to startups in the range of 30 lakhs-2crore. Typically Angel investors fill this gap in a successful ecosystem. This is a weak area of the Kerala Ecosystem. Funding delay is also an issue affecting survival of startups.
5. Support to startups other than IT product startups-As such startup policies and schemes are only supporting IT product startups. KSUM provide little support to

service companies and non IT product companies. The other agencies which support such entities are oriented more towards asset heavy business and is not much of formal support is available for the growth of such companies in Kerala.

6. Capacity building within Government for promotion startups- At present the Bandwidth and capability available in Kerala startup Mission to give tailored support and guidance to individual startups is limited and needs to be enhanced.

7. Issues of inclusivity-very few women led startups. Despite having a large proportion of women in Science and Technology education, the number of women led startups are very few at around 10-12% in Kerala. This is an important area that needs attention.

III. Communication and Internet Infrastructure

1. Challenges for Tele-communications-Even though there has been high tele-density in Kerala, it doesn't imply that the quality of the connectivity is at par with what is required for brining in the next digital revolution. At present there are various pockets of colonies where the communication networks has not been established for high data exchange. There are pockets of areas where the wireless connection is not at par with the 4G or 3G speeds.

2. The pockets of land not having telecom connectivity in terms of Mobile coverage are still a major concern along with pockets of land in urban areas where the quality of coverage has still not reached 4G standards.

3. Legal issues-The government regulatory function should be limited to giving permissions for the infrastructure of OFC and Telecom towers..

4. Socio cultural issues-In terms of expansion of 4G to 5G, the telecom infrastructure would be expanded almost 100 times the present. This can only be done with the support of the citizens and creating demand for higher speeds of connectivity.

5. Technical issues-The expansion of the telecom infrastructure would be based on the use cases of the established new connectivity avenues. The use of 5G is still under testing and can open doors for development of new technologies and use cases for changing the lives of the citizens.

CHAPTER 7
FINDINGS AND RECOMMENDATIONS

I Industry Investment and Capacity Building

1. To ensure equality in digital society, it becomes essential to make the widespread availability of good communication infrastructure, access to internet, access to computers and access to trained teachers at affordable costs to the citizens.
2. Proper training and early awareness provides an opportunity for teachers to ensure accessibility for all learners according to their needs.
3. The differently abled and disabled individuals as well as those in socially vulnerable situations would need to be given special attention.
4. Digital innovation labs could be set up throughout the State, to drive grassroot innovations.
5. The access to cloud computing and product testing infrastructure could be provided at subsidized rates to encourage entrepreneurs, students and innovators to develop various data intelligence innovations.
6. The use of artificial intelligence, virtual reality, robotics and electronics technologies can enable and improve the effectiveness of a wide range of teaching and learning techniques such as flipped learning, project based learning problem based learning and research led learning.
7. The State could envision setting up specialized fabs that focus on specific domains like sensors, memories or displays. The chip fabrication is capital intensive, however, it is an essential requirement to ensure indigenization of developing high quality electronics products.
8. Development of carbon neutral IT solutions are an important aspect in the future society.
9. Some of the emerging areas where India, Kerala State could emerge as the leading global destination are fabless design centres, embedded architecture, embedded systems design, VLSI design capabilities etc. Hence it is suggested that Centres of Excellence for common core infrastructure facilities be established in key locations on a PPP model led by the industry and supported by the Government up to 49% of the capex and operational expense that can help IT companies train people to develop skills, ideate, prototype and test solutions in a low cost and time efficient manner.
10. The universities in the state should aim to extend the boundaries of fundamental research to more towards applied research that can have immediate impact in the society and industry at large.
11. The universities should add technology transfer to create new products and industries as one of the primary objectives. To help this, faculty should be encourage to develop companies and products with students and make it legal for such faculty to take on multiple roles. The employment restriction in taking multiple roles should be abolished.
12. The students and faculty should be made aware of professional codes of conduct and practice them on a daily basis.

1. The government of Kerala consider adopting a cluster of Innovation program that can encourage companies, think tanks and academic/research institutions to undertake joint R&D projects and co-create innovative technologies and products.

2. Some of the recommended technical/business areas for consideration would include Mobility, Energy, Digital, Health and Advance Manufacturing and support the concept Make India for India and world through India stack /platformization strategy.

3. Considering the gap in Industry Academia collaboration, it is proposed to announce a CM Fellowship program of giving grant (up to 50% of the total costs) to Doctoral/postdoctoral scholars in few selected areas. A virtual fellowship team could be formed and incentivized to solve critical problems.

4. To promote industry engagement and promote scientific temper in the State, specific schemes can be created to fund the visits of industry fellows and scientists to work across the universities and research labs.

5. By enhancing the infrastructure facilities to Industry standard and by suitably enabling the faculty members on industrial domain skills, higher education institutions could productively augment their facilities and human resources for providing skills and knowledge, which will be beneficial for students, faculty and institution.

6. Government shall make investments in implementing such capabilities in the educational institutions for Learning Management, Virtual classroom equipment, Virtual classroom studies, connectivity and computing infrastructure.

7. To meet the requirements of the industry, the labs in Higher education institutions would need an upgrade of the equipment.

8. Gig economy is an emerging trend in the workplace all across the world. To prepare students for such new work models enabling student participation in Gig platforms and Gig economic activities while they are studying shall be a focus area for educational institutions.

9. Skill program accreditation body may be formed under development of electronics and IT to annually monitor, rate and approve skill based IT programs offered by Industries and institutions.

10. Knowledge capabilities in Engineering and Technology institutions will need to be strengthened to develop deep knowledge in medical devices industry domain.

11. Building skill centres in financial services and creating a talent pool in this domain alongside, technology areas such as Block chain can make Kerala a unique place for fulfilling the Non-Banking Financial centre needs of the State and outside.

12. Investments in educational institutions and development of "creative spaces" with various elements of creative industry can significantly improve the talent in creative space, thereby attracting new generation companies to the state.

13. ICFOSS could take the lead in developing open source technologies in association with students and startups, looking at the needs presented in the community

14. Digital University Kerala could take a leading role in developing open source technologies for hardware and integrated chip development where researches and engineers can help to provide open source solutions.

15. Universities such as Digital University, KTU and CUSAT could take a lead in creating an environment for promoting open source design in technology and engineering among undergraduate engineering/technology students.

16. Special schemes can be envisioned for training the entrepreneurs. The specific schemes for IT incubators under Kerala startup Mission can be expanded for software based entrepreneurs and Maker village can be used for extending the support for hardware entrepreneurs.

17. The incubators in the colleges can be offered specific funds to develop industry inner vision programs to cultivate the growth of entrepreneurship thinking among undergraduate students.

18. The universities in the State can help to develop curriculum and e-learning resources for inculcating entrepreneurship thinking among staff and students.

19. The companies could offer a range of industrial training and internship programs in partnership with universities to train the students and staff in entrepreneurship.

II. Information Technology Startups

1. Kerala startup Ecosystem provides only limited support outside IT product startups. This could be addressed through the following solutions. Establishing focused accelerators and incubators for non-IT startups in areas such as AgriTech, HealthTech, EduTech, Tourism Ayurveda, Genomics etc where Kerala has some existing strength. Involving reputed research, business and commercial entities in these areas for providing functional and business expertise/support to make this effective. Promote Digital transformation of non-IT MSME to help them compete globally. Linkage between the MSME and startup needs to be promoted as part of the policy.

2. Lack of High value startups and unicoms this could be addressed through the following solutions. Kerala Startup Mission should develop measurement frameworks, processes and expert capacity towards this purpose. Kerala Startup Mission also needs to develop and onboard a network of fulltime and part time technical experts/product managers/business advisors with global exposure. The experts will complement the above mentioned frameworks and process as well as help mature organizational capabilities, governance, product innovation etc. Facilitate broader market access for Kerala Startups.

3. Product Maturity and quality of startup products-This could be addressed through following solutions. Kerala has already invested in Design and Prototyping including Fab Labs. We need to extent it to soft capabilities and design specific training in areas such as design thinking, customer experience optimization, conducting customer workshops and focus group requirements, elicitation techniques etc. Establish incubators/accelerators with vertical or horizontal focus to develop startups with specialized/niche expertise and resultant products/services. Such incubators to be established in cloud computing, Big Data and AI, IOT and connected Technologies, Cyber Security and Augmented/virtual Reality. There is a need to incentivise IP/Patents creation by startups more aggressively. There is a need to aggressively identify industry immersion opportunities for startups via KSUM.

1. Funding and Investment-Strengthening bridge funding via KFC, KSIDC etc with startup loan targets for those entities. Develop stronger angel networks and HNI connects with more purposeful initiatives from KSUM. Create a special startup bridge fund are under KSUM to provide funding up to the tune of ₹2 crore in the form of equity/Debit Financing/convertible notes etc.
2. Support to startups other than IT product startups-Expand focus to service startups offering support to startups providing IT or non IT service in B2B on B2C model.
3. Capacity building within Government for promotion of startups-Increase professional depth and breadth of KSUM staff-recruit venture catalysts experienced managers and specialized mentors on full time scale of pay roles guide and mentor startups. There is a need to invest in developing a professional services capability in KSUM with the intent of making it financially independent in 5 years.
4. Issues of inclusivity-very few women led startups. Provide grants to social enterprises that run structured programs to train and empower women towards establishing micro enterprises of their own. Provide subsides on special incentives to women led startups in targeted industries. Institutionalize recognitions and awards for successful women led startups.

III Communication and Internet infrastructure
1. Legal issues-The rules pertaining to clearances and permissions need to be made completely online and there should be a time limit to the possible approval or rejection.
2. Social cultural issues- The mis-information on part of telecom towers need to be dispersed with and clear science based information needs to be told to the factions of society having fear towards the telecom towers in terms of EMF radiation and alleged health affects of living near the Telecom towers.
3. Technical issues-The use of 5G is still under testing and can open doors for development of new technologies and use cases for changing the lives of the citizens.
4. The expansion and provisioning of higher connectivity speeds would allow the private and public sector to use and establish new applications and physical devices for use of public.
5. Government should incentivize companies working in the sector and ensure that the take up of the established products is by the government and other private companies alike.
6. The Tribal colonies in the State need to be ensured to be provided internet connectivity.
7. The BPL families in each of the villages should be provided internet connectivity.
8. The identification of the families eligible for the free internet connectivity should be prepared at the local self-government level.
9. The eligible list of beneficiaries should be verified by the District collectors.

CHAPTER 8
ROADMAP- DIRECTIONS FOR GROWTH

The primary purpose of the road map   is to act as a blue print for the State in its resolve to use technology to develop, improve and enhance the wellbeing of its people. As Kerala is transforming itself into a knowledge economy, its forward progress has to be sustained through modernizing and developing all productive sectors of the Kerala economy. This forms the agenda for the next decade of growth. The impressive performance of the State with respect to human development indices needs to be leveraged for economic growth of the region by moving up in the value chain. The use of technologies for improving governance and delivery of services to citizen will also be a key consideration.   Keeping this in mind, the future focus of the Electronics and IT sector of the State is divided into two, the economic development and social development respectively. This is captured in Fig 2. As shown in Figure, the economic growth can be specific while the social growth can be targeted on the attainment of Sustainable Development Goals through digital transformation by leveraging on technology. In order to achieve the same, as discussed in the report, there is a need to enhance the infrastructure- both physical and human-, create ecosystems for fostering innovation, entrepreneurship and startups and improve the governance by adopting smart governance principles. To strengthen these enablers, there is a need to have specific policy interventions and investments in some infrastructure by the Government. Additionally, to foster innovation, to support entrepreneurship and to facilitate digital transformation for social good, fiscal incentives may have to be designed, from time to time. These are explained in the next few sections

Output	Economic Growth **Kerala to contribute to 10% of Indian IT & Electronics Industry in next 5 years**	Social Growth **Attainment of sustainable Development Goals through Digital Technologies**	Policy	Investment	Fiscal Incentives
Enablers	Infrastructure Development/Augmentation		Support		
	Human resource Development				
	Innovation, Startups and Entrepreneurship ecosystem				
	E-Governance and Smart Government				

Fig 2. Conceptual Roadmap for Electronics and IT sector

Roadmap- The outcomes

The overall outcome of the Strategy is to transform Kerala as an inclusive Knowledge Society. To achieve this, the State has to focus both on social and economic dimensions. As discussed earlier, Kerala could not gain much from the information technology growth so far and the State's share of the industry is abysmally low when compared to its immediate neighbours. One of the key targets for the next five year plan is to address this. The trend towards decentralized development in IT as against current model where growth is concentrated on a few centralized hubs can be a major advantage for the State, which has state wide urban continuum with good civil facilities. Keeping this in mind, it is proposed that Kerala should target garnering 10% of IT market share of the country in next 5 years. With IT sector estimated to reach around USD 350 Bn, this translate to around USD 35Bn. This is almost 10 times growth from the current level of around USD 4Bn. Similar growth may be targeted for Electronics industry also.

To make Kerala, a true knowledge society, the ambitious target in economic growth of IT industry have to be supplemented by focusing on the power of digital technologies in overall societal growth also. This involves adoption of digital technologies for rapid transformation of several basic sectors that affect human development. The attainment of various Sustainable Development Goals by leveraging on technology could be a good way forward in this direction. Technology could be used to minimize wastage, enhance the reach and facilitate several inclusive models of growth. Designing specific schemes towards this form the other aspect of the outcome expected during the next plan period.

The enablers

The digital strategy for the Kerala should build on its existing strengths. Some of the elements of which form the base of next stage of growth of IT sector in the state are given below

Infrastructure Development and Augmentation

The infrastructure forms a key element of development of any industry. Kerala was one of the first states in India to create a Wide Area Network (WAN) and later pursued innovative initiatives like Kerala Optic Fiber Network (KFON Project) which envisions providing high quality bandwidth connectivity across the State. Once KFON become fully functional within a year, Kerala will be the first State in India with seamless giga fiber connectivity across the State. State should plan to build its strategy for next stage of growth on this Information Highway to achieve technology led economic and social growth

One such opportunity is brought in by the global pandemic Covid-19 which created unprecedented disruptions in the work and life of people all around the globe. With uncontrolled spread of pandemic across the world, several countries have adopted lock down of normal activities of different durations. Many countries in Europe, Americas, Asian and African regions have drastically altered the conventional way of working of office spaces, factories, education institutions, entertainment and trade zones. Many of the service industries have adopted *Work From Home* practice where in the digitally controlled work in remote locations at individual or small group level is increasingly replacing the centralized

way of working prevalent till the onset of Covid-19 in early 2020. With the centralised nature of operation of IT industry getting altered to decentralised dispersed workspaces, Kerala can create a unique model of creating small work spaces throughout the length and breadth of the State which can bring in work from across the globe. This can facilitate State to convert itself as a global hub of developers and IT professionals working in small cohorts near their home and exotic locations throughout the State connected through a strong internet backbone provided through KFON. State should incentivize private entrepreneurs to set up small world class Work Near Home (WNH) centres which provides safe and secure workspaces. Specifically, dedicated development corridors have to identified to establish WNH centres to support decentralised growth in IT. The corridors between Trivandrum Technopark and Kollan IT Park, Chertala IT Park to Korallty IT park covering Inforpark region, Cyberpark Kozhikode to Kannur and Malappuram etc. can be developed as model IT corridors for decentalised growth

The third element of infrastructure that may enable the growth of the sector is establishment of common facilities for facilitating growth. This is relevant both for electronics and IT industries. In case of electronic industry, common testing facilities for various ESDM companies can prove to be a major factor for attracting SMEs in this sector. Similarly, in IT industry, State should strive to develop itself as a hub for IT product development. Success of IT product companies from Kerala like IBS, SunTec etc. is indicative of this potential. As next stage of growth of IT will be driven by product companies, State could create a policy framework that facilitate development of domestic IT product companies. Product testing facilities, mechanisms for early adoption of product, support for certifications, government run/ supported program on product development, fiscal incentives to support marketing, quality management etc. could be some of the factors that can facilitate this development.

Human Resource Development
The key resource that drives growth in IT and Electronics industry is the availability of quality human resources. The success of Kerala in providing educated resources for the development of Middle East region in 70's& 80's is a good example of how good quality resource could bring unprecedented growth in a region. The next stage of growth of IT industry require people at all levels specialized in several new technologies like Big Data, artificial intelligence, cloud computing, and other industry 4.0 technologies etc. Many of the conventional sectors, which had very limited adoption of IT so far, have started a rapid digital transformation move, primarily to address the challenges posed by the pandemic. In order to drive this transformation, resources at all levels of the growth pyramid are necessary. As discussed earlier in this report, proper interventions in developing human resources, combined with development of decentralized workspaces, can transform Kerala as a global software development hub or application development hub. During the next 5 years, it is expected that more than 10 Million jobs are getting created in this sector. By focusing on the aspects of Digital software engineering and application engineering, distributed computing, and DevOps and continuous integration, the State could harness a substantial portion of this demand. This can be done by creating a three tier digital curriculum which encompasses ITI, Diploma and Engineering/Post graduation, which would provide ample manpower with appropriate skill sets.

Another key element that could foster the industry is the development of resources capable of leading the knowledge industries from the State. As the new areas of IR 4.0 namely AI, Big Data, Blockchain, Quantum Computing, Cyber security, Space science etc. require knowledge intensive workers specializing in several application domains. The development of this talent forms a key mandate for the Universities and Higher Education Institutions of the State. The State should set up specialized centers of excellence in specific areas like Fintech, Health informatics, Digital tourism etc. to drive the growth in such areas. This will also enable the growth of conventional sectors of growth in the State along with the IT industry. Kerala University of Digital Sciences, Innovation and Technology (Digital University) needs to drive this transformation by setting up such CoEs which can act as catalysts for growth of High technology industry ecosystem in the State

Innovation, startups and entrepreneurship ecosystem

The IT industry in Kerala is primarily driven by homegrown companies as against the investment made by MNCs in other major hubs in the country like Bangalore and Hyderabad. Even though State has presence of a few global majors, the scale of operation of them is very low compared to the performance of domestic IT companies. There are several small IT companies and startups who are working on niche technologies and products and have potential to grow as large corporations, if right ecosystem support is extended to them. In the next stage of growth of IT and Electronics industries, the State should focus on these companies and create an ecosystem to facilitate their accelerated growth. Kerala was the first state in India to develop a startup policy that would help build various projects both in software and hardware. Though, the support from the Government for creation of startup ecosystem provided during the 13th Five year plan period is considered best in the country, there are several areas of improvement which needs to be addressed during the next phase of development. Support for innovative startups, provision for supporting R&D, testing facilities for electronics startups, fiscal incentives for IT and ITES service startups for expanding their business etc. could be some of them. Direct support from Government to adopt innovative products from startups by setting up innovation zones in all development line departments could prove to be very beneficial to the ecosystem. Similarly fiscal incentives for startups and companies that provide innovative solutions for rapid digital transformation of conventional sectors could be another right step in supporting an inclusive ecosystem for development of next generation SMEs and startups with exponential growth potential. As many of the homegrown startups are in the early stages of their accelerated growth, creation of venture capital fund for supporting their growth needs to be a key priority during the next plan period.

E-Governance and smart Government

As discussed earlier, Kerala is one of the top players in E-Governance in the country. Several initiatives from Kerala had become national models. The Akshaya Kendras, started in 2002 to provide citizen centric services have paved way for nationwide deployment of CSCs and the KITE (formerly IT@School) which stewards IT infrastructure and education in schools has proven to be invaluable during Covid times to ensure delivery of uninterrupted education all across the State. While State had made great strides in E-Governance at the

transaction level, there is a huge scope in developing it further to support creation of "Smart Government". The adoption of enterprise architecture similar to IndEA to provide seamless access to various services, creation of intelligence from the unified data to proactively bring about welfare measures, enhancing spend efficiency, increasing responsiveness to demand etc. are some of the areas to be focused in the next stage of accelerated growth. The e-governance today is focusing more on providing existing services to citizens over a digital platform and to enhance speed of operation within the Government. However, the next stage of e-governance needs to be transformative focusing on business intelligence that can be extracted from vast quantity of data dispersed within various departments. This should form a key agenda for the next stage development of e-government in Kerala. This could be developed with the support of startups and SMEs in the State.

The roadmap presented in fig 2 above provides three key elements of intervention to stimulate the enablers explained so far to achieve the stretched targets of social and economic development. These are explained in the next section

Interventions and Action Points

The key interventions which are required for supporting the exponential growth IT, ITES and electronic industry in the State could be broadly divided into three namely Policy Support, Investment Support and Fiscal incentives.

Policy Support

Kerala has an IT policy formulated in 2017 with 9 sub policies including one covering ESDM (hardware). Additionally, the EV policy of the State also overlaps with the development of electronics industry in the State. Together, these policies provide a very comprehensive model for development of the industry in Kerala. However, several elements of these exhaustive polices needs to be implemented effectively. It is necessary to revisit the policies to have a realistic assessment of areas which needs improvement in the present context and create a five-year roadmap for implementation. A key missing element in the current policy framework is the use of Data. A futuristic data policy which could provide right framework for extracting value from the data while ensuring the highest levels of protection of privacy and security of personal information should be an immediate priority. Similarly, there is a need to provide a clear and unambiguous framework for adoption of Industry 4.0 technologies. As a progressive State, Kerala should be a pioneer in bringing about policy prescriptions for adoption of AI, Blockchain, Cloud computing etc. in various aspects of governance and shall provide policy support for curating a right ecosystem for innovative startups and SMEs in these emerging areas. The State should also have a proper e-waste management policy. As workforce will increasingly shift to platform-based gig works, Kerala should bring policy support to facilitate the same while ensuring the welfare of the gig worker through appropriate social security measures.

Investment and Infrastructure

In order to facilitate the exponential growth of industry, there is a need for State to make substantial investment in augmenting physical and intellectual resources. In addition to the Rs 1500 Crore KFON network, State should invest partially in creating decentralised

work spaces (Work near Homes). The State should also plan to invest in common infrastructure to support the growth of IT product companies, electronics manufacturing units etc. Common testing infrastructure, IP support centres, common facility centres (like common cloud computing space, software banks, component procurement support system etc.) needs to be established in different parts of the State, perhaps with the support of private sector. As 5G rollout is expected across the nation by end of 2022, another key area of focus for next plan period will be to create an environment conducive for development of 5G industries in Kerala, Towards this, the KFON infrastructure have to be supplemented with a tower and dense antenna infrastructure so that Kerala can take a leadership role in 5G. Innovative policy and incentive measures have to be developed to make the State as the fully 5G enabled State within next plan period of 5 years. Rather than leveraging 5G for improving communication speed, the State should make investments in 5G enabling infrastructure with a view to leverage extensive 5G network for supporting industries that develop 5G products and services as well as to enhance the efficiency and productivity of existing business concerns and Government units by adopting smart technologies based on faster communication offered by 5G. The adoption of 5G should be viewed as way of transitioning Kerala into a "smart state" during the next plan period. Another key area of investment will be in augmenting the intellectual infrastructure of the State. Establishment of Centres of excellence in Universities and HEIs, introduction of new programs, mass skilling programs in new technologies etc. form part of this. Depending on the resource availability, State could also venture into developing a full-fledged fab facility for electronic chip making which can help State to leap forward in electronics manufacturing or leverage on the fab ecosystem growing elsewhere in the country by creating a supply chain component ecosystem for electronic industries. Using defence offset for facilitating such growth shall be a key priority during the next plan period.

Incentives
Incentives for players and facilitating agencies that support achievement of economic and social goals form the third key element of the Strategy. With limited geographical resources, Kerala has a competitive disadvantage when compared with neighboring States, in providing physical incentives like low cost land, built up space etc. However, this vulnerability can be negated by crafting innovative incentive systems that support startups, early stage companies and growth oriented SMEs. The incentives could be low cost access to common facilities, government procurement of products, low cost funding through various government financial institutions, performance linked incentives like employment linked reduction in State share of GST, amortization of land cost over a longer period, support for day 1 operations, incentives for upgradation of skills of the resources etc. A comparison of incentives provided by various States of Indian Union needs to be made while finalizing the incentive structure for the future. In addition to the incentives to support startups and SMEs, innovative incentive schemes to be developed to make Kerala as hotbed of new technology industries. As discussed in Chapter 3, the sectors like Medical devices, Space, innovative materials, 5G etc. are to be prioritised and comprehensive development plans for supporting the growth of industries in such areas needs to be developed and implemented during the next plan period.

Creation of an industrial ecosystem based on 5G networks (5G Leadership)
As discussed earlier, 5G primarily provides two distinct advantages

i) Faster access to mobile internet and data services
ii) Better connectivity for smart devices (like IOT)

As per IAMAI, Kerala ranks top in the country, just after Delhi with respect to internet mobile penetration. Even in 2019, 56% of Keralites have smart phones to access mobile internet and almost 100% of the State is covered by mobile networks. With the commissioning of KFON, Kerala will become the State with highest high-speed fiber data connectivity coverage. The State has also leveraged on network connections effectively during the pandemic by delivering on-line education (ranked No.1 in the country) and health-care (telemedicine). With KFON expected to provide a stable backbone for current LTE networks, State is expected to have reliable, low cost and accessible internet even without having 5G. The high bandwidth backbone will also aid high speed and high capacity data services in the current network itself

However, on the other hand, the capability of 5G to support smart network can actually may prove to be a boon to the State's industrial development. Even though the lack of smart cities and factories (potential customers of IR 4.0) may be a demerit to create demand for 5G, the State can make best use of 5G if proactive measures are taken to develop an ecosystem of companies and startups that could develop5G solutions for the country. The State wide network availability (riding on the KFON backbone) could enable cheaper development of 5G solutions in a decentralized manner and provide opportunities to test them at different demographic and geographic conditions. This should complement the already established Centre for IIOT under Digital University,   to develop such an ecosystem. A model for creating "Smart Keralam" by deploying connected devices in various fields like agriculture, utility management etc. can prove to help traditional sectors in their rapid digital transformation   It is important that a very clear and feasible plan for developing an ecosystem that support IIOT companies needs to be developed by Government, if the State plans to adopt early rollout of 5G

The factors may prove to be advantageous for a service provider to rollout 5G in the State are
a) Availability of low cost fibre backbone from KFON (this, however, depends on the policy on competitive and innovative pricing of this infrastructure. This is important given the limited success of other physical infrastructure providers like KINFRA in promoting industrial development due to the polices followed so far in infrastructure allotment)
b) High mobile internet penetration and use of smart devices even in rural areas
c) Low cost power and high availability and reliability even in remote areas (especially during peak network consumption hours) (Again there is a necessity for rationalizing the tariff to support faster adoption)
d) Good quality public infrastructure spread throughout the State. This is a very important advantage as all these buildings can host small cell antennas. This will enable faster roll out

e) Emphasis on hardware startups and a highly favourable government policy to support startups including state run investment funds, highly subsidized infrastructure, test beds etc.

f) Presence of potential consumers. The presence of current and potential consumers of 5G network like Smart Hospitals, smart classrooms, telemedicine, smart utilities etc. can be an advantage (however, as noted in next section, there is a strong need to augment "smartness" in most of the fields when compared to other States)

g) Support of Government to experiment new solutions within Government and outside (KDISC, a government agency and Kerala Startup Mission provide ecosystem for supporting such early experimentation)

While the above factors make Kerala, ideal for 5G roll out, the following points needs to be addressed, as they may delay if not inhibit the 5G rollout in the State

i) Lack of concentrated demand. As against other States having a higher density urban conglomerate which provides economy of scale and easiness of deployment, the geographical spread of population may prove to be too costly for 5 G service provides in their attempt to sweat their investment

ii) Limited amount of digitalization Even though Kerala was an early over in e-governance, the digitalization of services is very poor and "smart" operations needs to be augmented substantially to justify use of 5G

iii) Lack of Smart cities, commercial applications and smart factories. The absence of large factories, smart cities, utilities who uses smart devices etc. can be a show spoiler as the demand for smart services is limited in the State currently. There is a need for measures to support the adoption of such devices and practices

iv) Lack of Visionary polices and turf wars between government agencies. This can be the major limiting factor. From the discussion so far, it is clear that 5G roll out need coordinated effort of multiple departments and has to be treated as a major shift for industrial growth in the State. However, prior experience shows that the myopic policies of different stakeholders may prove detrimental in implementing such a comprehensive vision. There is a need to sensitise the larger benefits of 5G for the State (especially in creating Knowledge industry ecosystem) and proper policies have to be rolled out cutting across departmental silos

v) Public resistance and mass campaign for social change. It is known that the roll out of 5G require densification of mobile antennas. This maybe lead to public ire as an ill-informed media may misguide public against 5G. Moreover, 5G rollout being done primarily by private sector (and that too by leveraging on public infrastructure like KFON), the common anti-corporate rhetoric may gain momentum leading to roll out challenges. There is a need to address this proactively

If these issues can be addressed comprehensively through appropriate policy interventions and innovative schemes, Kerala can create a unique leadership position in new generation industries by leveraging on 5G

Closure

The roadmap outlined in this document is prepared by keeping the vision of Kerala to emerge as an inclusive knowledge society. As digital economy is radically re-defining the business landscape, there is a need to relook at the entire strategy of IT and electronics industry development keeping into account of internal and external forces of change. It is proposed that Digital Technology may be moved as a central element of strategy and be harnessed to realize the vision faster. By focusing on development of decentralized work spaces, muti-tier talent development, support to startups and SME units by creating common testing facilities, Kerala could develop the IT and Electronics industry in the State to realise both economic and social gains in next 5 years.

Appendix 1

PROCEEDINGS OF THE MEMBER SECRETARY STATE PLANNING BOARD

(Present: Sri Teeka Ram Meena IAS)

Sub:- Formulation of Fourteenth Five Year Plan (2022-27) – Constitution of Working Groups on **Information Technology** reg.

Read: -1. Note No.297/2021/PCD/SPB dated: 27/08/2021

      2. Guidelines on Working Groups

<u>ORDER No. 951/2021/SPB/I & I/DD   Dated   14 /9/2021</u>

As part of the formulation of Fourteenth Five Year Plan, it has been decided to constitute various Working Groups under the priority sectors. Accordingly, the Working Groups on **Information Technology** is here by constituted with the following members. The structure of the working group is in the form of a Core Group which encompasses three sub groups focusing different thematic areas. The Working Group shall also take into consideration the guidelines read 2nd above in fulfilling the tasks outlined in the ToR for the Group.

Chairperson (Core Group)

Sri.Biswanath Sinha,IAS, Principal Secretary, Department of Information Technology, Government of Kerala email- secy.itd@kerala.gov.in 9895122282

Members

1. Prof. S. M. Sameer, Professor, NIT Kozhikode email- sameer@nitc.ac.in 0495-2286720
2. Dr.Saji Gopinath, Vice Chancellor,Kerala University of Digital Sciences, Innovation & Technology email- vc@duk.ac.in 9400050850
3. Sri. Snehil Kumar Singh IAS Director, Kerala State IT Mission email- director.ksitm@kerala.gov.in 0471-2773100
4. Sri. John M Thomas, CEO, IT Parks email- ceotechnopark.org 0471-2700222
   Chief Executive Officer, Kerala Startup Mission, Technopark campus, Thiruvananthapuram. Email- ceotechnopark.org 0471-2700270

Convener

Sri Er Joy N R, Chief, Industry and Infrastructure Division, State Planning Board, chiefindustry@gmail.com, joynr_spb.ker@nic.in, chiefindustry.spb@kerala.gov.in, Mob: 9447000868

Co-Convener

Sri.Tomy Joseph, Deputy Director, Industry and Infrastructure Division State Planning Board. Mob:9846365394

Terms of Reference

To examine the reports of sub groups and bring out a consolidated report

Sub Group 1

i. Information Technology: Industry Investment and Capacity Building

Co-Chairperson

1 Sri. John M Thomas, CEO, IT Parks email- ceotechnopark.org 0471-2700222

Members

1. Dr. Rajasree MS Vice-Chancellor, Kerala Technological University email- vc@ktu.edu.in   0471-2598222
2. Sri.Alexander Varghese, Centre Head,UST Global email- alexander.varghese@ustglobal.com
3. Sri. Dinesh P Thampi, Vice President and Delivery Centre Head for TCS Kerala. Email- dineshthampi@tcs.com 9895399771
4. Sri. Sunil Jose, Centre Head, Infosys, Keralaemail- sunij@infosys.com 9895442319
5. Sri. K S Viswanathan, Vice President (industry initiatives), NASSCOM
6. Sri. Santhosh Kurup, CEO, ICT Academy Kerala email- ceoictkerala.org 8592994200
7. Prof. Alex James, IIITM-K, email- a.james@iiitmk.ac.in 9946710691

8. Sri. Sreekanth Arimanithaya Global Talent Head, Ernst & Young sreekanth.arimanithaya@gds.ey.com
9. Sri. Deepu S Nath, MD, TECHFAYA Innovations Pvt Ltd. Email- deepu@fiausa.com 9995710101
10. Sri. Binu Jacob,   MD and CEO, Experion Technologies India pvt. Ltd. Email- binujacob@experionglobal.com   9846755567

Convener

Sri Er Joy N R, Chief, Industry and Infrastructure Division, State Planning Board, chiefindustry@gmail.com, joynr_spb.ker@nic.in, chiefindustry.spb@kerala.gov.in, Mob: 9447000868

Co-Convener

Sri.Tomy Joseph, Deputy Director, Industry and Infrastructure Division State Planning Board. Mob:9846365394

Terms of Reference

1. Review the current status, achievements and challenges of attracting global and national IT players to Kerala
2. Assess the adequacies of current policies, park infrastructure, technological skills availability
3. Recommend policy changes quality of infrastructure and different models for infrastructure creation keeping in view other national centres of excellence.
4. Propose a promotional strategy based on benchmarking Kerala with other leading States in the IT sector
5. Assess the current programmes and initiatives for creating cutting edge technological capabilities within Kerala. Recommend areas of improvement for the 14th Five Year Plan
6. Evaluate the current University-Industry collaboration models and assess their effectiveness in capacity building based on measurable outcomes.
7. Provide recommendations for enhancing the impact of Digital Transformation Mission of Kerala
8. Recommend the role of Digital University Kerala (DUK) in capacity building of departments in e-governance

Sub Group 2

ii. Information Technology Start-ups

Co-Chairpersons
1 Dr. Saji Gopinath, Vice-chanceloor, Kerala University of Digital Sciences, Innovation and Technology email- vc@duk.ac.in 9400050850
2 Sri. John M Thomas ,Chief Executive Officer, Kerala Start-up Mission, Techno park campus, Thiruvananthapuram. Email- ceotechnopark.org 0471-2700270

Members
1. Prof. Rakesh Basanth, IIM, Ahemmadabad Incubation Centre email- rakesh@iima.ac.in

2. Sri.Prahlad Vadekkapat, National University of Singapore email-
   dr.vadakkepat@gmail.com +919074620684
3. Dr.V Madhsudanan Pillai Dean, Research & Consultancy, NIT Calicut
   email :deanrc@nitc.ac.i n 049 5-2286172,2286144
4. Mr Joy Sebastian, CEO, Techgentsia Software Technologies (Vconsole video conference
   app) email- reachjoy@gmail.com 94478896851
5. Ms. Teena James, CEO Revyire Global, Representative from Women IT email-
   tina@revyrieglobal.com 9847267857
6. Sri. Shilen Suganan Ex Kerala Head Arbitron, CEO, SS Consultancy Services and
   Malabar Angels Founding Member. Email shilen@ssconsult.in 9995868880
7. Sri. K.Joseph, Venture Capital
8 . Sri.Suresh Bhagavatula, IIM, Bangalore email-sureshbh@iimb.ac.in
9. Sri Sasi Kant Vallepalli. CEO, Quality Matrix kant@quality-matrix.com
   +91(40)-3827-1188
10 Sri. Arun Sathyan ,CEO Whitecloud Infotech

Convener

Sri Er Joy N R, Chief, Industry and Infrastructure Division, State Planning Board,
chiefindustry@gmail.com, joynr_spb.ker@nic.in, chiefindustry.spb@kerala.gov.in, Mob:
9447000868

Co-Convener

Sri. Tomy Joseph, Deputy Director, Industry and Infrastructure Division State Planning
Board.mob:9846365394

Terms of Reference

1. Review the growth and achievement of Start-ups in Kerala in the IT sector and assess the
   adequacies of national and state programs to continuously support the start-ups
2. Evaluate the functioning of the Incubation Centres and propose improvement to facilitate
   creating a robust start-up support system with appropriate linkages to research and
   finance
3. Propose policy changes and institutional arrangements for building a technology-driven
   start-up ecosystem and encouragement of women entrepreneurs
4. Propose policy changes to encourage and deepen the technology-driven start-up
   ecosystem in the industrial and information technology sectors in Kerala

Sub Group 3
iii. Communication and Internet Infrastructure

Co-Chairpersons

1 Prof. S. M. Sameer, Professor, NIT Kozhikode email-sameer@nitc.ac.in 0495-2286720
2. Sri. Snehil Kumar Singh IAS Director, IT Mission, Kerala . Email-
   director.ksitm@kevala.gov.in 0471-2525444   .

Members

1. Sri.John M Thomas, Chief Executive Officer, Techno Park, Thiruvananthapuram
. Email- ceotechnopark.org 0471-2700222
2 Sri. Seeram Sambasiva Rao IAS, Managing Director, Kerala State Information
   Technology Infrastructure Limited (KSITIL) email- md@ksitil.org 0471-4068006

3 Sri. Magesh Ethirajan, Director, CDAC Thiruvananthapuram email-magesh@cdac.in
   0471-2723333
4 Sri. Suresh Kumar C Chief Engineer (IT, CR & CAPS) KSEB
   email:ceit@kseb.in 9496011747
5. Sri.C K Prasad RGM, Railtel   email : arunnaduvattom @gmail.com   mob:
   9701387171

Convener

Sri Er Joy N R, Chief, Industry and Infrastructure Division, State Planning Board, chiefindustry@gmail.com, joynr_spb.ker@nic.in, chiefindustry.spb@kerala.gov.in, Mob: 9447000868

Co-Convener

Sri. Tomy Joseph, Deputy Director, Industry and Infrastructure Division State Planning Board. Mob:9846365394

Terms of Reference

1. Benchmark Kerala with other leading States on availability, access and quality of communication and internet infrastructure. Evaluate the progress of the State-driven as well as market-led (private sector) infrastructure creation.
2. Estimate the investments required to create a national best communication and internet infrastructure keeping in view the ambitions of Digital Transformation Mission timelines
3. Asses the access levels of BPL and other vulnerable population for this critical infrastructure and propose program and policies to provide free access

Terms of Reference (General)

1. The non-official members (and invitees) of the Working Group will be entitled to travelling allowances as per existing government norms. The Class I Officers of GoI will be entitled to travelling allowance as per rules if reimbursement is not allowed from Departments.
2. The expenditure towards TA, DA and Honorarium will be met from the following Head of account of the State Planning Board '3451-00-101-93'- Preparation of Plans and Conduct of Surveys and Studies.

<div align="right">

Sd/-
Member Secretary

</div>

To

      The Members concerned

Copy to

      PS to VC
      PA to MS
      CA to Member (V Namasivayam)
      Sr. A.O, SPB
      The Accountant General, Kerala
      Finance Officer, SPB
      Sub Treasury, Vellayambalam
      Accounts Section
      File/Stock File

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Forwarded/By Order

Sd/-
Chief Industry & Infrastructure Division
Convener

</div>

Service Area Wise Access(Wireless+Wireline) Subsriber base

Service Area	Subscribers (million)			
	Dec-20	Mar-21	Net Additions	Rate of Growth
Andhra Pradesh	89.00	90.14	1.15	1.29%
Assam	24.17	24.85	0.68	2.81%
Bihar	85.10	86.71	1.60	1.88%
Delhi	55.90	57.95	2.05	3.66%
Gujarat	68.75	70.36	1.61	2.35%
Haryana	27.44	28.19	0.75	2.74%
Himachal Pradesh	11.14	11.28	0.14	1.24%
Jammu & Kashmir	11.96	12.21	0.25	2.06%
Karnataka	69.41	70.79	1.39	2.00%
Kerala	45.98	46.04	0.07	0.15%
Madhya Pradesh	76.20	78.59	2.40	3.14%
Maharashtra	94.54	96.17	1.64	1.73%
Mumbai	38.01	40.71	2.70	7.09%
North East	12.31	12.55	0.24	1.95%
Odisha	33.72	34.56	0.83	2.48%
Punjab	38.42	39.54	1.13	2.93%
Rajasthan	65.63	66.77	1.14	1.74%
Tamil Nadu	82.39	84.65	2.26	2.75%
U.P.(E)	98.98	101.17	2.19	2.21%
U.P.(W)	62.80	64.03	1.23	1.96%
Kolkata	26.83	27.35	0.52	1.92%
West Bengal	55.15	56.57	1.42	2.58%
All India	1,173.83	1,201.20	27.37	2.33%

Annexure II
Service Area wise Rural- Urban subscribers at Quarter Ending March 2021

Service Area	Number of Subscribers (in million)			
	Total	Rural	Urban	% of Rural Subscribers
Andhra Pradesh	90.14	44.88	45.26	49.79
Assam	24.85	15.68	9.17	63.11
Bihar	86.71	56.88	29.83	65.60
Delhi	57.95	2.21	55.74	3.82
Gujarat	70.36	28.13	42.23	39.98
Haryana	28.19	12.51	15.68	44.38
Himachal Pradesh	11.28	7.56	3.72	67.01
Jammu & Kashmir	12.21	5.68	6.53	46.51
Karnataka	70.79	27.57	43.22	38.95
Kerala	46.04	20.41	25.64	44.32
Madhya Pradesh	78.59	35.61	42.98	45.31
Maharashtra	96.17	44.25	51.93	46.01
Mumbai	40.71	1.52	39.19	3.73
North East	12.55	6.56	5.99	52.28
Odisha	34.56	22.51	12.04	65.15
Punjab	39.54	13.59	25.95	34.38
Rajasthan	66.77	36.45	30.32	54.59
Tamil Nadu	84.65	25.08	59.57	29.63
U.P.(E)	101.17	63.50	37.67	62.76
U.P.(W)	64.03	30.48	33.55	47.60
Kolkata	27.35	1.50	25.85	5.49
West Bengal	56.57	34.86	21.72	61.61
All India	1,201.20	537.42	663.77	44.74

Annexure III
State/UT wise Total Tele density

Sl.No.	State/UT	Total Tele-density (%)		
		Total	Rural	Urban
1	Andhra Pradesh	89.24	131.42	242.68
2	Arunachal Pradesh	88.66	73.96	132.29
3	Assam	70.86	52.82	170.52
4	Bihar	51.85	41.17	129.26
5	Chhattisgarh	72.34	48.33	138.91
6	Goa	148.60	200.35	130.16
7	Gujarat	99.58	76.41	124.91
8	Haryana	116.26	72.12	179.87
9	Himachal Pradesh	152.50	113.88	490.11
10	Jharkhand	59.22	43.05	105.62
11	Karnataka	105.85	72.96	148.59
12	Kerala	129.47	199.17	101.26
13	Madhya Pradesh	67.66	41.70	131.88
14	Maharashtra Incl. Mumbai	108.07	69.42	149.92
15	Manipur	76.29	49.99	132.44
16	Meghalaya	73.27	54.58	145.46
17	Mizoram	116.63	117.30	116.08
18	Nagaland	77.02	77.61	76.23
19	Odisha	78.46	62.74	147.63
20	Punjab	124.39	75.85	193.87
21	Rajasthan	84.14	62.36	145.05
22	Sikkim	140.40	145.54	134.14
23	Tamil Nadu (incl. Chennai)	109.22	68.62	145.48
24	Telangana	114.00	91.68	139.69
25	Tripura	79.95	62.05	110.33
26	Uttar Pradesh (UPE +UPW)	69.31	49.55	132.74
27	Uttarakhand	116.12	89.83	164.94
28	West Bengal Incl. Kolkata	84.04	56.74	132.61
Union Territories				
1	Andaman & Nicobar Islands	118.17	72.74	178.29
2	Chandigarh	146.61	.	.
3	Dadra and Nagar Haveli and Daman and Diu	73.11	110.72	63.18
4	Delhi	211.63	.	.
5	Jammu & Kashmir	90.98	60.49	161.97
6	Ladakh			
7	Lakshdweep	121.16	.	.
8	Puduchery	75.16	72.66	76.24
Total		**88.17**	**60.27**	**141.03**

Annexure IV
Service Area wise Wireless subscriber base

Service Area	Subscriber base (in million)			
	Dec-20	Mar-21	Net Additions	Rate of change (%)
Andhra Pradesh	87.62	88.73	1.12	1.27
Assam	24.05	24.72	0.67	2.79
Bihar	84.89	86.47	1.58	1.86
Delhi	52.59	54.55	1.96	3.73
Gujarat	67.78	69.41	1.63	2.40
Haryana	27.13	27.88	0.75	2.75
Himachal Pradesh	11.05	11.19	0.14	1.25
Jammu & Kashmir	11.80	12.04	0.24	2.00
Karnataka	67.23	68.64	1.41	2.09
Kerala	44.68	44.84	0.16	0.36
Madhya Pradesh	75.51	77.87	2.37	3.14
Maharashtra	93.27	94.91	1.64	1.76
Mumbai	34.99	37.65	2.66	7.60
North East	12.21	12.45	0.24	1.94
Orissa	33.51	34.34	0.83	2.48
Punjab	37.73	38.84	1.11	2.94
Rajasthan	65.16	66.30	1.14	1.74
Tamil Nadu	80.46	82.76	2.30	2.86
U.P.(E)	98.59	100.76	2.16	2.20
U.P.(W)	62.43	63.62	1.19	1.90
Kolkata	26.17	26.67	0.51	1.94
West Bengal	54.91	56.31	1.41	2.56
All India	1,153.77	1,180.96	27.18	2.36