Smart City Sector, India

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1. Executive Summary

The Government of India started its smart cities mission in June 2015 to develop 100 Smart Cities across the country with an objective to provide a quality of life to its citizens using smart solutions.

The mission focuses on harnessing technology, especially technology that leads to Smart outcomes by creation of cities that are properly connected, adaptive, efficient, and resilient. It aims to create replicable models that can inspire other cities to become "smart". The mission promotes range of innovative ideas such as smart meters for energy and water, intelligent traffic-management systems, e-governance, citizen services, and established solutions such as waste-to-compost or waste-to-energy, recycling, reduction of waste and the need to integrate environment and social sustainability into the planning and resource management.

Smart Cities mean cities thoroughly connected with internets and are datafied. An enhanced penetration of internet, familiarity with smart phones and M2M/IoT devices, deployment of smart and emerging technologies and conducive regulatory environment are pre-requisite for the success of Smart Cities.

With heavy reliance on the Internet of Things (IoT), where objects would communicate with each other using internet and possibly without human intervention, IoT will play a crucial role. it is also necessary to combine M2M/IoT with Artificial Intelligence (AI) to simulate intelligent behaviour and to arrive at an accurate and reliable decision without human intervention.

The most important role in creation of technology backed Smart Cities will be to implement "Standards based technology solutions" for a diverse set of solution providers and offer world-class products and technologies, and at the affordable prices. This approach also helps Indian Smart Cities to become the lighthouses to guide other cities and helps the companies, system/solution providers to become globally competitive.

Standards based solutions also ensures that the technologies efficient & interoperable. Interoperability is essential and to ensure smart integration of various systems in a smart city, internationally harmonised standards that include technical specifications must be adhered to. Development and implementation of global standards ensure seamless interaction between components of different suppliers and technologies.

An international standards initiative for the development of M2M and IoT specification is oneM2M. oneM2M specifications as developed by a joint global collaborative effort, has already been transposed in India by the Telecommunications Standards Development Society, India (TSDSI) and has been adopted at national level by Telecommunication Engineering Centre as National Standard to strengthen the 100 smart cities implementation.

The Bureau of Indian Standards (BIS) in India has undertaken the task to formulate standardised guidelines for central and state authorities in planning, design, and construction of smart cities by setting up a technical committee under the Civil engineering department (CED) of the Bureau and the Electronics & IT department (LITD) of BIS, in association with Smart Cities Mission, Ministry of Housing & Urban Affairs have also released an initial set of smart cities ICT standards for ensuring well harmonized, secure and sustainable digital infrastructure across smart cities. These standards will act as guidelines for city administration to help them achieve maximum potential from their ICT infrastructure and tackle issues ranging from interoperability, integration, vendor lock-ins, data exchanges, etc. Standard on

IoT reference architecture is also based on oneM2M Specifications and data exchanges standards also include reference to ETSI NGSI-LD standard.

Many other important initiatives have also been taken up by the Indian government under the aegis of Ministry of Housing and Urban Affairs (MoHUA) to support the Smart City Mission and these initiatives have been introduced to support the capacity building, data exchange and creation of digital infrastructure. Indian Urban Data Exchange (IUDX) anchored under the Smart City Mission of the MoHUA is implemented & supported by the Indian Institute of Science (IISc) Bangalore, and is a state-of-the-art, open-source software platform that utilises the power of data to address the complex problems faced by urban India. IUDX resource access APIs are harmonized with ETSI NGSI-LD Specifications.

Indian Urban Observatory (IUO) has also been implemented, which enables plugging various sources of data from cities both from real-time and archival sources for generating insights through analytics for cities, academia, industry, and governments.

A Smart Cities Open Data Portal was also launched and is designed to host open datasets of 100 Smart Cities of India and more than 2,600 datasets from 95 Smart Cities are already uploaded on the portal for free access to the public.

DataSmart Cities and Data Maturity Assessment Framework (DMAF) to help cities build an ecosystem for data-driven governance was also rolled out in the initial plan for 100 Smart Cities and now, the government plans to expand the 'DataSmart Cities Strategy' to 500 cities.

Apart from Digital Infrastructure creation, Capacity building, real time monitoring and gap analysis has also been one of the major concerns of the Government and to address this, MoHUA has introduced National Urban Learning Platform (NULP) and the Urban Learning Internship Program (TULIP). Through this platform and program, Ministry conducts virtual trainings to build capacity and facilitate partnerships. It enrols knowledge creators, consolidates skills, and makes them available to its stakeholders. TULIP envisions to create synergies between advancing functional skills in students and harnessing their energy and ideas to co-create solutions for the future of these cities.

Performance Indicators such as an Ease of Living Index (EoLI) and Municipal Performance Index (MPI) were established in 2020, to identify gaps in urban policies, planning and implementation initiatives, and they offer an opportunity to plug these gaps. Similarly, ClimateSMART Cities Assessment Framework was also launched for the 100 Smart cities to incentivize a holistic, climate responsive development.

The sheer size and large opportunities created by this mission mode project has garnered and attracted international interest for both the technology implementation as well as investment proposals from around the world. Sweden, Israel, Netherlands, UK, and Hong Kong have shown interest in investing in India for developing these smart cities and Germany, UK and the many other EU member countries are already engaged in many projects with the Indian state governments on various Smart City related projects in India.

Smart City Living labs are also established in Panaji, Goa as a joint initiative between India and Denmark and at IIITH, with support from the Ministry of Electronics and IT (MEITY), Smart City Mission and Government of Telangana in collaboration with the technology partners European Business Technology Centre (EBTC) and Amsterdam Innovation Arena to discover & develop cutting edge innovations with smart city use cases and enrich them with the knowledge from research.

There has indeed been a great progress on a wide variety of smart projects in the 100 cities and towns selected under the Smart Cities Mission. These completed projects are providing social and economic benefits, especially to the marginalised sections of the populations of these cities. However, 49% of 5,196 projects for which work orders were issued across 100 smart cities in India remain unfinished, as per government data. Also, among 33 cities which completed their five-year duration this year, 42% projects are still incomplete. The reasons for lagging are Institutional and structural issues with the special purpose vehicles (SPVs) of public-private partnerships such as funding roadblocks, understaffed and unskilled manpower, and the lack of citizen participation etc.

The first detailed report on Smart City was released by SESEI in 2018. This 2nd edition intends to provide update on the status of the Smart City Project and the important initiatives introduced by the Government of India for supporting the Smart City Mission. It has been our endeavour to provide you with synopsis of various policy initiative and standards related information around the Smart City Mission in India.

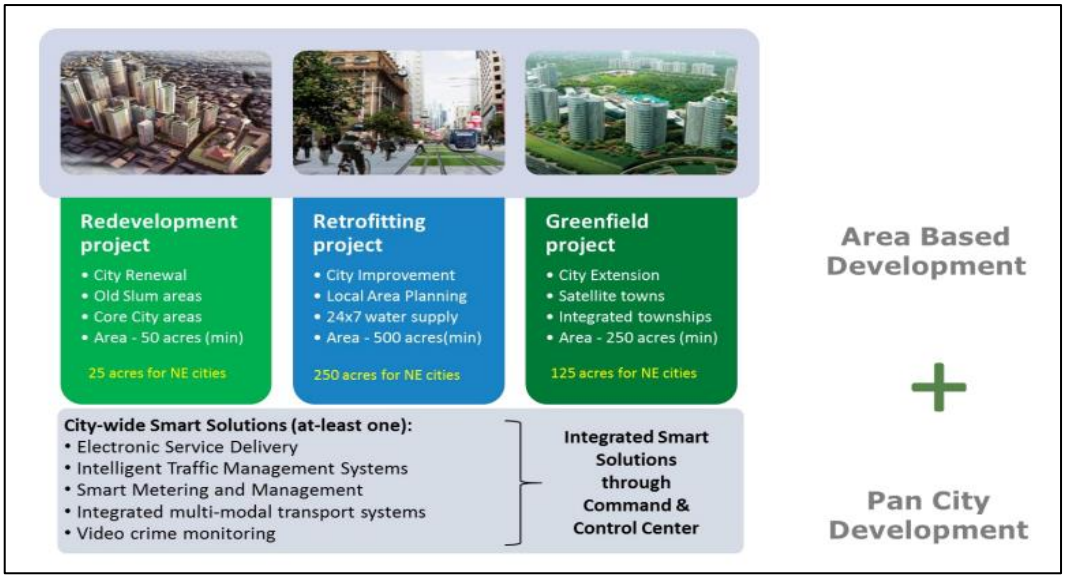
2. Smart City Mission – an overview

The Government of India launched the Smart Cities Mission on 25th June 2015, with an objective to promote sustainable and inclusive cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions.

Some of the core infrastructure elements in a Smart City would include adequate water supply, assured electricity supply, sanitation, including solid waste management, efficient urban mobility and public transport, affordable housing, especially for the poor, robust IT connectivity and digitalization, good governance, especially e-Governance and citizen participation, sustainable environment, safety and security of citizens, particularly women, children and the elderly and health and education.

- The strategic components of the Smart Cities Mission are city improvement (retrofitting), city renewal (redevelopment) and city extension (Greenfield development) plus a Pan-city initiative in which Smart Solutions are applied covering larger parts of the city.

- Area-based development will transform existing areas (retrofit and redevelop), including slums, into better planned human settlements, thereby, improving liveability of the whole cities. Development of well-planned and fully serviced new areas (greenfield) will be encouraged around cities to accommodate the rapidly expanding population in urban areas. Application of Smart Solutions will enable cities to use technology to improve infrastructure and services.



Selection Process: The selection process of Smart Cities was based on the idea of Competitive and Co-operative Federalism and followed a Challenge process to select cities in two stages.

The government selected 100 cities through a City Challenge Process in four rounds as below:

- In January 2016, MoUD announced 20 cities as winners from the first phase of the Smart City Challenge (Annex 1).
- In May 2016, MoUD released the second list of an additional 13 cities, selected on a fast-track basis, to be included in the first phase of the Mission (Annex 2).
- In September 2016, in the second round of the Smart Cities Challenge, the government announced the third list of 27 additional cities (Annex 3).
- In June 2017, 30 cities were added to the list as a part of fourth list of the Smart City Mission (Annex 4).
- In January 2018, government announced the names of another 9 cities as a part of fifth list (Annex 5). Meghalaya's capital, Shillong, was included as the 100th city in June 2018.

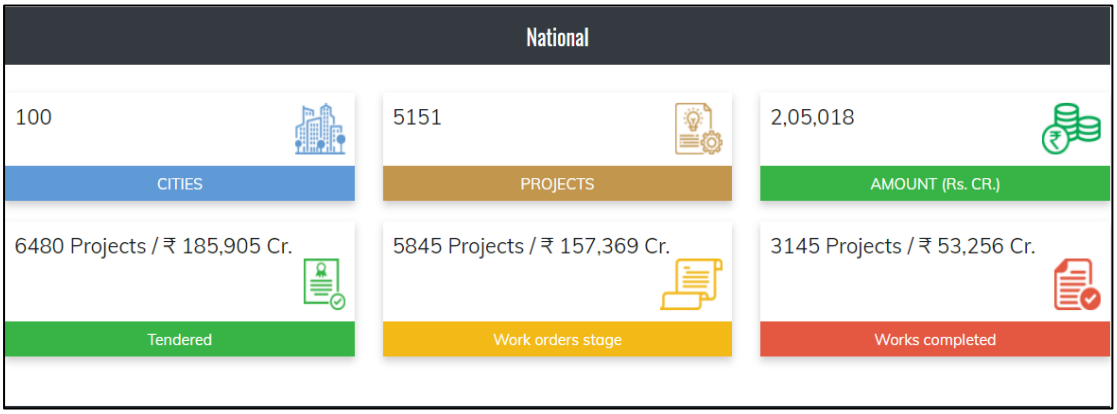
Four rounds of competition

	Round 1	Round 2	Round 3	Round 4	Total
No. of Selected Cities	20	40	30	10*	100
Period of selection	Jan 2016	May to Sep 2016	Jun 2017	Jan 2018	
Total no. of Projects	829	1,959	1,891	472	5,151
Investment (in ₹ Crores)	48,064	83,698	57,393	15,863	2,05,018
Avg. SCP Size (in ₹ Crores)	2,403	2,092	1,913	1,586	2,050

*Shillong selected as 100th Smart City in June 2018

Investments: According to the latest data provided by the Ministry of Housing and Urban Affairs (MoHUA), the total proposed investment in 100 smart cities is INR 205,018 crore (approx. €24.4 billion). Of the total investments, 6480 projects worth ₹ 185,905 crore (€22.13 billion) have been tendered, work orders have been issued for 5845 Projects worth ₹ 157,369

crore (€18.73 billion) and 3145 Projects worth ₹ 53,256 crore (€6.34 billion) have been completed.



According to the statistics of ministry of housing and urban affairs, the Centre has released Rs 27,282 crore (€3.25 billion) to 100 smart cities, but the state matching share is Rs 21,024 crore[1] (€2.5 billion).

Please click here to know more about the status of projects in each city selected under Smart City Mission.

The implementation of the Smart Cities Mission is done by a Special Purpose Vehicle (SPV) to be set up at city level in the form of a limited company under the Companies Act, 2013 and will be promoted by the State/UT and the Urban Local Body (ULB) jointly both having 50:50 equity shareholding. After selection, each selected Smart Cities must set up SPVs and start implementation of their Smart City Proposal, preparation of Detailed Project Reports (DPRs), tenders etc.

The SPV will convert the Smart City Proposal into projects through Project Management Consultants (PMCs) and implementation thereafter.

For more details on the commencement of Smart City Mission in India, please refer / download previous SESEI report on "Smart city Mission, India".

3. Government/Industry Initiatives to support the Smart City Mission

Government of India / Ministry of Housing & Urban Affairs (MoHUA) initiated several programmes to enhance the Smart City Mission's impact. The following paragraphs describe some of them.

3.1 Open Data Platform/India Urban Data Exchange (IUDX)

The 'India Urban Data Exchange (IUDX)' initiative is a collaboration between the Smart Cities Mission and the Indian Institute of Science (IISc), Bengaluru. IUDX has been developed to facilitate secure and authenticated exchange of data amongst various data platforms, 3rd

[1] https://economictimes.indiatimes.com/news/india/smart-city-mission-28-states-uts-fail-to-release-share-of-funds-for-smart-cities/articleshow/87790895.cms?from=mdr

party applications, data producers and consumers, both within a city to begin with, and scaled up across cities eventually at a national level, in a uniform & seamless way. The platform will provide full control to the data owners as to what data to expose and to whom. Built-in accounting mechanisms will enable it to connect with payment gateways which will form the foundation for a data marketplace. The whole platform will be developer friendly, via definitions of open APIs and data schema templates (formats for interpreting data), so that a whole new application ecosystem gets created.

IUDX, recently announced that it has successfully deployed operational data exchanges in 10 Indian cities and will now be entering its next phase where the platform is poised to be the core digital infrastructure of 25 more smart cities[2].

The Ministry of Housing and Urban Affairs (MoHUA) through Smart Cities Mission (SCM) has sanctioned INR 29 crores to support the ambitious goals of the program for the financial years 2021-22 and 2022-23. In the initial phase i.e., fiscal year 2020-21, the platform was first deployed in three pioneer smart cities – Pune, Surat, and Varanasi and then in seven more cities, namely Agartala, Bengaluru, Bhubaneswar, Chennai, Bhopal, Faridabad, and Vadodara. These cities are also deploying various use cases that will help improve the public infrastructure and facilities in the city.

IUDX has also become the first software platform in the country to fully adhere to the Architecture and API Specifications set by the Bureau of Indian Standards (BIS) for data exchange platforms. The Unified Data Exchange standard – IS 18003, is part of a series of 10 indigenous standards developed by BIS Smart Infrastructural Sectional Committee (LITD 28) for Indian Smart Cities to ensure a secure and sustainable digital infrastructure and to facilitate the implementation of various smart city projects. The foundational standard for this series is "IS 18000 Unified Digital Infrastructure – ICT Reference Architecture (UDI-ICTRA)"[3]. For more information please click here>>

3.2 National Urban Digital Mission

National Urban Digital Mission aims to build the shared digital infrastructure that will strengthen the capacity of the urban ecosystem to solve complex problems at scale and speed. On February 23, 2021, the central government launched the 'National Urban Digital Mission' to establish a digital infrastructure to formalise a citizen-centric and ecosystem-driven approach to urban governance and service delivery in cities by 2022. It is built as a public good and provides the ecosystem actors the foundational digital building blocks, ready-to-use platforms, standards, specifications, and frameworks. Examples include India Urban Data Exchange (IUDX), which is an open-source platform that will provide data on numerous urban indicators. Smart Cities Open Data Portal is another example, being created to develop products and build solutions and SmartCode, which will serve the software development demand of cities, providing data and solutions for various urban problems. For more information please click here>>

[2] https://iudx.org.in/iudx-successfully-deploys-across-10-indian-smart-cities/
[3] https://iudx.org.in/iudx-becomes-first-software-platform-to-fully-adopt-bis-standards-for-unified-data-exchange/

3.3 SmartNet

Smartnet is an initiative of the Ministry of Housing and Urban Affairs to support the development of cities across India and to create a resource-rich ecosystem of learning, sharing, and disseminating for city managers and primary stakeholders in the urban transformation of India.

The key objectives of Smartnet are:

- Providing a horizontal learning and knowledge sharing platform for exchange between cities, practitioners, academia, researchers, and technologists.
- Evolving a comprehensive framework to visualise and articulate the government's urban sector missions such as smart cities, AMRUT, Housing for All, HRIDAY and Swacch Bharat.

For more information, please click here>>

3.4 Ease of Living Index and Municipal Performance Index

The assessment framework on 'Ease of Living' (EoL) Index for cities was launched in June 2017 with the objective of framing an index to enable a shift to data driven approach in urban planning and management and promote healthy competition among cities.

The Municipal Performance Index, 2019 is a first of its kind initiative by the Ministry which seeks to examine the sectoral performance of Municipalities across a set of 5 verticals namely Service, Finance, Planning, Technology and Governance. These 5 verticals have been further divided into 20 sectors which will be evaluated across 100 indicators. These indices will help build a mature data ecosystem with a common baseline data that can be leveraged by States and cities as an instrument for urban planning and management. It will facilitate a competitive environment among cities and enhance avenues of investment.

The Ease of Living indicators are strongly linked to Sustainable Development Goals (SDGs) and this exercise will help the Country to track and achieve SDGs. Citizen Participation was included in the EOL 2019 exercise that will contribute 30% towards the scoring for the Ease of Living Index. The EOL 2019-20 was expanded to 114 cities in the country and more than 32 lakh citizens participated in the Citizen survey which was carried out during February to March 2020. For more information, please click here>>

3.5 DataSmart Cities and Data Maturity Assessment Framework (DMAF)

The Smart Cities Mission launched the DataSmart Cities Strategy in February 2019, as a roadmap for harnessing the potential of data to address complex urban challenges across 100 Cities. To successfully implement this initiative, the Data Maturity Assessment Framework was also launched to encourage cities to strengthen their data infrastructure and facilitate them in assessing their readiness and maturity on data. For more information, please click here>>

3.6 The Urban Learning Internship Program (TULIP)

The program intends to fulfil the twin goals of providing hands-on learning experience to recent graduates as well as benefiting States, ULBs and Smart Cities with infusion of fresh energy and ideas to solve critical challenges. TULIP envisions to create synergies between advancing functional skills in students and harnessing their energy and ideas to co-create solutions for the future of our cities. All 100 Smart Cities have registered on the TULIP portal. Till date, nearly 284 Smart Cities/ ULBs have participated in the TULIP Programme and have posted more than 13,000 internships and more than 100 interns have successfully completed their internships. For more information, please click here>>

3.7 City Innovation Exchange

Building on Prime Minister of India's management mantra for AtmaNirbhar Bharat (Self Reliant India), 'Innovation, Integrity & Inclusion', City Innovation Exchange (CiX) will facilitate innovation procurement in cities through a transparent & collaborative process. CiX marks the first step in the creation of Innovation Zones at the level of Urban Local Bodies, and vision shared by Smart Cities Mission with StartUp India.

CiX adopts the Open Innovation Model to build solutions to address cities' challenges. Open innovation helps in the purposive flows of knowledge and ideas from 'outside-in and inside-out' effectively closing the innovation capacity gap in urban local bodies and enriching the design and delivery of products and services. Open Innovation has been an underlying principle in the creation of the some of the most successful and user-friendly inventions in contemporary times.

CiX using a federated architecture will enable multiple stakeholders including Administrators (Cities), Citizens, Innovators (researchers, startups, and MSMEs), and Ecosystem Enablers (Startup India, incubators, academia, associations) collectively called the Quadruple Helix—to effectively collaborate and co-create innovative solutions. For more information, please click here>>

3.8 Climate Smart Cities

ClimateSMART Cities Assessment Framework was launched for the 100 Smart cities to incentivize a holistic, climate responsive development. This is a first-of-its-kind Assessment Framework for cities, aimed at creating a green mind-set in cities while they plan and undertake various developmental projects.

The Framework includes various air and climate relevant parameters that shall guide the cities and help them to assess their own preparedness to tackle the menace of climate change and degrading air quality. The Ministry announced the individual city readiness report of the first cycle of ClimateSmart Cities Assessment Framework during the 3rd Smart City CEO Conference held at Visakhapatnam on Jan 24-25, 2020. The cities can view their scores, performance report and recommendation for further improvement on the SmartNet portal. The concluded phase of assessment did not intend to rank the cities but to help them understand their status regarding climate mitigation and adaptation. Read more>>

3.9 Smart Cities Open Data Portal

Smart Cities Open Data Portal is designed to host open datasets of 100 Smart Cities of India and more than 2,600 datasets from 95 Smart Cities are already uploaded on the portal for free access to the public. This initiative is in line with the Open Government Data (OGD) Platform India (http://data.gov.in) developed by NIC as per the mandate given in the NDSAP Policy wherein Government departments are publishing their shareable datasets in open format through this platform. For more information, please click here>>

3.10 India Urban Observatory (IUO)

A state-of-the-art India Urban Observatory has become operational: as cities begin to implement 'smart' solutions, data is becoming a significant asset and an enabler for data driven governance, leading to urban transformation. The Observatory will plug into various sources of data from cities both from real-time and archival sources for generating insights through analytics for cities, academia, industry, and governments. The Mission has set up the IUO at the Ministry office in New Delhi. The Observatory is at the heart of all the technology initiatives and plug into the different sources of data from the cities, both from real-time and archival sources.

The Observatory is designed to provide an interactive showcase of collective insights on cities over various parameters using data through various sensors, devices, third party sources including citizens and social media. The IUO website (https://iuo.mohua.gov.in) was launched on 9th March 2020. With this step, the Ministry aims to disseminate knowledge in the form of insights / trends generated at the IUO as well as provide a platform for citizen engagement in the urban ecosystem. The website will also act as a repository of visual resources and urban data collected through multiple sources. It will also enable users to plot data on GIS map and generate insights. Read more>>

3.11 National Urban Innovation Stack (NUIS)

NUIS aims to catalyse transformative collaboration in the urban ecosystem through establishing a shared digital public good. NUIS will strengthen the capacity of the urban ecosystem to solve complex programs quickly and at scale by unlocking the power of urban data, build capacity among all actors of the quadruple helix, driving discoverability and collaboration between urban stakeholders, and enabling responsive and data driven governance. Read More>>

3.12 Smart City Living Labs

The Smart City Living Lab, an open-innovation ecosystem has been set up at IIITH, with support from the MEITY, Smart City Mission and Government of Telangana and in collaboration with the technology partners EBTC and Amsterdam Innovation Arena to discover & develop cutting edge innovations with smart city use cases and enrich them with the knowledge from research.

The primary goal of this innovation initiative is to enable discovering, sourcing, validating, proving, and taking to production, the various Smart City innovations, solutions, and products.

And bringing in the key stakeholders- governments, research, start-ups, tech companies, smart city players and policy makers.

Living Lab shall enable the following:

- Get expertise in IoT for Smart Cities related research and deployment
- Generate data for research
- Creation of a viable innovation and demand driven ecosystem in universities.
- Provide a test bench for IoT based Smart City implementations to start-ups as well as big companies

The IIITH campus would include different IoT verticals related to air quality, building energy, water quantity and quality, street lighting, etc. **For more information, please click here>>**

The Project Urban Living Lab in Panaji:

The Project Urban Living Lab in Panaji, Goa contributes to this transformation in cities. This joint initiative between India and Denmark is implemented under the Memorandum of Understanding (MoU) between the Royal Danish Embassy and the Imagine Panaji Smart City Development Limited (IPSCDL). The project is financed by the Danish Ministry of Foreign Affairs, Royal Danish Embassy, New Delhi for a period of two years. TERI is also working on this project. The aim is to develop and integrate global and local sustainable solutions that would enable the smooth implementation of the Smart Cities Mission by the Ministry of Housing and Urban Affairs (MoHUA), Government of India. ULLs provide a 'safe space' for collaboration and a testbed for innovation that bring together multi-stakeholder expertise to produce information, tools, technologies, and processes. Aligning with this concept, the Project Urban Living Lab (PULL) is working on developing solutions at a small scale to demonstrate if they can have a wider impact and be implemented at a larger scale. For More Information Please click here

3.13 Freight Smart Cities Plan

In July 2021, the Logistics Division under the aegis of the Ministry of Commerce and Industry has unveiled its plan for Freight Smart Cities to improve the efficiency of urban freight and create an opportunity for the reduction in logistics costs. This is likely to boost all sectors of the economy.

The initiative encompasses the following plan:

- Phase I – Identification of the initial **10 cities to be developed as 'Freight Smart Cities'**
- Formation of **city-level logistics committees in 10 cities** – including member participation from the government and the private sector
- **These committees are to co-create 'City Logistics Plans'** such as promoting electrification of urban freight, building peri-urban freight centres, developing truck routes, and managing night-time deliveries
- Expansion of the initiative to the next 75 cities in Phase II. Target segment includes all state capitals and cities that have >1 million population
- On the Freight Smart City initiatives, the Logistics Division is working closely with GIZ (Germany) under Indo-German Development Cooperation, Rocky Mountain Institute (RMI) and RMI India.

On this occasion, Minister of State for Commerce and Industry launched a website on 'Freight Smart Cities' and released a handbook outlining 14 measures that can be taken to improve urban freight. Read more>>

3.14 City Investments to Innovate, Integrate and Sustain (CITIIS) challenge

CITIIS Challenge was launched in partnership with Agence Française de Développement (AFD) and European Union, to extend a loan of EUR 100 million for implementation of upto 15 innovative projects selected through an All-India Challenge in four sectors- sustainable mobility, public open spaces, urban governance & ICT, and social and organizational innovation in low-income settlements. The CITIIS program was launched on July 9, 2018. The entire set of activities including organisation of preparatory Workshop, handholding of cities to enable submission of proposals by them, evaluation of proposals by the jury leading up to selection of 12 projects and signing of tripartite agreements with the concerned cities and States was completed in record time. The 12 projects are currently under implementation in the cities of Agartala, Amaravati, Amritsar, Bhubaneshwar, Chennai, Dehradun, Hubbali-Dharwad, Kochi, Puducherry, Surat, Ujjain, and Visakhapatnam. The design framework for CITIIS 2.0 is being conceptualized by AFD in consultation with SCM and MoHUA. For more information please click here>>

3.15 India Cycles for Change (IC4C) Challenge

The India Cycles4Change Challenge, launched in June 2020, is an initiative to inspire and support Indian cities to implement quick cycling-friendly initiatives in response to COVID-19.

The challenge was open to all cities with over 5 lakh population, capital cities and all smart cities. For Smart Cities, the interventions are a pan-city initiative and not limited to the ABD area only. A total of 107 cities registered for the challenge.

The India Programme of the Institute for Transportation and Development Policy (ITDP) is the knowledge partner of the Smart Cities Mission to assist the Mission in conducting this challenge and guiding cities in developing and implementing their proposals. Read More>>

3.16 Nurturing Neighbourhoods Challenge

In November 2020, Government of India launched "**Nurturing Neighbourhoods Challenge,** a 3-year initiative to enable Indian cities to adopt an early childhood lens in designing neighbourhood-level improvements that promote the health and well-being of young children and their caregivers.

The Smart Cities Mission, Ministry of Housing and Urban Affairs, has announced 25 shortlisted cities for the 'Nurturing Neighbourhoods Challenge' cohort, in collaboration with the Bernard van Leer Foundation (BvLF) and technical partner WRI India. The cities will receive technical assistance, capacity building and scale-up support to experiment, and implement trials and pilots over the next six months to demonstrate early wins, solicit citizen participation, and build consensus around their proposals[4]. For more information, please click here>>

[4] https://pib.gov.in/PressReleasePage.aspx?PRID=1699010

4. Countries supporting India's Smart City Mission

Leading economies worldwide have shown interest in India's smart city mission and are looking forward to participating in the development of smart cities. These include Spain, the US, Germany, Japan, France, Singapore, and Sweden[5].

- Spain has proposed to cooperate with India to develop Delhi into smart cities. The Barcelona Regional Agency of Spain has shown an interest in exchanging technology with India[6].
- Germany has inked a deal with India to develop Bhubaneswar (Odisha), Kochi (Kerala) and Coimbatore (Tamil Nadu) as smart cities[7].
- France has decided to support three Indian cities—Chandigarh, Nagpur, and Puducherry—and announced an investment of US$ 1.5 billion (EUR 1.3 billion)[8].
- Sweden, Israel, the Netherlands, the UK, and Hong Kong have also shown interest in investing in India for developing smart cities.
- Italy has shown interest in the smart city concept and decided to invest US$ 1.2 trillion over the next 20 years through numerous initiatives. The Italian companies will contribute in terms of design and technology for the smart cities, with services ranging from consultancy to actual construction of the infrastructure
- The United States 'Trade and Development Agency (USTDA) has decided to develop Visakhapatnam (Andhra Pradesh), Allahabad (Uttar Pradesh) and Ajmer (Rajasthan) as smart cities[9].
- Japan has decided to assist India with the development of Chennai, Ahmedabad, and Varanasi as smart cities.
- Singapore has shown an interest in helping India's Smart City Mission and offered to help develop Amravati, the new capital of Andhra Pradesh, as a smart city. The country is also looking at re-engineering and upgrading the transportation sector and retrofitting the older Indian city.
- Twenty cities across three Indian states—Punjab, Haryana, and Rajasthan—are likely to have a fast-track development under a new Indo-Canadian initiative to train smart city planners on capacity building and governance, reform implementation, and water supply and sewerage among others. The proposal aims at training at least 150 official urban planners and designers and building localised platforms and tools for efficient and predictable planning and execution of smart cities[10].

5. Key Challenges in implementing Smart City Projects

The slow progress in implementing the Smart Cities Mission is a matter of concern. Overall, less than 50% of the projects had been completed at the end of the Mission's six-year period.

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[5] https://www.ibef.org/government-schemes/smart-cities-mission

[6] https://timesofindia.indiatimes.com/india/spain-proposes-to-develop-delhi-as-smart-city/articleshow/47071701.cms

[7] https://www.business-standard.com/article/pti-stories/germany-to-develop-kochi-coimbatore-bhubaneswar-as-smart-116030700852_1.html

[8] https://smartcity.eletsonline.com/france-to-invest-1-5-billion-in-smart-cities-mission/

[9] https://www.daijiworld.com/news/newsDisplay?newsID=292697

[10] https://housing.com/news/canada-india-initiative-training-smart-city-planners/

- **Financing of smart cities:** Financing is one of the biggest challenges when it comes to the smart city challenge. The total investment approved under the smart city plans of 100 cities has gone upto Rs 2.05,018 crore. An analysis of the financial data reveals that the Centre, as well as most state and local governments, are finding it difficult to mobilise funds, transfer them to SPVs, and use them efficiently. According to ministry of housing and urban affairs, the Centre has released Rs 27,282 crore (€3.25 billion) to 100 smart cities, but the state matching share is only Rs 21,024 crore (€2.5 billion).

- **Availability of Master Plan**: Most cities in India do not have their master plans and development plans in place. This is a tragic situation if we talk about developing them into smart cities. The presence of both the requisites is the key to the implementation and encapsulation of the smart city project as that is where the changes would be monitored and there is no other way to make it simple, better, and efficient. Unfortunately, most cities in India lack the presence of it.

- **Advanced Technology Solutions**: Most of the Technology solutions in the Smart City space belong to the advanced technology category. Take for example "Internet of Things" (IoT) based data acquisition and analysis, Advanced data analytics using Artificial Intelligence and Machine Learning, Integration of voluminous data from across varied domains into a Command-and-Control centre, Use of advanced Video technology and real time systems for different domains. While the implementing agencies need not get into the details of these technologies, there is a need for them to at least know the nuances of these technologies. However, such working knowledge of these technologies is clearly missing from the smart City Practitioners in the field.

- **Cybersecurity Infrastructure:** Smart cities rely on sensors and network-connected devices and systems that generate large volumes of data, which are vulnerable to hacking by cyber criminals who can steal confidential data, shut down access to essential resources, and gain illegal access to security cameras. The data needs to be adequately protected.

6. Standards for Smart Cities in India

The main element that allows infrastructures to link and operate efficiently is standards as they make technologies interoperable and efficient. Interoperability is essential and to ensure smart integration of various systems in a smart city, internationally agreed standards that include technical specifications and classifications must be adhered to. Development of international standards ensure seamless interaction between components from different suppliers and technologies.

The adoption of standards for smart cities has been advocated across the world as they are perceived to be an effective tool to foster development of the cities. The Director of the ITU Telecommunication Standardization Bureau Mr. Chaesub Lee is of the view that "Smart cities will employ an abundance of technologies in the family of the Internet of Things (IoT) and standards will assist the harmonized implementation of IoT data and applications, contributing to effective horizontal integration of a city's subsystems".

Developing national standards in line with these international standards would enable interoperability (i.e., devices and systems working together) and provide a roadmap to address key issues like data protection, privacy and other inherent risks in the digital delivery and use of public services in the envisioned smart cities, which call for comprehensive data management standards in India to instil public confidence and trust.

Key Standards Development Bodies/Organizations in India, which are entrusted with Smart Cities standards development/ adoption are captured in following sections with their activities around it.

6.1 Telecommunications Standards Development Society, India (TSDSI)

TSDSI is an autonomous, membership based, standards development organization (SDO) for Telecom/ICT products and services in India. TSDSI develop standards for access, back-haul, and infrastructure systems, solutions and services that best meet India specific Telecom/ICT needs, based on research and innovation in India. TSDSI works closely with global standards' bodies (3GPP, oneM2M, ETSI, etc) to reflect Indian requirements into international telecom/ICT standards. TSDSI also plays an important role in encouraging generation of Indian IPRs in this technology intensive field and get them incorporated into international standards. This in turn promotes indigenous research, product development and manufacturing. Department of Telecommunications & Ministry of Electronics and Information Technology, Govt. of India through its Ministry of Communication are jointly supporting TSDSI as India's Telecom/ICT SDO.

Transposition of OneM2M Specifications by TSDSI:

As IoT/M2M plays a significant role in the expansion of the digitally connected society. Realising the important of a standards-based deployment in smart cities and to promote interoperability, security, and multi-vendor deployments, TSDSI took the first by transposing the oneM2M Release 2 and Release 3 and following its transposition process and handed over these releases to TEC/DoT for its adoption. Subsequently, the adoption of oneM2M Rel2 as national standard was done by TEC. TEC is also in the process of adopting oneM2M release 3 specifications as national standards.

- Click here for technical reports produced by TSDSI on M2M Use Cases in different verticals from Indian Context

Common Service Platform developed by C-DOT (Centre for Development of Telematics):

The Centre for Development of Telematics (C-DoT), an Indian Government owned telecommunications technology development centre, has also developed CCSP (C-DOT Common Service Platform), the oneM2M standards compliant common service platform which can be deployed on any off-the-shelf generic server platforms or cloud infrastructure. The business application providers can deploy their oneM2M compliant applications in either co-located infrastructure or on any public or private cloud.

Using the CCSP platform from C-DOT, the smart cities can reap all the benefits of using a standards compliant horizontal service layer and thus be more efficient, economical, and future proof. Along with the CCSP, C-DOT has also developed various oneM2M indigenously designed hardware nodes like AND (Application Dedicated Node), ASN (Application Service Node) and MN (Middle node).

To effectively showcase the strength of the platform, C-DOT has also developed various applications like Smart Living, Smart Street Light, Carbon Footprint Monitoring Application and Power Monitoring which are fully oneM2M compliant. Read more>>

6.2 Telecom Engineering Centre (TEC)

Telecommunication Engineering Centre (TEC), which is the National Standardization Body for Telecom and related ICT sector in India issued its "Standardization Guide – A policy document for adoption of Domestic/ international standards into national standards" vide O.M. No. 2-1/2018/SD/TSDSI/TEC/5 dated 08-05-2020.

oneM2M released its first set of specifications (Release 1) in Jan 2015, Release 2 in March 2016, and Release 3 in Dec 2018. Work is in progress on Release 4 and Release 5.

TSDSI-transposed oneM2M Release 2 specifications and submitted it to TEC/DoT in Jan 2018 for considering them for National adoption / ratification. TEC, after complying with the due consultation process and as per the Standardization guide, adopted TSDSI-transposed oneM2M Release 2 specifications as National standards vide O.M. No. 19-1/2019-STD/ TEC/2, dated 17-09-2020. TEC is also working on the adoption of oneM2M release 3 specifications. These standards will be quite useful for the development of interoperable ecosystem for IoT domain, especially for Smart cities.

As per the order, these national standards shall remain voluntary unless made mandatory for its use, reference, or adoption by regulation / Govt. directive. Click here for Standards

TEC has also prepared and released following technical reports related to smart cities:

- ICT Deployments and strategies for India's smart cities: A curtain raiser
- M2M/ IoT Enablement in Smart Homes
- Design and Planning Smart Cities with IoT/ ICT
- IoT/ ICT Enablement in Smart Village & Agriculture
- IoT/ ICT standards for Smart Cities (Report is under preparation and expected to release soon)

TEC also made a significant contribution to ITU-T Recommendation Y Suppl. 53 (12/2018) on IoT use cases (having five IoT use cases from India and one from Egypt) and Y Suppl. 56 (12/2019) on Smart city use cases (having smart city use cases from Japan, Korea, UK, and India). These use cases may be implemented to create smart infrastructure, which will resolve several issues of the respective vertical and in turn improve the quality of life.

6.3 Bureau of India Standards (BIS)

Bureau of Indian Standards (BIS), National Standard Body of India, through its technical committees have been developing standards related to smart cities. The Bureau says elements of aspirations for cities must be factored into consideration while measuring the delivery of services. For instance, a city would like to remain a 'Heritage City', a cultural hub, an industrial city, a business city, or a tourism city during its development. There must be scope for these features to remain at the core of its planning and growth.

6.3.1 Civil Engineering Division Council (CEDC)

The Civil Engineering Division Council (CEDC), of BIS is responsible for preparation of Smart City indicators in India. The work scope of CEDC is as follows: 'Standardization in field of Civil Engineering including structural engineering, building materials and components, planning,

design, construction and maintenance of civil engineering structures and built environment, construction practices, safety in building; but excluding those subjects which specifically relate to Water Resources Development and Management'. The Division Council is working towards achieving the above goal through 39 Sectional Committees covering wide range of subjects for basic building materials, design and construction to very high technical areas like Offshore Installations, Ports and Harbours, Cyclone Resistant Structures, etc.

CED59 on Smart Cities Sectional Committee have issued following standards:

List of Standards developed by CED 59 related to smart cities		
Sl. No	IS_No	Title
1	IS 17000: 2019	Sustainable Development of Habitats Indicators
2	IS 17451: 2020	Smart Community Infrastructure - Best Practices for Transportation - Guidelines
3	IS 17456: 2020	Smart Community Infrastructure Guidance on Smart Transportation for Allocation of Parking Lots in Cities
4	IS 17457: 2020	Sustainable Development of Habitats - Vocabulary

CED 59 had also drafted a Standard based on 'ISO 37120:2014-Sustainable Development of Communities: Indicators for city services and quality of life'.

6.3.2 Electronics and Information Technology Division Council (LITD)

BIS ICT divisional council (LITD) is having a few committees for finalizing standards in various areas. Some of the important sectional committees of LITD have been developing standards related to smart cities:

- LITD 17: Information Systems Security and Privacy
- LITD 27: IoT and related technologies
- LITD 28: Smart Infrastructure
- LITD 29-Blockchain and Distributed Ledger Technologies
- LITD 30: Artificial Intelligence
- LITD 31-Cloud Computing, IT & Data Centres

LITD 28 has released a few standards related to Smart cities as given below:

List of Standards developed by LITD 28 related to smart cities		
Sl No	IS_No	Title
1	IS 802.15.4:2021	Low-Rate Wireless Networks (Adoption of IEEE 802.15.4)
2	IS 18002-1:2021	Unified Digital Infrastructure Data Layer Part 1 Reference Architecture
3	IS 18003-2:2021	Unified Data Exchange Part 2 API specifications
4	IS 18008-1:2021	Smart Cities- GIS Part 1 Reference Architecture

5	IS 18006-1:2021	Municipal Governance - Part 1 Reference Architecture
6	IS 18006-3-1:2021	Municipal Governance Part 3 Property Tax Section 1 Taxonomy
7	IS 18004-1:2021	IoT System Part 1 Reference Architecture

IoT Reference Architecture, IoT RA IS 18004 (Part 1): 2021 is based on oneM2M CSF and Unified Data Exchange Part 2 API specifications (IS 18003: Part 2: 2021) includes NGSI-LD (ETSI CIM).

7. Conclusion

COVID-19 has affected almost the entire world, causing widespread disruptions in economies and healthcare services. It has also impacted some of the Indian government's marquee projects such as the Smart Cities Mission. Due to the pandemic plaguing the country, there has been a delay in executing the projects.

One of the greatest challenges facing smart cities is how to finance them. Smart city infrastructure requires a large capital investment. The government is concentrating on encouraging Public-Private Partnerships (PPP) for successful implementation of the smart city project in India.

Public Private Partnership (PPP) allows Government to tap on to the private sector's capacity to innovate. Greater involvement of the private sector in the delivery of services is another instrument as it enables higher levels of efficiency (this should be the prime motive for using the private sector rather than just tapping financial resources).

Master plan for Indian cities is much needed as most of our cities don't have master plans or a city development plan, which is the key to smart city planning and implementation and encapsulates all a city needs to improve and provide better opportunities to its citizens.

The mission is indeed a smart and evolving move dependent on careful planning, proper implementation, and continuous monitoring.

Also, Standard based product and solution implementation is of utmost important.

8. Glossary

S. No.	Acronym	Expansion
1	AC	Apex Committee
2	AMRUT	Atal Mission for Rejuvenation and Urban Transformation
3	BIS	Bureau of Indian Standards
4	CCS	Centrally Sponsored Scheme
5	C-DAC	Centre for Development of Advances Computing
6	CSC	Centre for Smart Cities
7	CEDC	Civil Engineering Division Council
8	LITDC	Electronics and Information Technology Division Council

9	GDP	Gross Domestic Product
10	HRIDAY	Heritage City Development and Augmentation Yojana
11	HPSC	High Powered Steering Committee
12	ICT	Information and Communication Technology
13	IT	Information Technology
14	MoUD	Ministry of Urban Development
15	NGO	Non-Governmental Organization
16	PCIC	Per-Capita Investment Cost
17	PPP	Public Private Partnership
18	SCM	Smart City Mission
19	SCPs	Smart City Proposals
20	SPV	Special Purpose Vehicle
21	SAAP	State Annual Action Plan
22	UDA	Urban Development Authority
23	ULBs	Urban Local Bodies
24	UT	Urban Transformation
25	WG	Working Group

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Annexures

Annexure 1: List of Smart Cities (1st Round)

Ranking	Name of State/UT	Cities Shortlisted
1.	Odisha	Bhubaneswar
2.	Maharashtra	Pune
3.	Rajasthan	Jaipur
4.	Gujarat	Surat
5.	Kerala	Kochi
6.	Gujarat	Ahmedabad
7.	Madhya Pradesh	Jabalpur
8.	Andhra Pradesh	Visakhapatnam
9.	Maharashtra	Solapur
10.	Karnataka	Davangere
11.	Madhya Pradesh	Indore
12.	New Delhi	New Delhi
13.	Tamil Nadu	Coimbatore
14.	Andhra Pradesh	Kakinada
15.	Karnataka	Belagavi
16.	Rajasthan	Udaipur
17.	Assam	Guwahati
18.	Tamil Nadu	Chennai
19.	Punjab	Ludhiana
20.	Madhya Pradesh	Bhopal

Annexure 2: List of Smart Cities (Fast-track)

Ranking	Name of State/UT	Cities Shortlisted
1.	Uttar Pradesh	Lucknow
2.	Bihar	Bhagalpur
3.	West Bengal	New Town, Kolkata
4.	Haryana	Faridabad
5.	Chandigarh	Chandigarh
6.	Chhattisgarh	Raipur
7.	Jharkhand	Rachi
8.	Himachal Pradesh	Dharamasala
9.	Telangana	Warangal
10.	Goa	Panaji
11.	Tripura	Agartala
12.	Manipur	Imphal
13.	Andaman & Nicobar	Port Blair

Annexure 3: List of Smart Cities (2nd Round)

Ranking	Name of State/UT	Cities Shortlisted
1	Punjab	Amritsar
2	Maharashtra	Kalyan
3	Madhya Pradesh	Ujjain
4	Andhra Pradesh	Tirupati
5	Maharashtra	Nagpur
6	Karnataka	Mangalore
7	Tamil Nadu	Vellore

8	Maharashtra	Thane
9	Madhya Pradesh	Gwalior
10	Uttar Pradesh	Agra
11	Maharashtra	Nashik
12	Odisha	Rourkela
13	Uttar Pradesh	Kanpur
14	Tamil Nadu	Madurai
15	Karnataka	Tumakuru
16	Rajasthan	Kota
17	Tamil Nadu	Thanjavur
18	Sikkim	Namchi
19	Punjab	Jalandhar
20	Karnataka	Shimoga
21	Tamil Nadu	Salem
22	Rajasthan	Ajmer
23	Uttar Pradesh	Varanasi
24	Nagaland	Kohima
25	Karnataka	Hubli-Dharwad
26	Maharashtra	Aurangabad
27	Gujarat	Vadodara

Annexure 4: List of Smart Cities (3rd Round)

Ranking	Name of State/UT	City Shortlisted
1	Kerala	Thiruvanathapuram
2	Chhattisgarh	Naya Raipur
3	Gujarat	Rajkot

4	Andhra Pradesh	Amaravati
5	Bihar	Patna
6	Telangana	Karimnagar
7	Bihar	Muzaffarpur
8	Puducherry	Puducherry
9	Gujarat	Gandhinagar
10	Jammu & Kashmir	Srinagar
11	Madhya Pradesh	Sagar
12	Haryana	Karnal
13	Madhya Pradesh	Satna
14	Karnataka	Bengaluru
15	Himachal Pradesh	Shimla
16	Uttarakhand	Dehradun
17	Tamil Nadu	Tiruppur
18	Maharashtra	Pimpri chinchwad
19	Chhattisgah	Bilaspur
20	Arunachal Pradesh	Pasighat
21	Jammu & Kashmir	Jammu
22	Gujarat	Dahod
23	Tamil Nadu	Tirunelveli
24	Tamil Nadu	Thootukkudi
25	Tamil Nadu	Tiruchirapalli
26	UP	Jhansi
27	Mizoram	Aizawl
28	UP	Allahabad
29	UP	Aligarh
30	Sikkim	Gangtok

Annexure 5: List of Smart Cities (4th Round)

Ranking	Name of State/UT	Cities Shortlisted
1.	Dadra and Nagar Haveli	Silvassa
2.	Tamil Nadu	Erode
3.	Daman & Diu	Diu
4.	Bihar	Bihar Sharif
5.	UP	Bareilly
6.	Arunachal Pradesh	Itanagar
7.	UP	Moradabad
8.	UP	Saharanpur
9.	Lakshwadeep	Kavaratti
10.	Maghalaya	Shillong