SCIF Smart City Analysis

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1. Introduction

The government initiative of smart cities programme will transform the way cities will function in future by leveraging communications and IT to bring in efficiency in the day to-day operations.

1.1 The Smart City

The concept of a smart city includes different functions to be carried on by different machines in a synchronised manner to increase productivity and reduce transitional leakages in the process. Since implementation of smart city involves the need of complex services and interconnectivity among human, between human and machine and between machines, the telecom infrastructure plays a crucial role.

The role of various domains for interconnection includes smart grids and meters, vehicle tracking, internet of things and machine-to-machine communications, control rooms and early warning systems, automatic traffic management, surveillance cameras, mHealth and virtual classrooms. In order to make this interconnection successful, smart cities will need massive telecom infrastructure, cloud and data centre frameworks for the quick deployment of information and communications technology (ICT) components in various domains. The data obtained from these will be used to drive economic competitiveness, environmental sustainability, and general livability.

By leveraging broadband as a core element of their development, smart cities of the future will:

- Foster economic growth
- Improve the lifestyle of citizens
- Create opportunities for urban development and renewal
- Support eco-sustainability initiatives
- Improve the political and representative process
- Provide access to advanced financial services

Smart cities will realize the above mentioned opportunities by partnering with public or private service providers where the telecom service providers and the ICT solution providers bring in their assets, expertise, and experience.

The smart city will invest in data-centers, government cloud control platforms for multimedia and M2M communications. Combined with an open data approach and IoT, these investments will enable a wealth of new applications that benefit the city and its population.

2. Architecture of Smart City

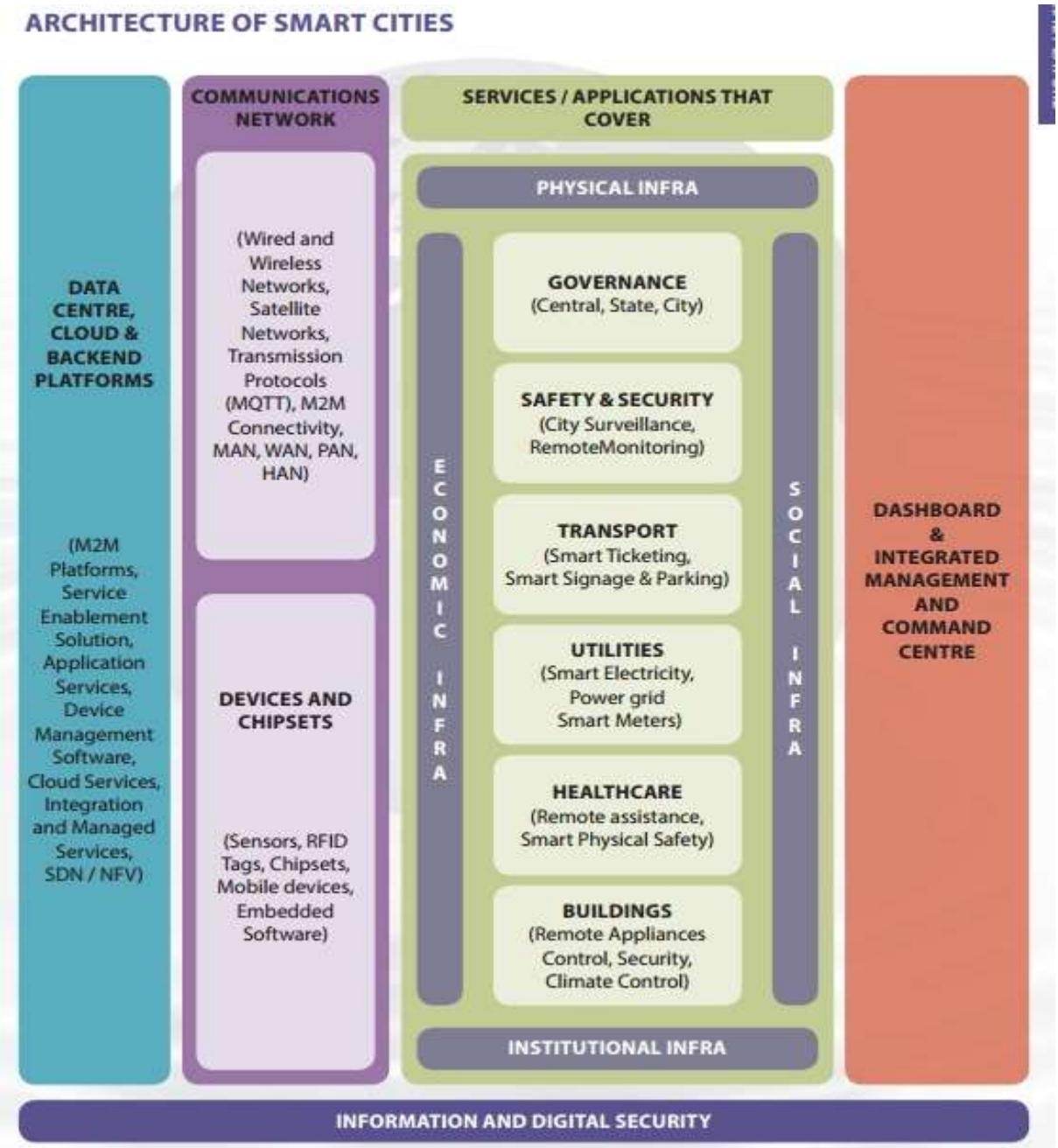


Fig: SITM (2016), Privision 17, https://www.sitm.ac.in/home/prevision, pp 77

3. Communication Infrastructure

Telecom Communication Infrastructure is primarily focussed in building telecom networks so as to connect intra cities, highways, towns and even links to overseas using either wired or wireless technologies. It is a culmination of various technological advancements including infrastructures in the field of civil, electrical, network and management layer. Thus this industry needs experts for the OSP portion and communication which comprises of RF, Switching, data and Transport (microwave, fiber) areas and IT networking in planning, project and operations roles apart from generalists for the ISP portion. Apart from this the management layers of NMS, OSS, and BSS needs software engineers to design and maintain the systems. Telecommunications infrastructure services provide technologies for setting up, maintenance, and consulting for data and voice communications.

A few examples of the telecommunications infrastructure services include:

- optical fiber installation
- cell tower site location
- radio antenna testing
- installation of standard phone equipment and data networks

Types

Telecommunications infrastructure services that specialize in telecommunications infrastructure development or telecommunications infrastructure design may offer a variety of planning, implementation, and testing services. Telecommunications infrastructure development helps in the growth of IT, GSM and CDMA. Telecommunications infrastructure design converge the voice and data with voice over IP and they are used in telephone lines, connecting the Internet, call recording, and for call management.

Applications

The telecommunication infrastructure serves across a wide dimension of industries and meet a variety of regulatory requirements for telecommunications cabling and infrastructure design. Some companies provide media gateways, soft switches, GPRS technology, mobile portals, billing and mediation systems while others provide voice over Internet protocol (VoIP) technology or digital European cordless telecommunications (DECT) systems.

3.1 Telecom requirements for smart cities

One of the key highlights of the Smart City is making use of digital technologies, IT and communications services including M2M communications to improve the city's infrastructure and services. It includes embedding smart devices like computerized sensors into the urban fabric that collect real time information and send it for processing by intelligent analytics systems with the results being used to optimize services such as transport, energy supply and healthcare. In such an environment the infrastructure systems, city equipment and home appliances will be connected to the network by IoT.

Telecom will play an indispensable role in transforming a city into a smart one as high speed and high capacity communication networks for transportation, security and energy verticals is of utmost importance. Hence a well-established telecom infrastructure is mandatory for the development of a smart city.

Applications and technologies such as location-based services, analytics, mobility, advanced metering, cloud computing, big data, near field communication, IoT, M2M communications, augmented reality and microgrids will be essential tools for setting up an interconnected smart city.

- M2M communications: Through an M2M technology, the required data can be automatically collected and transmitted using various sensors through a network module. Using specific gateways, the data can be decoded, which can further be used by analysts for the automation of machines. However, M2M communications focus on specific business processes and are vertical in nature. Therefore, a proper correlation of various operations must be made to achieve higher productivity and efficient outcomes.
- IoT: Internet of Things integrates different industry verticals into a single process and offers a horizontal view. It will form the basis of smart cities as the technology facilitates the interconnection of a large number of machines, devices, sensors and actuators with each other and with other higher-level systems including the cloud.
- Cloud services: Domain-specific applications and services can be scaled up with less investment in infrastructure, by making use of cloud. The elasticity of cloud resource provisioning can thus help the virtual verticals to manage the fluctuating user demands. A smart city will demand a cloud-based service delivery platform which integrates smart devices and infrastructure, and processes huge data on real time basis.

“The Central Role of Telecoms in The Smart City” report, commissioned from Innovation Observatory, throws light on the potential to use the technologies like Big Data and IoT ideas that make it easier to create a smart city infrastructure.

3.2 Communication Service Providers

With connectivity and data transmission expected to play a key role in smart cities, CSPs are likely to invest heavily in their networks to manage the smart devices in a smart city. The opportunity that Smart City projects will create for Communication Service Providers (CSPs) will include connectivity and data transport services. This is the core competence of CSPs, although they will need to invest in their networks and their software management systems to cope with a proliferation of smart devices and the new traffic patterns. Most importantly networks will have to deliver significantly higher Quality of Service and Service Level Agreements in order to cater for critical service domains.

Moreover, the CSPs have infrastructure to monitor and manage the performance of complex networks which places them in an ideal position to monitor, supervise and manage the performance and QoS of the network. The CSPs can offer better value added solutions and a unique positioning if they invest in setting up data centers, as they already have the necessary

connectivity and billing infrastructure. With right computing capabilities, this will help them in implementing analytical solutions linking their network data with the wider IoT ecosystem.

3.3 Effects in India

The development of a complete smart city will require a pragmatic approach to technological development, and ICT will play a major role as an instrument for sustainable development. By around 2023, the smart city technology market will be characterised by a diverse range of suppliers spanning multiple industry verticals. Ever since the announcement of smart city initiative in India, many vendors have been showcasing their offerings to tap the market opportunity.

Ericsson was among the first global vendors to explore potential opportunities for leveraging smart metering, public safety and remote health monitoring services in India. Many international telecom solution providers like Cisco and IBM have also been showcasing how connected systems of education, health care, smart buildings, transport and smart parking can transform the way communities are designed in order to ensure, social, technological, economic and environmental sustainability.

India's leading telecom operator Airtel is currently working with three electricity boards in the country on smart metering solutions. In addition, they also collaborated with the Odisha State Road Transport Corporation in order to deploy a satellite based vehicle tracking system and fuel monitoring system.

Also, Russia based Sistema JSFC is planning to develop smart cities in India along the lines of projects it has implemented in its home country.

Alcatel-Lucent engaged with governments, municipalities, and smart-city integrators in a number of domains:

- Ultra-broadband access gives citizens and businesses the broadband they expect in outdoor public places as well as indoors. Small cell and Wi-Fi options can help ensure superior coverage and quality while reducing carbon footprint.
- IP routing and transport solutions help cities transition from siloed to converged network administration for greater efficiency.
- M2M device management saves money and time with remote provisioning, configuration, OS and firmware updates, and device troubleshooting.
- Cloud technologies like SDN reduces cost and enable better business model that let providers differentiate in the marketplace.
- IMS communication allows better connecting public administrations and organizing communities of contact to provide them with a new conversation experience.

3.4 International experience

In India, the concept of smart cities has come late as compared to other countries across the globe. Many global cities have either deployed some part of IoT in their working or are planning to do so in the near future. Deutsche Telekom has announced a smart city pilot project to ensure a better flow of traffic, reduced CO2 emissions, smart mobility and ample parking space in Pisa, Italy. Under the project, the operator will integrate parking spaces in Piazza Carrara with a sensor-based parking management system.

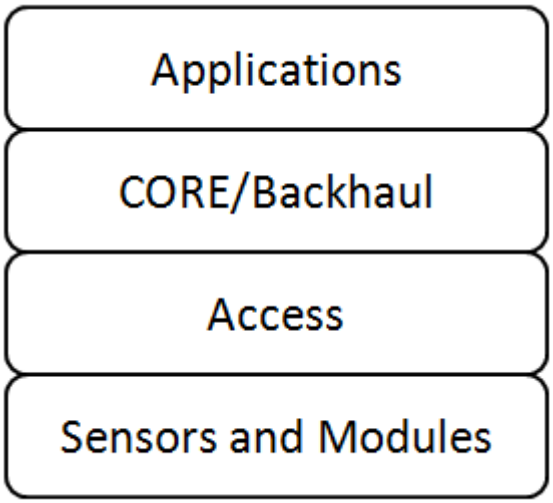
In Glasgow, as part of a £24 million project, the government is planning to put sensors on street lights and traffic lights and integrate them with the existing CCTV system in the city in order to know when exactly the bulbs need to be replaced. The sensors will also allow the officials to know when the streets are empty so that the lights can be turned off in order to save energy. In another project, Boston University has deployed BigBelly, a solar-powered trash receptacle and trash compactor which alerts the sanitation crew when the can is full.

3.5 Challenges and the way forward

Modernising cities into smart cities will require meticulous planning, effective capital disbursement and huge investment in infrastructure. However, leveraging technology to this end will have intrinsic impact on the massive amount of data and security. Another challenge in the development of a smart city relates to the standardisation of various smart devices and platforms provided by different vendors. The transformation of old infrastructure into a smart and well-connected one with standardised components is a big challenge. While it will take some time to develop fully smart cities in India, small segments can be implemented in a short span of time. The rise of growing urban population in combination with constrained natural and financial resources, are shaping the requirements for the evolution towards smarter cities.

3.5 The Layered Structure

The communication architecture can further be broken down into the below layered structure to explain the communication infrastructure as

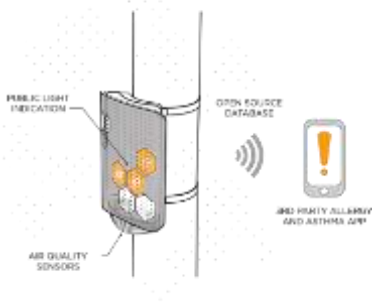


3.5.1 Sensors and Modules

Use of Sensor Technology - A smart city can create an efficient and smart services delivery platform for public and municipal workers by installing sensors in the city and to create platforms that allow the share of information and give it for proper use to the public, city managers, businesses and professionals. The platform can have common data warehouse where different sensor system store their information.

Array of Things:

The Array of Things (AoT) is an urban sensing project, a network of interactive, modular sensor boxes that will be installed around Chicago to collect real-time data on the city's environment, infrastructure, and activity for research and public use. AoT will essentially serve as a "fitness tracker" for the city, measuring factors that impact livability in Chicago such as climate, air quality and noise.



Reference: https://arrayofthings.github.io/

Electricity meter readings have evolved from the manual procedure of reading the mechanical meter, to automatic meter reading (AMR) which were deployed to reduce costs and improve the accuracy of meter readings, eventually to an advanced metering infrastructure (AMI) which differs from the AMR in that it enables two-way communications with the meter, driven by a growing understanding of the benefits of two-way interactions between system operators, consumers and their loads and resources.

Reference: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3574682/

- The city will be fitted with instruments and data aggregation mechanisms that allow the collection of increasing amounts of data about city life.
- These sensors, actuators, cameras and other instruments and aggregation systems will need to transfer data to and receive commands from back-end systems
- The data from different sources and city systems has to be available and be easily aggregated together to gain far greater insight into what is going on in the city.
- Detailed, measureable, real-time knowledge about the city will therefore be available at every level

Sensors and Devices: These are needed by a smart city and cover a wide spectrum of Electronics and Computational equipment. Typical devices that are part of a Data / ICT city infrastructure include:

- Sensors, Actuators, HMI's and HCI's
- Chipsets, Modules, Boards, PLC's
- Computers, Servers and Networking LAN infrastructure
- Mobile phones, Tablets and other Handheld devices
- Core Routing Switches & Access Switches
- Wireless Networking Gateways and Routers
- Firewalls and Network Routers
- OSP, Base Stations and Towers

3.5.2 Access

Small Cell

In the LTE-A perspective, a small cell is a low-power and low-cost radio base-station, whose primary design target is to provide superior cellular coverage in residential, enterprise and hot-spot outdoor environments.

Small cell may, in addition, provide 'smart caching' services. It enables to provide local caching services in order to reduce the load on the network backhaul (e.g., in the case of video traffic).

small cells are able to fulfill Smart City requirements in terms of interoperability, robustness, limited power consumption and multi-modal access with improved quality of experience

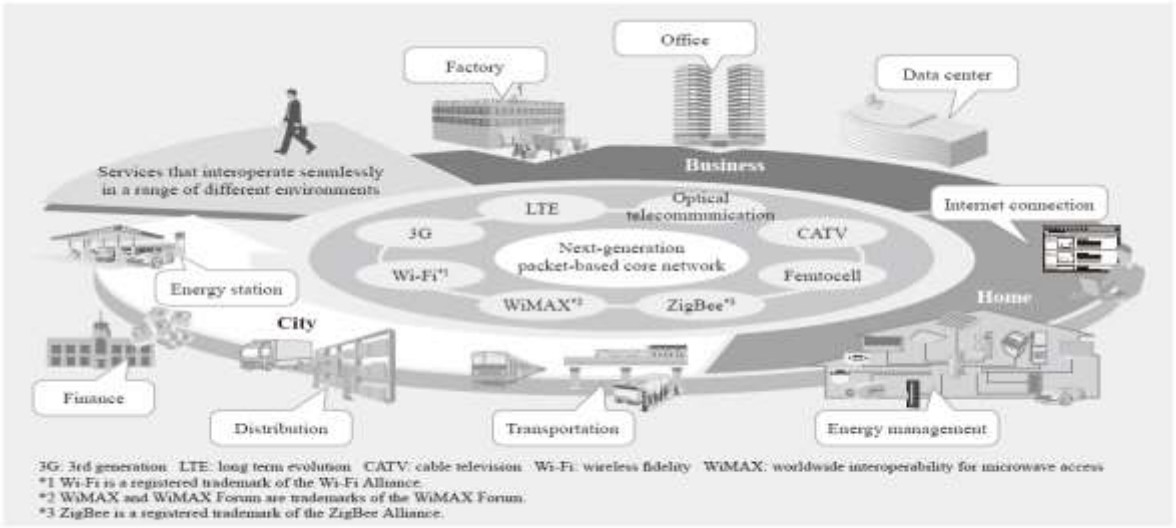


Fig. 1—Telecommunication Systems in Smart Cities.
Telecommunication systems connect together all the elements that make up a smart city to provide services seamlessly using most appropriate telecommunication technologies.

(Reference: http://www.hitachi.com/rev/pdf/2012/r2012_03_107.pdf)

3.5.3 Core/Backhaul

LoRaWAN - Low–Power, Wide-Area Networks (LPWAN) are projected to support a major portion of the billions of devices forecasted for the Internet of Things (IoT). LoRaWAN™ is designed from the bottom up to optimize LPWANs for battery lifetime, capacity, range, and cost.

The advantage of LoRa® is in the technology's long range capability. A single gateway or base station can cover entire cities or hundreds of square kilometers.

- Long Range
- Max Lifetime
- Multi-Usage
- Low Cost

Reference: https://www.lora-alliance.org/portals/0/documents/whitepapers/LoRaWAN101.pdf

ZigBee:
ZigBee is an IEEE 802.15.4-based specification that runs over 868MHz, 900MHz, and 2.4GHz, and it has a defined rate of 250 kbit/s (i.e., best suited for intermittent data transmissions from a sensor or input device).

Z-Wave: Supported by over 250 manufacturers in the Z-Wave Alliance, Z-Wave is used primarily for home automation systems because

(1) it is easily embedded into consumer electronics devices, and
(2) it minimizes power consumption (i.e., best suited for battery-operated devices).

Z-Wave runs on 868MHz and 900MHz over a 30m range and is designed to provide reliable, lowlatency transmission of small data packets at data rates of up to 100kbit/s (unlike Wi-Fi and other IEEE 802.11-based WLAN systems).

Optical Fiber: The cables can handle the long distance needed for such systems and provide large amounts of bandwidth to move data from diverse systems. Implementing large-scale fiber networks will require strategic media converter use to provide fiber-to-Ethernet interconnection at endpoint sites.

(Reference: https://www.perle.com/articles/3-essential-network-considerations-for-smart-cities-40117618.shtml)

XDSL Backhauling & LOS backhauling in the E-band: These are still in trial phase to overcome the bottleneck of small – cell.

GPON:

Benefits

- Lowers CAPEX and OPEX through efficient use of fiber
- High-speed bandwidth and triple-play services
- Scalable for business growth through a flexible and high capacity OLT

Application: Taipei becomes a Smart city with DASAN's FTTH GPON solution

(Reference:
http://www.dasannetworks.com/pds/contents_11/%5BDASAN_Success_Story%5D_Taifo_GPON_Solution_for_Taipei_City.pdf)

Leveraging IoT Platform

The market offers a variety of IoT platforms such as n.io, Thingworx, and Sensorflare to help make this transition easier. These IoT platforms typically implement the below functionality:

- Rapidly develop and implement applications through open APIs
- Display IoT information (e.g., readings, list of sensors, locations)
- Integrate IoT-related technical implementations for the required enterprise support systems (e.g., OSS, BSS)
- Remotely configure, control, and manage any type of device (e.g., controllers, devices, appliances)
- Gather, process, broker, share, transform, and analyze data from field devices
- Implement IoT-specific wireless solutions
- Specialized functionality for specific industries / markets (e.g., energy, automotive, etc.)

4. Benefits of an improved communication infrastructure in cities

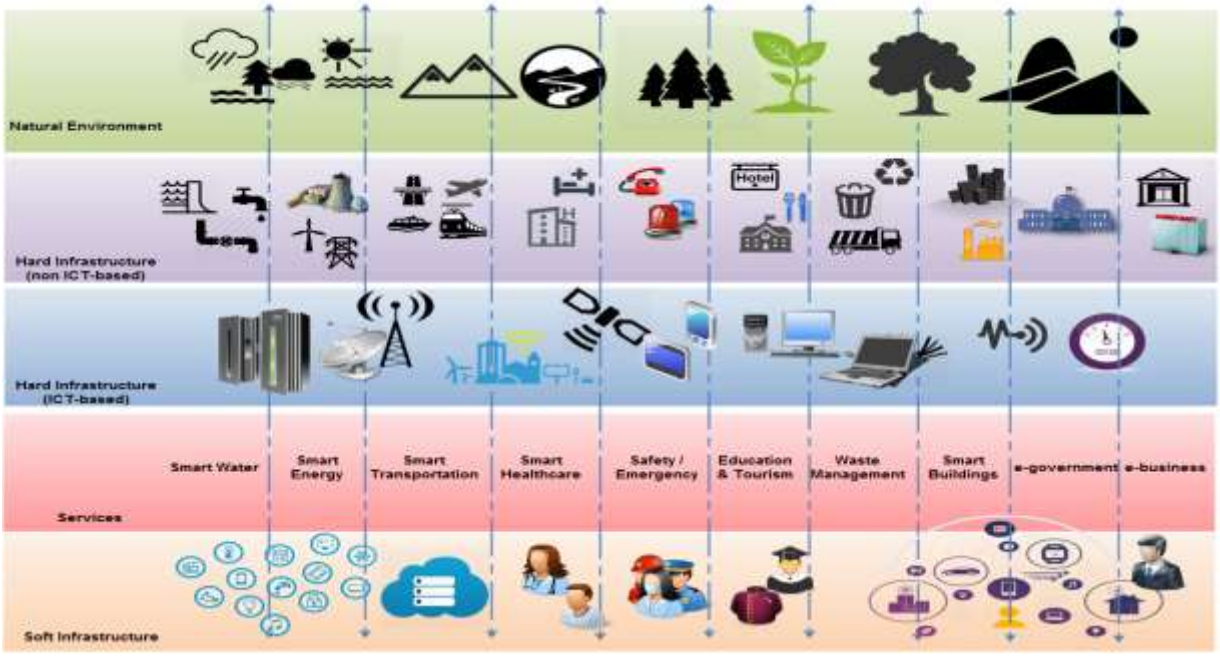


Figure 1 Multi-tier Smart city ICT meta architecture[1]

To develop ICT and data infrastructure in a city with the aim of being smart, there are three essential tasks to be implemented, they are:2

- **Big data for optimization of city operations**- Smarter ways to develop cities will emerge when city governments and citizens start thinking and planning for infrastructure components in a holistic manner. ICT can facilitate this process. One commonly used approach is to aggregate the different data streams in the city under a single roof. This enables the collection and integration of data from different individual domain systems across functions - creating system-wide efficiencies and allowing for new insights. These operation centers act as the nerve centers for different smart initiatives by providing the technology foundation needed for an integrated view.
- **Internet of things, Ubiquitous sensor networks, Data security**- Data is an important component of smart cities. The sensor networks, intelligent meters, mobile phones, and IoT devices all generate huge volumes of data. This generated data could be transformed by city government to generate new insights that could be monetized and sold to different stakeholders. The key would be to generate a suitable value chain for the data and an appropriate business model for the same at different layers.
- **Broadband**- Implementing smart city technologies often requires a robust, reliable, affordable broadband network. This underlines the need to continue to focus on bridging the digital divides, to harness the benefits of smart applications. Mobile broadband is also playing a major role especially in developing countries, where there is a lack of fixed infrastructure.

4.1 Telecom enablers of smart city[3]

- Telecom Network
- Cloud Computing
- Internet of Things(IoT) & IPv6
- Sensor Network
- Mobile Broadband

4.2 Role of ICT in smart city3

- Acts as an enabler to make a city smart
- Planning of ICT infrastructure be the prime focus area both for Greenfield & Brownfield smart cities.
- Intelligent and efficient use of resources
- Cost and energy savings
- Reduced environmental footprint
- Different systems and nodes are interconnected on common ICT infrastructure
- Interconnected and Independent services should evolve through
- Well Defined Digital Master Plan for the City
- Under centralized governance dashboard of stakeholders

4.3 Benefits:

- **ICT-enabled information and knowledge sharing**: Traditionally due to inefficiency on sharing of information, a city may not be ready to solve a problem even if it is well equipped to respond. With immediate and accurate information, cities can gain an insight on the problem and act before it escalates. [4]
- **ICT-enabled forecasts**: Preparing for stressors like natural disasters requires a considerable amount of data dedicated to study patterns, identify trends, recognize risk areas, and predict potential problems. ICT provides and manages this information more efficiently, so that the city can improve its preparedness and response capability. [4]
- **ICT-enabled integration**: Access to timely and relevant information (e.g. ICT-based early warning systems) need to be ensured to better understand the city's vulnerabilities and strengths. [4]
- **Accessibility to data**: There is a need for schemas that will promote openness and accessibility to data. While there will always be a concern in terms of “privacy” and the proprietary nature of data, most 'sensitive' data can perhaps be made anonymous before being made accessible. This question of balancing the need for both privacy and accessibility is still not well understood in terms of a legal and regulatory framework and needs to be addressed in the design of smart sustainable cities.
- **Open data**: It is recommended that data on energy, utilities, transportation, and other basic datasets are to be made public. This is vital in facilitating the cross-scale information sharing component of a smart city that was suggested above. Information sharing allows better operational decisions to be made and implemented. It is equally important to note that all data should be presented in a consistent and standardized manner. It is only when all data is based on the same parameters that it allows for meaningful exchanges and decision making, such as in the case of open application programming interfaces (APIs).
- **Managing massive data**: Cities come in various sizes and so does the information

associated with them. To get an accurate view of the data from various sources and various places, this information usually comes in huge packets and should be able to provide accuracy, analytical capabilities, data security, and data storage. Therefore, data needs to be managed using highly efficient database constructs.

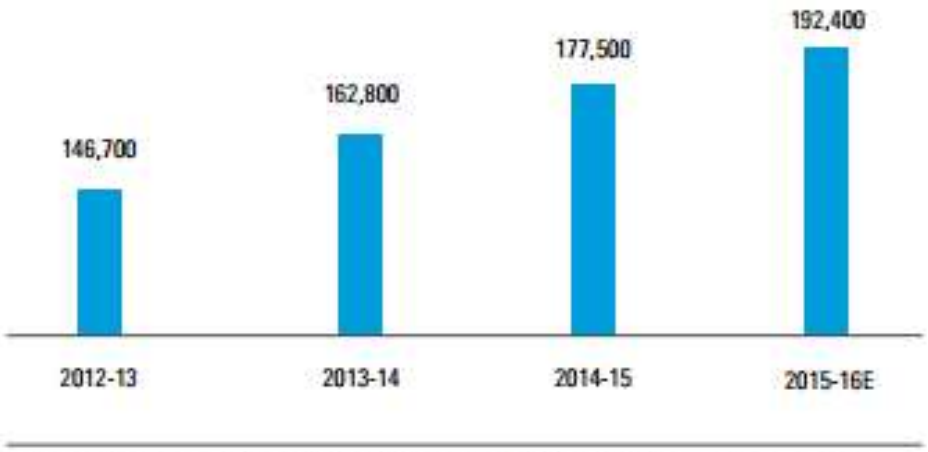
- **High performance**: Creating new insights from massive volumes of data needs to be complemented with digital infrastructures that are capable of high performance. Large amounts of data can place a lot of pressure on the workload and operational capacity of existing devices. To make the task optimal, the ICT systems should be reliable, ensure precise data transmission, minimize downtime, and avoid system failure. In cases of failure, the solution should be ready to handle and recover from error.
- **Maximum efficiency**: For ICTs to be ready to swiftly disseminate the information from one corner of the city to another, it should operate at its peak efficiency at all points of time. Improving quality and flexibility while minimizing capital and operational cost is crucial for both maximizing and maintaining the role of ICTs over time.
- **Telecom equipment manufacturers**[5]
    1. Procedural simplification in establishment of repair hubs, Anti Dumping Duty (ADD) payments and further smoothening of customs clearance process
    2. Customs duty on import of equipment and for manufacturers in SEZ's need to be revisited to rationalise the cost of business.
    3. Continue with self-certification process for testing of telecom equipment, till rollout of 3rd Generation Partnership Project (3GPP) testing standards.
    4. Consider releasing E-band spectrum in India with licence conditions as proposed by TRAI.
- **Mobile handset manufacturers**[5]
    1. Enhance ease of doing business through procedural simplifications in registration under CRS order and obtaining Equipment Type Approval (ETA).
    2. Industry is looking forward to certain reforms in statutory levies like VAT, excise and NCCD to compensate against the rising input costs and maintain global competitiveness.
    3. Considering that the unorganised sector in India handles majority of the e-waste, collection targets should be implemented in a phased manner.
    4. Handset imports should be rotated out from the National Calamity Contingency Duty (NCCD) list, as this is a rotational levy which has been applicable on handset imports since 2008.
- **Broadband**
    1. Broadband is the infrastructure of the future.
    2. The European Cities Monitor report cites "the quality of telecoms" as the 3rd ranking priority when businesses consider relocating[6].
    3. For every €1 spent on broadband, €14 can be generated for the local economy[7].
    4. 10% increase in broadband penetration producing 0.25%–3.6% growth in GDP[8].
    5. Broadband is responsible for 20% of new jobs across all businesses, and 30% of new jobs in businesses with less than 20 employees[9].
    6. For every 1,000 additional broadband users, 80 new jobs are created[10]
    7. On affordability of services and its mass utilization riding on a reliable, advanced-nation broadband infrastructure. [11]
    8. The Committee felt strongly that it is essential to review the implementation of NOFN to raise the aspirational level to match that of Digital India.[11]
    9. A highly scalable network infrastructure accessible on a non-discriminatory basis, to provide on demand, affordable broadband connectivity of 2 Mbps to 20 Mbps

for all households and on demand capacity to all institutions, to realise the vision of Digital India, in partnership with States and the private sector."[11]

- **Tower infrastructure**
  1. Increase in tenancy ratios has been the key growth driver for tower companies in India. Rise in tenancy ratios is attributable to the expansion of 3G and onset of 4G technologies and it is expected that the industry's tenancy ratio will increase to 2.9 times by March 2020 from 1.95 times as of March 2015.[1]
  2. Around 70 per cent of India's 400,000 towers are owned and operated by the tower companies.[12]
  3. Advent of new technologies, such as 4G by Telecom Service Providers (TSPs), along with expansion in the rural areas, are expected to be key drivers for the telecom infrastructure industry over the next five years.[13]
  4. Rapid growth in the sector has also prompted tower companies to invest heavily in capex. The aggregate capex spends increased from INR8,000 crore in 2013-14 to INR 10,200 crore in 2014-15. Net tower additions were also significantly higher at about 6,300 in 2014-15 vis-à-vis 3,200 in 2013-14. [13]
  5. One of the key emerging trends in the last few years is emergence of towers running on green energy. In line with the trend, 15 per cent of the total capex spends were incurred by towers running on green energy.[13]

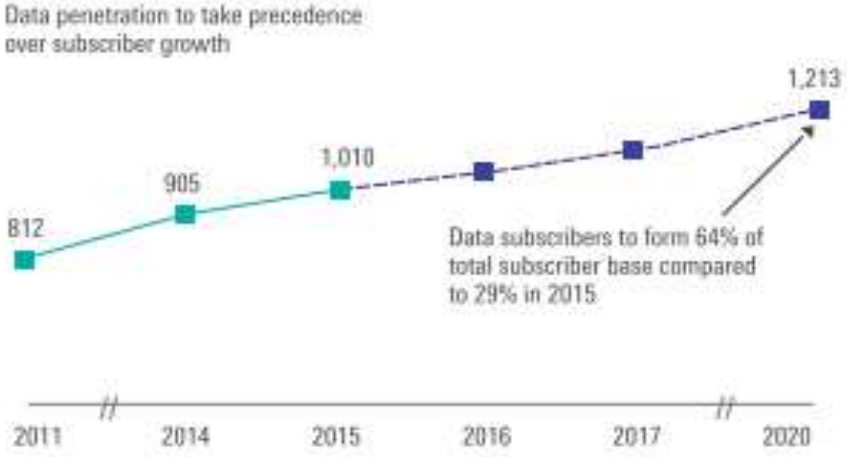
Source: Towers analysis presentation, CRISIL Research 2016

Revenues from communication services (INR crore)



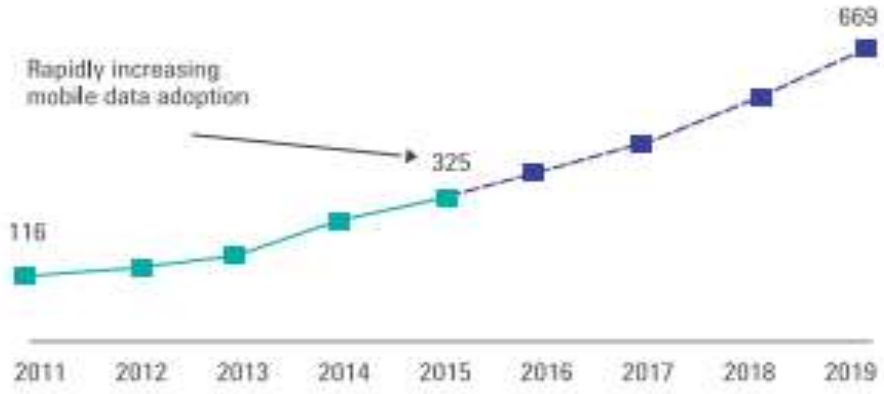
Source: TRAI reports 2012,2013,2014,2015 Telecom services analyst presentation 2016; CRISIL Research

Mobile subscribers (millions)



Source: Subscription data December 2015; TRAI; 2016 Telecom services analyst presentation 2016; CRISIL Research

Internet subscribers (millions)



Source: Subscription data December 2015; TRAI; 2016 Telecom services analyst presentation 2016; CRISIL Research

5. Key Stakeholders

It is important to first understand architecture of smart city. Based on which, OEM players' offer their product and services.

Figure below is the architecture required to implement IoT smart services.

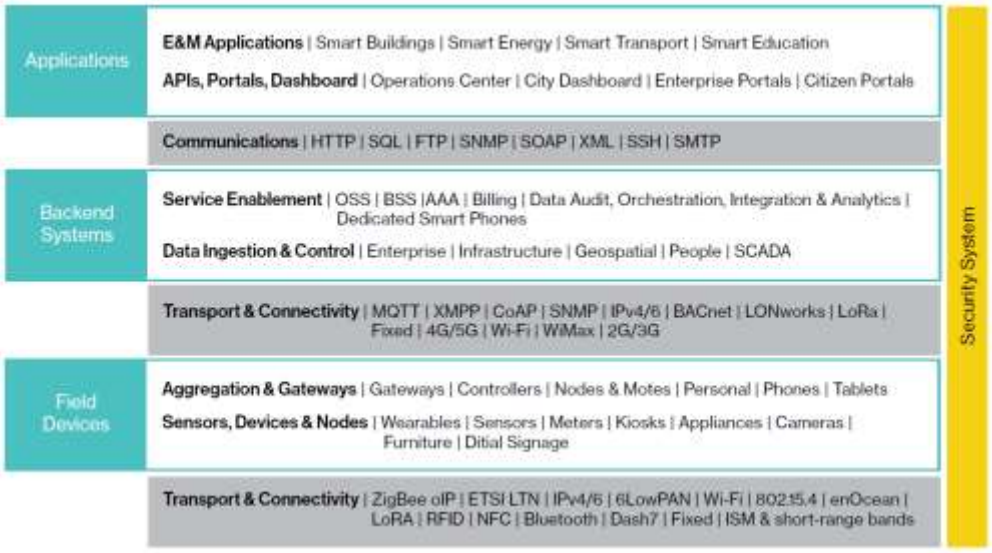
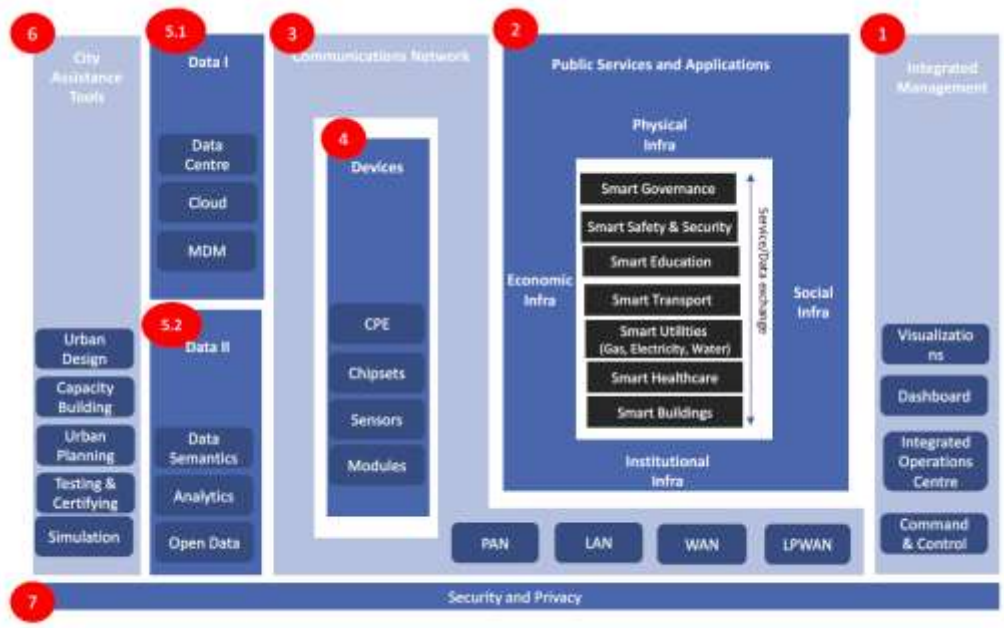


Fig1. Typical Architecture required to implement IoT smart services[1]

ICT Foundational pillars for a smart city[2]



Source: GAIA, Xerox and TSDSI

Figure 2: ICT PILLARS OF A SMART CITY

5.1 Communication Network

Communication Networking technologies provide the infrastructure of the smart cities to make all the devices, computers and people have convenient, reliable, secretive communication paths with each other. This includes

- wired network
- wireless networks,
- satellite networks,
- transmission protocols (MQTT), M2M connectivity;
- Networks that can be called MAN, WAN, PAN, HAN.
- Dedicated resources that could be allocated for critical communication or communication during emergencies or disasters.

5.2 Devices and Chipsets

Devices are an immense area and comprise a larger umbrella of routers, computers and other networking equipment.
Other devices being Sensors, RFID tags, Chipsets, Mobile devices, Embedded software, etc. that facilitate the 'sensor web' in cities
Devices need to be compliant with IPv6 addressing.

5.3 General Characteristics of Sensors, Devices and Communication systems for Indian Cities:

Within a city, many kinds of communication networks can exist, many kinds of communication networks will be needed to fulfil various needs and all could carry matter

relevant for a city's functioning. A smart city must combine legacy networks and new communication architectures in order to configure existing communication networks to achieve compatibility and interoperability.

Sensors and Devices: These are needed by a smart city and cover a wide spectrum of Electronics and Computational equipment.

5.4 Key Players

5.4.1 Sterlite Tech

They play a pivotal role in making Gandhinagar as India's first Wi-Fi city. 57km, comprising 30 sectors, with more than 2 lakhs population will benefit from Wi-Fi city. This city will be embedded with around 1,25,000 smart devices and more than 750 Wi-Fi access points.
(Reference: https://www.youtube.com/watch?v=oo7Gh42IxDk)

5.4.2 Sierra Wireless – India

Product Line:

- Embedded Solutions
- Networking Solutions: Routers and Gateways
- Cloud & Connectivity: AirVantage IoT Platform, smart SIM

5.4.3 IBM

Received Frost & Sullivan's 2014 Global Visionary Innovation Leadership Award as Best-in-class **Smart City integrator**[4].

(Ref: https://www.ibm.com/developerworks/community/blogs/ibmsyssw/entry/ibm_named_2014_global_best_in_class_smart_city_integrator?lang=en and http://www-03.ibm.com/press/in/en/pressrelease/49784.wss)

- Smart Energy Management
- Smart Water Management
- Smart Waste & Horticulture Management
- Smart Security Systems

(Ref: http://www-03.ibm.com/press/in/en/pressrelease/49784.wss)

5.4.4 CISCO

Network solution which CISCO provides[5]:

- Smart Parking
- Smart Building
- Energy Management Solution
- Remote Expert Solution
- Connected Learning
- Smart Work Spaces

- CISCO Service Grid – designed to automate and manage all tech operations in a Smart City

Ref:http://www.cisco.com/c/dam/en/us/products/collateral/switches/energymanagement-technology/smart_city_india.pdf

5.4.5 Schneider Electric

Services of Schneider Electric[6]:

- Smart Energy
- Smart Water
- Smart Buildings & Homes
- Smart Mobility
- Smart Public Services
- Smart Integration

Ref:http://www.schneider-electric.co.in/en/work/solutions/for-business/inclusive-smart-cities/by-solution-smart-energy.jsp

5.4.6 Siemens

Ref: https://www.siemens.com/in/en/home.html

5.4.7 Huawei

Ref: http://e.huawei.com/en/solutions/technical/smart-city

Solutions Huawei offers[7]:

- Smart Government
- Smart Industry
- Smart Life
- UC&C – Unified communications and collaboration – characterized by mobility, converged video and cloud collaboration.
- Other solutions and their detail description can be found in their brochure - http://enterprise.huawei.com/ilink/cnenterprise/download/HW_315743

5.4.8 Microsoft

Surat partners with Microsoft to become a smart city.

List of Activities to be carried out for Surat[8]:

- ✓ Intelligent Transit Management System
- ✓ Automatic Fare collection system
- ✓ Automated Traffic Control System
- ✓ Automated Sliding Door at High Mobility Corridor & BRTS Stations
- ✓ Public Bicycle Sharing- Non Motorized vehicle- PPP

- ✓ Battery operated Vehicles- PPP
- ✓ Ferry System- PPP
- ✓ Development of ERP with GIS Platform
- ✓ SMAC Center (SMArt City Center) [IoT (Internet of Things) : Big Data : Data Analytics]
- ✓ S-Connect Card Management System (Co-Branded Multi-Application Contactless Smart Card)
- ✓ Mobile Apps, Mobile tickets, Social Media, M-ID (Mobile Identity)
- ✓ Open Surat – Open Data
- ✓ Surat IT-MAC (Integrated Transport-Mobility Administration Center)
- ✓ Connected Surat [WiFi-Surat :: FTH (Fibre to Home)]
- ✓ MySurat.in [Active Citizen Engagement] 16 Data Center Strengthening & DR Site

6. Analysis of the solutions proposed by various cities for the Smart Cities Mission

6.1 :Port Blair

6.1.1 Aadhar Seeding

- So as to avail any of the online government services, there is a need to develop and implement de-depulicated common database of citizens with AADHAR / Ration Card Number / Voter ID Card / Driving License Number authentication.
- Also, it has been envisioned to make use of digital locker for issue and verification of digital certificates in delivery of services to its citizen.
- The websites of all administrative departments can be accessed through the online network.
- Citizens can avail 100% of the government related services pertaining to the 54 E-from by logging into the network. Another 78 high volume services will also be deployed on the network.
- Implementation of real time passenger information system would help in realizing the modal shift towards public transport from 30% to 50%.

6.1.2 City Navigation System

- Implementation of digital door numbering and addressing system will serve the ULB's governance needs and provide city navigation facility to citizens and tourists.
- The first pan city proposal of Project ‘Patha’ upon integration with street plan data on Zippr platform would impact the governance in the following ways:

1)

a) Information about the total number of assessment, ownership particulars, building use, built up area would be available on the zippr platform leading to improvement in assessment, revenue collection from property tax and utility services.

2)

b) The mobile app in the public domain would assist the locals and the tourists in various activities like city navigation, cab services, e-commerce services etc.
c) The mobile app would be useful in calling emergency services as the location would be indicated by the GPS system. This would cut the response time by 5-10 minutes.
d)

6.1.3 Disaster Management

- The island located in a very severe intensity zone is susceptible to natural disasters like cyclone, tsunami, earthquake and landslides. Preparedness to face natural disasters and mitigation of the effects can be handled in the long term by creating awareness and imparting training to the citizens in the area of disaster management.
- The reservoir in Dhanikhari is the single major source of fresh water supply to the city. Hence protection of this from any disasters is of prime importance.
- Protection of public properties through slope stabilization

6.1.4 e-Governance

- In order to provide efficient e-governance services to the citizens, action for back end computerization of high volume citizen centric services of different departments has to be done for enabling their access over web portals and mobile applications.
- The state portal www.andaman.gov.in ensures a hassle free access to statutory documents. Around 52 e-governance services including online services like birth and death registration, ration card, driving liscence, land records, passports, relief and rehabilitation works, tenders etc. are delivered through the Common Service Centres. The GoI has laid submarine cables for the local network connectivity.
  Challenge: Poor internet connectivity in shifting completely to an online based public service delivery system.
- For online tracking and monitoring of various services provided by the administer, the online dashboard www.atom/andaman.gov.in is made available to the senior officials of the administration.
  Challenge: Poor connectivity and non-institutionalization of the system
- Biometric attendance system increased the productivity over the past three years.
- Public grievance redressing within 15-30 days is one of the major strength of A&N administration. The online grievance redressal mechanism will cut short the time of acknowledgement to within two days.

a)

6.1.5 GIS

- For improving efficiency and transparency within the Government offices, it has been proposed to implement e-office, e-procurement, IMPACT etc. in all Government Offices.
- An Integrated GIS mapping solution for all Government Departments with different layers has also been proposed.

6.1.6 Property Survey

- The first pan city ptoject ‘Patha’ will implement digital door numbering address system throughout the Municipal Council limits which is a win-win proposal for both the citizens and the administration.

- All properties in the Municipal Council limits will be assigned a unique digital door number which will be integrated with the street map on a suitable IT platform. The door number will be associated with meta data of the property on different layers. The ULB can access this data through a suitably developed software interface in order to track payment of property tax and different types of cess, licence fee, thereby improving the revenue of the ULB.
- The citizens in general and tourists in particular can use the system through a mobile app for city navigation and emergency services. The transmission of GPS coordinates of the caller will reduce response time of emergency services. The businesses can also reap the benefits as the zippr address will lead to higher footfalls as tourists can easily navigate to the stores. All these benefits will accrue within 2-3 years of project implementation
- For the public, there are benefits like navigation in autos and cabs to different parts of the city, efficient delivery of e-commerce service and courier service, easy availability of emergency services like ambulance, fire, police etc.

6.1.7 Wifi

- Setting up of IP based wireless network for delivering e-governance services as the city lacks high speed internet connectivity, although a local network has been maintained by the GoI.
- The second pan city project titled 'Port Blair Connect' would establish a city wide IP address based wireless network which would enable the citizens to avail e-governance services through MAN in the absence of high speed Internet. It is aimed at overriding the Internet bandwidth deficiency by setting up of an IP address based wireless Metropolitan Area Network in the city in order to deliver all web based services to the citizens through the LAN.
- Issues Addressed by the Project:
  a) Websites of all Government Departments will be accessible by logging into the wireless network. There will be no need of Internet for browsing and downloading information from these sites.
  b) All 52 e-governance services will be provided through the MAN
  c) On-line payments can be made for availing services and making bill payments. iv. Grievance redressal and escalation facility will be operated on the LAN
  d) All PBMC services can be availed through this network.
  e) Data sharing between departments to reduce duplication of work
  f) The network can be used for real time data transmission pertaining to services

Thus, in effect, the literacy and high social development indices indicate that the level of acceptance in order to implement an urban transformation for a sustainable overall development is very high.

The task of making governance citizen-friendly and cost effective is increasingly relying on provision of on-line services to bring about accountability and transparency. Use of mobile phones has reduced cost of services. This advantage has to be tapped in order to improve e-service delivery in Port Blair.
The factors for ensuring success for implementation of the project are

(1) Capacity building within the establishment / department
(2) monitoring its implementation at highest level
(3) providing incentives and penalty.
However, due to unforeseen reasons, if the project turns out different from what is planned, RCA would be taken to analyse the cause and take remedial action. The SPV

would have access to expertise from various mainland organizations which would be invited to offer solutions to the hurdles in the implementation of the pan city proposals through software integration.

6.2 City: Raipur

6.2.1 GIS

- A GIS based route beats for city sanitation & DtoD is used for the Solid waste management programs in the city in all 70 wards with feature of employee performance & asset tracking for 30 days trial period

6.2.2 Aadhar Seeding

- GIS based Property survey is already under process in Raipur with unique ID
- Social security Aadhar seeding for service mapping will be linked to every city vertical and cross referenced for Property to service mapping. This will be backbone for every service delivery, redressal, data collation and analytics and monetization.
- Evidence based planning and design will be done on the one stop Integrated App/Portal for most municipal services based on aadhar seeded GIS mapping.
- Resource funding of 10cr in the year 2016-17.

6.2.3 CCTV Surveillance

- Complete CCTV surveillance network in all Smart Bus stations, public areas, commercial areas and traffic intersections of RMCC integrated to the RCCC. Augmented and encouraged with a private network based on Distributed Cost model.
- City buses will include GPS enabled CCTV camera & Panic button with 2Way Communication.
- CCTV surveillance is done for Intelligent Traffic Management System which includes IT tools for traffic management, enforcement and surveillance at 46 intersections identified by the traffic police department.
- Waste Asset Management: CCTV monitoring of secondary and primary dumping sites, GPS based tracking and optimum routing, RFID and bin monitoring with Geo fencing.
- Crowd sourcing and Community Policing: CCTV Surveillance will reduce the crime rates and ensure the safety and security. Engaging citizens to gathering traffic as well as accidental and crime data through app based user input for a safety and security.
- CCTV coverage will enable quick tapping of issues in the form of data and maps such as crime mapping, blind spots, accidental zones, peak hour traffic count, average travel time, etc. This will enable the police department to reduce crime and do preventive policing.

6.2.4 Command Control Centre

- City OS: Integrating the services of multiple city subsystems on a single command and control center through city OS will enable the use of city smart card across all the verticals for integrated incident reporting and management. The

smart city card, used across all verticals by every citizen, will promote true city wide inclusivity.

- The control centre for the RCOS would be the Raipur Command and Control Center (RCCC) which will leverage the State Data center which has already been created and Meghraj the Cloud service for integrated incident reporting and management.
- Intelligent Traffic Management: IT tools for traffic management, enforcement and surveillance at 46 intersections identified by the traffic police department include various technologies controlled from a Raipur Central Command Center(RCCC) shared by other Municipal verticals
- The RCOS will represent data through Command and Control Center which would provide a number of dashboards for every service vertical incorporating realtime data analysis, solution sourcing and informed decision making through SOP's.
- Facilitation regulatory framework Formulation by RCCC will reduce the Government response time to citizen complaints, creating faster service delivery and overall efficiency.

6.2.5 Traffic management centre

- The cities from across the country and other parts of the world have made successful efforts to address the issues related to urban mobility through intervention of technology which includes components such as intelligent traffic signals, number plate detection system, speed detection, red light violation system, , e-Challan, etc. which provide real time monitoring. Features such as Smart Parking, Smart Hoardings, Smart Bus Stops, and web based or apps and services etc. complement the monitoring efforts.
- Intelligent Traffic Management System:(ITMS) IT tools for traffic management, enforcement and surveillance at 46 intersections identified by the traffic police department. These tools include Smart Traffic Signals, Automatic number plate recognition system, Red-light violation detection system, E-Challan, Variable Message Signs, CCTV surveillance, and Traffic analytics. Audio aids in public transport, intersections and crossings for Divyang's would also be provided.
- The audio aids in buses, autorickshaws, intersections and crossings will help guide the differently abled so that they can travel with relative ease in the city. Facilitating Carpooling, especially between Raipur and Naya Raipur will also help reduce vehicular pollution.

6.2.6 Toll collection

- The state is already implementing a state wide common payment system and will help implement Raipur City Card based transit fare collection process easier to execute.
- The multi-modal nature of the transit includes parking and payment gateway RuPay(NCPI). This is processed through the Raipur Citizen Card which will enable multiple services and Transit Fare collection.
- System will enhance commuter convenience, integrating BRTS, Bus and IPTs including Taxis and Rickshaws.
- Toll collection would also be linked to electronic toll collection to increase the operational efficiency and Citizen convenience.

6.2.7 Smart Parking

- The multi-modal nature of the transit taken care by parking will ensure citizens are aware of Location, Capacity and Availability information of city parkings including nearest Parking Search with location enabled services.
- Smart On-street and off-street parking integrated on app based parking guidance with user charges and payment integration.
- Up-gradation of existing bus stops to Smart bus stops.
- Development of 4 multi-modal hubs at 4 corners of MRCC with Park and Interchange for Bus, Car, Taxi, Auto, e-Rickshaw and cycles with related infrastructure for the improvement of Major Roads and intersections and Smart parking.
- Development of smart parking at 15 locations integrated with charge stations and NMT parking and networked on a common middleware platform for integration with RCCC and front end app for Citizens "Park-in-Raipur".
- Smart Parking and RuPay enabled Citizen card together provide a complete solution for enhancing the Smart Raipur citizen Travel experience. This can be done by developing the existing thematic markets and Parking into Integrated Urban Beacons will have these off street multilevel smart parking.
- Financial resource of 56cr and enabling resource includes RUPTS, CG UT Policy and Traffic Police Department.

6.2.8 Passenger Information system

- Raipur Smart Card: Single card for Public Transit, Parking, other VAS and Municipal services.

6.2.9 Solid waste management

- Under SBM DtoD collection increased: 5312HH to 132034HH
- Use of Polythene is banned & use of paper & cloth bags are promoted
- GIS based route beats for city sanitation & DtoD, pilot project in all 70 wards with feature of employee performance & asset tracking for 30 days trial period
- Total Waste generated increased from 15140.0 to 16635.0 MT/Month
- SBM public toilet target completed,Community toilet 115 identified under PPP based Suvidha 24

More Akikaran with 100% fiber access to all Schools and hospitals across MRCC allows for an up-gradation and creating more Wi-Fi hubs, CSC Centres, CCTV coverage, Panic buttons, Asset management for waste and water, GIS based property database linked to other verticals, Command & Control Center, Raipur Smart City Card with digital wallet, Health education & mobility integration, crowd sourcing & community policing and Raipur City OS with an integrated City App/Portal.

6.3 City: Chandigarh

6.3.1 CCTV Surveillance

- Vehicle tracking system through GPS and CCTV surveillance
- The Proposed architecture will be based on Cloud Based Infrastructure for effective utilization of hardware and managing peak load effectively. The communication layer will be setup through a city wide fiber optic network for

providing services and capturing data from multiple sensors and CCTVs on real time basis. The command center will integrate all the city data and deliver a host of services that will help achieve the vision of improved citizen convenience, safety & Health.

6.3.2 Command Control Centre

- Sensor-based technology to control luminosity of LED lights based on brightness, traffic intensity etc., with control wrested with the central Command Centre (Pan-city solution).
- ICT-based safety, health and mobility solution for integrated multi-modal system is a platform which will provide centralized command center for city operation and Management
- The command center will integrate all the city data and deliver a host of services that will help achieve the vision of improved citizen convenience, safety & Health.
- In order to enhance citizen safety further, there is need for a Unified Command & Control Centre (UCCC) for coordinated and quick emergency response amongst various services like fire, ambulance, disaster management, Health etc.
- 24X7 Smart Transport Mobility Operations Administration Center has been proposed for fleet and incident management based on data integration platform for inter-departmental coordination of Transport, Traffic Police, Fire, Health and Disaster Management with real time video feeds being analyzed and reported through alerts into the unified control and command center (UCCC).
- Intelligent Multi-modal command & control center to supplement the ongoing individual initiatives Intelligent Traffic Management System (ITMS) coupled with city surveillance project shall form the basis for setting up of a unified command and control center doubling up as disaster management cell.

6.3.3 e-Governance

- Smart Integrated e-Governance includes a unified portal to access services with a personalized profile based mobile app which will act as one stop app and a gateway to enable tow way citizen engagement. This offers 78 services offered via 49 sampark kendras in time- bound manner with integrated system via Web, Mobile for ePayment & alert system on SMS & email
- Existing implementation of e-governance projects with high penetration of computing and mobile devices, availability of internet coupled with good proportion of tech-savvy citizens provides a perfect setting for centralized and integrated pan city ICT solutions to improve service delivery by the MC and emergency response system.
- Smart integrated e-governance for Unified Portal and Mobile Apps platform and interactive kiosks at select locations to access any public services within/via chandigarh.gov.in
- Aadhaar Number based Profiling having customized Mobile App using Locator
- Ease of Business through Payment Integration NPCI and Open Data for Startup India
- Document store in Digilocker Grievance redressal system
- Use of e-Gov to enable hassle free access to statutory documents where application forms (birth/ death certificate, water connection, property tax etc.) available online can be submitted online. Under e-district, citizens can access most statutory documents online. Most of the policies/regulations/bylaws and application forms have been published online for free access to the citizens.

6.3.4 Traffic Management System

- Issue: City has the highest per capita 4-wheelers in the country leading to traffic congestion, reduced travel speeds and dwindling road safety. With highest vehicle density in the country & inadequate public transport system, Chandigarh faces the threat of inconvenient, unpleasant traffic congestions leading to high pollution and consequently public health issues, and high risk of accidents. Nearly 400 annual incidences of road accidents occur putting a question mark on road safety.
- Initiative: The Pan-City solution emphasizes on intelligent traffic management with automatic light controllers (ALC), real-time tracking of traffic volume, displaying real time passenger information by GPS based Automatic Vehicle Location (AVL) on Public transport and individualized public transport (IPTs) such as Taxis and autos. 24X7 Smart Transport Mobility Operations Administration Center has been proposed for fleet and incident management based on data integration platform for inter-departmental coordination of Transport, Traffic Police, Fire, Health and Disaster Management with real time video feeds being analyzed and reported through alerts into the unified control and command center (UCCC).
- Chandigarh will strive towards providing its citizens choice of low-carbon mobility options such as – robust and energy efficient public transport system with last-mile connectivity (through e-rickshaws, Public Bike Sharing programs), elderly & handicap friendly streets, more walkable and cycle friendly streets. This will eventually support the modal shift from private vehicles to public transportation; facilitate reduction in congestion leading to a sustainable future which preserves the quality of life by maintaining air quality and promoting walking/cycling to public transportation stops. Traffic and transport interventions shall reduce traffic congestion and pollution levels
- Battery Operated Buses for Intra Movement of Sector 17 and Project 2: Electric Buses (Refurbish kits) for the existing fleet owned by CTU
- Encouraging safe walking and cycling will reduce fatal accidents of cyclists and pedestrians from 14.9% and 32.84% to zero by adopting 'VISION ZERO TRAFFIC CASUALTIES"'.
- To supplement the ongoing individual initiatives Intelligent Traffic Management System (ITMS) coupled with city surveillance project shall form the basis for setting up of a unified command and control center doubling up as disaster management cell.

6.3.5 Vehicle tracking

- ICT-based safety, health and mobility solution for integrated multi-modal system enables vehicle tracking system through GPS and CCTV surveillance
- Public Transport Buses no. increased by 24%. Electronic ticketing, passenger information system, vehicle tracking system undertaken for implementation by CTU. "CTU bus guide" App launched

6.3.6 SCADA-Power

- AMRUT (Atal Mission for Rejuvenation and Urban Transformation) for Recycling waste water for landscape, Implementation of PLC and SCADA, Smart Meters
- Potable Water - 24x7 supply, SCADA Installation, Smart Meters

- Waste Water - Augmenting Recycled Water distribution network and Treatment Facility, SCADA System both (Recycled water &Waste water network)
- Partner with private agency for installation of SCADA-based water distribution and management system with smart metering at individual property level, efficient leak detection & water pressure control systems, water quality monitoring systems, GIS- based hydraulic modelling etc.
- Implementation of PLC and SCADA based smart metering.
- SCADA system for 204 Tube wells/Boosters and filtration plants.
- SCADA-based dashboard monitoring the water supply network

6.4 City: Agartala

6.4.1 CCTV Surveillance

- The city is safe for most citizens and women, children and elderly feel secure. Public safety is achieved through police patrolling and CCTV surveillance on important road junctions and railway station area.

6.4.2 Command Control Centre

- To achieve the twin objectives of real time monitoring and creation of situational awareness, there is a need for institutionalizing an Integrated Command and Control Centre. This would aid in achieving operational optimisation, asset optimisation and would lead to predictive analysis.
- The dashboards to integrate analytics and achieve visualization of data relating to transport and reduction in water wastage/Non Revenue Water, tracking of the solid waste movement etc would require an integrated command and control centre. It is therefore proposed to create an Integrated Command & Control as a Pan City Solution to achieve the above stated objectives.

6.4.3 Traffic Management System

- Ensure efficient urban mobility – Warangal presently lack efficient public transportation system and share of personalised mode of transport and IPT is increasing many folds. Therefore, improving an efficient public transportation system would ensure achieving sustainable urban mobility in Warangal. It will include improvement of bus based public transport, organized smart parking provision, and traffic management through use of ITS
- Use of ITS for Public Transport Priority system and traffic management.
- Provision of cameras and sensor for speeding, junctions signal coordination for traffic movement, table top crossings with signal control for pedestrian priority, One App for traffic and public transport information, surveillance cameras to check illegal parking etc. for an effective traffic management

6.4.4 Buses/ Fleet Management

- Warangal, popularly known as “cultural pride of Telangana”, has a resident population of 8.1 lakh (2011 census) and a footfall of over 100,000 every day. The city added a number of public transport buses to its fleet on a number of routes to enhance the accessibility, affordability and efficient mobility for

mobility of residents. Further, 14 km length of new roads got added and a number of intersection improvements including signalization (12) have been implemented. A total of Rs.16.04 crores have been spent of maintenance of roads (GWMC)

6.4.5 Smart Parking

- Ensure efficient urban mobility – Warangal presently lack efficient public transportation system and share of personalised mode of transport and IPT is increasing many folds. Therefore, improving an efficient public transportation system would ensure achieving sustainable urban mobility in Warangal. It will include improvement of bus based public transport, organized smart parking provision, and traffic management through use of ITS
- An estimated Rs.315.7 crores will be needed for the development of smart multi-level parking in four locations on PPP basis on total area of 3.48 ha. On completion, planned parking space for over 2000 cars/two wheelers will be created within Retrofitting Area. On-street parking will be close to nil.
- Costing of encroachment free public areas and streets has been included as a part of open space development and street retrofftting which is about Rs.240 crores. This includes 55.46 km of retrofitting streets and development of smart parking for 2000 cars/two wheelers, monitoring cameras for parking and encroachment related violations the completion of which will result in 55.46 km encroachment free streets.
- SPV/GWMC can generate cumulative revenue from smart parking of 14 Cr per year. Replicating retrofitting approach to rest of the city will make GWMC more sustainable and efficient in service delivery

6.5 City: Kochi

6.5.1 Centralised command and control centre

- Centralized command and control centre backed by efficient ICT infrastructure covers Intelligent water management solutions for City-wide 24x7 supply
- Implementation of a intelligent water management solutions (including smart metering and command and control systems) for city-wide 24x7 water supply. The proposed solutions will use instrumentation and analytics to better manage demand and supply

6.5.2 Platform for citizen engagement and all citizen services; city dash board

- The Citizen engagement was structured so as to ensure platforms for all sections of society
- Active Citizen Engagement: Peoples Plan Scheme introduced in 1996 integrates citizens views with projects planned and implemented in the city. Ward committees meet every quarter to discuss development proposals.
- Effective Citizen engagement is critical at every stage including project planning, DPR preparation, implementation and O&M will be critical to ensure consensual buy-in, ownership and successful implementation. Citizen engagement during

implementation will be facilitated through the Citizen Advisory Forum and the active Ward Committee set up at KMC to ensure that all citizen issues are pro-actively captured and addressed prior to and during implementation

- Integrated Mobile Platform which provides a single mobile based platform for city information, citizen engagement as well as citizen services across service providers and would cover transport services, City information, Integration of all Public services, Infotainment, M-Commerce and Other Value added services
- The citizens have to interact with multiple agencies across multiple platforms making it an inefficient form of citizen engagement. An integrated platform for citizen engagement will improve the efficiency of citizen services considerably.
- Kochi adopted an extensive diverse and inclusive citizen engagement process through citizen interactions through Ward committee, Key stakeholders, Special groups, Events and Social Media

6.5.3 Smart metering (water)

- An energy efficient city can be implemented by approving Solar City master plan recommendations, Solar panels in Housing/ Institutions, Smart metering solutions
- with 10% of the energy through non-renewable energy
- 24x7 Water supply and Sewerage access to all by the revamp of Water supply distribution infrastructure; Smart metering and leak detection systems
- Under the IPDS scheme, the laying of underground electric cables and Smart meters will be promoted with an intention to reduce the overall losses in the distribution network. KSEB has already submitted a proposal of Rs 40 crore including AMR and Underground wiring
- Smart solutions that cater to provision of smart urban services Smart water supply system with smart metering of 10,000 HHs in the central city area; Solar powered LED street lighting in the area with a network of ‘smart poles’

6.5.4 Wifi- IT connectivity

- 24x7 Electricity, Digital Access and inclusion by scaling up of Electricity distribution infrastructure – T&D losses reduction through underground wiring; Strong IT connectivity in the city; WiFi hotspots in public spaces; Trade facilitation centres resulting in a Reduction in T&D losses
- Embedded Smart Solutions incudes Wifi hotspots and kiosks for public services at strategic points
- Integrated Mobile Platform which provides a single mobile based platform for city information, citizen engagement as well as citizen services across service providers and would cover infotainment which has Free Wifi, City search, Live streaming

6.5.5 Smart bulk metering at WTPs

- Inclusive Delivery of Essential Services to all citizens in a efficient manner having Bulk Meters Isolation valves with remote meter reading
- Intelligent water management solutions for City-wide 24x7 supply covering Bulk meters and Pressure Relief Valves/isolation valves to used to isolate a unit for service.

6.5.6 Smart card for all service payments

- Smart Card initiative – A unique EMV based Smart Card initiative for cashless payment solution for transportation is to be implemented in the city. The proposed Smart Card infrastructure will enable ease of ticketing and payment across all these modes of travel, enable seamless integration of the various public modes of transport and significantly reduce usage of private vehicles thereby reducing the city's carbon footprint. The Smart Card initiative would help in improving citizen convenience and improve public transport efficiency
- Platform and database creation to use Smart Card / Smart Phones as citizen interface points to deliver a range of G2C services: While mobility is the initial trigger for creation of the Smart Card infrastructure, the platform created will be utilised to deliver a range of G2C services from across various government departments using Smart Cards and Smart phones as citizen interface points through smart card solutions and mobile applications
- Integrated delivery of Government-to-Citizen (G2C) services using Smart Card and mobile platforms with extension of EMV enabled SMART Card solution to all service (including KMC, KMRL, KWA and other line agencies/departments) covering:
- Front-end Application to access and deliver citizen services of different departments and agencies
- Common Standards and Protocol to enable integration and database access for delivery of different services seamlessly through the Smart Card infrastructure (viz., Property tax, Water charges and Electricity charges database, social security benefits etc)
- Ubiquitous provision of PoS points for enabling payment across all modes of transport including metro, city buses, para-transit, common service centres and kiosks/retail points to increase transactions under the Smart Card Infrastructure

6.5.7 Kiosks (for urban services and grievnce)

- Embedded Smart Solutions for Wifi hotspots and kiosks for public services at strategic points
- Akshaya centres will provide a location for Tourist assistance and tourist information kiosk components under the smart city scheme.
- Enhancing Fort Kochi-Mattancherry's Tourist appeal by implementing key recommendations of the Heritage Management Plan includes 3.5 km Heritage Trail linking historic buildings with information kiosks, informative signages and sound & light shows
- Reviving commercial activities in central city area by the Redevelopment of Broadway including complete Pedestrianization (0.5km), with smart kiosks as help desks, property reconstitution where feasible, regulating loading and unloading of goods, street furniture, drainage, fire safety, provision of bins, development of walkways, provision of Smart, multilevel car parking at the existing parking area.
- Smart solutions for enhanced Mobility: Creation of Barrier free environment for children, the elderly, and differently-abled citizens, Equipped with and On-street and off-street smart parking facilities, Improved connectivity and linkage via proposed NMT corridors, Smart signage and interactive information kiosks
- Smart solutions for revival of identity of the Fort Kochi-Mattancherry-Central city area: What the Fort Kochi area lacks as a Tourist hotspot are intelligent interactive information platforms, signages, and accessible amenities. The

Heritage Information Kiosks addresses this issue while also catering to other services such as instant booking of homestays, etc

- Ubiquitous provision of PoS points for enabling payment across all modes of transport including metro, city buses, para-transit, common service centres and kiosks/retail points to increase transactions under the Smart Card Infrastructure

6.6 Financial Details

<table>
<tr><th>City</th><th>Tender Objective</th><th>Estimated cost of work</th><th>Payment terms</th></tr>
<tr><td>Ujjain(Ujjain Smart City Limited</td><td>Selection of System Integrator for Supply, Installation, Implementation and Maintenance of GPS based Vehicle Tracking Solution for Municipal Solid Waste Vehicles and Public Transport Vehicles</td><td>INR. 45,00,000</td><td>
<table>
<tr><th>S. No</th><th>(A) One-time cost @70% of accepted price bid</th><th>(B) Recurring Cost @30% of accepted price bid</th></tr>
<tr><td>1</td><td>70% of A (i.e. equipment cost, excluding software cost – if any) will be released on complete installation and commissioning of the System.</td><td>1st year - 27% of B in equal monthly installment.</td></tr>
<tr><td>2</td><td>20% of A, after 2 months of Go-Live.</td><td>2nd year - 30% of B in equal monthly installment.</td></tr>
<tr><td>3</td><td>10% of A, on completion of the warranty period on such equipment.</td><td>3rd year - 43% of B in equal monthly installment.</td></tr>
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Reference : https://smartnet.niua.org/sites/default/files/GPS_VTS_Ujjain.pdf

Proposals (Smart City Challenge Stage 2)		
City Name	Reference Link	Financial Content & page No.
Chandigarh	https://smartnet.niua.org/sites/default/files/resources/Chandigarh_SCP.pdf	Page 77 - Itemised Cost Page 78, 79 - Resource Plan Page 81 - Lifetime cost estimate Page 82 - Revenue and Pay-back
Ahmedabad	https://smartnet.niua.org/sites/default/files/resources/AhmedabadSCP.pdf	Itemised Cost – Page 77 Resource Plan – Page (78 – 80) Costs – 81 Revenue and Pay-Back – 82

Namchi	https://smartnet.niua.org/sites/default/files/resources/Namchi_SCP.pdf	Itemised Cost – Page 77 Resource Plan – Page (78 – 80) Costs – 81 Revenue and Pay-Back – 82
Chennai	https://smartnet.niua.org/sites/default/files/resources/ChennaiSCp.pdf	Itemised Cost – Page 77 Resource Plan – Page (78 – 80) Costs – 81 Revenue and Pay-Back – 82
Guwahati	https://smartnet.niua.org/sites/default/files/resources/GuwahatiSCP.pdf	Itemised Cost – Page 77 Resource Plan – Page (78 – 80) Costs – 81 Revenue and Pay-Back – 82
Jaipur	https://smartnet.niua.org/sites/default/files/resources/Smart%20City%20Jaipur%20_1.pdf	Itemised Cost – Page 83 Resource Plan – Page (84- 86) Costs – 87 Revenue and Pay-Back – 88
Surat	https://smartnet.niua.org/sites/default/files/resources/SCP_%20SURAT.pdf	Itemised Cost – Page 77 Resource Plan – Page (78 – 80) Costs – 81 Revenue and Pay-Back – 82
Kochi	https://smartnet.niua.org/sites/default/files/resources/Kochi_SCP.pdf	Itemised Cost – Page 77 Resource Plan – Page (78 – 80) Costs – 81 Revenue and Pay-Back – 82
Visakapatnam	https://smartnet.niua.org/sites/default/files/resources/VishakapatnamSCP.pdf https://smartnet.niua.org/sites/default/files/resources/VishakapatnamAnnexure.pdf	Resource Plan – Page (78 – 80) Costs – 81 Revenue and Pay-Back – 82 Itemised Cost - Annexure 3 - Sheet 7 (Page 8)
New Delhi	https://smartnet.niua.org/sites/default/files/resources/NDMC_SCP.pdf	Itemised Cost – Page 77 Resource Plan – Page (78 – 80) Costs – 81 Revenue and Pay-Back – 82
Other Annexure and proposals for other cities can be found at : https://smartnet.niua.org/38-751d940d-03b4-4643-aaf6-e65ad0c4d9ca?page=1		

6.6.1 Financial Support from Government

a. Central Grants

Smart City Mission will be operated as a Centrally Sponsored Scheme (CSS) and the Central Government proposes to give financial support to the Mission to the extent of Rs. 48,000 crores over five years i.e. on an average Rs. 100 crore per city per year.

b. Subsidies

Subsidies are funds which are non-repayable in nature. These are generally issued by government.

c. National Investment and Infrastructure

Funds like National Investment and Infrastructure Fund (NIIF) could be mobilized and could be used for smart city infrastructure development.

6.6.2 Existing Financial Infrastructure in India

a. Direct Financing

It deals with generating direct funds from the investor by selling securities for cash. The accumulated money then can be used for investment in development of smart projects for smart cities.

b. Financial Intermediaries

This option consists of raising money through financial intermediaries such as Banks, VC, and insurance companies.

c. Municipal Bonds

Tax free municipal bonds could provide huge financial support through which ULB's with poor financial health can raise funds and mitigate the risk among participating ULB's.

d. Equity Market Instruments

It is a form of financial asset. This represents the primary source of finance for acquisition of funds by issues of common shares to the investors for a return in the form of dividends as well as capital gains.

e. Mezzanine Financing

It is known as second tier debt. It is unsecured debt, where the lender also receives some rights to acquire equity.

f. Real Estate Investment Trust (REITS)

It is a type of financial instrument which does the investment in real estate through property or mortgage and traded in major exchanges like other instruments. It is a highly liquid instrument with promising dividend

6.6.3 Land Monetization and user Charges

a. Greenfield Smart Cities

Significant funding would be required as development has to be done from scratch for all the utilities such as water, waste, power etc. For the above mentioned requirements funds could be generated by sale residential/commercial

- Floor Area Ratio (FAR)
- Build Own Operate Transfer
- Design Build Finance Own Transfer Model

b. Existing Cities (Brownfield)

In Brownfield development scenarios, the funding charges can be levied for services provided.

c. Cross Subsidization and User Charges

This involves charging higher prices from one party in order to subsidize lower prices for another. Services can be designed in phased manner so that cost recovery can be enabled by this model.

d. Scalable Models

The cities that are not in the making become the preparation for new projects.

6.6.4 International Modes of Finance

a. New Development Bank

NDB by the BRICS Nations has formally started financing infrastructure investment and sustainable development projects in **Shanghai**.

b. Bilateral and Multilateral Agencies

Indian Government can coordinate with the World Bank and ADB for providing grants. Other funding agencies such as China-led Asian Investment Infrastructure Bank, Japan International cooperation Agency (JiCA), Germany's GIZ and KfW Development Bank.

c. Foreign Direct Investment and Foreign Institutional Investment

6.6.5 Financial Innovation for Smart Funding

a. Crowd Funding

Crowd funding is basically a methods where the people contribute voluntarily small amounts to a cause.

Example: Chicago City, where local community members are participating in the implementation of renewable energy projects through community based crowd funding model.

b. Nirbhaya Fund

A corpus of 10 Billion INR has been earmarked by the Government of India in the Union Budget 2013.

The funds allocated under this head can be utilized for development of Smart cities with a view to enhance safety and security of women. Safety in public transport systems, CCTV

cameras for Smart Cities to reduce Crime and other security measure in terms of Information technology, Road transportation and highways and railways etc.

c. Monetizing the Data

Smart cities will generate enormous amount of data by instrumented systems. The data could be provided for commercial use to other service providers who can further extract useful information from the same.

d. Smart Bonds

Common examples of Smart Bonds are Green Bonds, Social Impact Bonds, and Infrastructure Bonds etc.

e. Carbon Offset

The Multi-National Companies and Indian Corporate Giants could lead the road ahead by issuing green bonds.

f. Energy Saving Performance Contracts and Other Taxes

- Green Tax on fuel purchase
- Urban Tax on purchase of new vehicles
- Betterment charges payable on sale / registration of property.

7. Best Practices - Case Studies from cities across the world

Smart cities use information and communication technologies (ICT) to be more intelligent and efficient in the use of resources, resulting in cost and energy savings, improved service delivery and quality of life, and reduced environmental footprint–all supporting innovation and the low-carbon economy. Thus, ICT is an important sector that is involved in smart cities planning. Following are the best cases that are implemented by top smart cities in the world.

7.1 Barcelona:

The population of Barcelona is 1.6 million, and in 2011 had an unemployment rate of 17.2%. “Economically, Barcelona remains far ahead of other Spanish cities and some of the major economic hubs around the world. This is demonstrated in its GDP statistics where the city ranks 4th in the EU and 35th globally.”26 The level of entrepreneurship in Barcelona is the highest in Spain.[1]

Barcelona is an extremely compact city, which offers an advantage for sustainability. However, it leads to serious challenges of noise, traffic congestion and pollution. Tourism is one of the core industries in Barcelona, alongside knowledge-based and information services, media and fashion. Education is one of the key pillars of Mayor Xavier Trias' vision for Barcelona.[2]

Why was Barcelona chosen?

Barcelona is the second-largest city in Spain with a population of 1.8 million inhabitants. It is a compact city with an ever-increasing population. There were certain factors that were hindering normal life, such as:

- Traffic congestion
- Noise pollution
- Bad drainage system
- Insufficient local transport system
- Inefficient waste management
- Unavailability of parking space, and more

Smart city - Barcelona

Key change is that the smart city movement is a mechanism to use ICT strategically as an enabler for cities to achieve their goals. For Barcelona, the smart city is a means rather than an end. Ms Lopez Ventura explains "that's the main change from the previous movements, that technology is an enabler for projects." This philosophy is clearly reflected in their strategy, where technology is an enabler for:

- Efficient and sustainable urban mobility
- Environmental sustainability
- Business-friendliness and attracting capital
- Integration and social cohesion
- Communication and proximity with people
- Knowledge, creativity and innovation
- Transparency and democratic culture
- Universal access to culture, education and health

City leaders in Barcelona understand the city as something dynamic and changing; a network of networks, as illustrated in their conceptual model of the smart city in Barcelona, which is broken down into three layers: People/ Information/ City Structure.

Structure

Figure 1 Three Axis of Barcelona City[3]

The structure of entire smart cities project is based on the 3 axis of Barcelona city, and the above diagram represents the same on which the development is based on.

Smart city projects

There are over one hundred projects considered to be part of the smart cities work in Barcelona, and this number is growing. However, there are currently thirteen projects that the City currently sees as a key part of the Smart City PMO.

i. **Transversal Projects:**
- New Telecommunications Network – Integration of different fibre optic networks, boosting Wi-Fi network, reduced operating and maintenance costs, new business models.
- Urban Platform – Barcelona sensor platform, city operating system, and apps and services.
- Intelligent data – Open data, measurement of city indicators, and a central situation room for decision making and control.

ii. **Vertical Projects:**
- Lighting Directorate Plan – A strategic plan for lighting in Barcelona.
- Self-sufficient islands – Creating energy self-sufficient island, to improve practices related to consumption and production of energy.
- Electric Vehicles – Development of electro-mobility in the coming years, short-term (two years) and medium term (five years) in Barcelona.
- Telemanagement of Irrigation – Remote management system for centralized control of the automated irrigation infrastructure to control the duration and frequency of irrigation in each area.
- Orthogonal Bus Network or Directorate Mobility Plan – Orthogonal design of the bus network in Barcelona to improve urban mobility.
- Urban Transformation – Within the frame of the remodelling of the main streets of Barcelona will develop a series of smart cities and telecommunications projects. Citizen compromise to sustainability 2012-2022 – a roadmap for achieving a more equitable, prosperous and self-sufficient Barcelona.
- O-Government – Implementation of Open Government, strategy and a roadmap, to develop tools and web sites in specific areas of transparency, open data and civic

participation.

- Smart parking – Network of sensors and displays of parking availability across the city. Barcelona in your pocket – Barcelona contactless and mobile apps

As part of this, the city has been investing in 22@Barcelona, an urban regeneration project offering modern spaces for the strategic concentration of intensive knowledge-based activities. “This initiative is a new model for city development, providing a response to the challenges posed by the knowledge-based society”. Some technologies and projects being implemented at 22@ Barcelona include:[4]

- System of underground service galleries: Interconnecting the blocks and enabling service networks to be repaired or improved without the need for excavation in the streets.
- New fibre-optic telecommunications networks, with a dark fibre network: Allows companies to contract any service providers and create direct links between different parts of the district.
- New System of centralized public climate control: Involves savings at both the economic level and in the emission of CO2
- Selective pneumatic waste-collection network: Differentiates between organic and inorganic waste and paper.
- New electricity network: Guarantees a quality of electrical supply, more efficient gas and water-service supplies.
- 22@ Urban Lab: The goals of the Urban Lab are to use the city as a laboratory to test new solutions and services, facilitating market access and promoting competitiveness.
- The pilot projects on behalf of the project 22@Urban Lab: Improve resource management and efficiency and the urban quality of the neighbourhood.

Barcelona also created the Smart City Campus33, located in the 22@ innovation district. To further strengthen the strategy of the city and urban innovation, Barcelona wants to offer the city a test-bed and ‘storefront’ for companies to develop and test pilots.

The Smart City Campus will develop a cluster of ‘smart city’[5] companies, and the Council hopes this will foster connections between diverse sectors like ICT, energy and mobility, for the creation of an ecosystem that integrates not only companies (multinationals and SMEs), but also to institutions, research centres, technology transfer centres, and universities.

Conclusion

Thus, Barcelona has many smart city projects dispersed in various departments across the city. They are currently collating these projects, and devising a global vision to unite them under a single strategy. The 22@ Barcelona region is a focal point for economic development and innovation, and is being used by SMEs as a test-bed to trial new technologies. Barcelona understands the importance and role of vertical and horizontal working, and has reflected that in both their organisational structure and the projects that are undertaken. Collaboration with other cities is a significant priority for the development of ideas and networks, which they are facilitating through their City Protocol project.

7.2 Hong Kong

With a population of 7 million, Hong Kong is one of the most densely populated places in the world. This place strain on the housing stock and transport systems. Traffic congestion is a challenge. Environmental challenges are also significant in Hong Kong, specifically concerning air, solid waste and water pollution.[6,7]

Why Hong Kong?[6,7]
Hong Kong is named as 'Pearl of the East' because of its prosperity and the energetic citizen. But behind this good reputation, it also bears a lot of problems because the prosperity. These problems include housing problems, transport problems and environmental problems.

Housing problems are very serious in Hong Kong due to large population but small area of land in proportion. The government has carried out a certain of measures and policy to relief the problems.

Another troublesome problem in Hong Kong are environmental problems, for instance, air, solid waste and water pollutions. Environmental problems are not only the responsibility of Hong Kong Government, the Pearl River Delta must bear some.

The last main urban problems of Hong Kong are transport problems, it tormented Hong Kong for a long time. To relief the problems, many overpasses and subway were built or will be built. The land use development of Hong Kong will also be analyzed in this report.

Smart city- Hong Kong

In 1998, Hong Kong identified that ICT investment had the potential to have a positive economic impact. However, they were also aware that driving change in this area would bring about new challenges. In response to this they developed the Digital Strategy as the blueprint for Hong Kong's ICT development. Since then it has been "updated on a regular basis to consider technological and socio-economic changes." The current strategy contains five key action areas:

- Facilitating a digital economy
- Promoting advanced technology and innovation
- Developing Hong Kong as a hub for technological cooperation and trade
- Enabling the next generation of public services
- Building an inclusive, knowledge-based society.

Smart city projects

- **Electronic Information Management**[8]: Electronic Information Management (EIM), was central to the 2008 Digital 21 Strategy, and covers three central themes:
  1. Content Management
  2. Records Management
  3. Knowledge Management
- **E-government**[9]**:** The OGCIO is responsible for running the city's main website. They aim to meet 80% of citizen needs for dealing with the government on that website, through e-government services.
- **GovWiFi**[10]: Government Wi-Fi Programme (GovWiFi) aims to transition Hong Kong into a wireless city, providing free wireless internet services to all citizens. The programme places Wi-Fi facilities at designated government premises, and aims to ensure that:

- ✓ "Citizens can surf the web freely for business, study, leisure or accessing government services whenever they visit the designated Government premises.
- ✓ Business organisations can extend their services to a wireless platform to reach and connect with their clients.
- ✓ ICT industry players can make use of this new wireless platform to develop and provide more Wi-Fi applications, products and supporting services to their clients, and open up more new business opportunities."

- **Open Data[11]:** The Government holds a significant amount of data that could be of significant value to the public. These datasets include, for example demographic, economic, geographical and meteorological data, historical documents and archives. However, this information has not historically been in a format to facilitate value-added re-use by third parties.
  To combat this, the government launched a data portal entitled Data One (Data.One.gov.hk). This 18-month pilot scheme made geo-referenced public facilities data and real-time traffic data available for free. They held a competition for the best applications of this data, for which they received 41 entries. The winner was an app that located the nearest doctor, and tracked appointments. Following the success of this trial, and support from citizens and industry, the government plans to continue with the portal, and gradually add more datasets.

Conclusion

Hong Kong has made significant organisational and strategic investment in ICT, and has a clear strategy for ICT investment, as articulated in their 'Digital 21' strategy. They have a specific function for ICT strategy, housed in the Office of the Government Chief Information Officer, which employs over 700 staff. They have a focus on economic development through facilitating the digital economy, and aim to create world-class e-governance services as well as prioritising digital inclusion.

7.3 Boston

The population of Boston is 625,087 (2011) and is growing, with young people moving to Boston and "older Bostonians returning". This has fuelled one of the largest increases in population in the US between 2000-2010 at 4.8%. [12]

Why Boston?

Mobility is a significant challenge in Boston: with over 300,000 commuting into the city daily, congestion and parking is an issue. "Due to rush-hour traffic and the lack of a distinct grid roadway system, Boston was ranked the fifth most traffic delay-prone city in the nation, according to a recent study." [13]

Waste management in the city is also a challenge. The city spends over $40 million each year on residential waste and recyclables, and no issue generates more requests or complaints from citizens. Investment in education and crime are key priorities articulated by Mayor Menino in his "State of the City Address."

Smart city- Boston

Boston's Mayor's Office of New Urban Mechanics (MONUM) "pilots experiment that offer the potential to improve radically the quality of city services". It was set up by Mayor Menino in response to the challenge of being able to innovate within the public sector.[14]

The Office of New Urban Mechanics in Boston is entirely focused on working to deliver value to citizens, and focuses its attention at the interface between government and the public. Nigel Jacob, Co-Chair, Mayor's Office of New Urban Mechanics explains: "We developed an approach that is about active experimentation in what we call the 'civic engagement space', how people are able to get involved in civic life generally and with their government." Three principal areas of research include:

1. Clicks and Bricks
2. 21st Century Learning
3. Participatory Urbanism

Structure

There are broadly two types of project that MONUM engages in:

1. Innovation projects in their most general sense; this is generally incubation and Research and development projects.
2. Fostering relationships with city departments.

Smart City Projects

Boston Smart city projects in MONUM are carried out under three core programmes: 'Participatory Urbanism', 'Clicks and Bricks', and '21st Century Learning'.

1. **Participatory Urbanism**

- MONUM believes that smart technologies are fostering a new wave of citizen participation in the community. Projects driven under 'Participatory Urbanism' are intended to support the creation of new, citizen-centric products and services.
- Citizens Connect – This application for smart phones helps constituents make their neighbourhoods better by giving them an easy tool to report service problems. They are piloting an SMS version called 'citizens connect txt'.
- Community PlanIt – A platform to explore how online platforms can complement in-person community meetings, as well as reach an audience that might not attend a community meeting.
- Innovation District: Welcome home challenge – A competition focused on attracting and growing businesses in Boston's Innovation District.
- Participatory Chinatown – Participatory Chinatown is a video game-like platform to engage a broader range of constituents in informative and deliberative planning and development conversations.

2. **Clicks and Bricks**[15]

The 'Clicks and Bricks' programme of projects investigates how new technologies are linking how the city is built to how it is managed and experienced. Particularly, these focus on how to link "the interests and talents of both designers and technologists outside of City Hall with leaders and staff from the city's Public Works and Transportation departments."

- Redesigning the Trash System - The city is partnering with IDEO to look at this challenge through the lens of human centred design.
- Street Bump – Street Bump is a mobile app that helps residents to improve their streets. As they drive, the mobile app collects data about the smoothness of the ride; that data can provide the city with real-time information it uses to fix problems and plan long term investments.
- City Worker – To help city staff better manage its infrastructure and respond to constituent requests, the city has developed a smart phone application to be used by city workers. This allows workers to easily manage their daily work list and access and record information about the condition of city infrastructure such as street lights, trees and roads.
- Adopt-A-Hydrant – A pilot project that encourages Boston residents to shovel out snowed-in hydrants during the winter. Through the app, residents can claim hydrants they intend to shovel out after storms.

- Complete Streets – A project led by the Boston Transportation Department, Complete Streets is an effort to improve the flow of people and goods through Boston by making the city's transportation infrastructure greener, smarter and even more multi-modal.

3. **21st Century Learning**
   The 21st Century Learning programme aims to deliver convenient, integrated and life-long learning to the citizens of Boston. It aims to facilitate relationships between educators, students and parents to improve both the in-school and out of school educational experiences.
   - Boston One Card – As part of the city's effort to have its schools, community centres and libraries provide a seamless system of educational opportunities for young people, the city is piloting a single card that provides access to all these resources for Boston Public School students.
   - Discover BPS – This web app helps parents navigate the options of public schools available to their children.
   - Where My School Bus – This app is allows parents to sign up to see on a computer or smart phone the real-time location of their child's school bus.
   - Autism App/ Assistive Technologies – The city is working with two local companies and an international robotics company to develop new applications to help children with autism learn.
   - Classtalk – Classtalk is designed to help teachers send text message reminders to students about homework and tests.
4. **Better Traffic Management:** This plan will help the Boston Transportation Department be able to spot traffic problems faster, allowing them to spend more time fixing problems and less time looking for them.
5. **A Healthier Environment:** This plan will help the city to understand how their bike, parking and traffic management policies are impacting vehicle usage in the city; with this intelligence, the city will be able to see how it can meet its aggressive climate action goals by 2020.
6. **Transparency**: As part of its commitment to transparency, the city has performance metrics, service request data, meeting notices, and broadcast their meetings via City Council TV.

Conclusion

The Mayor's Office of New Urban Mechanics in Boston, set up by Mayor Menino is an essential mechanism for Boston's innovation in smart city investments. MONUM encourages and enables collaboration with innovative companies and SMEs, pilot projects, and supports other city departments through offering expertise and funding. It adopts a top-down and bottom- up model for innovation, and pays attention to good communications both internally and with other cities.

7.4 Seoul

Seoul is the capital of South Korea. With a municipal population of over 11.8 million, and a metropolitan population totalling over 25.6 million, Seoul is by far South Korea's largest city and one of East Asia's financial and cultural epicentres. A fascinating blend of ancient traditions and cutting-edge digital technology, home to endless street food vendors and vast nightlife districts, an extraordinarily high-pressure educational system and serene Buddhist temples, a trend-setting youth culture and often crushing conformism, extraordinary architecture and endless monotonous rows of grey apartment buildings, Seoul is a city filled with stark contrasts.

Why Seoul?

Seoul, Republic of Korea, is one of the world's most tech-savvy cities, retaining its top ranking in the United Nations e-Government Survey since 2003. It is also home of the World Cyber Games. "Smart Seoul 2015" was announced in June 2011 to uphold Seoul's reputation as a global ICT leader by boosting

its sustainability and competitiveness through smart technologies. Smart Seoul follows the u-City project (u-Seoul), which applied ubiquitous computing technologies to strengthen the city's competitiveness.

While u-Seoul improved the delivery of services by the traditional city infrastructure (such as transport and safety), it failed to improve the quality of life of Seoul's citizens. To overcome this drawback and improve the infrastructure of the city, Seoul was proposed as smart city.[16]

Smart city- Seoul

Korea's vibrant information and communication technology (ICT) industry, Seoul has established itself as a global leader in the application of ICR in the city functions and services. In 2011, the Korean government announced the launch of the Smart Seoul 2015 program. The program is built on the previous u-Seoul project, with the focus shifted from application of ICT in individual municipal facilities to development of new generation of ICT infrastructure and comprehensive framework of municipal management. The aims are to enhance the sustainable development and competitiveness of Seoul and promote a more blessed life among its citizens. The Smart Seoul strategy puts forward targeted measures on municipal planning as well as hard and soft infrastructure, such as communication network, facilities in streets and buildings, traffic and energy surveillance systems, etc.

Structure

The Smart Seoul Strategy is launched in 3 phases:

1. Individual service level, applies ICT to individual areas of traffic, safety/security, environmental and culture, etc., for example, putting in place a CCTV network covering public spaces across the city for maintaining public safety, and using a real-time bus schedule information system
2. The vertical service level, utilizes smart technologies to integrate relevant functions and services within the major sectors of the city to enable the provision of more advanced services.
3. The horizontal service level, establishes a comprehensive smart city ecosystem through seamless integration of the functions and services in different areas of the city.

Smart City Projects [17]

The Smart Seoul Strategy roughly covers smart infrastructure, smart governance and smart functions and services. They have used their core strength ICT to develop the strategies. The following are a few projects taken by the government:

- U-Seoul Net- The 192-km u-Seoul Net, an optical communication network dedicated to smart services, is established to enable government departments to handle huge amounts of data generated from a variety of smart devices and provide the citizens with free wi-fi services and full access to public services websites. With u-Seoul Net, the citizens can have access to various smart services anytime, anywhere.
- Smart Work Centre- Seoul Metropolitan Government is piloting a "Smart Work Center"31 project, allowing the government's employees to work from 10 offices – Smart Work Centres – located much closer to their homes. As employee check-in to a Smart Work Centre for their shifts they are permitted access to sophisticated groupware and teleconferencing systems, ensuring their absence

from City Hall in no way impedes their job performance.

- Community Mapping - Seoul's open governance model seeks to extend citizens the opportunity to participate in the administration of the city, and "Community Mapping" 32 was born with this pursuit in mind. Using ICTs such as geographical-information systems, the m.Seoul platform and social networks, citizens will be able to raise the issues of greatest concern to their neighbourhood or community.
- Smart Metering Project- Seoul's Smart Metering Project aims to reduce the city's total energy use by 10 per cent, and in 2012, Seoul is piloting a program installing smart meters in 1,000 households. Smart meters provide home, office and factory owners with real-time reports of their electricity, water and gas consumption. This information is presented in monetary units, and is accompanied by detailed information on a household's energy-consumption patterns and means of adjusting those patterns to reduce energy costs.
- u-Seoul Safety Service u-Seoul Safety Service has been in operation since April 2008, utilizing state-of-the-art Location Based Services and CCTV technologies to notify authorities and family members of emergencies involving children, the disabled, the elderly, and those suffering from Alzheimer's disease. Seoul has developed a smart device dedicated to this purpose and when its holder leaves a designated safe zone or pushes its emergency button, an emergency alert is sent to guardians, police, fire departments and CCTV Control Centres.
- Mobile Seoul (m.Seoul) Mobile Seoul (m.Seoul) makes use of Mobile Web technology and mobile applications to provide Seoul's citizens with 62 unique services over 11 types of mobile device. A wide range of public information is available over the Mobile Web, but the inconvenience of navigating is averted by mobile apps concentrating on the provision of the most commonly-demanded information.
- Disclosing Public Data Seoul Open Data Square36 is a key building block to the Information Open Square. Opened in April 2012, the website discloses public information under ten categories:
  1. General administrative work;
  2. Welfare, culture and tourism;
  3. City management;
  4. Environment;
  5. Safety/security;
  6. Education;
  7. Health;
  8. Industry;
  9. Economy;
  10. Transportation

Conclusion

Smart Seoul 2015 is a more people-oriented or human-centric project; and Seoul now aims to implement as many smart technologies as possible, but also to create a more collaborative relationship between the city and its citizens. The three pillars of Smart Seoul Cities set out their own unique priorities when planning a smart city, but all smart cities must display three essential traits:

• ICT Infrastructure: Securing next-generation ICT infrastructure is critical to the success of emerging smart-city services. Efforts to develop ICT infrastructure must anticipate future service demands, rather than respond only to those most apparent.

• Integrated City-management Framework: A well-defined 'integrated city-management framework' is essential. The many integrated subsystems, meta-systems and individual, building-block systems of a smart city will work in harmony only through the strictest adherence to common standards.

• Smart Users: ICTs are the tools to enable a smart city, but are of no use without smart-tech users able to interact with smart services. Increasing access to smart devices and education on their use, across income levels and age groups, must remain one of a smart city's highest priorities.

7.5 Rio De Janeiro

Rio de Janeiro, or simply Rio, is the second-most populous municipality in Brazil and the sixth-most populous in the Americas. The metropolis is anchor to the Rio de Janeiro metropolitan area, the second-most populous metropolitan area in Brazil and sixth-most populous in the Americas. Rio de Janeiro is the capital of the state of Rio de Janeiro, Brazil's third-most populous state. Part of the city has been designated as a World Heritage Site, named "*Rio de Janeiro:* Carioca *Landscapes between the Mountain and the Sea*", by UNESCO on 1 July 2012 as a Cultural Landscape.

Why Rio De Janeiro?

Natural disasters are a significant challenge for the city. In the 2010 landslide 25 people were killed in the city, 800 in the state, and 15,000 people were left homeless. The population of Rio is approximately 6.3 million, with around 20% of residents living in the 1000 favelas across the city. Rio is the most violent city in Brazil, with 37 murders per 100,000 per year. There is a lack of public transit. Currently the bus system is the main public transport service in Rio. Healthcare demands are changing, including a growing prevalence of chronic diseases. The upcoming Olympics and World Cup are focusing global attention on Rio, and redevelopment and investment in city services is underway.

Smart city- Rio De Janeiro

When the current city government came into administration in 2009, Rio faced significant challenges. The city was one of the most violent in Brazil, and there were significant political and economic challenges. Rio also had the lowest health and primary care capability in the country. Rodrigo Rosa.

The new administration made a very strong fiscal re-alignment in the first two years of government. The previous budget was not seen as sustainable and the city was unable to meet its operational needs. The first fiscal action was to cut all spending in the city by 20%, and to re-negotiate all City contracts. Mr Rosa claims that this re-focusing was a key enabler for developing new, more effective ways of operating the city, and incorporating new smart city technologies.

Smart City projects[18]

1. **Centre of Operations**

The Centre of Operations was created to respond to natural disasters. In 2010, the second year of the current administration, a big landslide killed fifty people. The centre of operations was originally in the

Olympic plan for 2016, but the Mayor decided that it was required immediately. It was built from scratch in eight months in partnership with IBM and Oracle, and is used by decision makers in the city to operate general city services, but especially to coordinate emergency response.

Over time, the administration has begun to develop routine operational uses for the Centre of Operations. For example, the garbage trucks are coordinated through GPS, so in an emergency the trucks can be re-purposed for other tasks. This helps the city manage resources and improve efficiency of response.

2. Open Data

One of the core principles of the centre of operations was that it was to be transparent. Mr Rosa explains that "if you want to manage a city, one of the best ways to do it is to circulate information - to facilitate the flow of information." For example, all the media companies, TV and radio stations have a seat inside the Centre of Operations. There is a press room and they have access to the information. This helps ensure that the information is spread out to society through the traditional mechanisms of media, and through the internet. Rio has made a significant amount of their data freely available to the public. Largely these datasets fall into two categories:

1) The data portal data – which provides in-depth city information, such as crime rates, mortality rates etc.
2) Centre of Operations data – which holds information for everyday management - e.g. congestion, weather etc.

Conclusion

The upcoming Olympics and World Cup are bringing the world's attention to Rio, and is a strong catalyst for investment in the city. Rio is making use of Public Private Partnerships (PPP) to help fund infrastructure projects as well as stimulate private sector growth. One example of a successful smart city PPP is the Centre of Operations, which was initially created to support the City in responding to natural disasters, but is now facilitating significant cross-disciplinary working. The City is now investigating how the centre of operations might continue to support smart city investments.

7.6 Dubai

Dubai is the largest and most populous city in the United Arab Emirates (UAE). It is located on the southeast coast of the Persian Gulf and is the capital of the Emirate of Dubai, one of the seven emirates that make up the country. Abu Dhabi and Dubai are the only two emirates to have veto power over critical matters of national importance in the country's legislature. The city of Dubai is located on the emirate's northern coastline and heads the Dubai-Sharjah-Ajman metropolitan area. Dubai will host World Expo 2020. Dubai has emerged as a global city and business hub of the Middle East. It is also a major transport hub for passengers and cargo.

Why Dubai?

Dubai is a fast-growing city that has developed as a global hub for business, trade and tourism over the last four decades. The population of Dubai grew from 0.6 million in 1993 to over 2.2 million in 2013, representing an annual growth rate of over 6.5%. Dubai is now a major tourist destination, playing host to over 11 million tourists in 2013. Hotel guest nights grew at an annual rate of 12.8% between 2003 and 2013.

The Government of Dubai has built a city with world class infrastructure and governance. However, as the city heads into its next phase of growth, several challenges lie ahead.

Smart city- Dubai[19]

Dubai has announced a Smart City initiative that will leverage the Internet of Everything to become one of the world's most connected and sustainable cities with the Expo as the platform for unveiling this vision. It has been estimated that $7-8 billion could be spent on smart city infrastructure within the pillars of life, society, mobility, economy, governance and environment.

They gathered information on the current state of smart city readiness in Dubai through workshops and questionnaires with Strategic Partners. All data collected underwent a collaborative analysis and validation to confirm current services and initiatives, identify challenges, and plan the next steps.

Learnings from the Current State Analysis lead to a set of action items to ensure challenges were addressed and an aligned approach was enabled:

- Forming a map of the city infrastructure, data, systems, applications and e-Services
- Documenting the KPIs, supporting data, assumptions and current usage standards
- Identifying a listing of findings, open issues and recognised opportunities
- Providing a description of the overlaps among current and future between the various entities
- Submitting quick fixes and recommendations for resolving the immediate issues

Smart City projects[20]

- The Dubai Data - Led by the Dubai Data Establishment and decreed by the Dubai Data Law of 2015, is the single most comprehensive city-wide data initiative guiding the opening and sharing of city data across the public and private sector. Dubai Data will stimulate a new data economy for the city, unlocking opportunities and ultimately enriching quality of life for all Dubai stakeholders, including government departments, private organisations, investors, residents and visitors.
- The Happiness Meter – It is one of Dubai's first strategic 'smart city' initiatives. As the world's first, city-wide, live sentiment capture engine, the meter represents a measurement gauge for the happiness goal. However, the Happiness Meter is more than just another silo tool to collect experience feedback: through the centralised data dashboard a map of happiness across the city can be created, which allows private sector and government entity hosts of Happiness Meter touch points to relate and rank customer experiences within industry sectors and geographic areas, as well as differentiate between direct and web based interactions.
- The Smart Dubai Index- will be a universally applicable set of indicators which will highlight the achievements of Smart Dubai, and illuminate future opportunities, looking ahead as the city prepares to welcome the 50 million visitors to Dubai by 2020. The Index Wheel was developed in collaboration with the International Telecommunications Union and the Dubai Statistic Centre to evaluate and measure how facilities and services in Dubai contribute to the vision of Smart Dubai.
- The Smart Dubai Platform, Smart Dubai is pioneering a new class public-private partners with its Strategic Partner for the Smart Dubai Platform, du. du will be contributing their expertise to build a collaboratively-designed platform that brings the most advanced technology innovations on the market to support smart city experiences for all Dubai residents, visitors, business owners and city decision makers.

Conclusion

Dubai has adopted its own a unique smart city approach. This aspiration is underpinned by the three themes of communication, integration and cooperation. It is this integrated approach that will bear fruit and help it achieve its aspiration of becoming a truly global smart city.

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