IoT Technologies and Applications for Smart Sustainable Cities

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What is a Smart Sustainable City ?

'A smart sustainable city is an **innovative city** that **uses** information and communication technologies **(ICTs)** and **other means** to **improve quality of life**, **efficiency** of **urban operation and services**, and **competitiveness**, while ensuring that it meets the **needs of present and future generations** with respect to **economic**, **social**, **environmental** as well as **cultural aspects'**

-ITU and UNECE

UN Habitat New Urban Agenda 2030

Aims to promote the establishment of **Smart Sustainable cities,** as these would be hub of economic activity the world over

- **Principles for a new Urban Paradigm**
- **Principle** 1: **Socially inclusive** and **engaging**
- **Principle** 2: **Affordable, accessible** and **equitable**
- **Principle** 3: **Economically vibrant** and **inclusive**
- **Principle** 4: C**ollectively managed** and **democratically governed**
- **Principle** 5: F**osters cohesive territorial development**
- **Principle** 6: R**egenerative** and **resilient**
- **Principle** 7: S**hared identities** and **sense of place**
- **Principle** 8: W**ell planned**, **walkable**, and **transit-friendly**
- **Principle** 9: S**afe, healthy** and **promotes well-being**
- **Principle** 10: L**earns** and **innovates**
- **Leverage ICT technology** for meeting these objectives

Dimensions of a Smart City

Dimensions of a Smart Sustainable City

1. Smart Planning
2. Policy Standards & Regulations
3. Smart Living
4. Smart Mobility
5. Smart Environment
6. Smart Economy
7. Smart Governance
8. Smart People
9. Key Performance Indicators

What is sustainability ?

- In plain words , sustainability is the process of living in harmony with our ecosystem
  - ➢ Environmental protection
    - Flora/ Fauna
    - Environment – Air/water
  - ➢ Development of people of all walks of life
    - Social
    - Culture
    - Traditions
  - ➢ Economic development
    - Inclusive
      - Kashmir – Japanese delegation

Why is sustainability important ?

- **Whatever we do today should work for tomorrow as well !**
- If we undertake a **project/program** without considering tomorrow, then that project program can not be sustained
- Many civilisations have perished as at some point of time they drifted from their sustainability pledge
  - Indus Valley civilisation
  - Civilisation on the banks of Saraswati river
- **In case we do not wake up still, nature is going to terminate us too !**

Sustainable Development Goals (SDGs)

Indian Scenario – Smart Cities

- Started in 2015
- 100 cities have been identified
- Some ciites have started working on ICT related solutions
- Challenges
  - **KPIs** (Key performance Indicators)not being followed
  - Efforts at replicating the advanced cities
  - The consultant plays a key role in deciding what all the city should have
  - Stakeholders are driven on a predetermined path , while under an illusion that it is they are the decision makers
- Sustainability has taken a back seat.

Challenges faced by Cities in Developing Nations

Challenges faced by Cities in Developing Nations

- Air Quality
- Waste Management
- Water Management
- Health
- Education
- Energy
- Financial Inclusion
- Disaster preparedness
- Communications
- Security
- Governance deficit
- Corruption

Challenges faced…

Water Management

- Next world war over water ???
- Conservation of water
- Equitable distribution and accountability
  - Political intervention
  - Corruption
- Preservation of perennial rivers
  - Clean Ganga ?

Challenges faced…

Health

- Health in Rural areas
  - 1.25 Billion people-70% population lives in villages
  - 6,50,000 villages
  - A total of 150,000 total doctors in the country
- Other challenges
  - Mother and Child care- Prenatal and Post Natal
  - Tracking and tracing patients
  - Chronic patients
  - People with special needs- Epilepsy
- Maintenance of Citizen's Health records
- CME for Doctors and Nurses

Challenges faced...

Education

- Schools in the Rural India ?
- No. of Teachers
- Quality of Teachers
- Content
- Higher Education
  - 100% cut off – Delhi University
    - Are the students below 99% good?
    - Is it the fault of the University ?

Challenges faced..

Disaster Preparedness

- Disasters a big challenge
  - Terror attacks
  - Earth quakes
  - Tsunami and Floods
  - Collapse of Buildings
  - Collapse of Flyovers

Challenges faced....

Financial Inclusion

- No banks in Rural Areas
- Local Money lenders/ Middlemen
- Glaring difference in quality of life in Rural and Urban India
  - Migration of populations from villages
  - Creation of slums in cities

Challenges faced..

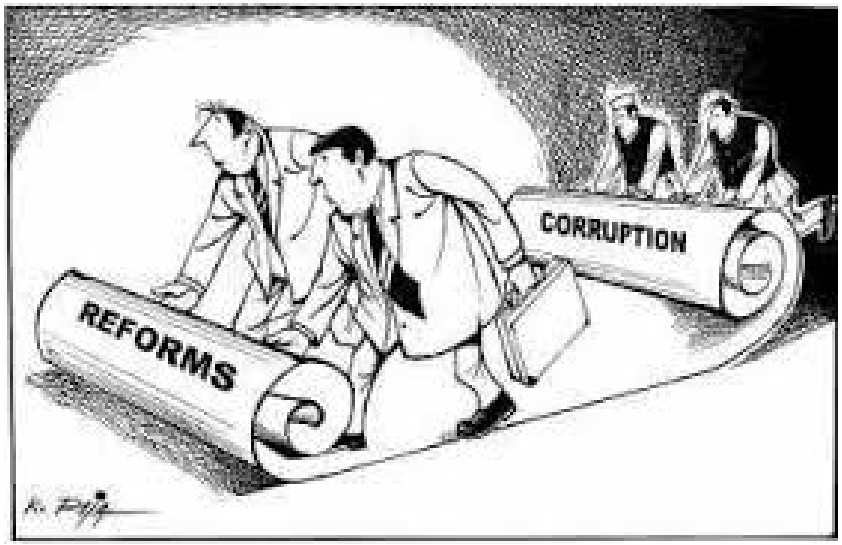
Governance deficit

- No single window clearances
  - Multiple departments
- People have to move from pillar to posts to get their basic entitlements
  - Land records
  - Ration cards
  - Passports
  - Birth /Death certificates

Challenges faced…

Corruption

- ***Premium*** for all services
  - Driving licence
  - Death Certificates!
- Growth of middlemen
  - Land mafias
  - Land scams
- Toll collection
  - A tale of two states !



Challenges faced…

Communications

- A primary requirement for development
- Poor Rural Tele-density
- Poor back haul connectivity
- Broadband Network challenge
- BB a must for any form of electronic service

Mitigation of Challenges leveraging Technology

Role of IoT in Mitigating challenges

Environment

- Air pollution management
  - Automated PUC monitoring & Control
    - IoT devices for Monitoring
- Water Management
  - Controlled water distribution
    - IoT managed
  - Cleaning of rivers
    - IoT devices for Monitoring & Control of effluents
      - US $ 30000 for imported devices

Role of IoT in Mitigating challenges

Green patch management

- IoT devices for
  - Soil Quality monitoring
  - Controlled irrigation
    - Drip irrigation based on soil condition
  - Fertilizers
  - Pesticides

Role of IoT in Mitigating challenges

Safety and Security

- **Road Safety**
  - Smart vehicles
    - Prevention of thefts
    - Prevention of accidents

- **Homeland Security**
  - Crime and Criminal Tracking system
  - Non-Clonable ID

Role of IoT in Mitigating challenges

Security

Non Clonable ID

- Trace and Track
- Security related
  - Delhi Police during CWG 2010
    - Prevention of Suicide attacks
  - Tracking of fertilizer bags
    - Prevention of IEDs
- Documents requiring authentication
  - Fake Passports
- Detection of fake medicines
  - Ghana conference
- Detection of illicit liquor
  - Prevent unwanted casulities

Role of IoT in Mitigating challenges

Energy Sector

- Smart Metering
  - No Power pilferages
    - Smart Meter manufacturing
    - Monitoring & Control
- Solar Micro units
  - Village home units - ` 2,500 per household
    - Light bulb
    - Fan
    - Charger
- Reduced emphasis on Grid supply
- Savings on Transmission losses
- Savings on precious foreign exchange
  - Diesel for Mobile towers

Role of IoT in Mitigating challenges

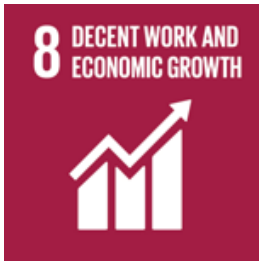
Disaster Management

- **Monitoring of Infrastructure**
  - Bridges
    - Australian experience
  - Flyovers
  - Old Building
- **Inventory Management for Disasters**
- **GIS Mapping of Resources**
  - Gas pipe lines
  - Water supply
  - Electric cables
  - Communication cables

Mobility

- Road Safety
  - Smart vehicles – IoT Controlled
    - Prevention of accidents
  - Autonomous vehicles
    - Challenge Uber model
- Intelligent Traffic Management System
  - AI/ IoT System based
- Information dissemination system
  - Metros
  - Busses
- Huge transportation implications
  - Pollution of the environment

SDG – 8



Air Quality Management

- Individual vehicle Exhaust Monitoring – IoT based
- No polluting Industries around
- Non Conventional Sources of Energy
  - Solar
  - Wind
  - Fuel Cell based

SDG 11 / SDG 13

Water Management

- Recycling/Green patches – Drip Irrigation – IoT based
- Drinking water/ Water ATMs
- Water Harvesting
  - Rain Water
  - Sewage treatment
  - Saline Water utilization
- Monitoring Pollution- IoT based, Centralised
  - Effluents
  - Industries

- **SDG – 6/ SDG 11**

Solid Waste Management

- General Solid Waste Management – Is Indore the role Model?
- Decentralized Units
- Garbage Segregation
- Effluent Treatment plants
  - Centralized Monitoring – IoT based
- Generation of Fertilizers (organic)
- Aerobic/Anaerobic Toilets
- e-Waste Management
- Processing Plants for proper disposal
- Reduction in Hardware requirements

SDG 6/ SDG 11

Housing

- **Vaastu Shastra -** Ecofriendly
  - Low heating / cooling requirements
- Bhutan Example
  - Natural light 12 hours a day
  - Heating/cooling solar and wind
- Others
  - Hollow bricks
  - Local Materials – Prashank
- Inclusive – UN Habitat 2030
  - Houses for the domestic and industrial help within each of these housing complexes (**Dharavis to be prevented**)

SDG – 1 / SDG 11

Agriculture

- Clusters around cities
  - Chandigarh city– Le Corbusier
- Food/ Vegetables (Local produce best for the area)
- Animal Farms
- Controlled Irrigation – IoTs based
- **PURA**(Providing Urban amenities in Rural Areas) important to ensure inclusive development
  - Dr. Abdul Kalam's vision
  - Financial Inclusion
  - Prevention of Infrastructure overload in cities

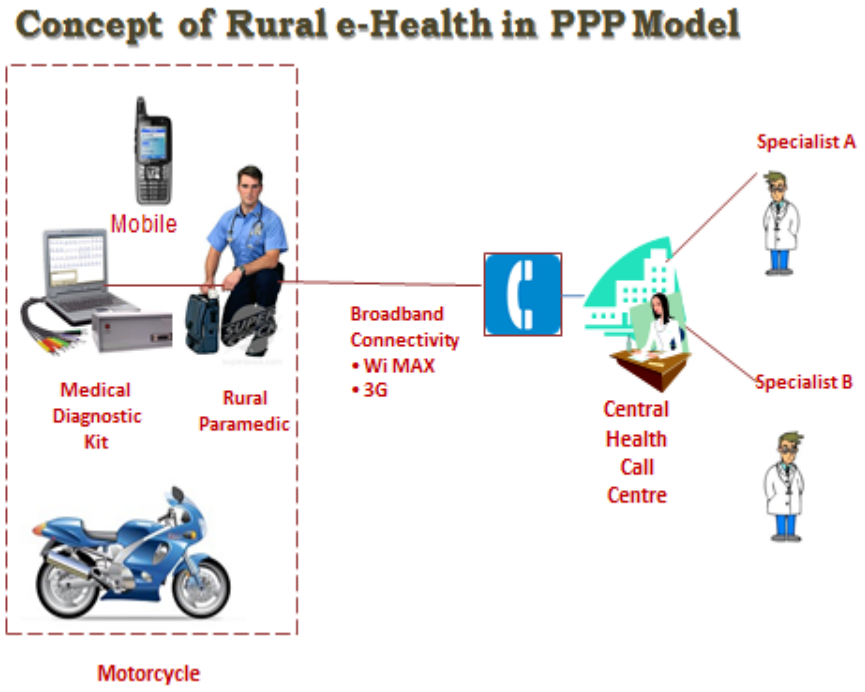
- **SDG – 1/SDG – 2/ SDG – 8**

Health

- Smart Ambulances
  - Monitoring of critical patients enroute to hospitals
- Citizen Health Record
- People with special needs – IoT monitoring
  - People with Epilepsy
- Promotion of Local medicines
  - Learn from tribals
- Mother and child care – mHealth
- Chronic Patient Management
- Rural Telemedicine

SDG – 3

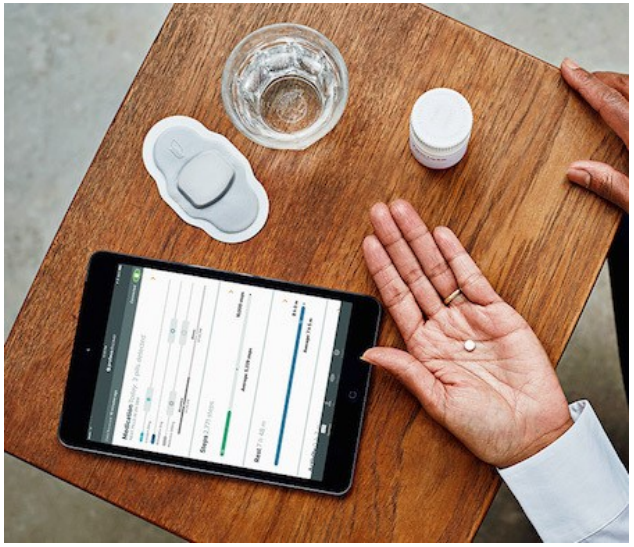
Health



Pathological Kit

Health

- **Ingestible sensors**
- **Remote monitoring** of patients
- **Implantable Continuous Glucose monitoring system**
- Open **artificial pancreas** system
  - Controlling diabetes
- Managing **Parkinson's disease**



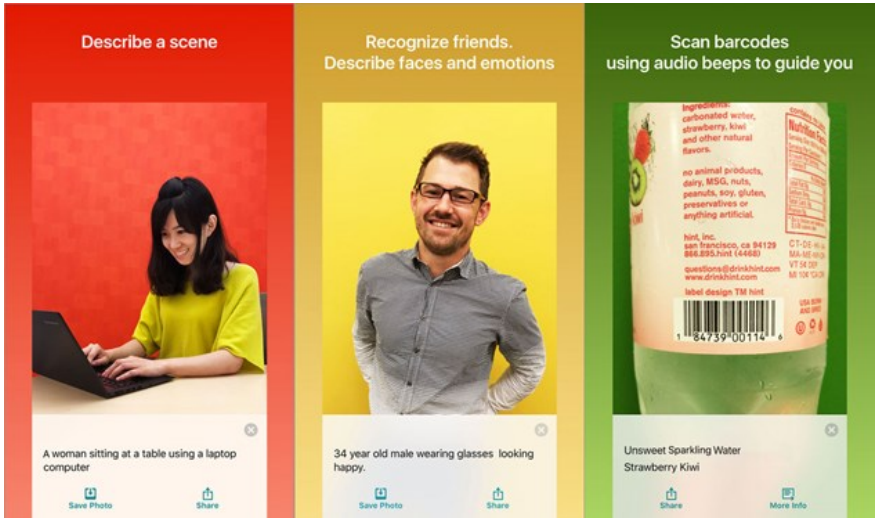
Health Sector

-Physically challenged

- Visual disability is one of the biggest challenges an individual can face.

- There are three facets to this challenge:
  - Recognize friends/ Describe faces and emotions
  - Understanding the product/ services details while shopping
  - Describing a scene

- Path breaking solution from
- **Microsoft – Seeing AI**



- https://www.youtube.com/watch?v=R2mC-NUAmMk

Education

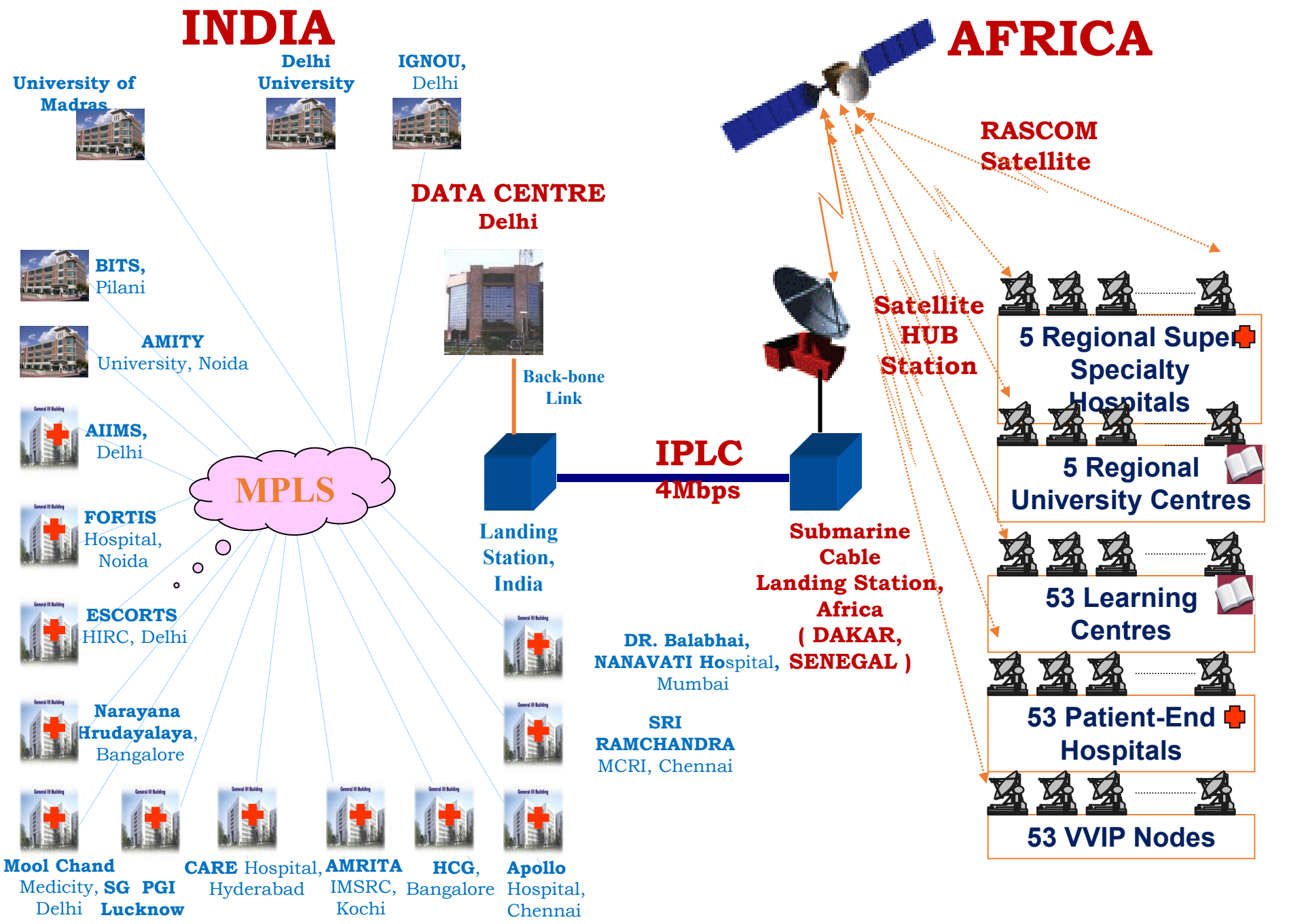
- Objective of education
  - Inclusive
  - Equitable
  - Equal Opportunity
- e-Networks
  - Maintain quality throughout (No long distance schooling)
- Digital Libraries
- IoT Enabled classroom boards

- **SDG – 4/ SDG – 5/ SDG – 8**

Education

e- Networks

- Virtual Classrooms
  - Pan Africa
  - UNOM
  - SAARC
- Collaborative research/ 'Centers of Excellence' replication
- Digital content /Digital Libraries
- Skill Development – 'Learn as you Earn'
- Employability enabling courses



ARCHITECTURE OF PAN-AFRICAN e-NETWORK

Source of inspiration……..

Governance

- Land records
  - GIS mapping
- Infrastructure
  - GIS mapping
- Citizen Centre- Online
  - With SLA conditions

  - **SDG 11**

Safety and Security

- Women/Children – Safety
  - Panic button in mobile
  - CCTV cameras in the city – IoT Controlled
- Terrorist threats
  - Non clonable IDs
- Crime and Criminal Tracking System
- Big Data Analytics
  - Preventive measures for controlling crime
- No slums like Dharavi – biggest slum in Asia
- *Dharavi – Hub of organized crime

SDG – 5

Communications

- LTE/4G Networks
  - Less energy consumption
  - Use of Solar energy
- FMC –Fixed Mobile Convergence
  - Less no of Mobile Towers
  - Less energy consumption
  - Lower Non Ionizing Radiation
- Continuous monitoring of EMF radiation in the town

Growth of Flora/Fauna

- Local Trees/Plants -IoT monitoring
- Regular planting of trees
  - Special Monsoon drive in Delhi
- Maintenance of the ecosystem for the Fauna

SDG 11 / SDG 13

Energy

- Natural Lighting
- Smart Lighting
  - Human presence based
- Smart cooling/heating
- Smart metering. – IoT
  - No Power pilferages
- Grid linked Reverse metering
  - Back feeding to the grid from individual households during low consumption periods

Energy (2)

- Smart Grids
- Solar Energy
  - Mini/Micro Units.
- Cooking
  - Solar
  - Piped gas - controlled (IoT)

Reliability – 3/4 days of autonomy

SDG 7

Financial Inclusion

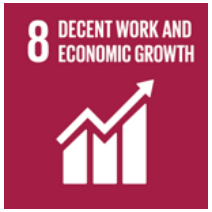
- Bank to Mobile direct transaction- m Banking
  - Postal Rural ICT devices-not at the mercy of postmen !
- Separate Bank A/Cs for all
    - Jan Dhan Yojana in India
- Accessibility to Finances
    - Financial Transactions using Bhim/PayTM/mPaise
  - Equal work equal pay
    - Payments only into individual accounts
      - Monitoring by enforcement agencies

- **SDG – 1/ SDG – 5 / SDG – 8**

Economic Growth

- Generation of employment opportunities
  - Through intense economic activity
- Increased Employability of young population
- Policy measures

SDG – 8



Infrastructure and industrialization

- **Resilient Infra**
  - Transportation/Roads/Railways/ Cycle lanes
  - Bus services
  - City Centres
- **Industrialization**
  - Support localized industries
  - Incentives for local products
- **Innovation**
  - Create Centers of excellence linking Educational Institutions with the Industry
  - Ancient knowledge dissemination to be encouraged
    - Egyptian Pyramids
    - Concept of Time – Indian literature
- No need to reinvent the wheel

SDG – 9

Wholesome World

- **Knowledge Dissemination**
  - Sharing of Knowledge
  - Sharing of best practices
  - Sharing resources
- Antithesis of Protectionism
- ***Vasudeva Kutumbakam***
  - Not only humans, but the whole environment included
- **Reduce inequality within and among countries**
- **More people like**
  - Wilhelm Rontgen (X Ray)
  - Jonas Salk (patent free polio vaccine)
- Innovations for the welfare of the world

SDG – 10

Conclusions

- **Smart Environment**

  A decentralised approach to
  - Waste Management
  - Water Management
  - Energy- Solar
  - Housing for the domestic help

  A Centralised IoT based mon./Control system
  - Air Pollution
  - Effluent treatment

- **Smart Living**
  - All new public private buildings with net Zero waste production
  - All new buildings with Zero energy requirements
  - Incentives for all old buildings for switching over to Net Zero waste/ Zero energy requirements

Conclusions

Lesser the better

- **Sustainability** lies at the very core of survival of this world
- **Smartness** lies in making do with as less resources, as possible in our cities without compromising on the **Quality of Life**.
- Our current resources should be able to sustain our future generations
- Redeployment of resources is also a way of ensuring sustainability.
  - Circular economies/ cities
- Sustainability should be an integral part of Project Planning Process stage itself
- **Leveraging technology** is the way out !
- **IoT** Can play a big role in this

About
United For Smart Sustainable Cities (U4SSC)

United 4 Smart Sustainable Cities (U4SSC)

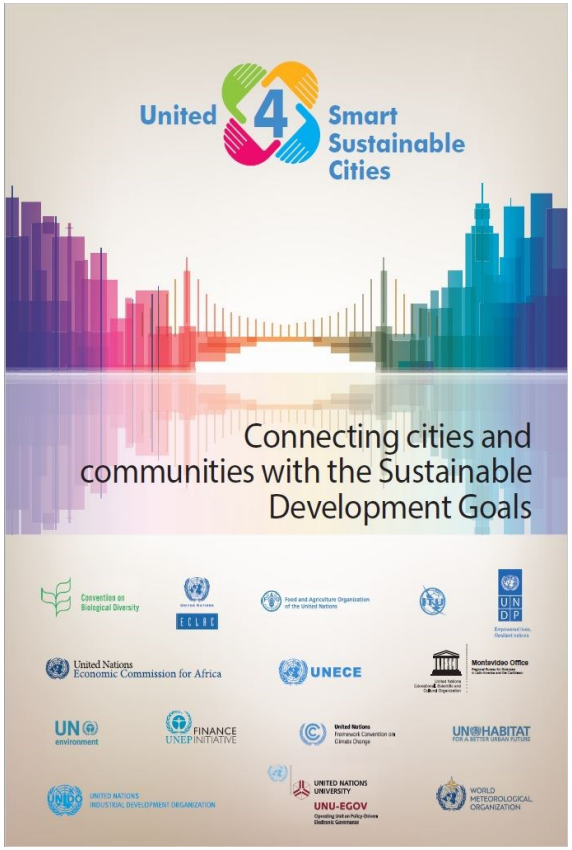
U4SSC is a United Nations Initiative coordinated by ITU and UNECE and supported by other 14 UN agencies to respond to the Sustainable Development **Goal 11:**

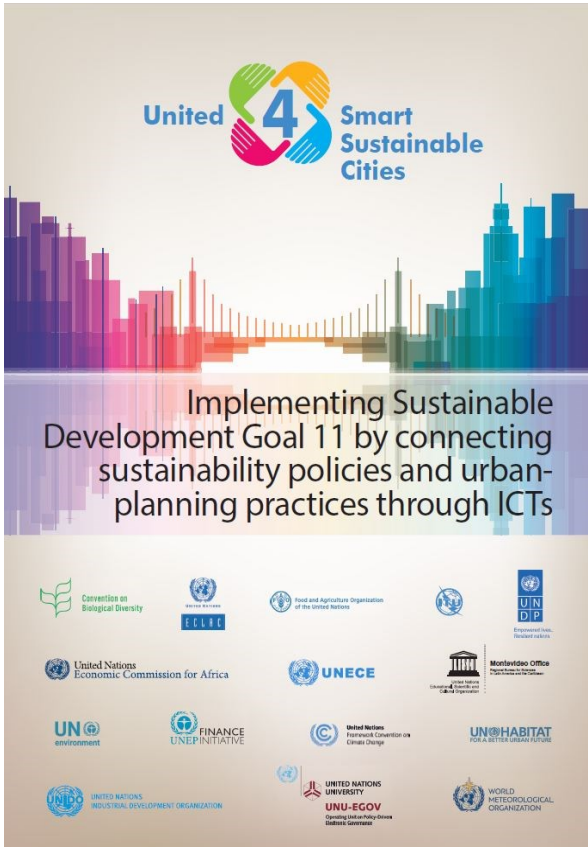
"Make cities and human settlements inclusive, safe, resilient and sustainable.

It advocates for public policy to encourage the use of ICTs to facilitate and ease the transition to smart sustainable cities.

Supported by:

U4SSC publications





Available for free on the U4SSC website:
http://itu.int/go/U4SSC

U4SSC Key performance indicators for Smart Sustainable Cities

The U4SSC Initiative has developed a set of international **key performance indicators (KPIs) for Smart sustainable cities (SSC)** to establish the criteria to evaluate ICT´s contributions in making cities smarter and more sustainable, and to provide cities with the means for self-assessments.

Over 50 cities worlwide are already implementing these KPIs

U4SSC current work

U4SSC is currently working on the following deliverables:

- Guidelines on tools and mechanisms to finance SSC projects
- Guidelines on strategies for circular cities
- City science application framework
- Blockchain 4 cities
- Guiding principles for artificial intelligence in cities - New
- The impact of Artificial Intelligence and cognitive computing in Cities - New
- The impact of data processing and computation in cities - New
- **The impact of sensing technologies and IoT in cities - New**

U4SSC work on Sensing Technologies and IoT

Aspects of IoT covered include:

- Robotic – Drones
- City IoT
- Wearables
- Environment Monitoring
- Indoor positioning
- Mobility positioning
- Integrated sensing
- Smart manufacturing/Industry 4.0