Leveraging ICTs for Smart Sustainable Cities (SSC)
Sept 29 – Oct 02, Bangkok, Thailand
Urbanization

refers to a process in which an increasing proportion of a society live in cities and the suburbs of cities. Historically, it has been closely connected with industrialization.
Sustainability

Definitions of Sustainability

**Sustainable Development (SD)**
Meeting the needs of the present generation without compromising the ability of future generations to meet their own needs.
-- Brundtland Commission, 1987 --

**Sustainability**
The possibility that human and other forms of life on earth will flourish forever.
-- John Ehrenfeld, Professor Emeritus, MIT --

**Sustainable Development (SD)**
Enough - for all - forever.
-- African Delegate to Johannesburg (Rio+10) --
In 2007, for the first time in history, the majority of the world’s population 3.3 billion lived in cities. By 2050, city dwellers are expected to make up 70% of Earth’s total population, or 6.4 billion people.
Focus Group on Smart Sustainable Cities (FGSSC)


• As an open platform for smart-city stakeholders to exchange knowledge in the interests of identifying the standardized frameworks needed to support the integration of ICT services in smart cities.

• Participation is open to all.
Defining the role of ICTs in environmentally sustainable smart cities, and identifying the ICT systems necessary to their development;

Identifying or developing a set of Key Performance Indicators (KPIs) to gauge the success of smart-city ICT deployments;

Establishing relationships and liaison mechanisms with other bodies engaged in smart-city studies and development including related activities at the ITU, other SDOs such as IEC, ISO and relevant civic, municipal and governmental organizations, industry consortia and academic / research institutions.

Identifying future smart-city standardization projects to be undertaken by its parent group, ITU-T Study Group 5;

Developing a roadmap for the ICT sector’s contribution to Smart Sustainable Cities, providing cohesion to the development and application of technologies and standards.
Focus Group Working Group Structure

ICT Role, Definition & Roadmap for Smart Sustainable Cities

Smart Sustainable Cities ICT Infrastructure

Standardization gaps, KPIs and metrics

Policy & positioning (communications, liaisons and members)

FG-SSC
Urbanization Trends

1900 | 2 out of every 10 people lived in an urban area
1990 | 4 out of every 10 people lived in an urban area
2010 | 5 out of every 10 people lived in an urban area
2030 | 6 out of every 10 people will live in an urban area
2050 | 7 out of every 10 people will live in an urban area

Defined by UN HABITAT as a city with a population of more than 10 million
1.5 billion people (22% of the population) live in 600 cities.

There are currently 23 megacities with populations over 10 million.

77% of the Latin American population is urban and urbanisation rates keep rising.

By 2025, there will be 36 megacities.

By 2030, India will have 68 cities of more than 1 million.

6 mega cities with more than 10 million.

These will need 2,000 square kilometers of paved roads and 7,400 kilometers of railroads, 20 times what has been built in the last 20 years.

Global urban growth between 2005 and 2030, to come from China and India.

In 20 years, China’s cities will have added 260 million people – more than the entire population of the United States today.

In 2030, numerous Indian cities will have larger economies than many countries. Mumbai’s GDP is projected to reach $265 billion.
Population

Key
- Cities over 10 million people (greater urban area)
- Predominantly urban 75% or over
- Predominantly urban 50 - 74%
- Urban 0 - 49%

US 246.2 81%
GERMANY 62 75%
RUSSIA 103.6 73%
CHINA 559.2 42%
INDIA 329.3 29%
BRAZIL 162.6 85%
MEXICO 84.962 77%
UNITED KINGDOM 54 90%
NEW YORK 21.4
MOSCOW 13.4
Saving PLANET
Future Generations

REVENUES
Increased Job growth

PEOPLE
Quality of Life
Landscape

Technology
- Data Convergence
- Sustainability & Green
- Internet of Things

Economics
- Aging Workforce,
- Need for Renewed Infrastructure
- Evolving Business Models

Policy
- Regulatory Framework
- Global Standards
- Incentivization
Scope of ICT Today
BIG DATA

- Every day, the world creates 2.5 Quintillion (?) bytes of data.
- 90% of all the Data today has been created in the last 2 years (2011-2012).
- In the 11 years between 2009 and 2020, the size of the "Digital Universe" will increase __ (?) fold. That's a 41% increase in capacity every year.
- In addition, only 5% of this data being created is structured and the remaining 95% is largely unstructured, or at best semi-structured.
- Sources of this data: Sensors, social media posts, pictures posted, videos posted, comments, transactions, GPS data etc.
Everything Will be Connected – Internet of Things
Analytics, Informatics & Dashboards

- Wireless Sensor Networks
- Energy & Environmental Data
  View, Compare, Share
- Analytics
  Prediction
  Energy Savings Strategies
  Operational Optimization
- Real-time Information / “Pulse”
Overview of a Smart Sustainable City & Role of ICT
City / Community = \( \sum \) Buildings

- Government
- Residential
- Hospitality
- Hospitals
- Schools
- Universities
- Energy
- Transportation
- Retail
- Sports & Entertainment
Attributes of a “Smart City”

MOBILITY
SUSTAINABILITY
LONGEVITY
SECURITY
RELIABILITY
EFFICIENCY
TECHNOLOGY
FLEXIBILITY
SCALABILITY
INTEROPERABILITY
Smart Cities are well managed, integrated physical and digital infrastructures that provide optimal services in a reliable, cost effective, and sustainable manner while maintaining and improving the quality of life for its citizens.

“Internet of Things” (IoT) for cities
Foundational Aspects

**Economy**
- Employment
- GDP
- Market – GLocal
- Viability
- Investment
- PPP
- Value Chain
- Risk
- Productivity
- Innovation
- Compensation

**Governance**
- Regulatory
- Compliance
- Processes
- Structure
- Authority
- Transparency
- Communication
- Dialog
- Policies
- Standards
- Citizen Services

**Environment**
- Sustainable
- Renewable
- Land Use
- Bio-Diversity
- Water / Air
- Waste
- Workplace

**Society**
- People
- Culture
- Social Networks
- Tech Savvy
- Demographics
- Quality of Life
- User Experiences
- Equal Access
- End Consumers
- Community Needs
- The City as a Database

© 2014 Sekhar Kondepudi
Some of these infrastructure verticals are “obvious”

What additional verticals should we consider that are missing?
<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Example Components</th>
</tr>
</thead>
</table>
| Real Estate & Buildings        | • Synergies between energy efficiency, comfort and safety and security ....  
                                | • Building as a Network – Integration of Multiple Technologies (HVAC, Lighting, Plug Loads, Fire, Safety, Mobility, Renewable, Storage, Materials, IAQ etc)  
                                | • Software – Efficiency, Automation & Control, Analytics & Big Data Management                                                                 |
| Industrial & Manufacturing     | • Data Interoperability  
                                | • Sustainable Production & Zero Emissions  
                                | • Networked Sensors & Cloud Computing  
                                | • Factories of the Future                                                                 |
| Energy & Utilities             | • Smart Grid & Smart Metering – Generation / Distribution / Measurement  
                                | • Wireless Communications  
                                | • Analytics & Policies  
                                | • Load Balancing, Decentralized and Co-generation                                                                 |
| Air, Water & Waste Management  | • Water Information Systems (WIS)  
                                | • Integrated Water, Waste and Energy Savings Optimization Schema  
                                | • Sensor Networks for Water and Air Systems                                                                                                                                 |
| Safety & Security              | • Video Surveillance & Video Analytics  
                                | • Seamless Communication during Natural & Man Made Disasters                                                                                                                                 |
| Healthcare                     | • Smart Hospitals  
                                | • Real Time Healthcare including Analytics  
                                | • Home & Remote Healthcare incl. Monitoring  
                                | • Electronic Records Management                                                                 |
| Education                      | • Flexible learning in an interactive learning environment  
                                | • Accessing world class digital content online using collaborative technologies  
                                | • MOOCs                                                                                                                                 |
| Mobility & Transportation      | • Intelligent Transportation Technologies in the Age of Smart Cities:  
                                | • Traffic Management – Monitoring & Routing  
                                | • Real Time Linkage to Emissions, Traffic Patterns, Reduced Fuel Consumption .  
                                | © 2014 Sekhar Kondepudi 30
Real Estate & Buildings

- ... solutions that turn buildings into living organisms: networked, intelligent, sensitive and adaptable ...

- ... synergies between energy efficiency, comfort and safety and security ....

- Building as a Network – Integration of Multiple Technologies (HVAC, Lighting, Plug Loads, Fire, Safety, Mobility, Renewable, Storage, Materials, IAQ etc)

- Software – Efficiency, Automation & Control, Analytics & (Big ?) Data Management

- Integration with Smart Grid

- Distributed Energy

- Coexist with Productivity, Efficiency, CSR, Sustainability and GHG reduction goals
• Data Interoperability
• Sustainable Production
• Zero Emissions
• Plant Optimization
• Networked Sensors
• Cloud Computing
• Intelligent & Integrated Processes
• Factories of the Future
Utilities – Electricity & Gas

- Smart Grid – Generation / Distribution
- Smart Meters – Measurement & Integration of smart capabilities
- Wireless Communications
- Analytics & Policies
- Decentralized and Co-generation
- Load Balancing
- Increased Efficiency
- Communications networks— utility-wide voice and data communications networks and services
- Intelligent utility network
Waste, Water & Air Management

• **Smart Water**
  - New Distribution Approaches for Stable and Continuous Water Supply
  - New Water Purification Technologies
  - Water Treatment / Re-Use / Re-Cycle
  - Wireless Sensors / Smart Metering for Optimal Usage / Analysis

• **Smart Air**
  - Pollution Sensors – Outdoor Air Quality

• **Waste Management**
  - Sensors to detect toxicity
  - Improving Efficiency of Waste Collection
  - Auto Sorting / Tracking - Reuse & Recycling
  - Bio-Medical Waste
Mobility

- Intelligent Transportation Technologies in the Age of Smart Cities:
  - Traffic Management – Monitoring & Routing
  - Smart Charging
  - Intelligent Public Transit
  - Real Time Travel Information
  - Transit signal priority
  - Centralized fleet vehicle management
  - Real Time Linkage to Emissions, Traffic Patterns, Reduced Fuel Consumption
Safety & Security

- Video Surveillance
- Video Analytics
- Workflow
- Situational Awareness
- Enhanced Emergency Systems
- Natural Disasters
- Intra-Agency Communications
• **Smart Hospitals**
  • Gaining real-time line of sight and responses to individualized health information.

• **Smart” Communications – Patient to Clinician**

• **Intelligent & Efficient Public Health**

• **Real Time Healthcare including Analytics**

• **Privacy and protection of patient information**

• **Home & Remote HealthCare incl. Monitoring**

• **Health Waste Management**

• **Electronic Records Management**
Education

- Flexible learning in an interactive earning environment
- Delivering education through different devices – from televisions to ipods to mobile phones to netbooks – beyond our schools and into homes
- Accessing world class digital content online
- Adaptive learning programs and learning portfolios
- Collaborative technologies and digital learning resources
- A digital learning portfolio including online learning & testing that gives students, teachers and parents an integrated view
- MOOCs
The multiple systems within a city can be thought of as sub-networks of a larger network ie “System of Systems” or a “network of networks”

When these sub-systems are integrated with one another, they can be thought of as the “Internet of Things” (IoT) for cities.

All of these systems comprise of sub-systems, components & devices which have nodes, end points and behave like a network in terms of their end use characteristics and interactivity with other nodes.

This is completely analogous to an IT or DataCom network.

ICT is at the CORE acting as the “NERVE CENTER”
Role of ICT in Smart City Solutions

**Data Analytics**
- Prediction
- Accessibility
- Management

**ICT Infrastructure**
- ICTs Specific to Smart Sustainable Cities.
- Internet of Things
- Ubiquitous Sensor Networks.
- Data Security.
- Mobile Broadband

**Physical & Service Infrastructure**
- Smart Energy
- Smart Buildings
- Smart Transportation
- Smart Water
- Smart Waste
- Smart Physical Safety and Security
- Smart Healthcare
- Smart Education
## Infrastructure

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Example “Smart” Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building Management</strong></td>
<td>• Building Automation</td>
</tr>
<tr>
<td></td>
<td>• Building Control</td>
</tr>
<tr>
<td></td>
<td>• IT Network Systems</td>
</tr>
<tr>
<td></td>
<td>• Crisis Management Solution (power, infrastructure damage...)</td>
</tr>
<tr>
<td><strong>Data Communications &amp; Security</strong></td>
<td>• Voice/Video/Data</td>
</tr>
<tr>
<td></td>
<td>• Structured Cabling</td>
</tr>
<tr>
<td></td>
<td>• TCP/IP/BAS Protocols</td>
</tr>
<tr>
<td></td>
<td>• Remote VPN Access</td>
</tr>
<tr>
<td></td>
<td>• Computer &amp; Network Access</td>
</tr>
<tr>
<td></td>
<td>• Firewalls &amp; Managed Security Services</td>
</tr>
<tr>
<td></td>
<td>• Mobile Broadband</td>
</tr>
<tr>
<td></td>
<td>• Mobile Security</td>
</tr>
<tr>
<td></td>
<td>• Data Security Infrastructure</td>
</tr>
<tr>
<td><strong>Smart Grid / Energy / Utilities</strong></td>
<td>• Energy Logistics / Distribution (electricity, water, gas)</td>
</tr>
<tr>
<td></td>
<td>• Heating &amp; Cooling</td>
</tr>
<tr>
<td></td>
<td>• Lighting</td>
</tr>
<tr>
<td></td>
<td>• Back-Up Power</td>
</tr>
<tr>
<td></td>
<td>• Leakage Monitor</td>
</tr>
<tr>
<td><strong>Physical Safety and Security</strong></td>
<td>• Access Control</td>
</tr>
<tr>
<td></td>
<td>• Video Surveillance Intrusion Detection</td>
</tr>
<tr>
<td></td>
<td>• Biometrics</td>
</tr>
<tr>
<td></td>
<td>• Perimeter and Occupancy Sensors</td>
</tr>
<tr>
<td></td>
<td>• Fire Alarm Panels</td>
</tr>
<tr>
<td></td>
<td>• Detection (Smoke/Heat/Gas/Flame)</td>
</tr>
<tr>
<td></td>
<td>• Fire suppression</td>
</tr>
<tr>
<td><strong>Emergency Response</strong></td>
<td>• Integrated Fire Department</td>
</tr>
<tr>
<td></td>
<td>• Police and Medical Services</td>
</tr>
<tr>
<td></td>
<td>• Centralised and Remote Command and Control</td>
</tr>
<tr>
<td></td>
<td>• Scalable Decision Making Process</td>
</tr>
<tr>
<td><strong>Traffic and Transportation (Mobility)</strong></td>
<td>• Traffic Control &amp; Monitoring (rail, underground, buses, personal vehicles)</td>
</tr>
<tr>
<td></td>
<td>• 24/7 Supply Management (logistics)</td>
</tr>
</tbody>
</table>
The Connected Society

Connected consumers, enterprises & organizations

Connected homes
Connected healthcare
Connected buildings
Connected charging station
Connected truck
Connected bus
Connected car
Connected micro generation
Connected meters
Connected service organizations

Standardized technology
Identification and authentication
Payments

Source - Ericsson
Agenda

1. Urban & ICT Trends
2. Overview of a Smart Sustainable City & Role of ICT
3. Defining a Smart Sustainable City
4. Summary

© 2014 Sekhar Kondepudi
Need for a Comprehensive Definition

• There is a lack of agreement on the definition and on the specific parameters that characterise a smart sustainable city.

• Need to
  • provide an overview of the main attributes that make cities smart and sustainable
  • explore the role and potential of ICTs within SSCs
  • acknowledge, the key ICT infrastructure need to enable SSC strategies

• 3 Key Pivots
  • Smartness or Intelligence
  • Sustainability and the Environment
  • Cities – An Urban Landscape.
3 Different Approaches in Literature

- **Technology based approach:** The technology based approach focuses on the use of hardware. It emphasizes that ICT infrastructure should be the basis for the development of a city.

- **Human centric approach:** This approach focuses on investment in human and social capital for the establishment of smart cities. This would mainly include the involvement of the ICT based entrepreneurs capable of developing innovative products and processes.

- **The integrated approach:** This approach is focused on improving the quality of living of the citizens by integrating technological and social innovation. It aims to improve the performance of sectors including transport energy, urban safety, energy use, waste disposal with the application of ICT while maintaining cities as an integrated network rather than a set of individual sectors.
Objectives & Methodology

- **Objective** to develop a comprehensive definition for a smart sustainable city, which incorporates the different perspectives for different key stakeholders, addressing key indicators and attributes.

- **Audience** for this study is anyone who would like to get a fundamental handle on what constitutes a Smart Sustainable City and what attributes; indicators and characteristics are typical.

- The project sourced over 100 definitions and descriptors for Smart Sustainable Cities from different sources
  - Academia & Research Communities
  - Government Initiatives including the EU
  - International organizations such as the United Nations, ITU
  - Corporate / Company Profiles
  - Market Research Vendors
  - Trade Associations
  - Standards Development Organizations

- A detailed analysis of different key words and attributes along with indicators, rankings and perspectives from these diverse sources was performed.
## Sample Definitions (Total 120)

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition</th>
<th>Keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hitachi. &quot;Smart City Overview.&quot; Smart Cities : Hitachi.</strong> Hitachi, Web. Last Accessed 9 Feb. 2014. <a href="http://www.hitachi.com/products/smartcity/vision/concept/overview.html">http://www.hitachi.com/products/smartcity/vision/concept/overview.html</a></td>
<td>Hitachi’s vision for the Smart Sustainable City seeks to achieve concern for the global environment and lifestyle safety and convenience through the coordination of infrastructure. Smart Sustainable Cities realized through the coordination of infrastructures consist of two infrastructure layers that support consumers’ lifestyles together with the urban management infrastructure that links these together using IT.</td>
<td>Coordinated infrastructure, lifestyle safety, lifestyle convenience, urban infrastructure, IT</td>
</tr>
</tbody>
</table>
## Logical Groupings

<table>
<thead>
<tr>
<th>Category</th>
<th>% Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Life &amp; Lifestyle</td>
<td>6%</td>
</tr>
<tr>
<td>Infrastructure &amp; Services</td>
<td>18%</td>
</tr>
<tr>
<td>ICT, Communication, Intelligence, Information</td>
<td>26%</td>
</tr>
<tr>
<td>People, Citizens, Society</td>
<td>11%</td>
</tr>
<tr>
<td>Environment &amp; Sustainability</td>
<td>16%</td>
</tr>
<tr>
<td>Governance, Management &amp; Administration</td>
<td>9%</td>
</tr>
<tr>
<td>Economy &amp; Financials</td>
<td>8%</td>
</tr>
<tr>
<td>Mobility</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Criteria

- ICT
- Smart Living
- Smart People
- Smart Environment & Sustainability
- Smart Governance
- Smart Mobility
- Smart Economy

- ICT / Communication / Intelligence / Information
- Infrastructure & Services
- Environment / Sustainable
- People / Citizens / Society
- Quality of Life / Lifestyle
- Governance / Management / Administration
- Economy / Resources
- Mobility
- Efficiency
- Improving / adaptable / flexible
30 Key Terms

- ICT
- Adaptable
- Reliable
- Scaleable
- Accessible
- Security
- Safe
- Resilient
- Economic
- Growth
- Standard of Living
- Employment
- Citizens
- Well Being
- Medical

- Welfare
- Physical Safety
- Education
- Environmental
- Physical & Services Infrastructure
- Transportation & Mobility
- Water
- Utilities & Energy
- Telecommunications
- Manufacturing
- Natural & Man Made Disasters
- Regulatory & Compliance
- Governance
- Policies & Processes
- Standardized
“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 and environmental aspects”.
Urban Trends

Overview of a Smart Sustainable City & Role of ICT

Defining a Smart Sustainable City

Summary

© 2014 Sekhar Kondepudi
Cities of the Future

Intelligent
- Recognizes you and customizes itself based on your preferences

Collaborative
- Ensures that you stay connected to the right people & the right information in real time

Efficient
- Uses hard & soft resources optimally while increasing productivity

Secure
- Assures both information & physical security at all times

Experiential
- Delivers goodness in the way you work & live

© 2014 Sekhar Kondepudi
Discussion