Use Case Analysis for Smart Cities and Communities

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Contents

• Introduction
• Smart cities and communities
• Examples of use cases
  – Crowdsensing, Open data, Recommendation
• Global City Teams Challenge
• Towards wise cities
• IES-City Framework
Enabling Technology for IoT

"Internet of Things – converging technologies for smart environments and integrated ecosystems” River Publishers
Putting all together for IoT

Network Connectivity
(The ongoing convergence of evolution of devices)

Computing Clouds
(Deployment of large shared infrastructure)

Trust

Big Data
(Accumulation of data from sensors and social networks)
From living space to community space

1. **Automation**
   - Connectivity
   - Comfort
   - Energy Cost

2. **Integration**
   - Measurement
   - Control
   - Optimisation
   - Environmental Cost

3. **Intelligence**
   - Digital Infrastructure
   - Information
   - Mobility
   - Sustainability
   - Safe Cities

**Smart Home**

**Smart Building**

**Smart Cities**
Towards Public Sector IoT

• Smart city
  – Use enabling technology for IoT to improve the quality of life in cities and communities

• Smart cities and communities (SC&C)
  – Increase citizen engagement
  – Data-driven applications
Social-Cyber-Physical Systems
Infrastructure for SC&C

Source: NIST – Sub, Ahmed, Sriram
Typical Use Case for SC&C

• Several applications in smart city crowdsensing

• vCity Map application:
  o Monitor Road conditions
  o Data is collected from participating cyclists

• SmartCitizen application:
  o Mobile sensing involves residents in producing and sharing beneficial information regarding the city (weather conditions, health related issues and traffic situations)

Source: “People-centric computing and communications in smart cities ” IEEE, 2016
A mature smart city

- Enable individual citizens, businesses, NGOs and the municipality itself to both contribute and extract data, and to create and make use of applications based on that data.

Source: Machina Research, 2016
oneM2M White Paper
Enabling open data transparency

A web page of London Datastore
Context-aware collaborative recommendation

- Users Information
- Device/Item Information
- Context Information
- Recommender Algorithm (Collaborative based)
- Trust Index/Value
- Recommendations
Global City Teams Challenge

• Establish and demonstrate replicable, scalable and sustainable models for collaborative incubation and deployment of interoperable, standard-based IoT solutions and demonstrate their *measurable* benefits in Smart Communities/Cities

• Enable the measurement science for real-world IoT deployments in scale

Community-centric Smart Connected Services:
*Sense, Report, Act, and Refine*
From Smart Cities to Wise Cities

- Why “Wise”?  
  - deeper and more long-term than mere “Smart"

- Wise Cities  
  - leverage the massive amounts of data generated by today's devices and sensor to guide long-term thinking, planning, and activity.
IES-City Framework

https://pages.nist.gov/smartcitiesarchitecture
Urban Applications
<table>
<thead>
<tr>
<th>Sub-category</th>
<th>Issues</th>
<th>Kind of applications (examples)</th>
</tr>
</thead>
</table>
| **Built environment**        | • to manage and improve building performance, safety and comfort  
                               • to know, use and manage the land resources into built environment                                                                                                                                     |                                                                                                                                                                     |
| Smart Home                   | • to enable automatic and remote control of home systems and conditions  
                               • to create services to improve the awareness of home residents about energy and water consumption  
                               • to activate remote assisted living services  
                               • to optimize the efficiency of heating systems, reduce energy consumption and environmental impact, lowering utility bills | • home monitoring and management systems  
                               • building monitoring and management systems  
                               • energy monitoring and management systems  
                               • water monitoring and management systems  
                               • consumption monitoring systems                                                                                                                                 |
| Smart Building               | • to enable automatic and remote control of home and building systems and conditions  
                               • to create services to improve the awareness of building occupants about energy and water consumption | • building monitoring and management systems  
                               • energy monitoring and management systems  
                               • water monitoring and management systems                                                                                                                                                                      |
| Land use and management      | • to collect and provide information about available land resources and how they are used  
                               • to management natural resource                                                                                                                                            | • land use classification systems  
                               • GIS enabled land mapping  
                               • smart land use planning systems                                                                                                                                                                                                 |
### Water and wastewater

- to collect, manage, distribute, use, reuse and recycling water
- to reduce water consumption and contamination, enable the effective utilization of water resources
- to reduce costs and increase the reliability and transparency of water distribution

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<tbody>
<tr>
<td><strong>Water collection and management</strong></td>
<td>• to map and monitor the hydrology network&lt;br&gt;• to monitor groundwater level&lt;br&gt;• to predict and manage events (like storm) in time&lt;br&gt;• to monitor water quality and take corrective action in case of any degradation of water quality&lt;br&gt;• to analyze, predict and manage water consumption</td>
<td>• weather forecasting systems&lt;br&gt;• systems for geo-spatial mapping of networks</td>
</tr>
<tr>
<td><strong>Water distribution</strong></td>
<td>• to map, monitor, manage and make efficient the water distribution network&lt;br&gt;• to detect outage, breakage, leakage, ghost pipes in the network&lt;br&gt;• to monitor water quality and take corrective action in case of any degradation of water quality</td>
<td>• ghost pipe detection and management systems&lt;br&gt;• water leakages detection and management systems&lt;br&gt;• outage management system&lt;br&gt;• real-time hydraulic modeling water distributions tool&lt;br&gt;• water and wastewater SCADA&lt;br&gt;• application for geospatial management of water distribution network&lt;br&gt;• quality water monitoring and correcting systems</td>
</tr>
<tr>
<td><strong>Water consumption</strong></td>
<td>• to enable consumers to understand, monitor and control their water usage</td>
<td>• online systems for understanding and monitoring the water usage</td>
</tr>
<tr>
<td><strong>Wastewater management</strong></td>
<td>• to monitor sewer lines infrastructure&lt;br&gt;• to improve wastewater treatment</td>
<td>• plant monitoring and control systems&lt;br&gt;• sewer lines infrastructure monitoring and control systems</td>
</tr>
</tbody>
</table>
### Waste

- to favor recycling and reuse of the products in order to convert waste into a resource and create closed-loop economies
- to involve citizens in city sanitation
- to improve efficiency of waste collection and transportation systems
- to improve the waste disposal processes

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<td>Citizens engagement</td>
<td>• to create awareness on waste segregation and recycling</td>
<td>• online platform to sell and regain value from products</td>
</tr>
<tr>
<td></td>
<td>• to provide visibility on city sanitation, route planning for garbage collection, resource optimization, efficient asset management, efficient maintenance, visibility of waste bins, air quality measurements etc</td>
<td>• web portal to share and provide information</td>
</tr>
<tr>
<td>Collection and segregation</td>
<td>• to optimize the pick-up routes and schedules</td>
<td>• waste collection scheduling systems (based on sensors and GPS devices)</td>
</tr>
<tr>
<td></td>
<td>• to reduce the manpower</td>
<td>• automated waste collection systems</td>
</tr>
<tr>
<td>Waste disposal</td>
<td>• to evaluate the energy production from waste</td>
<td>• energy simulation systems</td>
</tr>
<tr>
<td></td>
<td>• to enable smart landfill management</td>
<td>• landfill management systems</td>
</tr>
<tr>
<td></td>
<td>• to monitor pollution levels at landfills</td>
<td>• pollution and contamination control systems</td>
</tr>
</tbody>
</table>
## Energy

- to manage the demand-supply gap
- to reduce energy losses, consumption and carbon footprint
- to provide reliable 24x7 energy supplies and reliable metering
- to favor the creation of a single and smart electricity grid
- to improve energy asset management, energy operations and customer service for citizens and business

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| **Energy supply** | • to improve supply by integrating decentralized renewable energy sources  
• to provide advanced energy supply service management: load management, demand-response, real time monitoring and control  
• to create large customer profiling | • demand/response management systems  
• energy simulation systems  
• real-time consumption monitoring and control systems  
• carbon reporting and management systems  
• energy service management systems |
| **Energy transmission and distribution** | • to regulate load and capacity factors to maintain stability in the grid  
• to manage unpredictable energy production  
• to identify theft and pilferage  
• to track defaulters | • electric SCADA  
• solutions for substation automation  
• solutions for feeder automation  
• overloading management solutions  
• self-healing grid systems |
| **Energy demand** | • to reduce energy demand from buildings and industrial plants  
• to identify target customers and define strategies for effective energy management  
• to activate smart prices policies  
• to collect accurate information on energy usage | • electric infrastructure management systems  
• GIS mapping systems  
• network mapping and consumer indexing systems  
• smart streetlights systems  
• large customer profiling solutions  
• energy service management systems  
• consumption monitoring systems |
## Transportation

- to reduce pollution levels and/or greenhouse gas emissions and energy consumption
- to reduce traffic congestion
- to optimize trip planning and management, transport mode selection and allowing seamless multimodality
- to change the behavior of the drivers in the long term
- to improve public safety

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| **Travel demand/cons.**      | • to reduce the mobility needs for both individuals and goods and travelling time  
                                • to improve the use of public transport, also increasing its reliability                                                                 | • online services to access to public transport and information  
                                • bicycle sharing systems  
                                • carpooling/ car sharing applications  
                                • multi-channel citizen services to report maintenance issues  
                                • cash less payment systems for multiple mode of transportation  
                                • GPS-based system for real-time tracking of public transport                                                                 |
| **Traffic management**       | • to monitor and analyze traffic information and provide real-time traffic information and periodic traffic forecast  
                                • to improve efficiency in incident management  
                                • to improve efficiency of freight vehicle operations  
                                • to provide efficient management of streets and off street parking spaces                                                                 | • GPS-based system for real-time tracking of public transport  
                                • GPS-based vehicle tracking systems  
                                • smart parking systems  
                                • smart traffic lights systems  
                                • freight ICT services  
                                • efficient incident management systems  
                                • real-time roadway traffic monitoring and analysis systems  
                                • video analytics-based scenario simulations systems                                                                                   |
| **Surveillance**             | • to remotely monitor the public transport and roads                                                                                                                                                    | • video analytics-based surveillance systems  
                                • efficient incident management systems                                                                                                  |
## Education

- to increase access, improve quality and reduce costs to education

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<td>Learning outcomes</td>
<td>• to evaluate teacher performance</td>
<td>• education analytics platforms</td>
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<tr>
<td></td>
<td>• to monitor student attendance and performance</td>
<td>• teacher performance management systems</td>
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<tr>
<td></td>
<td></td>
<td>• biometric identification systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• student performance management systems</td>
</tr>
<tr>
<td>Learning and teaching</td>
<td>• to facilitate distance education</td>
<td>• e-Learning platforms</td>
</tr>
<tr>
<td></td>
<td>• to improve curriculum design and publication processes</td>
<td>• video conference systems</td>
</tr>
<tr>
<td></td>
<td>• to improve the quality of teaching</td>
<td>• curriculum management solutions</td>
</tr>
<tr>
<td>Service management</td>
<td>• to improve quality and safety of school infrastructures</td>
<td>• online teacher training solutions</td>
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<tr>
<td></td>
<td>• to reduce costs for personnel and infrastructures management</td>
<td>• online centralized admission systems</td>
</tr>
<tr>
<td></td>
<td>• to reduce access costs to school</td>
<td>• online teacher recruitment</td>
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<tr>
<td></td>
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<td>• integrated school management systems</td>
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<tr>
<td></td>
<td></td>
<td>• surveillance systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• GPS-based tracking systems in buses</td>
</tr>
</tbody>
</table>
## Health

- to improve quality of care, patient safety and outcomes
- to improve the effectiveness and efficiency of healthcare services
- to reduce costs
- to increase communication about health

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| Health care systems    | • to provide real-time information regarding hospitals and availability of beds, waiting times, doctor offices and appointments, etc.  
                         | • to have an integrated management of patient information               | • logistic management systems  
                         | • to provide citizen with direct access to their health information     | • administrative systems  
                         | • to provide online access to health services                          | • patient information management systems  
                                                                                     | • online patient portals                                                 |
| Health care delivery   | • to improve diagnosis and enhance patient care                        | • remote diagnostic and support systems  
                         | • to monitor dissemination of epidemics                                | • critical decision support systems  
                         | • to reduce health problems                                            | • medical simulation systems  
                         | • to provide remote assistance to patients                             | • remote monitoring and assistance systems  
                         | • to forecast the care demand                                          | • diagnostic analytics systems  
| Communication          | • to increase health information dissemination                          | • Internet information portals  
                                                                                     | • communication systems                                                |
### Socio-economic development

- to meet social needs and to increase standards of life within urban areas
- to improve enterprises efficiency and competitiveness

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| **E-Governance**              | • to improve efficiency, effectiveness, transparency and accountability of communications and transactions between government and public administration, and citizens and businesses | • e-government applications  
                              |                                                             |   • open data platforms                                          |
| **Social Innovation and Inclusion** | • to increase engagement of citizens in the city functioning  
                                        • to favor access to city's services and opportunities. | • citizen reporting platform for contacting local authorities  
                              |                                                             |   • social networking applications                            |
| **Economy and Business**      | • to create of multi-sectorial economy, smart industries and smart manufacturing | • e-commerce solutions                                    |
Public safety, policing and emergency response

- to anticipate and respond rapidly to emergencies and threats
- to improve safety and security within urban areas

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<td>City surveillance and crime prevention</td>
<td>• to detect misbehavior of individuals</td>
<td>• mobile emergency services</td>
</tr>
<tr>
<td></td>
<td>• to monitor social events and crowd behavior</td>
<td>• cyber security tools</td>
</tr>
<tr>
<td></td>
<td>• to support human capacity in surveillance</td>
<td>• incident control systems</td>
</tr>
<tr>
<td></td>
<td>• to enable citizen to provide information about criticalities</td>
<td>• surveillance systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• integrated response and emergency systems</td>
</tr>
<tr>
<td>Communication</td>
<td>• to increase citizen awareness and education</td>
<td>• online platforms and services</td>
</tr>
</tbody>
</table>

