Semantically Enriched Vision of Smart City

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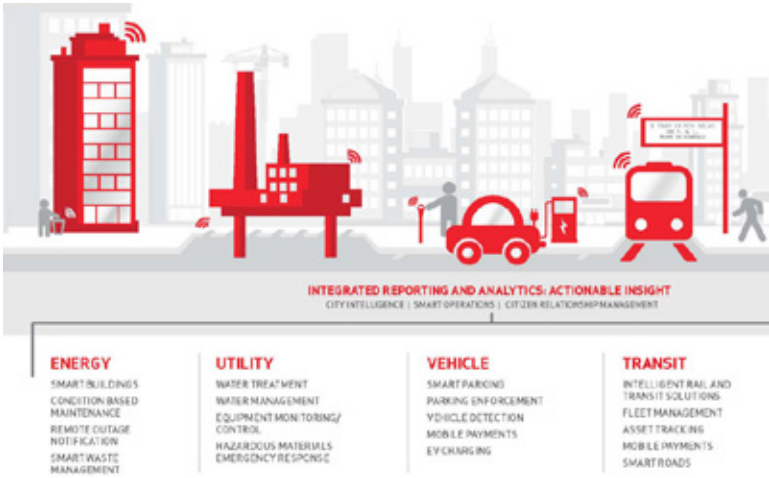
Debates to achieve a sustainable and harmonious tomorrow have been increasingly influenced by discussions of smart cities. Researchers argue collaborative information and communication technology with different level of social participation of residents is a fuel for quality of life that reduces the environmental impact of urbanization. In similar fashion, policymakers emphasize on high technological solutions to offer new ways of operating, learning, living, working and travelling, and apply smart, innovate and combined strategies to fuel economical development. Government's vision places the people at the heart of the smart city concept, and they focus on achieving a smart governance framework, connected by innovative technologies that enable citizens to experience all public services with ease and low cost, fuelling economic development to stimulate a high quality life for all.

India is drawing on the development of smart cities at the global level. Since the arrival of new government in India, a new technical term, a modern buzz word "Smart City" is increasingly used by public authorities and private developers to address the urbanization and sustainability solutions. Vision of 'Digital India', has a plan to build 100 smart cities across the country.

There is much debate on the ways to approach objectives of smart city but regardless the disparity of views, technology is the common denominator.

ICT or ubiquitous computing paradigm is the central nervous system of smart cities. Smart city solutions relies on the widely distributed smart devices to monitor the urban environment in real time, to react in time, to establish automated control, to collect information for intelligent decision making, and to facilitate various services and improve the quality of urban living. The distributed network of intelligent sensor nodes, as well as the data centers/clouds where the sensor data are stored and shared, constructs the main body of smart city infrastructure.

Wireless sensor networks develop the foundation for Smart Cities, adopting a spatially distributed network of autonomous intelligent sensors to measure a variety of physical or environmental parameters, such as pressure, noise, temperature, sound, ambient light levels, and toxic gas concentration, for efficient urban management. This monitoring capability can be effectively used in the emerging



initiatives of smart city. Every second, massive amounts of heterogeneous data are being produced by these sensors that bring the challenge to develop a common platform to share unambiguous meaning of collected data. This aim can be achieved by the concept of Semantic Sensor Network (SSN). SSN enables sharing and reusability of sensor data from various sensors in a meaningful way and endures system to process sensor data in heterogeneous environment.

In 1998 father of web, Berners-Lee coined back the term semantics to achieve the vision "Lead the Web to its full potential". He described semantics as a common framework technology to enhance visibility of knowledge and enable automated processing for machines and humans alike. Semantic Web extends the description of contents and services over web in a machine process able and understandable format and let humans and machines to work in an integrated environment through semantic interoperability of the knowledge. At the bottom level, for sensor and sensor network applications, there are no ubiquitous standards. The backbone of the sensor service infrastructure and the API to sensors is provided by OGC standards as part of its Sensor Web Enablement (SWE) program viz SensorML and Observation & Measurement (O&M). While the OGC SWE standards provide description and access to data and metadata for sensors, they do not provide facilities for abstraction, categorization, and reasoning offered by semantic technologies. World Wide Web consortium (W3C) is another authority responsible for Semantic Web standards for sensor networks. To facilitate this process, linguistic techniques, such as extensible markup language (XML), resource description framework (RDF) and web ontology language (OWL) have been developed as standard formats for the sharing and integration of data and knowledge as explicit metadata and logical reasoning. The availability of tools and reasoning systems has contributed to the increasingly widespread use of semantics, and this technology is growing and started applying in various application domains as biology, medicine, geography, geology, agriculture and defense. Applications of semantics are particularly prevalent in the life sciences where it has been used by the developers of several large biomedical ontologies, including the SNOMED, GO and BioPAX ontologies, the Foundational Model of Anatomy (FMA) and the National Cancer Institute thesaurus. These ontologies are the result of collaborative efforts across different community commonly aimed at facilitating online knowledge sharing and exchange.

World Wide Web consortium initiated a dedicated Semantic Sensor Networks Incubator group (the SSN-XG), which ran from March 2009 to September 2010, worked on an OWL ontology to describe the capabilities and properties of sensors, the act of sensing and the resulting observations. The SSN ontology was developed by group consensus over a period of some eleven months. The SSN ontology, available at http://purl.oclc.org/NET/ssnx/ssn, describes sensors, the accuracy and capabilities of such sensors, observations and methods used for sensing.

Sensors are nowadays part of our everyday life. In the vision of smart city, SSN is visualized as the key solution for heterogeneous sensors which enables semantic sensor information annotation for real time systematic measurement and handling of environmental dynamics to achieve essential solutions or services. Semantic Sensor Network technologies provide a mechanism for better communication among these sensors. Advantages of SSN are as follows:

- Semantic sensor information annotation enables smart decision making with real time heterogeneous sensor measurements.
- SSN can be used as a common platform for knowledge sharing across the boundaries of proprieties data format provide a sound foundation for innovative solutions.
- SSN fill the gap between human process able and machine understandable information which develop a strong platform for human and machines to achieve better tomorrow for mankind.

In smart cities data being produced by sensors is enormous and there is a strong need to time these data streams and build applications and services to take smart decision by performing analysis of these data streams in real-time.

Reference : www.goo.gl/OzPlyW