International Journal on Advances in Engineering, Technology and Science

IJAETS, Volume: 1, Issue: 1, October 2015

Smart City: Concept and Challenges

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Abstract: Cities are engines of growth for the economy of every nation. Urban development is turning out to be progressively dependent on powerful utilization of intelligent services. To provide better administrations to all the citizens and enhancing the effectiveness of organization procedures, the idea of a smart city has been praised as a promising answer for the coming challenge of global urbanization. Development of smart city is a step in this direction.

Keywords: Smart City, Challenges, Global Urbanization, ICT, IoT

I. INTRODUCTION

Over half of the world's population is living in cities. The rapid growth of population creates extreme pressure to redesign existing cities and should plan new cities from the ground level to become green and efficient to improve the livelihood of city inhabitants [1].

There is no universally accepted definition of Smart City. The definition varies from city to city and country to country, depending upon the level of development, willingness to change and reform, resources and aspirations of the residents etc.

- "Cities that have deployed or are currently piloting the integration of information, communications and technology (ICT) solutions across three or more different functional areas of a city." Arrowsmith [1].
- "City that makes intelligent responses to different kinds of needs including daily livelihood, environmental protection, public safety, city services and industrial and commercial activities." Su et al [2].
- "City that monitors and integrates conditions of all its crucial infrastructures." Hall [3].
- "A city that connects the physical infrastructure, IT infrastructure, social infrastructure and business infrastructure to leverage the collective intelligence of the city." Hartley [4].
- "The application of complex information system to integrate the operation of urban infrastructure and services such as building, transportation, electrical and water distribution and public safety." Harrison and Donnelly [5].

The definitions share a common theme which combines information and communication technology (ICT) with interests in human and social capital and urban infrastructures and services to make sustainable growth in economics and create high caliber of life style for the residents.

A smart city can make smart reactions to various types of requirements including daily lifestyle, environment protection, public security and safety, basic services, industrial and business administrations. The goal of smart city effective and efficient utilization of resources and provide better services to its citizens. For older cities, it includes redesigning of infrastructures, utilities and services and including innovation based particularly keen framework based applications. Therefore a city may be considered smart when investments in human and social capital, infrastructures and services are incorporated with ICT services to drive inventive ways to deal with practical development towards sustainable economic growth.

II. SMART CITY FEATURES

The fundamental concept of smart city is seamless integration of physical infrastructure to digital infrastructure. A city with a ubiquitous overlay of ICT connected things, organizations and people. For example, having sensors in cars connected to traffic management system which analyze traffic flow data and provide drivers a better route to their destination. It may also provide safety instructions and send data to administrator for quicker response time in case of any incident.

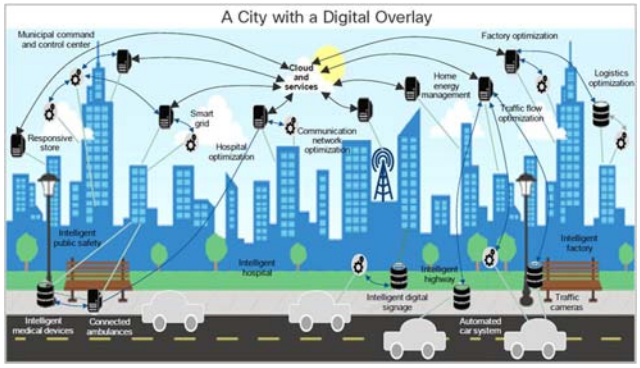

Figure 1: Smart City
Source: IDC Government Insights, 2013

Smart city represents innovation in city management, its services and infrastructures. ICT based solutions are the key element that makes a city smart. However, simply deploying expensive technology in a city is a complete misunderstanding this concept.

A smart city can be defined by six characteristics [6]: smart economy, smart people, smart governance, smart mobility, smart environment and smart living.

1. *Smart Economy*
   - Innovative spirit
   - Entrepreneurship
   - Economic image and trademarks
   - Productivity
   - Flexibility of labour market
   - International embeddedness
   - Ability to transform
2. *Smart People*
   - Level of qualification
   - Affinity to lifelong learning
   - Social and ethnic plurality
   - Flexibility
   - Creativity
   - Cosmopolitanism/Open mindedness
   - Participation in public life
3. *Smart Governance*
   - Participation in decision-making
   - Public and social services
   - Transparent governance
   - Political strategies and perspectives
4. *Smart Mobility*
   - Local accessibility
   - International accessibility
   - Availability of ICT infrastructure
   - Sustainable, innovative and safe transport system
5. *Smart Environment*
   - Attractivity of natural conditions
   - Pollution
   - Environmental protection
   - Sustainable resource management
6. *Smart Living*
   - Cultural facilities
   - Health conditions
   - Individual safety
   - Housing quality
   - Education facility
   - Touristic attractivity
   - Social cohesion

III. CHALLENGES

Any city is based on six core systems: economy, people, governance, transportation, environment and living. The working of city is determined by the effectiveness and efficiency of these systems. These systems are considered holistically as well as individually. The major challenges are described in five categories:

1. Privacy, security and trust
2. E-governance
3. Transportation system
4. Energy and environment
5. Health and living

Privacy, Security and Trust

Users implicitly expect systems to be secure and privacy-preserving. When personal data is collected by smart devices like phones, sensors, vehicles privacy is the main concern. The challenge is to separate users' real identity from the collected data. It requires advanced technologies like encryption, access control and intelligent data aggregation. User identity management and user preference consideration should also be integrated with the privacy preservation which is a big challenge. Data privacy and personal identity is not only a technical aspect but also concerning with legal and communication aspects [7].

E-Governance

The lack of horizontal and vertical integration across various e-government and urban initiatives and low level of interest shown by many national authorities limit the efforts for the systematic development and implementation of e-governance. Standardization and interoperability are key requirements for the adoption of technologies to provide better e-governance.

Transportation System

New technologies should be developed for reducing the mobility needs for people and goods. Vehicle manufacturing process should also be improved to increase the vehicles passenger and goods capacity. Availability of accurate location information is also a big challenge. Therefore hybrid satellite/positioning techniques need to be developed where signals are not available directly from GPS [8].

Distributed Urban Traffic Control Systems are capable of tracking cars location in real time. Technologies like setup fast lane for emergency services, dynamic carpool system [9], WiSafeCar [10] can be used to optimize the utilization of transport system.

Energy and Environment

Smart energy grids are the backbone of smart city. A successful combination of smart processes and smart technologies will enable energy efficiency and savings. The increasing energy demand in cities is a very big challenge in near future. New surveillance and control strategy should be developed for both buildings and energy networks for intelligent and adaptable management of the energy system. Sensor networks can also be used among consumer, producer and the grid in terms of reliability, real-time behavior and utilization. This can be used for power quality control, feedback and will increase the energy efficiency of the entire city.

Other challenges are: new technologies increase electromagnetic noise to environment, interference and network performance, addressing authentication, security, profiles and certification, new light sources (LED), intelligent street lighting system.

Health and Living

As the world's population is aging it is getting sicker at the same time. By 2050, half of the developed world become chronically ill [11]. Local hospitals and healthcare facilities were cited among the most important features [12], while ICT plays an important role in bringing unique responses to these needs. Current trends in personal healthcare system are enabled by the advances in ICT, biomedical engineering, healthcare technologies, micro and nano-technologies, contribute to the need for better healthcare solutions.

The big challenge is social communication, access to public and private services, policy and ethics, safety of people living independently, product distribution, product life cycle, early field trial, pricing strategy, geographical localization and positioning, interoperability and maintenance, configurable, adaptable, secure framework and decision support systems.

IV. CONCLUSION

The concept of smart city gained importance in the last years. Making ICT enabled services and applications available to the citizens, businesses and authorities makes the day to day life simple and smart. This requires an integrated version of a city and its infrastructures in its components. A smart city can be referred as six characteristics: smart economy, smart people, smart governance, smart mobility, smart environment and smart living.

This paper also identifies major challenges for developing smart city like privacy, security and trust, e-governance, transportation system, energy and environment and health and living. In order to achieve the goal of a smart city there is a need of increase efficiency and efficacy of government, developing environment friendly applications, increasing mobility, providing better health facility and good policy making.

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