IOT Services Impact as a Driving Force on Future Technologiesby Addressing Missing Dots.

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Abstract: Technology has totally changed the culture and working of people. With every passing day it is gaining popularity and becoming one of the most important gadgets of our lives. Researchers are enthusiastically pursuing areas of research which can contribute to Internet of Things (IoT). Now a day's sensing communication, control and actuation is becoming more refined and available everywhere, there is momentous overlap in these communities, still there are some missing gaps that need to be filled and addressed for better understanding of communication among these real life objects. To give an overview for Major IOT areas of Services and discuss the loopholes and missing gaps with research community by adding a critical review and feedback, the paper addresses missing Dots of IOT with its vital role for driving future technology.

*Keywords***:** IOT, Smart City, Smart Homes, Virtual Architecture, IOT Stack, Smart Devices, Sensors, Smart Vehicle.

1. INTRODUCTION

2. Current era of Information technology is introducing latest technology gadgets with every passing day IoT(internet of Things) is one of them. It is considered as the network of physical objects including electronic devices, vehicles, smart building, smart home appliances and many other real life objects which have been embedded with network connectivity, with the help of software and sensors to exchange or share data for some intelligent processing. It provides the opportunity to share data anywhere with anytime manner needs open, scalable, secure and standardized infrastructure which don't exit fully today. This is mainly focusing on Technology rather mainly focusing on other related areas[1].
3. We cant correlate ubiquitous computing, Internet Protocol, communication technology, embedded devices, its applications rather it's a bigger picture by enabling even social websites. Internet of people, internet of devices. Infect it provides a combined flavor of all these technologies. Some IoT projects are EPoSS which provides sustainable structure for smart system integration. BRIDGE project was developed for Radio Frequency Identification (RFID) and EPC global Network which identifies items via Electronic Product Code (EPC). Do-it-Yourself Smart Experience project (DiYSE) was intended to motivate common people to develop and install and manage applications to convert their normal living in smart environment. Further projects including Internet of things architecture (IoT-A) provide the opportunity for business-based internet of things, Experimental Living Labs for Internet of Things (ELLIOT) and Internet of things at work have started their work with the promise that they will further extend their work and will contribute to the research on IoT in Europe[3]..

Figure 1: IOT Building Blocks

Here are few guidelines which can be used as catalyst for successful contribution to internet of things sometimes we use to call them 4Es of IoT.

1) Envision: IoT should provide holistic scenarios focusing on private, business and social benefits.
2) Extend: It should leverage existing developments and technologies.
3) Enable: It should have ability to solve adaptation challenges like privacy, security and confidentiality, invent new mechanism for sharing cost and benefits.
4) Evaluate: Proper discussion should be done among stakeholders for New approaches to make them user centric.

4. IOT APPLICATION AND CHALLENGES:

If we compare applications with challenges with social needs and developments to enable major technologies including nano-electronics and cyber physical system to which face challenges from many different aspects.

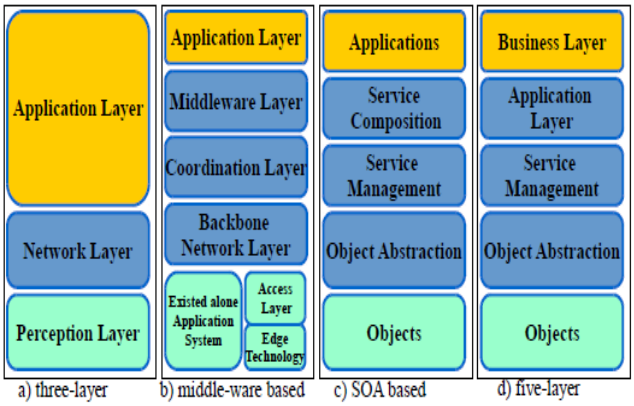

Figure 2: IOT Layered Architecture

In Smart Cities high qulity of life is available supported by some sustainable services including environment, mobility and economy. Although several challenges are there but still ITC Infrastructure is the backbone for the extensive development in these areas:

- People should be trained to use some cutting-edge technologies for smart and better services instead of relying on traditional procedures.
- Information gathered by sensors can be described by following schemes or by creating algorithms for exchange of information in a productive and useful manner among different City services for residents.
- To design a mechanism for cost effective deployment and Installations of such sensors.
- Ensuring reliable readings for huge amount of sensors used by different objects.
- Preference should be given to the algorithm and protocols which use less energy but also main focus should also be on a bigger picture for processing and analysis of data ffor the whole city. Which will ultimately be helpful for the large scale deployment of IOT and its integration.

5. SMART GRID AND SMART ENERGY:

With every passing day there is increase in urbanization which eventually increased demand for energy and there is more awareness about the supply, consumption and infrastructure. Energy resources will no longer be based upon fossils or nuclear resources. As a result, renewable energy and alternative sources of energy are gaining popularity which ultimately need a flexible and intelligent grid where power fluctuations can be controlled in the source and sinks by suitable reconfigurations. All such functions can be achieved by network intelligence devices such as devices, appliances, micro generation equipments, and grid infrastructure and consumer products. Future energy grids should have medium and small power plants and sources of energy can be combined virtually and incase of disaster in any particular area they can be made isolated from the grid system so as not to disturb the services in adjustment areas [16,17].

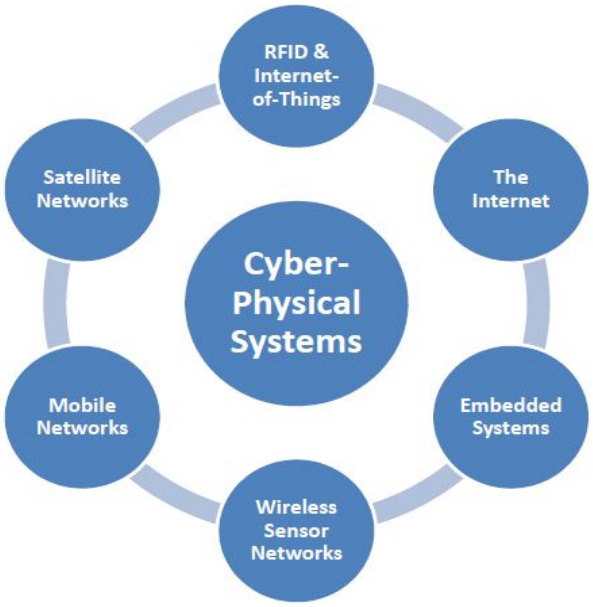

Figure 3: Large Scale Cyber-Physical Systems Components

If we consider the major challenges we can rank cyber-physical system's integration with existing grid system as a biggest challenge.

Through smart grid efficiently transmission of energy is possible by using smart transmission concept from distributed to concentrated power plants by considering standard security standards.

So the smart grid is like implementation of 'Internet' in which energy packets are treated just like a data packet. So concept internet of energy (IoE) is used. It provides power distribution, storage of energy and management of grid concept in an innovative way. It will provide the vast range of energy storage and monitoring from local devices to international level devices. Smart metering is one of the real life example for this kind of energy management which provide information for users and help them to better plan and manage their energy requirements as per their needs with much more efficiency to reduce the wastage level of energy for end users and to facilitate more consumers. In order to facilitate the communication between different vendor products protocol stack is needed. Depending upon connectivity Cloud based IoT concepts may be advantageous. Transfer of information and energy will be controlled and monitor by energy gateways. Here are some challenges to achieve smart energy grid:

- Communication among network elements should be in a very safe and secure environment by considering all the standard security measures.
- Interoperability and scalability should also be addressed.
- Efficient, reliable and robust smart sensors should be used for energy saving.

- Technologies for data obscurity with major concern on privacy of individual and public data should be ensured.
- Critical and delicate latencies should be dealt with professional honesty.
- System partitioning based upon local or cloud based information with intelligence.
- Proper use of filters and mining should be ensured while processing data in bulk quantity at large scale level.
- Reliable internetworking of heterogeneous systems should be doing by real-time design methods and models.
- Self healing and damage control system concept should be implemented and its factions should also be scalable.
- In case of fluctuation during the process of electric supply of energy from alternative energy sources (including wind forms and solar grid stations) power grids should respond accurately and in timely fashion.

6. SMART TRANSPORTATION & MOBILITY:

Transportation has been considered as backbone for life on earth since ages and its even true in our modern life of technology. The concept of internet of vehicles (IoV) connected with the concept of internet of energy (IoE)represents future trends for smart transportation and mobility applications. Representing human behavior in the design, development and operation of cyber physical system in autonomous vehicle is a challenge. It is difficult to account for the stochastic effects of the human driver in mixed traffic environment [18]. While talking about IoT in the context of automotive and telematics following application scenarios are considered :

- Standards must be defined regarding charging voltage of power electronics and recharging system must be controlled by system within the vehicle
- Components of bidirectional operation and flexible billing for electricity need to be developed.

IoT has already been used in vehicle control and management system. Certain technical functions of vehicles are monitored on the garage or the maintenance center. Data from sensors is collected by small on board unit and communicated to the service center via internet.vehicles organize themselves to avoid traffic jams and to optimize drive energy usage. Mutual interaction among vehicles and with the infrastructure provides safety while reduces number of accidents [19].
IoT provides multi-modal transport Based on momentary traffic situation an individual solution will be mix of individual vehicles, vehicle sharing, railway and computer system. IoT provides interaction between the vehicle and the environment i.e. sensors, actuators. The concept of internet of vehicles (IoV) is the next step for future smart transportation and mobility applications and requires creation of new mobile ecosystem based on trust, security and convenience to mobile services.

Figure 4: Basic Building Blocks for IOT[5]

Smart sensors in the road and traffic control infrastructure need to collect information about the road, traffic status and weather conditions. This requires robust sensors and actuators. This reliable communication needs to be based upon M2M communication protocols which consider timing, safety and security constraints[5]. Expected high amount of data will need sophisticated data mining techniques. However there are some research challenges:

- Safe and secure communication with elements at the network edge, inter vehicle communication, and vehicle to infrastructure communication
- Energy saving robust and reliable smart sensors/actuators in vehicle and infrastructure
- Technologies for data anonymity addressing privacy concerns
- System partitioning (local/cloud based intelligence
- Identifying and monitoring critical system elements detecting critical overall systems in due time
- Technologies supporting self-organization and dynamic formation of structures and restructuring
- Ensure trust and secure exchange of data among different ICT infrastructure

1) SMART HOMES, BUILDINGS AND INFRASTRUCTURE:

Severalorganizations are working to equip homes with technology that enables the occupants to use a single device to control all electronic devices and equipments. It focuses on environmental monitoring, energy management, assisted living, comfort and convenience. It includes platforms that use sensors. These sensors monitor systems like energy generation and metering, heating, ventilation and air conditioning (HVAC), lighting and security key performance indicator. The information is processed and made available through mobile phones, touch

screens and 3-D browsers. Sensor based data is processed by cloud hosted software. Smart building concept can be divided into three layers (1) Envelope: It deals with building structure including Green materials, design and thermal structure. (2) Connectivity: it deals with building operation controls through sensors, actuators and telecom infrastructure. (3) Software: it involves building operations optimization. Its main components are visualization, analytics and data storage. There are different integrated services that are provided by these layers subsystems like lightening, power and electricity, HVAC, security, water and waste management. Integration of cyber physical system with both buildings and outer entity like electrical grid requires stakeholders' cooperation to achieve interoperability. Architecture of building automation system is divided into three levels

i. Field Level: Devices access and data distribution.
ii. Automation Level: Rules Distribution and Rules Engine
iii. Management Level: Algorithm distribution and composition.

In the context of Future IoT intelligent Building Management System can be considered part of much larger information system [15].

2) SMART FACTORY AND MANUFACTURING:

IoT allows access to devices and machines in the manufacturing system. It has digitized the manufacturing system. It allows factory to its running applications around like connecting it with smart grid, sharing the production facility as a service. Smart factory can access external stakeholders like suppliers of production, logistics, maintenance and retooling actors. Enterprisesare making huge use of available data**,** business analytics, cloud services, embedded technology, sensor technology, RFID, GPS, M2M, mobility, security, ID detection technology, wireless network and standardization. Some of the main challenges associated are affordability, network integration and interoperability of engineering systems[7].

3) SMART HEALTH:

Health monitoring devices are application specific, non-interoperable and diverse in architecture. The IoT can be used in clinics to monitor the critical patients. Sensors will collect the comprehensive physiological information, use clouds and gateways to analyze data and send the data wirelessly to the caregivers. IoT plays a vital role in healthcare applications from managing chronic diseases to preventing them. There are many challenges in cyber-physical network like hardware, connectivity, software development and communication. New and innovative technologies are needed to cope with trends on wired, wireless, high speed interfaces, miniaturization and modular design for products having multiple devices integrated[10].

Required Progress of IoT applications can be summarized as

- There must be standardization of sensors and MEME interface for an open platform to create broad and open market for bio-medical innovators
- Providing high degree of automation in information gathering and processing
- Availability of real-time data to caregivers anywhere with appropriate software and privileges
- Devices can be re-used for data travelling over trusted web
- Data should be interchangeable within clinical pathways, home, ambulance, clinic, GP and hospital without manual transfer of data.

4) SMART LOGISTICS AND RETAIL:

IoT provides efficient solutions in retail sector by addressing the right person, right content at right time at right place. Adapting to the tastes and priorities of changing population will be critical task for retailers worldwide. To keep up with all changes retailers must use smart connected devices. They are also using sensors, beacons, scanning devices and other IoT technologies to optimize operations. The generated data allows them to understand how their products, customers, affiliates, employees and external factors come together[11].

5) FOOD, WATER TRACKING AND SECURITY:

Food and water are most important resources of the world. Organic foods production without addition of certain chemical substances will be valued. Similarly fresh water is also important for daily life. IoT can be used for the tracking of food or water from production place to consumer [14]. IoT applications need developmental framework that will assure the following

- The things connected to IoT should provide valued services to the larger system
- System should provide APIs that that allow users take advantage of system suitable to their needs and developers to innovate something new from provided data and services
- Security should be maintained to prevent system from attacks

There are also some challenges to achieve smart goals like

- Design of secure, tamper-proof and cost-effective mechanism for tracking food and water from production to consumer
- Secure way of monitoring production process providing sufficient information and confidence to consumers and providing details of production process
- Ensuring trust and secure exchange of data among applications and infrastructure to prevent false information which will affect health of consumers and create economic damage to stakeholders.

6) PARTICIPATORY SENSING:

People living in a communityupon each other in different activities like good restaurant hunt, car mechanic, movie, phone plan etc.

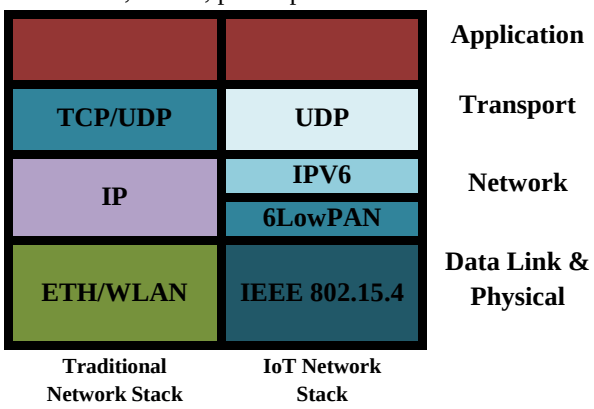

Figure 5: IOT VS Traditional Network Stack

The development in IoT has made it easier to facilitate people lives. Smart phones are made up of lots of sensors, actuators like camera, microphone, speakers, temperature gauge and displays. Participatory sensing application utilizes each person's mobile phone and car with automatic sensory stations that take multiple snapshots of the immediate environment [15]. However there are many challenges

- Design of the algorithm with given same observations at different conditions
- Design a robust mechanism for analysis and processing of observations in real time
- Reliability and trustworthiness of observed data by proper identification and authentication of data sources
- Ensuring privacy of individuals while providing observations
- Addressing scalability and large scale deployments.

7) MISSING DOTS:

Social, economic and technical implications have to be in place in order to have full deployment of IoT. Atzori came up with comprehensive IoT paradigm that classified the concept of technologies and standards through the convergence of Internet, Things and Semantic visions (Figure 6) [1]. Later, Tereffy et al. proposed to modify Atzori to serve human-centered prospective of IoT [2]. Figure 7 illustratesTereffy's framework that serves as a design tool for HCI audience with the following findings:

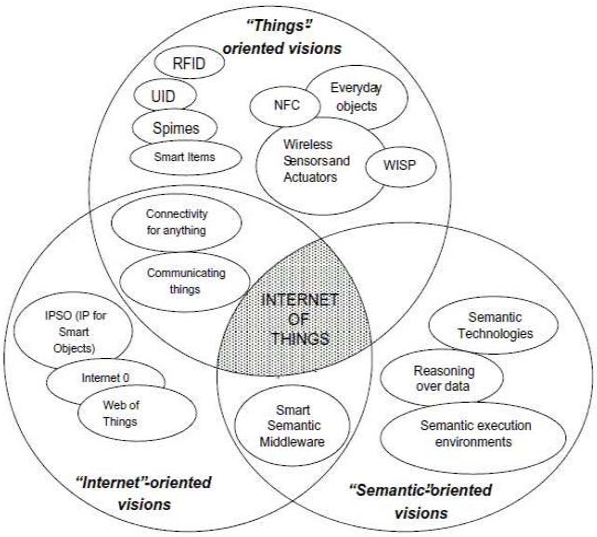

Figure 6: Connecting Dots [1]

i. HCI hasn't covered well in Things / Semantic category in Atzori paradigm

ii. Paper identified the Internet category as out of scope of HCI. This can be investigated further or studied it in the "Internet" point of view

iii. The only design approach can be used with HCI is the Participatory design. Building a design using this HCI concept can be a great opportunity for future research work.

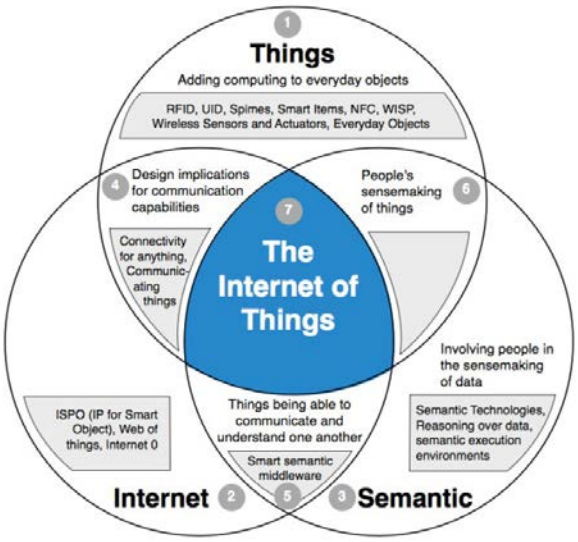

Figure 7: Dot Connection Point [2]

Following Table (Table 1) shows the comparsionAtzori paradigm and Tereffy's framework and illustrate the transformation.

Category	Atzori's framework	Modified framework (Tereffy's framework)
Things	Physical components (RFID, NFC,etc)	Adding computing to everyday objects
Internet	Protocols and language to communicate between objects	Outside the scope of HCI
Semantic	Technologies: store, process and use data generated by IoT	Involve people in the sense making of data
Things / Internet	Connectivity and communicating	Design implication for communication capability
Semantic /Internet	Designed software that allow communication between things by translating data to different format (Middleware)	Things being able to communicate and understand each other
Things / Semantic	Scalable infrastructure to semantically process vast amount of IoTdata (Atzori didn't cover this area well)	How data can affect people's sense making of things
IoT	Combination of technologies that make up IoT	Considerations that need to be taken when designing IoT

Table 1: IOT Framework Comparison

The Things oriented vision includes technical and physical components. In this vision, Varity of everyday objects are introduced, added or upgraded. On the other hand, the Semantic vision addresses the representation, storing, processing, exchange and sharingdata that will involve people in sense making of this data, where semantics is more challenging as a concept and difficult to design. Chetty et al. introduced Home Watch tool to manage home bandwidth. This tool mainly focuses on meeting functional requirements, but lacks the human centered aspects such as managing access to maintain individual privacy and sharing social relations[?].Recent studies and research focus on design HCI some on virtual possessions. The used design may lead to negative outcomes due to the design limitation to handle the variety and massive metadata. The challenge resides in building scalable infrastructure to store vast growing data that can affect '*people sensemaking of things'*. So, the Things/Semantic area still immature yet and required more investigation and further research work.

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