ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 10, October 2015

Shrewd Cities with Internet of Things

Prof. Mayur Raut[1], Mr. Shashank Singh[2]

Asst. Professor, Dept of Electronics and Telecommunication Engineering, SIT, Lonavala, Pune, Maharashtra, India[1]

BE Student, Dept of Electronics and Telecommunication Engineering, SIT, Lonavala, Pune, Maharashtra, India[2]

Abstract: The Internet of Things shall be able to incorporate transparently and seamlessly a large number of different and heterogeneous systems by giving open access to appropriate subsets of data for the development of a plethora of digital services. To build common architecture which is general for IoT is hence a very complex task, mainly because of the extremely large variety of devices and services that may be involved in such a system. In this paper, we focus specifically on urban IoT system which is being a broad category, are characterized by their specific application domain. Urban IoTs are designed for supporting the Smart City vision, which aims at exploiting the most advanced communication technologies to support value-added services for the administrative of the city and for the citizens. Furthermore, the paper is going to discuss and present the technical solutions and best-practice guidelines adopted in the Padova Smart City project, a proof-of-concept of deployment of an IoT island in the city of Padova, Italy, performed in collaboration with the city municipality.

Keywords: Automation, Smart Cities, Urban IOT Architecture.

I. INTRODUCTION

Electronic devices are the first everyday devices to be connected to the Internet, so that they can use Internet content. Games and televisions consoles now come standard with networking capability, and the devices, along with traditional networked devices like computers, are driving much of the increase in making use of energy. These devices do not have a built-in capability to measure and report their energy use. As a result, they cannot participate in systems to improve whole use of building energy or integrate with renewable energy sources or electricity grid. Electricity metering is important for understanding energy efficiency trade-offs and advanced methods of grid and renewable energy integration.

In this complex scenario, the application of the IoT paradigm to an urban context is at a particular interest. As it is responding to the strong push of many national governments to adopt solutions of ICT in the management of public affairs and thus realizing Smart City concept. Although there is no formal and widely accepted definition of “Smart City,” the final aim is to make better use of the public resources and increasing the level of the offered services to the citizens, by reducing the operational costs from the public sources. This objective can be pursued by the deployment of an urban IoT which includes communication, underlying framework that provides simple, economical, and unified access to a plethora of public services and increasing transparency to the citizens. An urban IoT can bring a number of benefits in the management and optimization of traditional public services like transport and parking, lighting, maintenance of public areas and garbage collection, salubrity of hospitals and schools.

The objective of this paper is to describe the specific characteristics of an urban IoT and the services which can be responsible for the adoption of urban IoT by local governments. Finally, we support this concept and discussion by reportage of our experience in the “Smart City” project, which is a proof of concept of development of an IoT island in the city of Padova (Italy). More in detail, this section describes the web service to get near and for becoming completely cognisant of IoT services, with the related data formats and communication protocols, and the link layer technologies [1].

II. RELATED WORK

Fig. 1 shows the conceptual representation of an urban IoT which undercover following points:-

A. Services and Smart city concept:

According to Pike Research on Smart Cities, the Smart City market is estimated at hundreds of one thousand million dollars by 2020, with a one year disbursal spending reaching nearly 16 billion. This market springs from the synergic linking of main industry and service sectors, such as, Smart Mobility, Smart Buildings Smart Utilities, Smart Governance and Smart Environment. These sectors have also been considered in the European Smart Cities project to delineate ranking criteria that can be brought in use to assess the level of “smartness” of European cities. Nevertheless, the Smart City mart has not really taken off yet, for a number of political, technical, and financial barriers [2]. Under the political dimension, the primary obstacle is the attribution of decision-making power to the different wager holders. A feasible way to remove this roadblock is to institutionalize the entire decision and completion process, focusing the crucial planning and management of the smart city aspects into a single, dedicated department in the city. On the technical side, the most relevant issue consists in the no interoperability of the diversified technologies presently used in city and urban developments. In this respect, the IoT vision can become the edifice block to accomplish, a united citified scale ICT platform, thus unleashing the potential of the Smart City vision.

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 10, October 2015

B. Buildings health structure:
Proper maintenance of the historical buildings of a city requires the continuous surveillance of the actual conditions of each building and identification of the areas that are most subject to the pursuance of outer agents. The citified IoT can provide a distributed database of building structural integrity computations, gathered by sensible sensors located in the buildings, such as vibration and deformation sensors to supervise the building stress, aerial agent sensors in the surrounding areas to monitor pollution levels, and temperature and moisture sensors to have a full depiction of the environmental conditions [3]. This database should reduce the requirement for costly periodic morphological testing by human operators and will allow targeted and proactive maintenance and reclamation actions. Hence it will be possible to combine vibration and seismic readings in order to better examine and understand the impression of light earthquakes on city buildings. This database can be made publicly accessible in order to make the civilians alert of the care taken in conserving the city historical heritage.

C. Waste Management and Regulation:
Waste regulation is a common problem in most of the current cities, due to both the cost of the service and the problem of the depot of waste in landfills. A deeper discernment of ICT solutions in this domain, however, may result in significant assets, frugal and ecological advantages. For time being, the use of intelligent waste containers, which detect the level of load and permit for an optimisation of the trucks route, can reduce the cost of waste collection and make better the feature of material recovery[4]. To understand such a smart waste management service, the IoT shall connect the end devices which include intelligent waste boxes, to a control centre where optimization software processes the data and assesses the optimal control of the collector truck fleet.

D. Management of Air Quality by 2020:

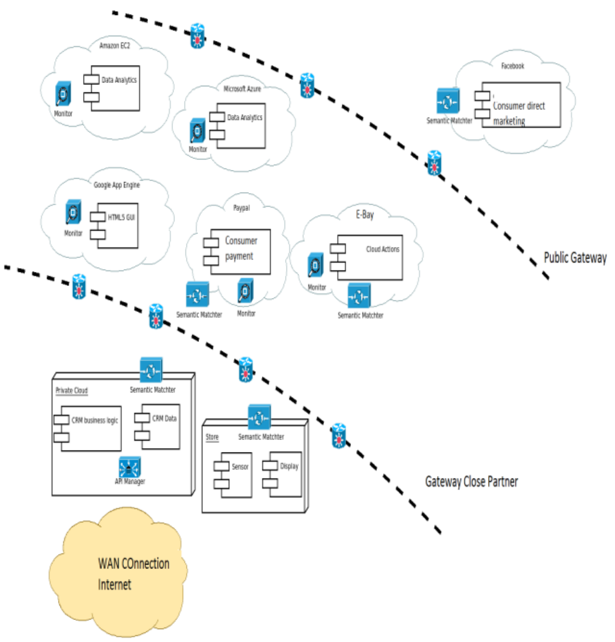

Fig. 1 Conceptual representation of Urban IoT

The European Union officially espoused a 20-20-20 Renewable Energy Directive setting climate change reducing aims for the next ten years. The targets call for a 20% reduction in greenhouse gas emissions by 2020 compared with 1990 levels, 20% reduction in use of energy through better energy efficiency by 2020, and a 20% increase in the use of renewable energy by 2020. A metropolitan IoT can provide means to monitor the quality of the air in crowded areas, parks, or aptness trails [5].

Also would like to add that linking facilities can be provided to let health applications running on joggers' contraptions be availed to the infrastructure. In such a way, people can always find the healthiest path for outdoor activities and can be regularly getting linked to their favoured personal training application. The realization of such a service needs that quality of air and pollution sensors be dispensed across the city and the sensor data be made publicly available to civilians.

E. Monitoring of Noise:
We can see noise as a form of acoustic pollution as much as carbon oxide is for air. In such case, the city authorizations have already issued specific laws to reduce the amount of noise in the city centre at particular period of time. Metropolitan IoT can offer a noise monitoring service to measure the amount of noise generated at any given period in those places that need the service [6]. Besides building a space-time map of the areas where there is noise pollution, such a service can also be used to enforce public security, by means of sound detection algorithms that can identify the noise of crashes of glass or brawls.

F. Traffic Congestion and Monitoring:
On the same line of air quality and monitoring noise, a feasible Smart City service that can be enabled by urban IoT comprises in watching the traffic bottleneck in the city. Even after camera-aimed traffic monitoring systems are already available and deployed in most of the cities; low-power general connection can provide a denser source of information. Traffic monitoring may be accomplished by using the perceiving capabilities and GPS installed on modern vehicles [7], and also espousing a mixture of air quality and acoustical sensors along with a given road.

This instruction is very important for the city authorities and citizens; for them who are erstwhile to control traffic and to send officers where needed and for the later to design in advance the way to attain their wished destinations.

G. Automation and Salubrity of Public Buildings:
We can also say it as the most important other application of IoT technologies. It is the monitoring of the consumption of energy and the purity of the environment in public buildings by means of different types of sensors and actuators that control lights, humidity and temperature. By commanding these parametric, indeed, it is possible to increase the level of easiness of the persons who stay in this environment which can also have a good return in names of productivity, while to minimize the costs for heating or cooling [8].

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 10, October 2015

III.ARCHITECTURE OF URBAN IOT

From the analysis of the services described in Section II, it clearly emerges that most Smart City benefits are dependent on a main architecture, where a dense and heterogeneous set of peripheral devices deployed over the metropolitan area create various types of data that are then delivered through suitable communication technologies to a control centre, where the storing of the data and its processing is performed. A primary characteristic of an urban IoT infrastructure, hence, is its ability of unifying different technologies with the existing communication infrastructures in order to promote a progressive expansion of the IoT, with the interconnection of other devices and the realization of original functionalities and services. Other basic aspect is the necessity to make the data collected by the metropolitan IoT easily available to the civilians and authorities. It increases the responsiveness of authorities to city problems and put forward the consciousness of the involvement of citizens in public matters [9].

In the protocol architecture we can discern three distinct functional layers, namely (i) Data (ii) Application/Transport (iii) Network that may demand devoted entities to make work the transcoding between constrained and unconstrained formats and protocols. In the remaining section, we specify in more detail the requirements at each of the three functional layers in order to guarantee interaction among the different parts of the system.

1) Data Format: As mentioned, the urban IoT pattern sets in architectures based on web services, data trade is typically attended by a explanation of the transported content by means of semantic representation languages, in which the extensile Mark-up Language (XML) is probably the most common. The size of XML messages is often very large for the limited capacity of typical devices for the IoT. For these reasons, the group which is working for the World Wide Web Consortium has proposed the EXI format [10], which makes it possible even for very restrained devices to inherently promote and generate messages by making use of open data format which is compatible with XML. As in the right hand side Fig.2 it shows the unconstrained IoTs which includes HTML/XML (data), TCP (transport layer), IP (network) and similarly on the right hand side the other Fig. 3 in tabular representation shows the Constrained IoT nodes which includes of EXI (Data), Messages (transport), UDP (Network).These both nodes are capable of interfacing with each other and each layer is able to link with each other of the protocol architecture.

HTML/XML [Data]
TCP [Application/Transport]
IP [Network]

Fig.2.Unconstrained IoT nodes

2) Transport Layers and Application: Many of the transportation that counters the Internet presently is conveyed at the application layer by HTTP over TCP. The prolixity and difficulty of aboriginal HTTP make it unfit for deployment on inhibited IoT devices. The human-readable format of HTTP, which has been the reasons for its achievement in conventional networks, turns out to be a limiting factor due to the large amount of heavily correlated data.

3) Network Layer:
IPv4 is the leading addressing technology organization that assigns IP addresses at a universal level, has recently announced the exhaustion of IPv4 address blocks. IoT networks are anticipated for inclusion of billions of nodes, each of which shall be uniquely addressable. A solution to this problem is offered by the IPv6 standard [11], which provides a 128-bit address field, thus making it possible to assign a unique solution.

EXI [Data]
Messages[Application/Transport]
UDP[Network]

Fig3.Constrained IoT nodes.

IV.DEVICES

We finally describe the devices that are essential to realize an urban IoT, classified based on the position they engage in the communication flow.

1) Servers at the backend: At the root of the system, we find the backend servers, situated in the control center, where information are gathered, stored, and processed to produce added-value services. In precept, backend servers are not compulsory for an IoT system to properly operate, though they become a fundamental element of a metropolitan IoT, where they can support the entry to the smart city services and open data through the legacy network infrastructure.

2) Gateways: Moving toward the "edge" of the IoT, we find the gateways, whose role is to interlink the end devices to the main linking infrastructure of the system. Gateway devices shall also provide the linking between unrestrained link layer technologies, mainly used in the core of the IoT network, and restrained technologies that provide connection among the IoT outlying nodes.

3) IoT Peripheral Nodes: Finally, at the edge of the IoT system, we discover the contrivances in charge of producing the data to be delivered to the main center, which are mostly called IoT outlying nodes or IoT nodes. Generally speaking, the price of these devices is very low, starting from 10 USD or less, confiding on the kind and number of sensors/actuators mounted on the board. Mobile devices, such as smart mobile phones, PCs, or laptops, may also be an important part of a metropolitan IoT,

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 10, October 2015

providing different ways to collaborate with it. The NFC transceiver incorporated in last-generation mobile phones may be used to recognize labeled objects, while the service granted by most common operating systems for mobile devices can improve the data linked to that object.

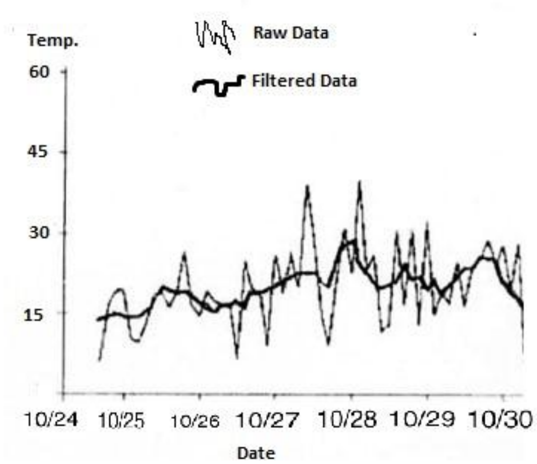

Fig. 4 Data collected Temperature

The Fig. 4 shows the analytical data collected in the following mentioned dates. The Y- axis shows the temperature and the X axis shows the Date on which the data is collected.

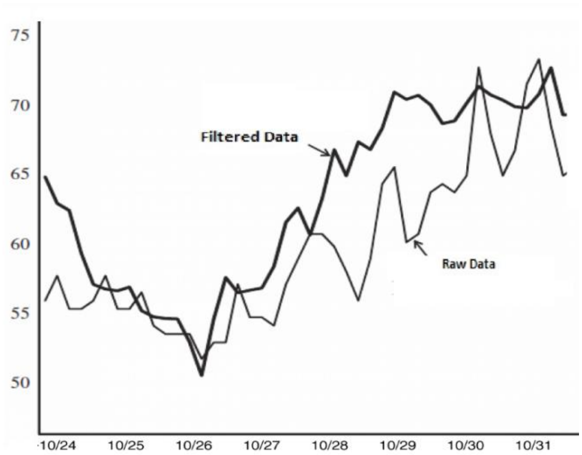

Fig. 5 Data Collected Humidity

The Fig. 5 shows the analytical data collected in the following mentioned dates. The Y-axis shows the Percentage of humidity and the X axis shows the Date on which the data is collected.

V. EXPERIMENTAL RESULTS

The context discussed in this paper has been employed successfully to a number of different use cases in the data of IoT systems. For specimen, the empirical wireless sensor web testbed, with more than 300 nodes, deployed at the University of Padova [12] [13].

- Street light: Each road light is completely localized on the city map and peculiarly connected to the IoT node attached to it, so that IoT data can be enhanced with data information.

The surveillance of the correct operation of the bulbs is executed through photometer sensors that directly scale the intensity of the light emitted by the lamps at regular time intervals or upon request.

- WSN gateway: The gateway has the function of contacting the constrained link layer technicality used in the sensors cloud with traditional WAN technologies used to furnish connectedness to the central backend servers. This portal hence plays the role of 6LoWPAN border router and RPL root node.

The Fig. 6 shows system architecture of the smart city which comprises of various modules like Ethernet, internet, planning etc. It shows how the small and large electronic components and the appliances are remotely controlled and operated.

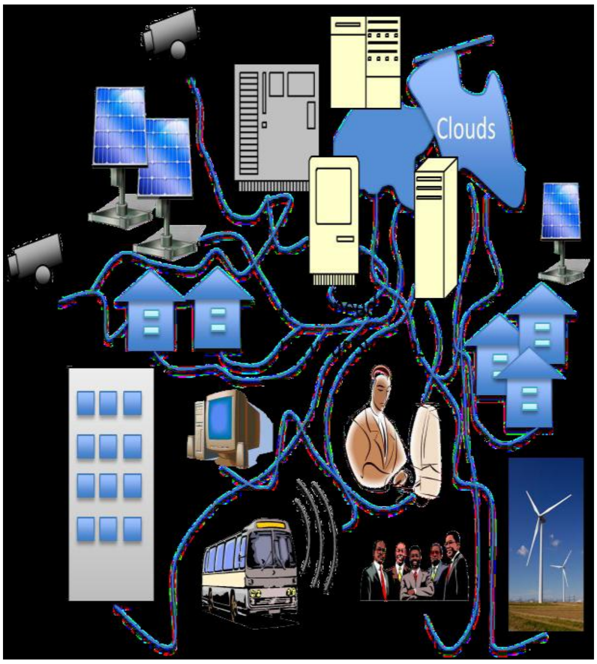

Fig. 6 System Architecture of Smart City

VI. CONCLUSION

In this paper, we examined the explanations currently available for the accomplishment of urban IoTs. The conferred technologies are close to being standardized, and industry players are already agile in the manufacturing of devices that take benefit of these technologies to enable the applications of interest. In fact while the range of scheme options for IoT systems is broad, the set of regulated protocols is considerably smaller. The permitting technologies have reached a level of fruition that permits for the pragmatic attainment of IoT solutions and services, starting from field trials which will optimistically help to plain the suspicion that still prevents a massive adoption of the IoT paradigm.

REFERENCES

[1] A Laya, V. I. Bratu, and J. Markendahl, “Who is investing in Machine-to machine communications?” in Proc. 24th Eur. Reg. ITS Conf., Florence,Italy, Oct. 2013, pp. 20–23.

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 10, October 2015

[2] M. Dohler, I. Vilajosana, X. Vilajosana, and J. Llosa, "Smart Cities: Anaction plan," in Proc. Barcelona Smart Cities Congress, Barcelona, Spain,Dec. 2011, pp. 1–6.
[3] T. Nuortio, J. Kytöjoki, H. Niska, and O. Bräysy, "Improved route Planning and scheduling of waste collection and transport," Expert Syst. Appl.,vol. 30, no. 2, pp. 223–232, Feb. 2006.
[4] T. Nuortio, J. Kytöjoki, H. Niska, and O. Bräysy, "Improved route Planning and scheduling of waste collection and transport," Expert Syst. Appl.,vol. 30, no. 2, pp. 223–232, Feb. 2006.
[5] R. Al-Ali, I. Zualkernan, and F. Aloul, "Amobile GPRS-sensors array forair pollution monitoring," IEEE Sensors J., vol. 10, no.10, pp. 1666–1671,Oct. 2010.
[6] N. Maisonneuve, M. Stevens, M. E. Niessen, P. Hanappe, and L. Steels,"Citizen noise pollution monitoring," in Proc. 10th Annu. Int. Conf. DigitalGov. Res.: Soc. Netw.: Making Connec. Between Citizens, Data Gov., 2009,pp. 96–103.
[7] X. Li, W. Shu, M. Li, H.-Y. Huang, P.-E. Luo, and M.-Y. Wu, "Performance evaluation of vehicle-based mobile sensor networks for traffic monitoring," IEEE Trans. Veh. Technol., vol. 58, no. 4, pp. 1647–1653, May 2009.
[8] W. Kastner, G. Neugschwandtner, S. Soucek, and H. M. Newmann, "Communication systems for building automation and control," in Proc.IEEE, Jun. 2005, vol. 93, no. 6, pp. 1178–1203.
[9] C. E. A. Mulligan and M. Olsson, "Architectural implications of smart city business models: An evolutionary perspective," IEEE Commun. Mag.,vol. 51, no. 6, pp. 80–85, Jun. 2013
[10] "Efficient XML Interchange (EXI) Format 1.0," J. Schneider, T. Kamiya,D. Peintner, and R. Kyusakov, Eds., 2nd ed. World Wide Web Consortium,Feb. 11, 2014.
[11] S. Deering and R. Hinden, Internet Protocol, Version 6 (IPv6) Specification, RFC2460, s.l.: IETF Dec. 1998. [Online]. Available: https://www.ietf.Org /rfc/rfc2460.txt.
[12] P. Castellani, M. Gheda, N. Bui, M. Rossi, and M. Zorzi, "Web Services for the Internet of Things through CoAP and EXI," in Proc. IEEE Int. Conf. Commun. (ICC 2001), Kyoto, Japan, 2011.
[13] P. Casariet al., "The Wireless Sensor networks for city- Wide Ambient Intelligence (WISE-WAI) project," MDPI J. Sensors, vol. 9, no. 6, pp. 4056–4082,Jun. 2009. [Online]. Available: http://www.mdpi.com/1424-8220/9/6/4056.