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Internet Of Things In Smart Cities

Anila AnilPrasad
Department of Computer Science
University of Mumbai
Mumbai, India

Dr. Harshali Patil
Associate Professor
MET Institute of Computer Science
Mumbai, India

Harsh Kumar Gupta
Department of Computer Science
University of Mumbai
Mumbai, India

Dr. Jyotshna Dongardive
Assoicate Professor
Department of Computer Science
University of Mumbai
Mumbai, India

Abstract-
The Internet of Things is a new communication paradigm that predicts a near future in which everyday objects will be fittedwith microcontrollers, transmitters for protocol stacks, and thecorrectdigital communications that allow them to communicatewith each other and with users, becoming an essential component of the Internet.The concept of the Internet of Things aims to make the Internet more widespread and immersive.Furthermore, by enabling simple access to and interaction with a wide range of devices such as home appliances, surveillance cameras, tracking sensors, displays, vehicles, and so on, the Internet of Things will encourage the development of a number of applications that use thepotentially enormous amount and variety of data collected by such objects to provide new services to organizations, citizens, and government departments.

Keywords— Smart Web Services, Internet Technology, and Communication.

I. Introduction

Due to the strong push from many national governments to adopt(Information and Communications Technologies)ICT solutions in the management of public affairs and understand the so-called Smart City concept, the application of the Internet of Things to urban context is of particular interest in this scenario. Although there isn't a formal, widely accepted definition of a "smart city," the ultimate goal is to make the most of the use of public resources while reducing operational costs for public administrations and raising the quality of the services provided to citizens. This goal can be achieved by implementing an urban Internet of Things, or a communication infrastructure that offers easy, unified, and affordable access to a wide range of public services, bringing out and increasing transparency for the people. An urban Internet of Things could offer a number of advantages for managing and improving traditional public services like transportation and lighting, parking surveillance and servicing, cultural heritage preservation, hospitals, garbage collection, and education. The availability of multiple kinds of information gathered by an extensive urban Internet of Things may also be used to improve transparency and encourage actions toward citizens, raise people's awareness of the state of their city, encourage participation of citizens in the management of public administration, and encourage the development of new services based on those offered by the internet of things. Cities and regions are drawn to the application of the Internet of Things to the Smart City and become early adopters of such technologies, acting as engines for the adoption of the Internet of Things on a larger scale.

Smart city Concept and Services:

A smart city employs a framework of information and communication technologies to create, deploy, and promote development practices to address urban challenges and build a technologically enabled and sustainable infrastructure. “Improving the quality of life for people living in cities all over the world”, sensors installed in buildings, such as vibration and deformation sensors to monitor building stress, atmospheric agent sensors in surrounding areas to monitor pollution levels, temperature, and humidity. Smart cities include city services with connected capabilities that residents interact with on a daily basis. Enhanced connectivity through effective M2M(machine to machine) device management promises to transform every aspect of city life, whether it is public safety building automation, traffic control, or waste management. Progressive cities are adopting this technology because it has the potential to improve quality of life, streamline municipal communications, and lower long term costs. People everywhere are excited about the chance to invest in modern technology. Other cities are looking to Bristol, UK as a leader in innovation because of their investment in an Internet of Things ecosystem.

By 2020, the market for "smart cities" is predicted to be worth hundreds of millions of dollars with spending of close to 16 billion. This industry is the result of synergistic connections between important industry and service sectors such as Smart Utilities, Smart Governance, and Smart Environment, Smart Buildings, and Mobility.In order to establish a ranking that can be used to evaluate the level of "smartness" of European cities, these sectors have also been taken into account by the European Smart Cities project. However, the Smart City market has not taken off, for a number of technical, political and financial barriers. Last but not least, although a business model is still lacking, recent efforts have been made to close this gap. The problem is made worse by the negative global economic environment, which has figured out the overall loss of investments on public utilities. The circumstance avoids the potentially enormous Smart City market from materializing. The first step in resolving the situation is to create those services that combine very clear social utility with smart parking and other investments with a high return. Consequently, smart buildings will serve as catalysts for the additional value-added services.

Table 1: Services Specification for the Padova Smart City Project

	Service	Network type(s)	Traffic rate	Tolerable delay	Energy source
1	Structural health	802.15.4; Wifi and Ethernet	1 pkt every 10 min per device	30 min for data; 10s For alarms	Mostly battery powered
2	Waste management	WiFi; 3G and 4G	1 pkt every hour per device	30 min for data	Battery powered or enery harvesters
3	Air quality monitoring	802.15.4; Bluetooth And WiFi	1 pkt every 30 min per device	5 min for data	Photovoltaic panels for each device
4	Smart parking	802.15.4 and Ethernet	On demand	1 min	Energy harvesters
5	Smart lighting	802.15.4; Wifi and Ethernet	On demand	1 min	Mains powered

1.Structural Health of Buildings: Internet of Things can be used to remotely monitor the building. The most recent technique used throughout the world, particularly in buildings exposed to harsh environments, is structural health monitoring using Internet of thinking. Sensors are used to gather information from the structure, which allows us to spot damage and recommend solutions. Monitoring the actual conditions of each building and identifying the areas most vulnerable to the effects of outside forces are necessary for the proper maintenance of a city's historical buildings. The Internet of Things might offer a distributed database of structural integrity measurements for buildings, collected by sensors to have a full characterization of the environmental condition.

2.Waste Management: Waste management is a problem in many cities today because of the expense of the service and the issue of garbage storage in landfills. ICT solutions' increased adoption in the domain could save money and promote environmental and economic benefits. For the purpose of using clever waste containers that can determine the load and permit route optimization for collector trucks, the cost of waste collection can be decreased, and the level of recycling.

3.Air Quality: The targets call for a 20% decrease in greenhouse gas emissions from 1990 levels by 2020, as well as a 20% decrease in energy consumption and an increase in energy efficiency. Urban IoT can offer ways to monitor the air quality in crowded places, parks, or exercise trails. The infrastructure can be connected to health applications running on joggers' devices thanks to improved communication facilities.

4.Smart Parking: Road sensors and intelligent displays that show drivers the best parking spots in the city are the foundation of smart parking. There are numerous advantages to using the service, including reduced CO emissions from vehicles, less traffic congestion, and contented residents. Because there are so many European businesses offering products on the market for this application, the smart parking service can be directly integrated into the urban IoT infrastructure. It is possible to implement an electronic verification system of parking permits in spaces designated for residents by using shortrange communication technologies like Near

Field Communication (NFC) or Radio Frequency Identifiers (RFID).

5.Smart Lighting: This service, in particular, can adjust the street lamp intensity depending on the time of day, the weather, and the people are present. In order to function, this service, Street lights must be integrated into the Smart City infrastructure. It's possible to take advantage of the increased number of WiFi hotspots that are connected connection to people.

II. URBAN IOT ARCHITECTURE

The analysis of the services in Section II makes it clear that the majority of Smart City services are based on a centralized architecture, in which a diverse array of devices dispersed throughout the urban area produce various types of data that are then transmitted to a control center for storage and processing. Therefore, the ability to integrate various technologies with the current communication infrastructures in order to support a progressive evolution of the IoT, with the interconnection of other devices and the realization of functionalities and services, is a characteristic of an urban IoT infrastructure.

III. WEB SERVICE APPROACH FOR IOT SERVICE ARCHITECTURE

Despite the fact that IETF standards are being adopted specifically because they are open and royalty free, based on Internet best practices, and depend on a large community, many different standards in the IoT space are competing to be the reference one.

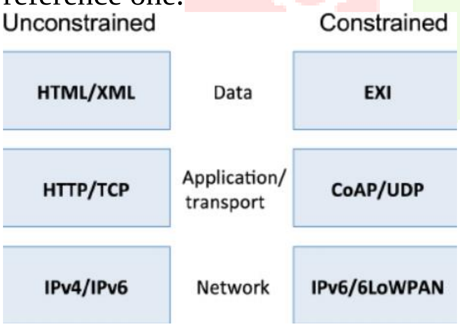

Figure 1: Protocol stacks for unconstrained (left) and constrained (right) IoT nodes.

The reference architecture for the urban IoT system, which includes both an unrestricted and a restricted protocol stack, is shown in Fig. 1. The first group consists of the protocols, like XML, HTTP, and IPv4, that are currently the de-facto standards for Internet communications and are frequently used by regular Internet hosts. The Efficient XML Interchange (EXI), the Constrained Application Protocol (CoAP), and 6LoWPAN,which is appropriate even for very constrained devices, serve as these protocols' low complexity matches in the protocol stack. It is possible to perform the transcoding operations between the protocols in the left and right stacks in Fig.1 in a low complexity, resulting in simple access and the ability of IoT nodes to communicate with the Internet. It may be relevant to point out that systems that do not take advantage of the EXI/CoAP/6LoWPAN protocol stack to be a part of the IoT system for cities, provided that are able to communicate with each layer of the Fig.1's left side of the protocol architecture. Three distinct functional layers, namely (i) Data, (ii) Application/Transport, and (iii) Network, can be seen in the protocol architecture in Fig. 1. These layers may each require specialized operators to perform transcoding between constrained and unconstrained formats and protocols. To ensure interoperability between the various system components, we go into greater detail about the requirements at each of the three functional layers in the following sections

IV. DEVICES

We now discover by explaining the devices, categorized according to their position in the communication flow, that are necessary to realize an urban IoT.

A. Backend Servers

The backend servers, which are found in the control center and serve as the system's brains, are where data is gathered, saved, and processed to create added value services. In theory, backend servers are not required for an IoT system to function properly, but they do become a crucial part of an urban IoT where they can facilitate access to the smart city services and open data through the legacy network infrastructure. These backend systems are frequently taken into account when interacting with IoT data feeders.

Database management systems: The massive amount of data generated by IoT peripheral nodes, such as sensors, must be stored by these systems. The load on these systems can be quite high depending on the specific usage scenario, so the backend system must be properly dimensioned.

Web sites: Web interfaces are the first choice for enabling interoperability between the IoT system and the "data consumers," such as public authorities, service operators, utility providers, and regular people, due to the widespread familiarity with them among users.

Enterprise resource planning systems(ERP): In a complex organization like a city administration, ERP components are invaluable resources for managing the information flow across various business functions. The management of the potentially enormous amount of data gathered by the IoT can be made simpler by integrating database management systems with ERP components. This also makes it possible to separate information flows based on their nature and relevance and makes it easier to develop new services.

B.Gateways

As we move closer to the "edge" of the IoT, we come across gateways, which connect endpoints to the system's primary communication infrastructure. The gateway must therefore provide protocol translation and functional mapping between the unconstrained protocols and their constrained counterparts, namely XML-EXI, HTTP-CoAP, and IPv4/v6-6LoWPAN, in accordance with the conceptual protocol architecture shown in Fig.1. It's important to keep in mind that not all of these translations need to be housed in a single gateway, even though they might all be necessary to enable interoperability with IoT peripheral devices and control stations. Instead, it is feasible and occasionally practical to divide the translation tasks among various networked devices. For instance, multiple 6LoWPAN border routers can be supported by a single HTTP-CoAP proxy.
Additionally, gateway devices must act as a bridge between constrained technologies, which instead pr ovide connectivity among IoT peripheral nodes, an d unconstrained link layer technologies, which are primarily used in the core of the IoT network.
Additionally, gateway devices must act as a bridge between constrained technologies, which instead pr ovide connectivity among IoT peripheral nodes, an d unconstrained link layer technologies, which are primarily used in the core of the IoT network.

C. IoT Peripheral Nodes

The IoT peripheral nodes, or simply IoT nodes, are the devices at the edge of the IoT system that are responsible for producing the data that will be delivered to the control center. The price of these devices is typically very low, starting at 10 USD or even less, depending on the type and quantity of sensors/actuators mounted on the board. IoT nodes can be grouped based on a wide range of attributes, including the way they are powered, their networking role (relay or leaf), their sensor and actuator equipment, and the link layer technologies they support. The Radio Frequency tags (RFtags), which have very limited capabilities but can still be used as IoT node, are most likely the most constrained IoT nodes. This is largely because of their extremely low cost and passive nature of their communication hardware, which does not need an internal energy source. Object identification by proximity reading, which can be used for logistics, repair, monitoring, and other services, is the typical use of RFtags.
Mobile devices that offer additional ways to interact with an urban IoT, such as smartphones, tablet PCs, or laptops, may also be a significant component of it. For instance, the NFC transceiver built into recent smartphones may be used to identify tagged objects, and the geolocation service offered by the majority of popular mobile operating systems can enhance the context data related to that object. Additionally, mobile devices can connect to the Internet of Things in a variety of ways, such as 1) through an IP connection offered by the cellular data-link service, or 2) by directly connecting to some objects using short-range wireless technologies like Bluetooth Low Energy, low-power WiFi, or IEEE 802.15.4. Additionally, it is possible to create specialized mobile applications that will make it simpler to interact with IoT objects and the system as a whole.

V. IOT SOLUTIONS

A. Operator Solutions

Approximately 10 billion connected devices need to be managed right now. Even more connected devices are introduced by the Internet of Things. Operators will need to be ready to meet both customer and connected device industry expectations. With the help of our solution, operators can simplify the deployment of mobile services, cut costs associated with device management, and generate new revenue streams.

B. Manufacturer Solutions for Devices

Device manufacturers must be able to manage their products easily once they are on the market, in addition to being able to quickly certify products for the market. With our solutions, which enable connected device activation and management, we make this easy for device manufacturers.

C. Service Provider Solutions

Reliable service is provided by service providers who are tasked with managing a complicated and occasionally disjointed process. Our products enable service providers to manage devices remotely while lowering costs. With analytics, we can also streamline processes, offer insights into productivity, and enhance customer service. With the help of this solution, service providers can expand their revenue sources.

D. Enterprise Solutions

Connecting thousands of employees who may be dispersed across multiple countries or even the globe is a challenge for businesses. These businesses must be able to manage the demands placed on data centers, special visibility requirements, and authorization requirements.

E. Automotive Solutions

With 37 percent of McKinsey 2015 Consumer Survey respondents saying they would switch car manufacturers if the only one offered full access to apps, media, and data, the intelligently connected car and its promise of seamless connectivity and personalization are significantly influencing car purchases. Now, automakers must work with mobile service providers to develop intelligent vehicles that can control complicated vehicle systems and maintain connectivity while being scalable and simple to manage.

Figure 2: IoT Applications for Smart City

VI. Conclusion

In this paper, we analyzed the solutions currently available for the implementation of urban IoTs. In reality, the number of open and standardized protocols is much smaller than the range of design options for IoT systems, which is rather wide. The technologies have also advanced to the point where they can now be used to practically implement IoT solutions and services, beginning with field trials that should help reduce any remaining ambiguity surrounding the IoT paradigm. It has also been suggested that a practical proof-of-concept deployment carried out in cooperation with the Italian city of Padova serves as a pertinent illustration of how the IoT paradigm can be applied to smart cities.

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