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A Middleware Framework between Mobility and IoT Using IEEE 802.15.4e Sensor Networks

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Abstract-In this paper, we propose a mobility framework for connecting the physical things in wireless ad hoc sensor networks. Our area of study is the internet of things by using an ad hoc sensor network. Our purpose in this study is to create a mobility framework for the internet of things. For example- how we connect many physical objects and give them a sense of sensing each other in an ad hoc environment. We can connect different physical objects in a framework of an ad hoc sensor network. Our main contribution is a new methodology for simulating mobility physical objects for the internet of things. Our methodology uses the correct and efficient simulation of the desired study and can be implemented in a framework of ad hoc sensor networks. Our study will generate a new framework for solving the issue of connectivity among physical objects. The proposed mobility framework is feasible to run among physical objects using the ad hoc sensor network.

Keywords: Ad Hoc Network; Sensor; Internet of things; Physical Objects; Simulation;

I. INTRODUCTION

A wireless ad hoc sensor network is the collection of sensor nodes in the wireless environment that can be connected in ad hoc network[1]. These sensor nodes can be detect and measure the pressure, light, heat, waves etc.[2] This sensor based system creates a communication environment for connecting the physical things with each other that improve the credibility, security and reliability of the processed information[3], [4].

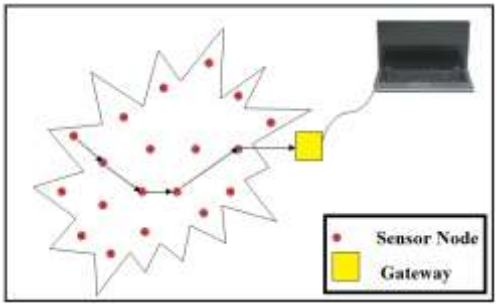

Figure 1. Sensor Nodes Connected with Gateway

According to Siemens research[5], up to 2020, near about 26 billion physical objects will be connected together in the internet. There is a lack of technical standardization in internet of things[6]. That time is not far away when billions of physical things linked together in real time. They can communicate each other and forwarding and process required data on the cloud. For example- Refrigerator at home remind the owner of his/her dieting schedule[7]. When some items are near to finish, expire or expired inside the refrigerator. So when data is gathered and processed in real time the refrigerator will order the food from hyper market without wasting time and resources and more economical for the future of smart city.[8], [9]

According Siemens analysis[5], in 2020, more than 37% of total data will be stored in the clouds. In this analysis, 14996 exabytes of 40,026 exabytes will be stored in cloud for internet of things.[10]

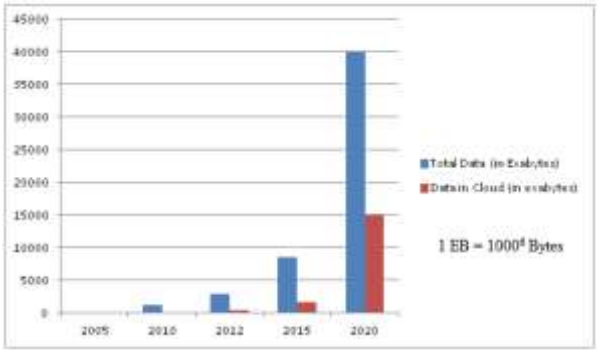

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Figure 2. Siemen's Analysis for growth of cloud based data vs. total data

Based on the research articles published at ON World[11], the sensor based wireless devices are increasing exponentially day by day. According to on world report, between 2011 and 2016 has been reached 553%, total wireless sensor based devices will be 24 millions. Between 2014 and 2016 the growth is almost double. It means the growth of sensor based devices in 2014 was 15% and it will be increased 18% to reach 33% up to 2016.[12]

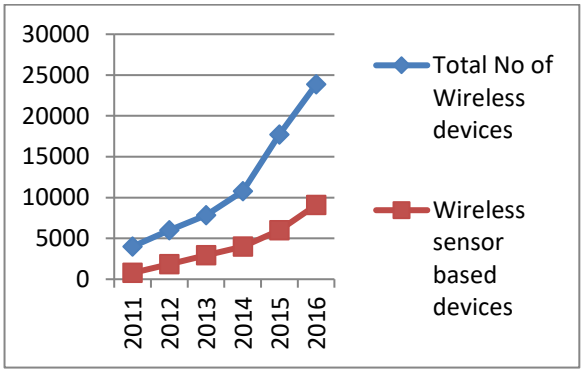

Figure 3. On World research for growth of wireless sensor devices vs. Total Wireless devices

According to the on world research report, the new wireless technology is growing year by year. The following figure represents the growth of wired, displaced wireless and new wireless. From 2011 to 2016 the new wireless is growing from 3% to 18%.[13]

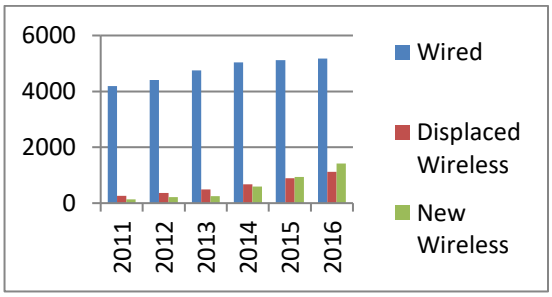

Figure 4. growth of new wireless vs. displaced wireless and wired.

According to latest study by MIT Technology Review, in 2020 about 40% of machine to machine communication will be established in Asia, 28% in Europe, 19% in North America, 7% in South America and 4% in Africa. According to the study, the total number of internet connected physical things will reach approximately more than 28 billion. The sensor network is increasing rapidly which will make it easier to collect data from different physical objects and store data in clouds. [14]

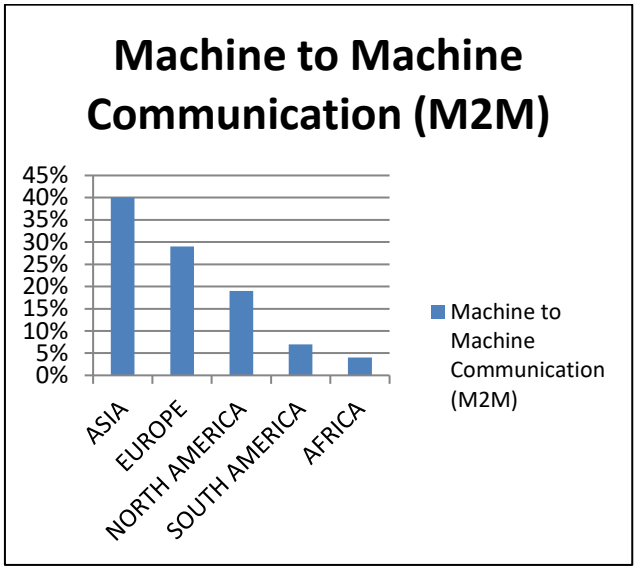

Figure 5. Growth of Machine to machine communication in the world.

II. METHOD

A. Internet of Things

The concept of internet of things has developed primarily by the wireless sensor network. In 1999, Kevin Ashton presents the idea of internet of things and uniquely identifies physical objects and their location in the internet architecture[15]. The Internet of Things consists of three main components:

i) Physical Objects
ii) Sensor Networks
iii) Data Flow

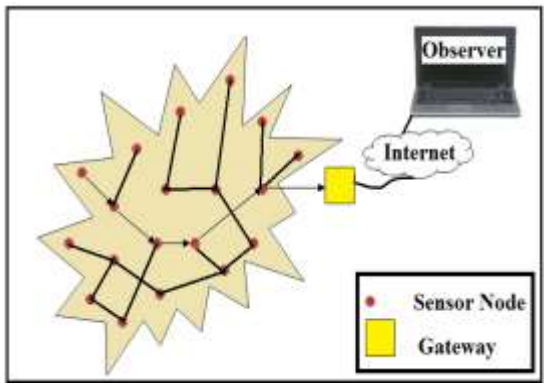

Figure 6. Internet of Things

The Internet of Things represents the interconnected physical things[16] that are uniquely identified with

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sensors. It is the future of communication.[17] The physical object should be smart. It means that the smart object should have unique id, sensor, connection and able to generate events and can be connected to each other. The smart object has the capability to connect in heterogeneous environment[18]. The IoT framework provides the facility to the smart physical things connected each other using standard platform for communication[19]. The development of internet of physical things is continuously growing with related technologies like cloud computing, sensor network, robotics and Future Internet technologies[20]. The following difficulties are in the development of internet of things.

i) Difficulties in security and privacy.
ii) Difficulties in the utilization of uniquely identification.[21]
iii) Difficulties in large scale testing with complex sensor based network.
iv) Difficulties in developing business which embraces the full potential of the Internet of Things.[22]

B. Ad hoc Sensor Network

Ad hoc sensor networks are wireless, self connected and fixed infrastructure less network[23]. In the recent years, ad hoc sensor network attracted a lot of attention of researchers. Every connected device is works as a router in mobile ad hoc network[24]. In internet of things, it provides communication environment in a moving environment for example-people use mobile phones when they are walking. In the moving environment it provides connectivity between devices or things.

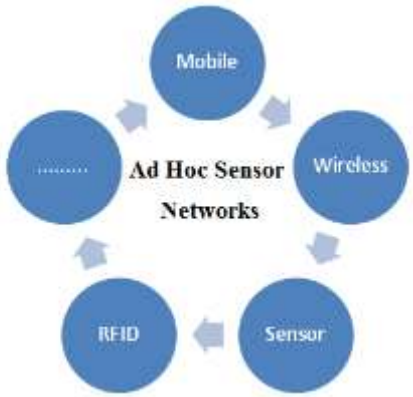

Figure 7. Ad-Hoc Sensor Network

The mobile ad hoc network is a self maintaining, self organizing, self repairing and self configuring network. These features are very useful for internet of things. Sensor network is generally centralized network because the centralized node gathers all the data from sensor devices. But in ad hoc sensor network, there is no centralized approach[25]. So every sensor node in ad hoc sensor network gathers information from another node and sends it to the next neighborhood node. Every sensor node has the parameters that are normally measured such as temperature, humidity and proximity.

IV. RESULT AND DISCUSSION

The proposed framework of internet of things is divided into two parts: first part is the network of internet of things and second part is the middleware. The network of sensor nodes in a particular area is connected to the gateway. The problem in most proposed framework is the security and privacy of the gateway. We propose privacy and security in middleware of the framework. Proposed framework middleware is divided into five parts. These parts are physical things, Sensor Network, IOT Services, IOT Business process management and Mobility Applications.[26]

All the physical objects are smart objects that are able to connect each other because they have sensor and unique id. They can transfer information dynamically from one physical object to another in a dynamic connected environment of sensors in ad hoc network. IOT Service provider creates an infrastructure in internet of things environment for the services required. The IOT business process management is used to get maximum throughput in terms of sharing the resources, savings and reusability of things.

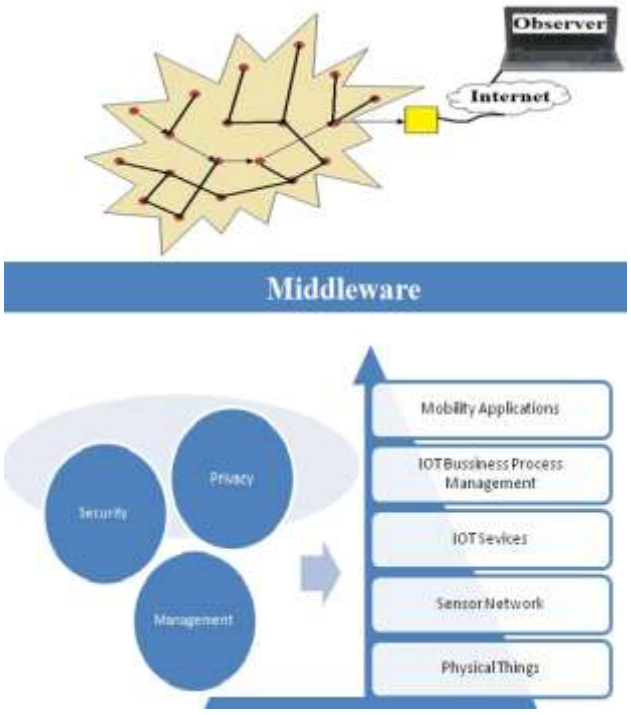

Figure 8. Proposed framework

The IOT service contains a lot of storage devices, switches, routers with algorithms and servers. It provides service to the physical device connection. Using these service physical devices connect to each other and transfer signals and information to each other using internet. It merges the technology with service layer to store sensor data in clouds efficiently using management of sensor network, monitoring, and information transferring and virtual viewing. The sensor nodes proper placement is most important for data transmission and reception more efficiently and properly. So many researchers proposed many algorithms for transferring and reception data. But it is so complex to implement these algorithms practically.

V. CONCLUSION

The proposed Mobility framework for connecting the physical things in wireless ad hoc sensor network is working as internet of things framework to receive data from physical devices. This framework is divided into things location, wireless connection among physical things and the management functions. There are so many sensors placed, they send data to the cloud servers through internet of things gateways. Through this framework, we can connect many physical objects and give them sense of sensing each other in ad hoc environment. Our main contribution is a new methodology for simulating mobility physical objects for internet of things. Our methodology uses the correct and efficient simulation of a desired steady, and can be implemented in a framework of ad hoc sensor network. The proposed mobility framework is feasible to run among physical objects using ad hoc sensor network.

The mobility framework for internet of things in ad hoc environment has been done and results were collected. The fundamental functions of the proposed system have been introduced in ad hoc network system of internet of things. Framework has been tested in wireless ad hoc network environment of internet of things. The results showed successful and expectation for future scope in the area of IOT.

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