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A Survey on Architectures of Internet of Things

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Abstract: In the era of new generation networking systems, Next generation networks, software defined networking, data aware networking and Internet of Things are prominent areas for researchers to develop various architectures and systems, and the concept of Internet of Things was initially a computing paradigm. Various types of physical devices such as sensors and actuators are used as data collection objects and are used for decision making in providing the service to the customer. The Internet of Things (IOT) covers a diverse range of devices, technologies and networks to provide smart applications and services. The impact of IOT is more on today's real world environment. As the devices, networks and networks under IOT integration are different in nature and their architectures, do not have any commonalities, IOT architecture cannot be defined as a single architecture. Multiple architectures have to be defined for IOT so as to support diverse range of devices and technologies which is quite complex. This paper surveys various architectures that are under use
Keywords: Internet of Things, Sensors, Context Aware Computing, Data Collection

1. Introduction

Applications that serve different purposes need different types of sensors to collect data. To bring in coordination among heterogeneous devices, the Internet of Things technology has adopted the standards of TCP/IP protocol suite which is designed to meet the needs of traditional wired internet. However, entire IOT environment is wireless and TCP/IP protocol suite has to undergo significant challenges in order to meet the service needs of Internet of Things. Hence, The Internet of Things can be viewed as a paradigm of wireless communication associated with internet and a diverse range of devices. The networks that do participate in the Internet of things include Smart Networks, RFID Networks, Control gateways, Home Networks and Security Networks etc... Sensor Devices, Communication mechanisms, service providing based on the context and Remote method invocation are the key working components in the construction of IOT Architecture.

The primary source of input data for Internet of Things are all from analog sources and needs to be transmitted across several gateways, networks and data acquisition systems. Maintenance of data that is obtained from analog sources and providing the data whenever required by the application is the crucial part of IOT application development. In order to maintain integrity in services and resource management, an enterprise manager needs to be maintained in a central server or group of servers that serves the need of data maintenance and processing. Data collected from any source will be converted into digital form by the analog to digital converters and maintained as a repository in the servers. The server maintains the data and serves the applications with data whenever required. This is a continuous process in most of the applications of Internet of things. Most of the service providers in the field of Internet of things will generally look over the cloud storage as an alternative of maintaining a server in this regard

2. General Architecture

The architecture of Internet of things needs to maintain communication patterns from device to device, device to cloud, device to gateway and for back end sharing of data.

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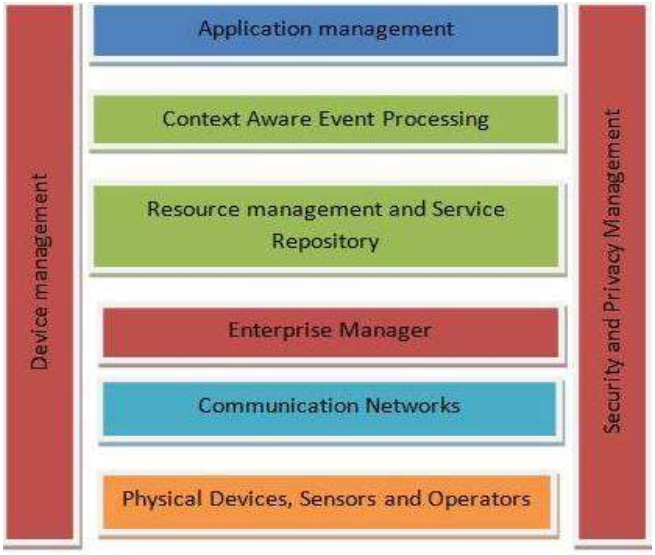

Fig-1: General Architecture of IOT

The above figure shows the general architectural view of the Internet of Things covering all the components of the IOT. Each and every component plays a major role in providing the service as and when required from time to time. Starting from data collection in device management to the Application management for providing the service to the customer, the IOT needs to manage the communication among each phase of the general architecture.

Different devices are manufactured by different companies. Hence the device to device communication pattern is necessary. As the data maintenance is taken care of by the central server or a cloud server, the servers must be in a position to receive data from diverse range of devices and networks and gateways which directly shows the need of device to network gateways and device to cloud communication patterns. Also the data that is stored in cloud servers or central servers needs to be transmitted to this diverse range of devices and networks as and when required, in order to incorporate this, back end sharing of data for data and security for data must also be incorporated in the applications.

To cope up with all the above requirements, different researchers proposed different architectures for Internet of Things. Most prominent of them being the three layered architecture and the five layered architectures

3. Three layered architecture of IOT

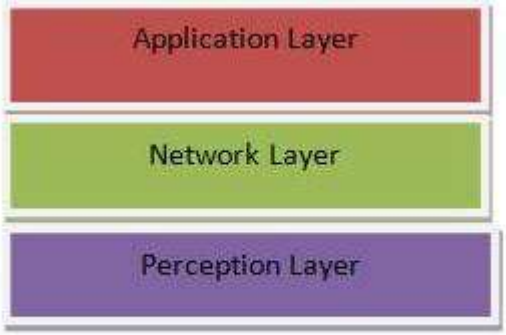

Fig-2: Three layered Architecture of IOT

The three layered architecture is equipped with Application layer, Network Layer and the perception layer. The perception layer deals with the physical properties of the IOT components, devices such as sensors and actuators. It also aims to convert the data acquired from the devices into digital format that is suitable for transmission through the network layer.

Suitable technologies can be incorporated in this layer in order perceive data from perceivable devices and non perceivable devices in this layer.

Network layer receives the data from the perception layer and is responsible for transmitting the data to the layer above it i.e., Application layer by using suitable network technologies. Data storage and maintenance, Data retrieval is the main task that is carried out in this layer and this data will be transmitted to the application layer as and when required. For smooth functioning of the network layer, some third party middleware may also be required and incorporated such as cloud storage for secure and massive processing of data, Zigbee, FTTx, for faster transmission of large amounts of data.

The Application layer primarily deals with the user related activities and operations. It uses the data acquired from the network layer and provides the user with multiple user interface tools and sensing tools in order to facilitate the developers and users to realize the vision of Internet of Things.

However, each layer in this three layered architecture constitutes of full load and complex functionalities is to be carried out. In order to balance the load on each layer and to get rid of confusion among the complex functionalities, the five layered architecture of Internet of Things has been introduced which includes Business layer , Application layer, Middleware layer, transmission layer and the perception layer

4. FIVE layered architecture of iot

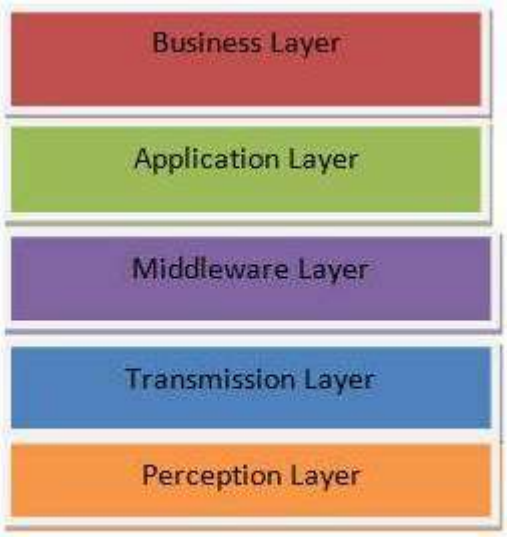

Fig-3: Five layered Architecture of IOT

As in the three layered architecture, the perception layer in the five layered architecture takes care of data acquisition from physical devices such as sensors, actuators etc.. And converts the data acquired into digital format using analog to digital converters and submits the data to the transmission layer which is just above it through secure channels. The Transmission layer on the other hand will handle data transfer from perception layer to the middleware layer which is the central storage for all data maintenance. It uses different network technologies for this data transfer such as field area networks, home area networks, and other networks depending on the network traffic, data transfer speed required, location and application requirements.

The middleware layer is newly introduced in this architecture between the transmission layer and the application layer so as to take care of data maintenance and traffic maintenance. This layer also maintains data transfer history so as to offer more smart services

to the users. The database management, cloud storage and service issues are addressed in this layer.

As in the three layered architecture, the Application layer serves the users with different variety of services and provides the users with required interfaces to interact with diverse physical devices that are incorporated as a part of Internet of things. The business layer introduces the concept of overall management of the system. This layer also focuses on the privacy and security issues that rise as a part of the architecture.

In addition to the above architectures, more architectures for Internet of things has been introduced in later stages to incorporate more sensing devices, computing capabilities and also facilitate the users with more smart services namely the SOA based architecture and the API oriented architecture.

In the SOA based architecture, the physical devices such as sensing devices are continuously maintained and monitors through a sensing layer thus by providing integrity among and communication pattern among hardware objects. It is equipped with the network layer to support lightning speed data transmission and to support diverse range of networks including wired and wireless communications. The SOA based architecture also incorporates the service layer to take care of all the services required by users or third party applications and managed by the architecture. The interaction layer provides always keeps on providing the different user interfaces and interaction methods to support wide variety of services and applications.

The API oriented architecture on the other hand mainly focuses on user convenience and faster service maintenance. This architecture brings out the computational capabilities of ubiquitous computing and serves the users with more augmented reality applications and health care applications. This architecture uses web development elements such as REST, JSON for user interface creation and adoption, XML web services for faster and efficient service providing thus gained more popularity among all the architectures of Internet of Things. The Representational State Transfer (REST) is the architectural style of using the web approach in the API oriented architecture that provides scalability and robustness for all the smart services that are provided through IOT.

All the resources are maintained in a resource repository, services are maintained in a service repository, and the users are recognized as the mobile and web users. Taking the help of the REST web platform will also be helpful to employ various web protocols to be used in Internet of things such as HTTP. This principle of individual maintenance of services, resources and separation of user layer from the service and resources, categorization of user types will result in the simple functionalities. By deploying the suitable algorithms for resource management, service management and security management and procedures to maintain data history and integrity, the API oriented architecture provides the services as and when required with more quality and lightning speed.

The identification and authorization of resources is the primary task that the API oriented architecture moves with. It then continues to monitor the resources continuously for the status of the resources. The architecture then moves to manipulate the services according to the available resources such as network speed and service type. It mainly uses hyper media as the service engine for maintaining the service repository and will have the self descriptive messages to take care of network activities. As a result, the users, resources and services will be in a position to understand what to do next and have a clear vision of the realized IOT service at a faster speed. The API oriented architecture uses the cloud storage for data storage and maintenance and uses the cloud storage as a service to operate massive amounts of data.

5. CONCLUSION

Providing real time service to the users and organizations is a challenging task carried out by the Internet of Things. However, different types of services require different physical devices and infrastructure needs to be equipped, hence resulting in multiple architectures. The Internet of things is now becoming a major part of human life by incorporating itself by providing smarter service. One can think of developing a unified architecture to bring all the services under a single service stratum so that users can avail more number of services with a single application interface.

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