FOG: A Novel Approach for Adapting IoT/IoE in Cloud Environment

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Abstract -

Fog computing refers to bringing networking resources near the underlying networks.Fog computing allows us to communicate with multiple clouds at the same time. The Internet of Things (IoT) refers to the use of intelligently connected devices and systems to leverage data gathered by embedded sensors and actuators in machines and other physical objects. Thing is nothing but it may be communicating or non-communicating devise which exists in the world. Previously the communication is through radio frequency identification tags(RFID). IoT includes smart objects which are digital and performs some work for humans. As human producing data increasing day by day we are required to have additional storage, which leads us to CoT. Mission critical and latency sensitive IoT services require a very quick response and processing. In this case, it is not feasible to communicate through the distant cloud, over the Internet. Fog computing plays a very vital role in this regard.

Keywords: IoT, Fog computing, IoE, IoC.

1. INTRODUCTION

The Internet of things (IoT) is the internetworking of physical devices that enables the devices to collect and exchange data. The IoT includes smart objects as well. Smart objects are physical, digital components, which performs some work for environment and humans. Because of this we can say the IoT is not only the software and hardware approach but also includes interaction and social aspects. The IoT works on the schema of machine to machine (M2M) communications but is not limited to it. M2M refers to communication between two machines, without human involvement. In the IoT, even unconnected components may become part of it, with a information communicating device, similar to an RFID tag, sensed through a device, which eventually is connected to the Internet. In the IoT, unintelligent items (things) become the communicating nodes.Figure 1 shows basic idea of IoT.

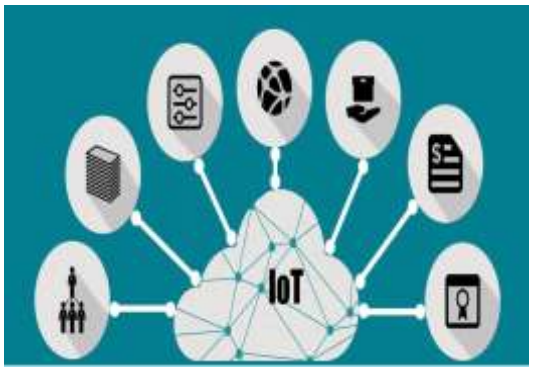

Fig 1- Connecting the physical devices and smart objects.

When people become part of IoT and add huge information, the IoT upgrades into the Internet of Everything (IoE). The IoE is a network of networks where trillions of connections create well chances for data exchange and communication. The IoE brings the people, data, processes, and things together, making inter-connections more relevant and valuable. In this way, data is transformed into activities, making new capacities, wealthier encounters, and unparalleled financial open door for organizations, individuals, and nations. Today, people are associated to the Internet through devices, such as mobiles, computers, laptops, tablets, and social media. As the big changes continues in the IoE, this connectivity of people would happen in myriad ways, especially through different types of sensors. For example, different transport related sensors can provide important data on a vehicle passing, and traffic updates. This data can be used to create further services. Some times vehicles themselves would become nodes on the Internet. Connected things would be able to share this information with people, machines, and other things, enabling more robotic services, including context awareness. This allows more control over the environment. Figure 2 shows the basic building blocks of the IoE. IoT based services are rapidly gaining importance. Since 2011, the number of people on Earth are lesser than the number of connected devices. Connected devices have already reached 9 billion and are expected to grow more quickly and reach 24 billion by 2020. With increasing numbers of different devices connected

to the IoT and generating more information, it is going to be a big problem for a standalone IoT to perform power and bandwidth constrained tasks efficiently. In this regard, the IoT and cloud computing amalgamation has been visualized. The mission critical and latency sensitive IoT services require a very fast response and processing.

Fig 2: Connecting people, data, things and process

In this situation, it is not doable to communicate through the different cloud, over the Internet. In this regard Fog computing plays a very important role. Fog computing refers to bringing networking resources near the underlying networks. It is a network between the underlying network(s) and the cloud(s) which allows us to communicate with multiple clouds. Fog computing extends the traditional cloud computing approach, by enabling the creation of modified and better applications or services. Fog is an edge computing and micro data center (MDC) approach for IoTs and wireless sensor networks (WSNs). In this article, we exhibit a description on how the fog is going to work and how it will be usefull in the efficient, effective, and good management of resources for the IoT and other underlying devices.

2. THE CoT(CLOUD OF THINGS)

What's to come is web 3.0, the pervasive computing web. Since 2011, the quantity of individuals on Earth has as of now been dwarfed by the quantity of associated gadgets. With an abnormal state of increment in connected devices, there will be a great deal of information in future. Overseeing and putting away that information locally and briefly won't be conceivable any longer. Rental storage room will be required. In addition, this colossal measure of information should likewise be used in a more powerful manner, making further administrations. Information must not just be shaped to data, and further to learning, however it ought to be made a method for knowledge for the client. Such a kind of handling is impractical at the IoT end, where gadgets are lightweight and not rich in assets. This suggests handling and calculation should likewise be made accessible there on a rental premise. This is conceivable with distributed computing. The IoT and distributed computing working in coordination make another worldview called the CoT. The CoT helps in overseeing IoT assets and gives more cost-effective and effective approaches to create administrations. The arrangement of administrations is augmented fundamentally with cloud IoT incorporation. With the CoT, the administrations to be given are in the cloud, giving universal access to the clients, expanding the extent of the administrations, and making the entrance of administrations much less demanding and productive. For the specialist co-op, it likewise helps in making cost-effective administrations and creates more monetary benefit. The CoT gives the important foundation and applications that can be reused by various partners, for example, end clients, government associations, wellbeing divisions, crisis offices, city offices, and application integrators, in making client driven administrations and taking advantages from the IoT and additionally the cloud.

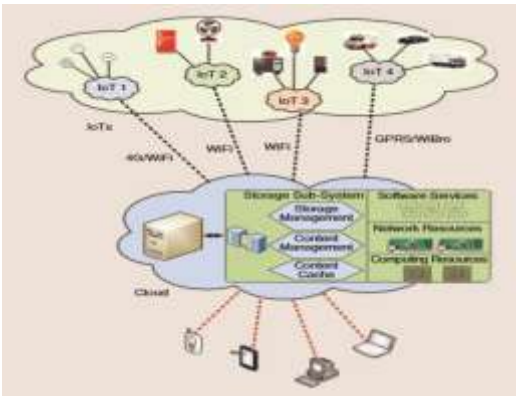

Fig 3:The CoT data communication

With the CoT, different resources can be normalized and grouped in accordance with the semantics of the "things," thus enabling a Things as a Service (TaaS) approach. Data analysis also becomes more practical with the CoT. However, there are some situations where the CoT also requires a middle ware to handle huge processes and process the data before letting it go in the

cloud. With the changes of the IoT into the IoE, a number of problems are involved. Location and personal data security becomes a main concern, for this an additional security layer and data iltration at the middleware layer are required. That middleware is termed as "fog," as discussed in the next section. The CoT overall communication pattern is presented in Fig. 3.

3. FOG COMPUTING

Fog computing, an MDC approach, is a big virtualized platform, which provides storage, calculations and interconnecting services between the end nodes in the IoT and clouds. As opposed to the cloud, which is more incorporated, fog computing focuses on the administrations and applications with broadly distributed deployments. As shown in the overall architecture in Fig. 4, the fog will provide high quality streaming to mobile nodes, like moving vehicles, through access points positioned accordingly, such as along highways and tracks. The applications with low latency requirements will suits for fog. Fogs are going to play an important role in smart communication. Context aware computing can also be made possible with a fog MDC. The middleware is the component that receives the information from the underlying nodes. In standalone approach we wont do any pre-processing of related tasks, but in fog middleware sometimes we may get such situations. Therefore, the gateway has to be develop smarter with fog capabilities. We call such a type of gateway a fog smart gateway (FSG). An FSG is more context aware and works on the approach of the feedback from the application. For different services the networks and nodes may not be physical always, virtual sensor nodes and virtual sensor networks are also requirements for different services. By using fog pre-processing, data security, temporary storage and privacy, and other such tasks can be done easily and more efficiently. The information gathered from WSNs and the IoT will be transmitted through gateways to the cloud. The collected information is then stored in the cloud, and then it is provided as a service to the users. Since the fog is localized, it provides low-latency communication and more context awareness. It can perform pre-processing and advise the cloud, before the cloud could additionally adjust that information into improved administrations. With heterogeneous hubs, heterogeneous sorts of information would be gathered. Interoperability and transcending then turns into an issue. The mist assumes an indispensable part in such manner. Similarly, the IoT and WSN alliance, in which at least two IoTs or WSNs can be combined at a certain point, can be made conceivable through the mist. This will consider the making of rich administrations.

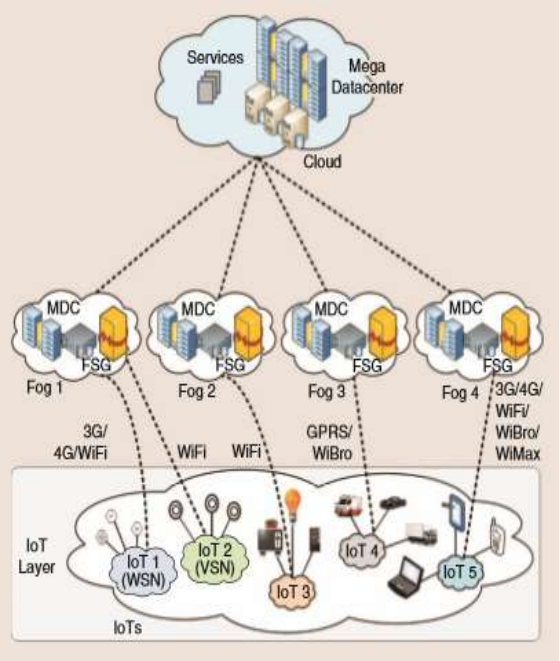

Fig 4 Smart Gateway with Fog Computing

3.1 THE DISTINGUISH BETWEEN FOG AND CLOUD :

Both cloud and fog computing provide temporal storage, computation, application, infrastructure for communication, and data resources sharing, but they are different from each other. The main difference is the fog's presences to the underlying accessing nodes. The cloud is generalized, while the fog is localized. The fog extends the distant cloud to the edge of the network, closer to the accessing devices, IoTs, and WSNs. In other words, the fog is a descended cloud. Fog includes an additional layer of security to the delicate information, including social insurance, area, metropolitan security, and other related administrations. The nature of cloud administrations, especially mixed media, relies on the nature of the center system. Then again, mist is much wealthier since it is accessible locally. Also, when asset obliged gadgets are to be offloaded, fog is the most feasible arrangement, instead of the cloud (or the cloud just), on the grounds that it is more effective and simple to get to. Keeping in view the fundamental assignments mist can give,

its general layered design is introduced beneath in Fig.5

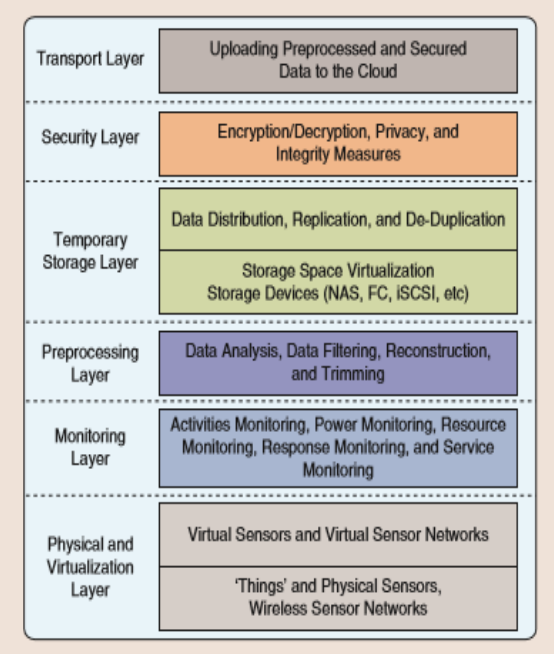

Fig 5 Layered Architecture of Fog

In the physical and virtualization layer, physical hubs, WSNs, virtual hubs, and virtual sensor systems (VSNs) are overseen and kept up as per the prerequisites. The observing layer watches the exercises of the basic hubs and systems. Which hub is performing what undertaking at what time and what is required from it next is checked here. Other than this, the power obliged gadgets or hubs are checked on their vitality utilization premise also, so that viable measures can be taken in time. The pre-processing layer performs information administration related undertakings. It investigates the gathered information, performs information sifting and trimming, and at last, more important and vital information is produced. Information is then briefly put away in the haze assets. Once the information is transferred in the cloud and it is no longer required to be put away locally, that information is then expelled from the capacity media. The IoT and WSNs may produce some private information too. Universal social insurance and savvy human services administrations produce private information of the patients. Additionally, area mindful information may likewise be touchy at times, which ought to be made secure. This is the place the security layer becomes possibly the most important factor. At last, at the vehicle layer, the prepared to send information is transferred to the cloud, loading the center to the base and permitting the cloud to make more valuable administrations.

CONCLUSION :

With tremendous growth in IoT services, management of services, quality of service, effectiveness, efficiency, and users' contentment have become important. What's to come is the CoT, in which IoTs are integrate with cloud computing for better asset administration and administration provisioning. On account of sight and sound substance, much assets are required. Crisis, social insurance, and other dormancy touchy, and additionally security protection delicate administrations, require mist, as a MDC, to be available between the fundamental hubs and the far off cloud. Productive and in time booking and administration of assets permit server farms to perform as indicated by the circumstance and help consumer loyalty.

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