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RESEARCH ARTICLE

A NEW ERA OF NETWORKING: INTERNET OF THINGS.

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Abstract

This paper provides information of the Internet of Things (IoT) with brief explanation on enabling technologies, protocols, and application issues. The IoT is being possible because of the RFID latest developments, Internet protocols, communication technologies, and smart sensors. The basic tool for the IoT is to have smart sensors collaborate directly without human involvement to deliver a new class of applications. In the future years, the IoT is expected to act as the bridge diverse technologies developed by new applications connecting physical objects to support of intelligent decision making. This paper also provide some of the key IoT challenges presented in the paper and provide a summary of related research work. This also presents the need for better horizontal integration among IoT services. The Internet of Things (IoT) shall be able to incorporate transparently and seamlessly a large number of different and heterogeneous end systems, while providing open access to selected subsets of data for the development of digital services. Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system.

Introduction:-

The Internet of Things (IoT) is a recent communication system that envisions a near future, in which the objects of everyday life will be equipped for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet [1]. The number of physical objects is being connected to the Internet at an unprecedented rate realizing the idea of the Internet of Things (IoT). IoT concept, hence, aims at making the Internet even more immersive and pervasive. Furthermore, by enabling easy access and interaction with a wide variety of devices such as, for instance, home appliances, surveillance cameras, monitoring sensors, actuators, displays, vehicles, and so on, the IoT will faster the development of a number of applications can be use. The Internet of Things builds out from today’s internet by creating a pervasive and self-organizing network of connected, identifiable and addressable physical objects enabling application development in and across key vertical sectors through the use of embedded chips, sensors, actuators and low-cost miniaturization.

Evolution of internet of things:-

Internet of Thing turns out as the find version of network communication.

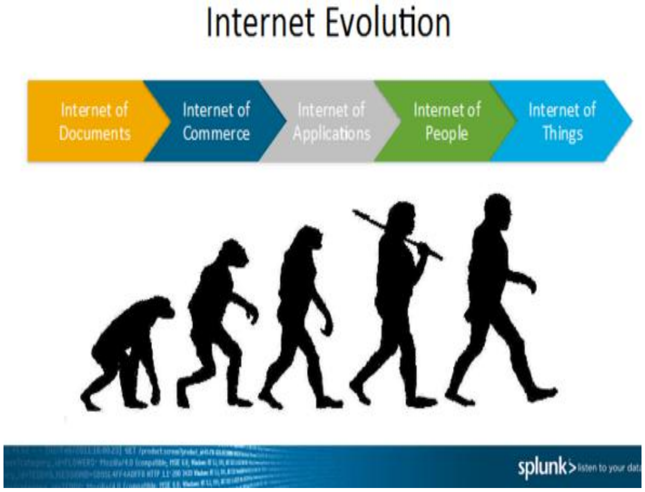


Fig1: Evolution of Internet of Things.

- First wave of evolution of internet Connecting Computer (1990Era) .
- Second wave of evolution of mobile phone Connecting People (2000 Era).

Evolution of Internet of Things day to day very important in today's life. In 2003, there were approximately 6.3 billion people living on the planet and 500 million devices connected to the Internet[3]. The Internet of Things (IoT) is generally thought of as connecting things to the Internet and using that connection to provide some kind of useful remote monitoring or control of those things. This definition of IoT is limited, and references only part of the IoT evolution. It is basically a rebranding of the existing Machine to Machine (M2M) market of today.

Fig 2: The overall picture of IoT emphasizing the vertical markets and the horizontal integration between them.

The IoT transforms these objects from being traditional to smart by exploiting its underlying technologies such as ubiquitous and pervasive computing, embedded devices, communication technologies, sensor networks, Internet protocols and applications. Fig. 2 illustrates the overall concept of the IoT in which every domain specific application is interacting with domain independent services, whereas in each domain sensors and actuators communicate directly with each other. For example, smart-homes will enable their residents to automatically open their garage when reaching home, prepare their coffee, control climate ,control the other type of function control systems, TVs and other appliances. Also, new protocols are required for communication compatibility between heterogeneous things (living things, vehicles, phones, appliances, goods, etc.). For example, the survey by Atzori et al. [4] covers the communication between technologies, wired and wireless and the elements of wireless sensor networks (WSNs). In [5], the authors address the IoT architecture and the challenges of developing and deploying IoT applications. Enabling technologies and application services using a centralized cloud vision are presented in [6]. The authors in [7] provide a survey of the IoT for specialized clinical wireless devices using 6LoWPAN/IEEE 802.15.4, Bluetooth and NFC for mHealth and eHealth applications.

IOT Element:-

To better understanding the IOT building blocks helps to gain better meaning and functionality of the IOT.

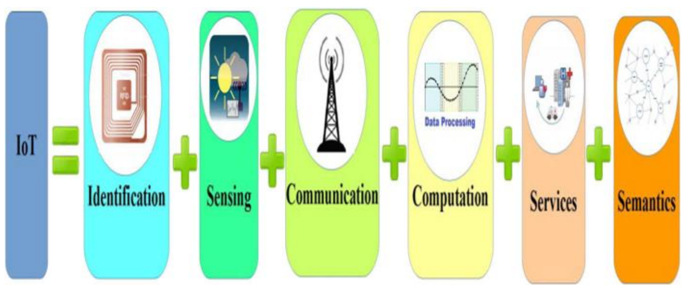


Fig. 4: The IoT elements.

Identification:-

Identification is crucial the IoT to name and match services with their demand. Many identification methods are available for the IoT such as electronic product codes (EPC) and ubiquitous codes (uCode) [21]. Distinguishing between object's identification and address is imperative since identification methods are not globally unique, so addressing assists to uniquely identify objects.

Sensing:-

The IoT sensors can be smart sensors, actuators or wearable sensing devices. For example, companies likeWemo, revolv and SmartThings offer smart hubs and mobile applications that enable people to monitorand control thousands of smart devices .

Communication:-

The IoT communication technologies connect heterogeneous objects together to deliver specific smart services. Examples of communication protocols used for the IoT are WiFi, Bluetooth, IEEE 802.15.4, Z-wave, and LTE-Advanced. Some specific communication technologies are also in use like RFID.

Computation:-

Processing units (e.g., microcontrollers, microprocessors, SOCs, FPGAs) and software applications represent the "brain"and the computational ability of the IoT. Cloud Platforms from another important computational part of the IoT.

Services:-

IoT services can be categorized under four classes [8] Identity-related Services, Information Aggregation Services, Collaborative-Aware Services and Ubiquitous Services. Identity-related services are the most basic and important services that are used in other types of services. Smart healthcare and smart grids fall into the information aggregation category and smart home, smart buildings, intelligent transportation systems (ITS).

Semantics:-

Semantic in the IoT refers to the ability to extract knowledge smartly by different machines to provide the required services. Thus semantic represents the brain of the

IoT by sending demands to the right resource. This requirement is supported by Semantic Web technologies such as the Resource Description Framework (RDF) and the Web Ontology Language (OWL). In 2011, the World Wide Web consortium (W3C) adopted the Efficient XML Interchange (EXI) format asa recommendation [9].

Application Protocols:-

Constrained Application Protocol (CoAP):- The IETF Constrained RESTful Environments (CoRE) working group created CoAP, which is an application layer protocol [12], [13] for IoT applications. The CoAP defines a web transfer protocol based on REpresentational State Transfer (REST) on top of HTTP functionalities. REST represents a simpler way to exchange data between clients and servers over HTTP . REST can be seen as a cacheable connection protocol that relies on stateless client-server architecture.

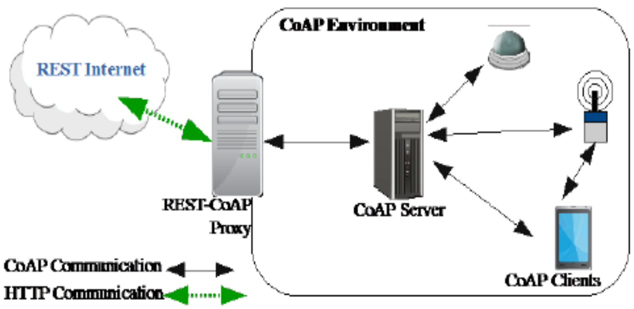


Fig.3: CoAP functionality.

The overall functionality of CoAP protocol is demonstrated in Fig.3. CoAP aims to enable tiny devices with low power, computation and communication capabilities to utilize RESTful interactions. CoAP can be divided into two sub-layers, namely: the messaging sub-layer and the request/response sub-layer. The messaging sub-layer detects duplications and provides reliable communication over the UDP transport layer using exponential backoff since UDP does not have a built-in error recovery mechanism. The request/response sub-layer on the other hand handles REST communications. CoAP utilizes four types of messages: confirmable, non-confirmable, reset and acknowledgement. Some of the important features provided by CoAP include [65], [68].

- Resource observation: On-demand subscriptions to monitor resources of interest using publish/subscribe mechanism.
- Block-wise resource transport: Ability to exchange transceiver data between the client and the server without the need to update the whole data to reduce the communication overhead.
- Resource discovery: Server utilizes well-known URI paths based on the web link fields in CoRE link format to provide resource discovery for the client.
- Interacting with HTTP: Flexibility of communicating with several devices because the common REST architecture enables CoAP to interact easily with HTTP through a proxy.
- Security: CoAP is a secure protocol since it is built on top of datagram transport layer security (DTLS) to guarantee integrity and confidentiality of exchanged messages.

Message Queue Telemetry Transport (MQTT):- MQTT is a messaging protocol that was introduced by Andy Stanford-Clark of IBM and Arlen Nipper of Arcom (now Eurotech) in 1999 and was standardized in 2013 at OASIS [14].MQTT aims at connecting embedded devices and networks with applications and middleware. The connection operation uses a routing mechanism (one-to-one, one-to-many, many-to-many) and enables MQTT as an optimal connection protocol for the IoT and M2M.

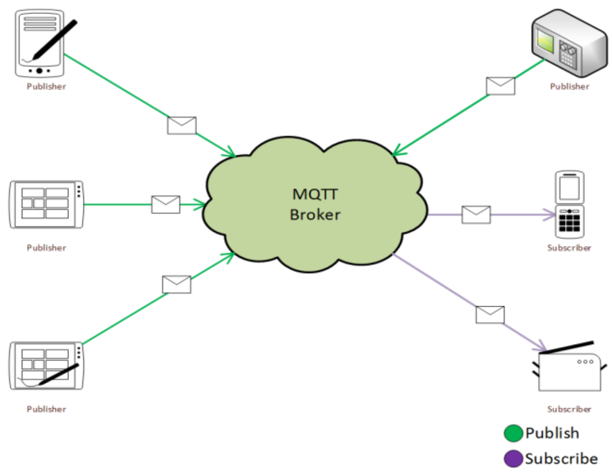
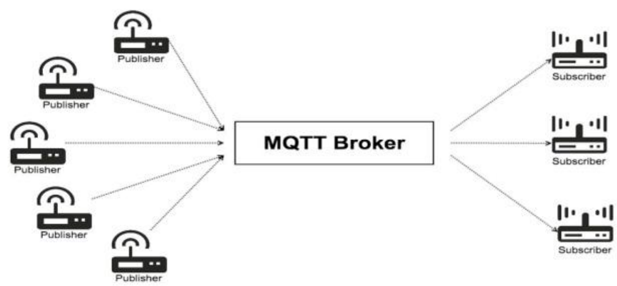


Fig.4: Architecture of MQTT.

MQTT utilizes the publish/subscribe pattern to provide transition flexibility and simplicity of implementation as depicted in Fig. 4. MQTT simply consists of three components, subscriber, publisher and broker. An interested device would register as a subscriber for specific topics in order for it to be informed by the broker when publishers publish topics of interest. The publisher acts as a generator of interesting data. the MQTT protocol represents an ideal.



Publish / Subscribe

Fig.5: Communication of MQTT.

messaging protocol for the IoT and M2M communications and is able to provide routing for small, cheap, low power and low memory devices in vulnerable and low bandwidth networks.

Extensible Messaging and Presence Protocol (XMPP):- XMPP is an IETF instant messaging (IM) standard that is used for multi-party chatting, voice and video calling and telepresence [15]. XMPP was developed by the Jabber open source community to support an open, secure, spam free and decentralized messaging protocol.

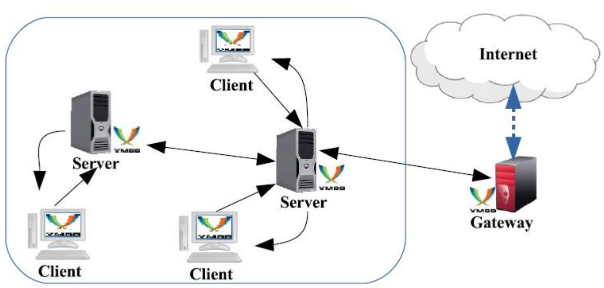


Fig.6: Communications in XMPP

XMPP allows users to communicate with each other by sending instant messages on the Internet no matter which operating system they are using. XMPP allows IM applications to achieve authentication, access control, privacy measurement, hop-by-hop and end-to-end encryption, and compatibility with other protocols. Fig. 6 illustrates the overall behavior of XMPP protocol, in which gateways can bridge between foreign messaging networks.

QoS criteria, iot challenges and future directions:-

There are many challenges that need to be addressed. Examples of key challenges include availability, reliability, mobility, performance, scalability, interoperability, security, management, and trust. Addressing these challenges enables service providers and application programmers to implement their services efficiently.

- Availability
- Reliability
- Mobility
- Performance
- Management
- Scalability
- Interoperability
- Security and Privacy

Conclusions:-

The idea of the Internet of Things (IoT) is rapidly finding its path throughout our modern life, aiming to improve the quality of life by connecting many smart devices, technologies and applications. This paper tries to enlighten more & more details of IoT as possible.

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