An Integrated IPv6 Architecture for smart environment using IoT and Cloud Computing

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***Abstract*— Smart objects which are actually companied with the energy efficient micro controllers, Low power radio frequencies transceivers and actuators as well as sensors. The expansion of an extended range of gadgets ready to be specifically associated to the Internet and It is leading to a new ubiquitous-computing paradigm: the Internet of Things (IoT). Internet of Things aims at providing smarter services to the end-user or the environment.In the era of internet of thing s IPv6 is promising protocols for the complex and distributed network. This article facilitates the design of IPv6 and internet of things with cloud computing architecture. It also provided the current working methodologies of IPv6 and its Low power protocols architecture and exhausted IPv4 Header and Addressing comparative studies.**

***Keywords*— IPv6; Internet of Things; Cloud Computing;**

I. INTRODUCTION

The 'Internet of Things' (IoT) paradigm is a next wave in the era of computing and it has been identified as one of the emerging technologies in the field of Computer Science and Information Technology. The concept of Internet of Things is integrates seamlessly with the real world of things. The 'things' in IoT could be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an IP address and provided with the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The goal of the IoT is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any path or network and any service in heterogeneous environment. Internet of Things is another insurgency of the Internet. A radical evolution of the current Internet into a Network of interconnected objects that not only harvests information from the environment and interacts with the physical world, but also uses existing Internet standards to provide services for applications, data exchange, analytics, and communications. Fueled by the prevalence of devices enabled by open wireless technology such as Bluetooth, Radio Frequency Identification, Wi-Fi, and telephonic data services as well as embedded sensor and actuator nodes, IoT is on the verge of transforming the current static Internet into a fully integrated Future Internet. The Internet unrest prompted the interconnection between individuals at a phenomenal scale and pace. The IoT revolution will be the interconnection between objects to create a smart environment. Smart environment can be defined as ''the physical world that is richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives, and connected through a continuous network". Smart connectivity with existing networks and context-aware computation using network resources through Wi-Fi and 4G-LTE wireless internet access is an indispensable part of IoT .

The advancements and convergence of Micro-Electro-Mechanical systems (MEMS) technology, wireless communications, and digital electronics has resulted in the development of miniature Smart devices like sensors wearable's, actuators ,IP-based constraint devices having the ability to sense, compute, and communicate wirelessly in short distances. These tiny devices called nodes interconnect to form a Wireless Sensor Networks (WSN) and find wide ranging applications in smart parking spot monitoring, environmental monitoring, infrastructure monitoring, traffic monitoring etc. This has the ability to provide a sensing capability which is critical in realizing the overall vision of IoT. The solid advancement of the Internet of Things (IoT) is drastically changing conventional view of the present Internet towards an incorporated vision of savvy objects collaborating with one another. IoT also presents smart solutions by adopting heterogeneous technologies which are essential for the enhancement along with the adoption of Internet Protocol Version6 (IPv6) which provides an unique address to each thing connected to the network that allows the location and identification of connected smart devices. Detection of the physical status of smart devices through sensors together with collection and processing of detailed data, allows immediate response to changes in the real world. For example, parking slot sensors sensing the details every five seconds and sends to the monitoring system which will make the system alive. This fully interactive and responsive network provides a wide range of smart applications and services like smart parking, remote health care monitoring, intelligent transportation, smart distribution, home automation, systematic recycling, etc., will help the society at large.

Although the IoT concept has been around for several years now, it increases the potential attack surface for hackers and other cyber-criminals [1]. An increase in research has led to maturity in this field, yet, the crucial issues that have not been solved are heterogeneity, scalability, mobility, security, privacy, addressing, etc. More devices online means more devices that need protecting, and IoT systems are not usually designed for cyber-security, said Marc Blackmer, product marketing manager for industry solutions at Cisco[2]. One of the important challenges in IoT is security. IoT is mainly operational through Internet and the Integration of Wireless Sensor Networks (WSN). A challenge on the integration of WSN within IoT is to be a major bottleneck. The integration of security mechanisms and data privacy are also the major

concern. Any leakage of information could severely damage the privacy of users. Even if different wireless technologies are secured by their own, their integration generates new security requirements. The creation of end-to-end secure channels could be one of the steps in the creation of a securely integrated WSN. In order to avoid unauthorized users to access to the functionality of the WSN, authentication and authorization mechanisms must be developed [3].

An important move towards the IoT would be to facilitate suitable IP-based WSN technologies to support the network of things. In IoT, the 'things' are to be connected and controlled only through Internet Protocol (IP). Due to the depletion of IPv4, adopting IPv6 to the space of things is still questionable and more challenging. Creation of suitable and scalable identification mechanisms that can provide unique and virtual identifiers to all the different network elements is important. Protocols should be carefully designed in terms of the trade-off between interlayer independence and optimization [4]. Mobility management is one of the most important research issues. Because, mobility protocols are generally targeted for global mobility, it introduces significant network overhead in terms of increasing delay, packet loss, and signaling when mobile nodes change their point of attachment within small geographical areas. So methods for reducing handover delay are essential for the IoT[5]. Having studied the complexity in implementing IoT, there is a call from researchers worldwide to design an Integrated Architecture to resolve the technical issues in a coherent fashion.

In this paper Section I deals with introductory part; Section II presents the Review of Literature**.** Section III presence the proposed a IoT General Architecture. Section IV concludes the research work.

II. REVIEW OF LITERATURE

Research specialists have proposed distinctive designs to enhanced IPv6 internet of things and cloud computing. IoT methods are already created by the researchers. In this article we carried out some of the related research.

Zikria et al,this piece of work including the Internet of Things Applications and gives network architectures,

Montavont et al, have produced a complete evaluation of mobile IPv6 over 6LowPAN. Contiki based operating system for IPv6 is established and Diagrammatic representation of the data packet tunnelling, performance analysis by mobile IPv6. **Syamsuddin et al.** proposed a novel idea of accomplishing efficiency in cloud computing through IPv6 development. In this method offers many useful benefits. The author gives important features of IPv6 and useful for improving cloud computing infrastructure for this methods security, network management and performance. the problem study of this paper is find out decision making analysis and selecting the most important attributes of ipv6 for cloud computing. Author have introduced the application of Ternary Analytics Hierarchy Process it solves the problem of particular attribute selection of IPv6.This AHP (Analytics Hierarchy Process) provides simpler decision making process and less calculation o f complexity. Identifiers are the attributes are the important attributes in IPv6 to Authentication, mobility and interface streamline cloud computing development. **Raj et al**. presented a secure smartcard based parking services. Provides how the parking sensors communicated with the smart gateway or IoT networks and how the user access the IoT based parking services. **Gelogo et al.** proposed an IPv4 and IPv6 interoperability framework for cloud computing deployment. and provide the different transaction protocols such as Stateless IP ICMP Translator(SIIT) and Network Address Translator and Protocol Translator (NAT-PT).The author also provide some of the cloud computing and the different categories of cloud services. The author has introduced a new framework for dual stack mobile nodes. The dual stacked mobile nodes with both IPv4 and IPV6 enabled dual stack transaction protocol, serve as a bridge between heterogeneous network of IPv4 and IPv6 in order to support mobility. Dual stack Home Agent router that is fit for encapsulation, decapsulation, mapping of IPv4 and mobile IPv6 address.

Lamaazi et al. presents how to integrate the management protocols in IPv6 into the emerging IoT networks based on protocols such as 6LoWPAN and also provides IPv6 and its different management protocols overview. The authors focuses on the IoT based wireless Sensor Networks (WSN) and also provide some solutions of IP based WSN developments. Low power devices connected through internet with the help of 6LowPAN solutions also provided. Author has presented with COMAN (Management of Constrained Networks and Devices) which is used to account the networks and devices constrain, and their management. **Moghadam et al.** Has proposed a new EPC based IPv6 addressing mechanism with the help of reader NetID to provide a unique and hierarchical address for RFID. This mechanism has to overcome the addressing problem of RFID. This piece of work enumerates Advantages and implementation mechanisms are provided. EPC plays the major role in sharing and retrieving information in the safe way and it has three different groups: Object Name Service (ONS), Electronic Product Code, Information Services (EPCIS) and Electronic Product Code Discovery Services (EPCDS). Proposed method has generated a unique IPv6 address by using EPC code. **Geng et al :** has proposed Multi-frequency band 6LoWPAN accessing to IPv6.they have proposed the architecture of the interconnecting system of multi-frequency band 6LoWPAN accessing to IPv6 Internet. The data flow between ipv6 network to 6lowPAN given detailed. Proposed a scheduling mechanism based on the multiplexing technology and the TUN/TAP technology oriented uplink and downlink packets. The access test and the throughput test are done by the author. The test results are proved the proposed packet scheduling mechanism makes the gateway have a high throughput and tests showed that multi-frequency band 6LoWPAN can access to IPv6 Internet properly. Limitation: the authors didn't focus about the packet loss issues. **Choi et al:** proposed a PMIP based mobility schemes CoAP-PMIP and CoAP-DPMIP.PMIPv6 with CoAP method is helps to exchange the message data between mobile client and sensors. In this method authors have LMA (local Mobility Anchor) and MAGs (Mobile Access Gateways).In the second method is distributed PMIPv6 with CoAP here client can exchange with sensors with the help of DMAGs. The author also provided ns3 emulator test results and they produced DPMIP is the bset scheme

III. PROPOSED ARCHITECTURE

The aim of this Architecture is to access the IPv6 integrated IoT smart services through mobile devices in a secured manner at anywhere and anytime. The Architecture is to be designed by developing Authentication, Authorization and Accounting

of the devices and users. For each smart application a secured gateway is also to be designed for having access by the authorized users. The IPv6 protocol is used for communication between the mobile users, and smart applications through IoT. Figure depicts the proposed security Architecture. It involves smart applications, smart security gateway, integrated cloud and mobile users.

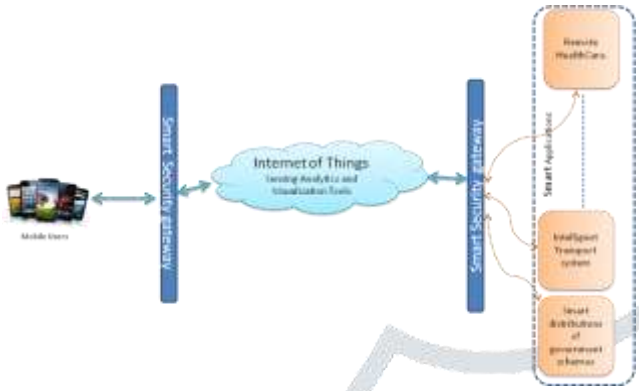

Fig. 1 IoT General Architecture

A. Smart applications:

Internet of Things have a lot of smart applications such as smart Distribution of Government Schemes, Intelligent Transport System, Remote Health Care, Smart Grid, Smart Cities, and Smart Home etc. In these smart applications is avail in the services of the respective fields. The smart application service provider can also enrolled and authenticate with the IoT centralized cloud holders.

B. Smart Security Gateway:

The Smart Security Gateway is the primary piece of the proposed architecture and assumes a key part in empowering the IoT enabled system to access to the smart application services. Smart security gateway performs the rich tasks and preprocessing. It checks the authentication methods and when it gets success it provides Smart Application Services to the user. Secondly Smart Security Gateway receives Low power sensors information and stored it temporally. Preprocess and it sends to an internet sever via IPv6 network.

C. Integrated IoT-Cloud

There are two different technologies which have already started dominating the information Technology. These are namely called Internet of things and Cloud Computing. The exponential development of both Cloud and IoT has influenced the innovation experts to predict a novel worldview where these two advances are coordinated together. Cloud and IoT have seen totally autonomous development. Integration of both technologies has several advantages. Integrated Cloud can help for the IoT to develop its applications and it will be access anything, anywhere, anytime. Integrated IoT cloud it offers the storage resources and also maintain a all user and application services providers credentials and databases.

D. Mobile Applications:

The mobile users are the beneficiary of the IoT services. Users can access the available applications through their mobile anywhere, they must be connected with the IoT systems, so that the before registered their details and authenticate with integrated IoT system via visualizing aid like android applications or any other user interface mechanisms. Registration must in the system so user can did various levels of authentication to access the services such as device authentication and user authentication.

IP version 6 low end IoT Model:

IP version 6(IPv6) is a new version of internet protocol and design as the successor to IP version 4(IPv4)[RFC-791]. IPv6 was introduced by the Internet Engineering Task Force (IETF). IPv6 gives many advantages such as large address space, auto configuration, simplified header formats, quality of services, IP Host Mobility, Multicast, security and innovative applications. It has a different type of transaction techniques such as Dual Stack, tunnelling and translation

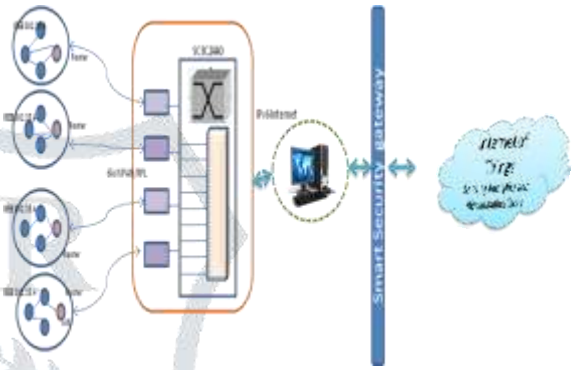

Fig. 2 IP version 6 low end IoT Model

1) *Large Address Capabilities*: IPv6 increases the IP Address size from 32 bits to 128 bits; to supports high level of addressing. It has some unique identities, auto configurations of addressing and high numbers of addressing nodes. The scope of the IPv6 is Multi casting Addressing.

2) Simplified header formats: reduce the common case processing cost of the pocket handling and limit the bandwidth cost of the IPv6.Table 1 illustrated the comparative case study of current IoT IPv6 Header and Exhausted IPv4

TABLE I

Exhausted IoT IP version 4 Header	**IoT IP version6 Header**
Version 4	New Version value 6
Internet Header Length	Removed
Type of services	Traffic classified
Total length	Pay load length field
Identification	Removed to fragment extension header
Fragment offset	Removed to fragment extension header
Type to live	Hop limit field
Protocol	Next header field
Header Checksum	Removed
Source Address	same, enhanced 128 bit length
Destination Address	same, enhanced 128 bit length
options	Removed Extension header

Table 2 shorted with a addressing methods present IoT integrated IPv6 Addressing methods and Existing IoT IP version 4 methods.Ipv4 has 32 bits Address that makes it to address 2^{32} unique address while IPv6 has 128 bits address.IPv6 is overcomes the old IPv4 Address formates.

TABLE III

Exhausted IoT IP version 4 Addressing	IoT IP version6 Addressing
Internet Address Classes	Not applicable
Multicast Addressing (224.0.0.0/4)	IPv6 multicast Addressing (FF00::/8)
Broadcast Addressing	Not applicable
Un specified Addresses is 0.0.0.0	Un specified Addresses is ::1
Loopback address is 127.0.0.1	Loopback address is ::1
Public IP Addresses	Global Addresses
Private IP Addresses	Site local addresses(FEC0::/10)
APIPA Addresses (169.254.0.0.16)	Link-Local Addresses (FE80::/64)
Syntax: Dotted decimal notations	Colon hexadecimal notations
Mask: Dotted decimal or prefix length	Prefix length notation only
DNS forward: A resource Record	AAAA resource records
DNS reverse: IN-ADDR.ARPA domain	IP6 ARPA domain

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IV. CONCLUSIONS

The faster development of the Internet of Things has been integrated with distributed cloud computing and IPv6 will be beneficial and more efficient. There are millions of registered users have got beneficial from the IoT infrastructure. In this paper, firstly discussed the widely accepted and deployed IPv6 integrated IoT and cloud architecture. And also explained its Components how the components are interacted with the Integrated IoT systems are given. Secondly we proposed IP version 6 low ends IoT Model and we did the comparison of header and addressing methods between old IP protocol and today's IP version 6 protocols. Our further research will be on IPv6 Integrated IoT security mechanism.

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