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SURVEY ARTICLE

A Survey on 6LowPAN & its Future Research Challenges

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Abstract: ----- The term (IoT) Internet of Things is well thought-out to be the subsequent or next big prospect, and test, for the Internet engineering society, clients of technology, society and companies as a whole. It entails linking embedded devices such as home appliances, weather stations, sensors and even playthings to the networks that are based on Internet Protocol (IP). According to recent surveys it is obvious that the number of IP-enabled embedded devices is growing fast, and even though tough to guess, will definitely outnumber the figure of personal computers (PCs) and servers in the prospect. Through the progresses made over the past decade in low-power radio, battery, microcontroller and microelectronic technology, the drift in the industry is for smart embedded devices called smart objects to turn out to be IP-enabled, and an essential part of the most recent services on the Internet. These services are no longer cyber, just including data created by humans, but are to become very associated to the physical world around us by counting sensor data, the monitoring and control of machines, and other sorts of physical context. We name this most modern frontier of the Internet, consisting of wireless low-power embedded devices, the Wireless Embedded Internet. In this paper we draw on the term low-power wireless area network (LoWPAN). This paper is all about 6LoWPAN, giving an overview of the technology and its future research challenges particularly taking routing, NEMO and Mobility into consideration.

Keywords: - 6lowPan, Zigbee, Smart Objects, IPV6

1. Introduction: - Steadfast wireless communications systems and above all industrial wireless sensor and actuator networks (WSANs) are eradicating the physical and economical fences/hurdles that formerly made it thorny or impracticable to entrée several types of information in the process industry. The core concerns about consistency, safety or security, and integration along with the lack of device interoperability have hindered the exploitation rate .Till now wireless networks act in accordance with the IEEE 802.15.4 standard which is based on proprietary protocols. However this does neither facilitate choices of easy expandability nor can these networks interoperate/compatible with other ones. With just preliminary beginning of the novel internet protocol version 6 there is an alternative now to allocate a worldwide distinctive address to approximately every device. This initiative came up to hook up sensor networks with the IPv6 world. And for this motive the IPv6 over Low power Wireless Personal Area Networks (6LoWPAN) task group of the Internet Engineering Task Force (IETF) has been established to pact with this theme/subject. If we glimpse so the Internet has been an enormous achievement over the earlier period of 20 years, rising from a small academic network into a worldwide, ever-present network brought into play on a regular basis by over 1.4 billion inhabitants. It was the supremacy of the Internet standard, strapping diverse networks together, and the ground-breaking World Wide Web (WWW) sculpt/model of uniform resource locators (URLs), the hypertext transfer protocol (HTTP) and universal content markup with the hypertext markup language (HTML) that made this achievable. As the Internet of personal computers, servers, routers and has been growing, an additional Internet uprising has been going on which we called The Internet of Things (IoT). The idea following the Internet of Things is that embedded devices or smart objects are unanimously becoming IP enabled worldwide, and a fundamental part of the Internet. Illustration of systems and embedded devices utilizing IP today varies from personal health devices, mobile phones and home automation, to smart metering, industrial automation and environmental monitoring systems. The level of the Internet of Things is by now anticipated to be massive, with the prospective of trillions of devices becoming IP-enabled. The brunt or impact of the (IoT) will be noteworthy, with the guarantee of improved environmental monitoring, smart grids, energy savings, better logistics, and more efficient factories, better healthcare and smart homes. Likewise vital expansion has been occurring in the services that are exercised to supervise and manage embedded devices. At present these services are almost unanimously built on Internet technology, and more usually are implemented utilizing web-based services. Web Service technologies have entirely altered the way enterprise applications and businesses are planned and organized. And this mixture of Web-based services and Internet-connected embedded devices crafts the IoT a prevailing standard. Millions of embedded devices are by now IP-enabled, but the IoT is at rest in its immaturity in 2009. Even though the aptitudes of power, processor and communications technology have incessantly improved, and so has the intricacy of communications standards, protocols and services. As a result, so far, it has been feasible to bring into play Internet abilities in solitary the most powerful embedded devices. Furthermore, low power wireless communications confines the handy bandwidth and duty-cycle on hand. During 1990s and early 2000s we have witnessed an outsized array of proprietary based networking and low-power embedded wireless radio technologies. This has split the market and sluggish down the exploitation of such technology. In 2003 The Institute of Electrical and Electronics Engineers (IEEE) unveiled the 802.15.4 lowpower wireless personal area network (WPAN) standard, which was the most important landmark, providing the first universal low-power radio standard. Immediately after that, the ZigBee Alliance built up a solution or a way out for ad hoc control networks over IEEE 802.15.4, and hence fashioned a lot of exposure about the applications of wireless embedded technology. Proprietary networking solutions ZigBee are vertically or perpendicularly bound to a link-layer and application profiles only work out a small fraction of the applications for wireless embedded networking. They also have troubles with evolvability, Internet integration and scalability. An innovative model was desired to make possible low-power wireless devices with inadequate processing capabilities (see Figure 1) to contribute in the IoT, forming what we entitle the Wireless Embedded Internet.

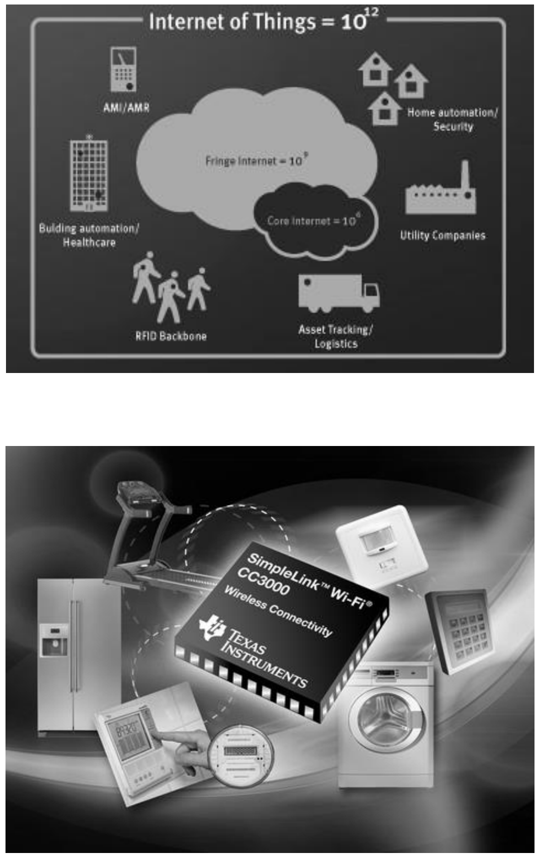

Figure 1: Wireless embedded 6LoWPAN device

6LoWPAN shatter down the hurdles to utilizing IPv6 in low power, processing-limited embedded devices over low bandwidth wireless networks. IPv6 was developed in past 1990s as a solution or key to the fast expansion and confrontation facing by the Internet.

• 6LoWPAN meaning:-

IPv6 over Low power Wireless Personal Area Networks.

• 6 in 6LoWPAN:-

The 6 is used because it is based on IPv6. IPv6 is the new Internet Protocol. IPv6 has replaced IPv4, because IPv4 runs out of address range. IPv4 offers 2^{32} = 4,294,967,296 IP addresses in the Internet. IPv6 uses 128-bit addresses, so the new address space supports 2^{128} = 3.4×10^{38}addresses.

• Lo in 6LoWPAN: -

Lo stands for Low Power. IP communications and Low Power consumption is usually contrary. IPv4 started in 1981. Vint Cerf, the originator intended to hook up some universities together. A communication standard for 2 billion people on this nice plant was not his objective. In addition 30 years ago our world was not that green as it is at present. We attempt to save power as often we can. Anyhow, we do save power because we would like to be green. We have to save power because the sensors are wireless on battery power.

• WPAN in 6LoWPAN:-

WPAN stands for Wireless Personal Area Networks. A WPAN is a personal area network for connecting devices around a person. A popular WPAN is Bluetooth. Bluetooth is in use to interconnect our computer accessories or our audio equipment like Bluetooth headset or hands free kit. 6LoWPAN is more. In 6LoWPAN you can create meshed networks with higher distance. By using 868/915 MHz instead of 2400 MHz the coverage in buildings is much better.

• 6LowPAN Protocol Stack:-

6LowPAN working group efforts on the research of IPv6 protocol suite based on IEEE802.15.4 standard, and puts up self-organization 6LowPAN network with route protocol [34]. Its emergence provoked the expansion of LR-WPAN. 6LowPAN technology bottom layer espouses PHY and MAC layer standards of IEEE802.15.4, and 6LowPAN desires IPv6 as the networking technology, its goal market primarily is wireless sensor networks. In view of the addresses and security are claimed in wireless sensor networks, plus an additional expansion of IPv6, initiating IPv6 protocol into embedded equipment has turn out to be an unavoidable propensity. But the payload length sustained by MAC in IPv6 is greatly larger than one afforded by 6LowPAN bottom layer, in order to put into practice the seamless connection of MAC layer and network layer, 6LowPAN working group recommended that adding or toting up an adaptation layer between MAC layer and network layer to accomplish the header compression, fragmentation, reassembly and mesh route forwarding. The reference model of 6LowPAN Protocol Stack as shown in Figure 2.

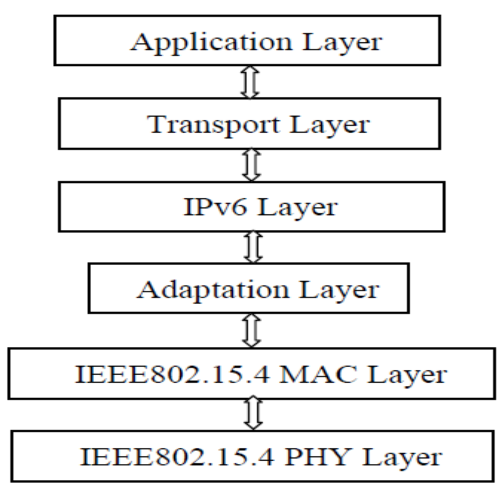

Figure 2: Reference model of 6lowpan protocol stack

2. History and Standardization: -

6LoWPAN is a set of standards defined by the Internet Engineering Task Force (IETF), which constructs and sustains all core Internet architecture work and standards. 6LoWPAN standards make possible the efficient and resourceful utilization of IPv6 over low-power, low-rate wireless networks on simple embedded devices all the way through an adaptation layer and the optimization of related protocols. The IETF 6LoWPAN working group was legitimately founded in 2005, even though the history of embedded Internet Protocol goes back farther. All the way through in 1990s it was presupposed that Moore's law would progress computing and communication competence so quickly that in next to no time any embedded device may possibly put into practice the IP protocols. Even though to some extent true, and the Internet of Things has matured quickly, it did not grasp for cheap, low-power wireless radio technologies and low-power microcontrollers. A huge majority of simple embedded devices still employs 8-bit and 16-bit microcontrollers with very restricted memory, as they are low-power, cheap and small. Premature work on diminishing Internet protocols for bringing into play with low power microcontrollers and wireless technologies comprises NanoIP from the Centre for Wireless Communications [1] and μIP from the Swedish Institute of Computer Science [2]. IEEE 802.15.4 standard unveiled in 2003 and which was the major aspect leading to 6LoWPAN standardization. For the very first time a worldwide, extensively supported standard or model for lowpower wireless embedded communications was presented [3]. The esteem of this innovative standard gave the Internet society the required back-up to regulate an IP adaptation for such wireless embedded links. And consequently the first 6LoWPAN specifications were uncovered in 2007, first with an informational RFC [4] indicating the fundamental requirements and objectives of the primary standardization, and then with a standard track RFC [5] stipulating the 6LoWPAN format and its functionality. In the course of experience with implementations/executions and exploitations, the 6LoWPAN working group kept going to work on improvements to header compression [6], 6LoWPAN Neighbor Discovery [7], use cases [8] and routing requirements [9]. Then in 2008 a new IETF working group was fashioned, Routing over Low-power and Lossy Networks (ROLL) [10]. The task of this working group was to identify routing requirements and elucidations or solutions for low-power, wireless, erratic networks. Though not limited to exploit with 6LoWPAN. In 2008 ISA initiated standardization of a wireless industrial automation system called SP100.11a (also known as ISA100), which is 6LoWPAN based. Up to date activities and events allied to 6LoWPAN comprise the IP for Smart Objects (IPSO) Alliance established in 2008 to advance the exploitation of IP in smart objects and Internet of Things business [11], and the IP500 Alliance which is developing or crafting a recommendation for 6LoWPAN over IEEE 802.15.4 sub-GHz radio communications [12]. Consortium (OGC) spells out IP-based elucidations for sensing and geospatial applications. In 2009 the European Telecommunication Standards Institute (ETSI) [13] established a working group for regulate M2M, which consists of an end-to-end IP architecture companionable with 6LoWPAN.

3. Relation with Other Trends:-

We have numerous other trends to take into consideration when making judgment about the Internet of Things. These comprise machine-to-machine (M2M) communications, ZigBee, wireless sensor networks (WSNs) and the Future Internet.

ZigBee is a protocol specification or pattern from an industry particular interest group called the ZigBee Alliance, concentrating in an ad hoc control [14]. It is in progress since 2003 in conjunction with IEEE 802.15.4 standardization [15], and indicates a vertical protocol stack elucidations/solutions with resemblances to Bluetooth. It mostly exploits IEEE 802.15.4 features, adding service discovery and application protocol profiles, and ad hoc networking on top of that. This Alliance publicized in 2009 that it will initiate to put together IETF standards such as 6LoWPAN and ROLL into its upcoming specifications. Previous work has revealed how ZigBee application profiles can be passed over 6LoWPAN and UDP/IP [16].

Machine-to-machine (M2M) communications has turn out to be a fashionable industry expression for the remote monitoring and controlling of machines over the Internet. Usually, M2M systems consist of M2M modules usually a cellular modem incorporated into embedded devices together with an Internet-based back-end system. The M2M module computes and manages the device, and communicates over Internet Protocol with the back-end Machine to Machine service. In recent times, M2M gateways to local embedded networked devices have turn into more common. Credit goes to native IP, 6LoWPAN networks are able to connect with M2M services through simple routers and consequently 6LoWPAN can be well thought-out to be an accepted expansion of M2M.

The Future Internet [17] is an expression used to portray research, that how the Internet protocols and architecture could look like in 10 to 20 years. The US National Science Foundation has a long-standing program on Future Internet Design (FIND) which covers up network architecture its principles as well as mechanism design [18]. Also numerous European projects concentrate on Future Internet research, for example the EU 4WARD project [19], in collaboration with the European Future Internet Assembly [20]. One of the themes of the project is how 6LoWPAN and wireless embedded networks type functionality can be made an essential and integral part of the Future Internet.

Wireless Sensor Network (WSN) moves toward from a scholastic movement starting in the mid 1990s into research on low-power ad hoc wireless networked actuators and sensors. The US government was very fascinated and engrossed in the application of low-power sensing in security and military applications, and granted an extensive fund for the subject matter. The research area soon after developed into an extensively fashionable subject with a huge range of applications, and a vast collection of trials and results. More recently the marketable applications, significance of standards, and the significance of Internet services have encouraged the WSN society to turn out to be involved with IPSO Alliance and the 6LoWPAN Standardization.

4. 6LoWPAN Applications:-

The motives why there is such a hefty or outsized number of scientific solutions in the wireless embedded networking market is that market of embedded applications, scale and the requirements, fluctuate riotously. The range of these Applications can be from personal health sensor monitoring to large scale facility monitoring, which vary significantly. The perfect utilization of 6LoWPAN is in applications where:

A) Embedded devices required to communicate with Internet-based services.
B) The network desires to be unwrap/open, reusable and evolvable for new exploitations and services.
C) Low-power heterogeneous networks have to to be coupled together.
D) Scalability is required across outsized network infrastructures with mobility.
E) Connecting the Internet to the physical world facilitates a wide range of interesting.

F) Applications where 6LoWPAN technology may possibly be applicable, for example:
G) Healthcare automation and logistics
H) Home and building automation
I) Enhanced energy efficiency and effectiveness
J) Personal health and fitness
K) Industrial automation
L) Real-time environmental monitoring and forecasting
M) Smart metering and smart grid infrastructures
N) More supple/flexible RFID infrastructures and exploitations
O) Enhanced security systems and fewer detrimental defense systems
P) Vehicular automation
Q) Asset management and logistics

4.1. Facility Management:-

This is a very appealing application for the Internet of Things, and is one use case that has been scrutinized in depth by the SENSEI project [21]. It entails the incorporated management of building facilities. F.M services are becoming more familiar, and are usually web-based. Wireless embedded networking has an outsized collection of applications in facility management including the following:

Door access control: This application entails the use of RFID or active tag based identifiers to manage and monitor the access to different parts of a building automatically.

Building automation: It involves the use of sensors and control to advance the operations and effectiveness of a building.

Tracking: This application engages the use of active tags on inhabitants or personnel's, supplies and equipment which are followed/tracked by the wireless infrastructure throughout a facility. Tracking results are employed in security and logistics optimization, asset management.

Energy reduction: Energy cutback in facilities can be accomplished through smart lighting control, ventilation and air conditioning control, heating control, and the automatic power control of electric equipment.

Maintenance: An accurate maintainability of facilities can be enhanced through the remote monitoring of the building itself and the systems in the building which at present are normally monitored manually.

Smart metering: The utilization of resources in hefty facilities can be condensed and better controlled through more intelligent metering of electricity, gas and water using an automatic metering infrastructure (AMI).

The stakeholders in facility management comprise the suppliers of intelligent facility management systems and services, consumers of these services and third parties. The suppliers of facility management services take an imperative responsibility as a massive amount of data desires to be collected or composed, processed and leveraged to endow with the services mandatory in a favorable way. The automation systems in facilities might consist of building automation, access control, maintenance monitoring and metering systems and tracking. Clients of facility management include building holders/owners or renters, building users and facility managers. Furthermore several third parties are occupied with facility management such as insurance companies and utilities security companies.

5. Internet protocol version 6 (IPv6):-

Today's internet is based on internet protocol version 4 (IPv4). Developed in early nineteen-eighties it endows with more than 4 billion addresses. Due to the massive expansion of web-enabled devices scientists assumed that at the end of 2011 no more IPv4 addresses would be available [22]. IPV4 wraps up an address space of 2128 addresses that would be 6.7_X10^{23} addresses per square meter surface of the earth. Therewith the new requirements can be provide somewhere to stay for decades. Internet Protocol (IP) is employed in the worlds largest networks. Every desktop computer (PC) hold ups IP, which constructs IP idyllic to bring into play when one desires to hook up a wireless sensor network to a larger backbone network. Setting up a wireless sensor network can even be administered by the IT department on a company, without any acquaintance of RF networks at all. IP is not optimized for low-power, low-cost sensor networks. But since it's a very supple protocol it can moderately be tailored to craft an ideal fit for a wireless sensor network.

Addressing:

As far as addressing is concern so the most observable distinction between IPv4 and IPv6 is the number of addresses supported by these two versions. IPv4 holds up 2^32 addresses, while IPv6 holds up 2^128 addresses.

A usual IPv6 address might look like this:

2001:0000:0000:0000:0000:00FF:FE00:0301 all leading zeros can be omitted, leaving the address to look like: *2001:0:0:0:0:FF:FE00:301*. At last zeros in the center can be substituted by a double colon, leaving the address to: *2001::FF:FE00:301*

All IPv6 networks have a prefix. All devices in the similar network have the same prefix. The prefix is written like this: *2001:0:0:0:0:FF:FE00:301/64*, meaning that the prefix is 64 bits long. Thus the prefix for this example is: *2001:0000:0000:0000*

6. Zigbee vs 6lowPan:-

Following are some points which clearly tell us why ZigBee is not competitive, and shouldn't be weighing against 6LoWPAN and IPv6:

- ZigBee is a small-scale isolated ad-hoc networking while 6LoWPAN is extremely scalable networking as an end-to-end part of the Internet, it is IPv6.
- ZigBee is restricted to a solitary radio standard while 6LoWPAN is applicable to any low-power, low-rate wireless radio (or even wired See www.watteco.com). IP protocols bind together heterogeneous networks.
- The only good part of ZigBee is application protocol profiles. And guess what, there is an IETF specification for using ZigBee profiles over UDP/IP. http://www.ietf.org/internet-drafts/draft-tolle-cap-00.txt
- ZigBee is not a standard; it is a particular interest group. Will it be around in a few years? The IETF constructs open, long-lived, standards. IPv6 will be around for 20+ years.
- Large-scale enterprise automation, M2M, metering systems etc. require end-to-end addressing, security, mobility, traffic multiplexing, reusability, maintainability, and web-services which are globally scalable… this is the kind of thing IPv6 was designed for.

7. Why 6LowPan:-

7.1. Smart devices Networking: the future is IP:-

Just like cars, modern buildings make use of an ever growing number of sensors which are requisite by an innovative regulations for air quality, energy etc. The conventional building automation approach uses a mixture of self-regulating vertical field bus networks for lighting, HVAC, closure control, metering, etc. This network frequently exploits wired buses, generating a tremendously complex web of thousands of wires. This was also the circumstances of computer networking in back 1980s. Internet Protocol crafts a basic distraction as it allows an agnostic networking layer that holds up any application and any vertical use case. IP/Ethernet networks are progressively more utilized in the core backbones of buildings.

6LoWPAN is capable to enlarge the reach of IP even farther. It becomes possible to construct low bit rate IP networks over wireless links for instance. From the building IP backbone, you can now get to almost any building location without wires, and consequently deploy luminosity sensors, temperature; submeters for a fraction of the installation costs of non IP wired solutions. Low power IP networks also inherit from the military origin of the Internet a high flexibility and automatic configuration, the standard RPL routing protocol forms a mesh network automatically without a need to configure complex routing tables. Even better, it will restore the network automatically whenever possible!

All applications, even proprietary sensors, can distribute one single IP network eliminating redundancies. This IP network can merge multiple physical transmission technologies and even evolve over time, without any impact on connected devices.

7.2. Friendly for developers:-

The majority developers at present are familiar with IP networking. Do you want to make clear in your mind that a sensor is connected, just use ping command! Do you want to learn the routing topology, use traceroute! For developers with a telecom profile, it is achievable to interact with sensors straightforwardly utilizing standard CoAP and UDP. Developers having an IT Background are more familiar with the web, Watteco endows with a friendly XML REST interface that feels just like browsing a web site, and automatically takes care of effortless tasks like historization of data points. This will drastically diminish the cost and development time your fresh/new projects.

7.3. Standard based Stack:-

- IEEE 802.15.4 (Sub GHz or 2.4 GHz) - 6LoWPAN (RFC 6282) - IPv6 (RFC 2460)
- RPL (RFC 6206-6550-6551) – CoAP (Drafts Core, Link Format, Blockwise and Observe)
- Application profile: IPSO or ZigBee® ZCL
- Frequent interop tests with other vendors
- Based on the Contiki open source operating system

8. Literature & Research

Studies: - There have been many studies on NEMO and group mobility. 6LoWPAN brings into play the PHY and MAC layer protocols defined in IEEE802.15.4, while the upper protocol in network layer is the IPv6 protocol. To prop up seamless data transmission between MAC layer and network layer, a network adaptation layer between them is initiated by 6LoWPAN working group. The adaptation layer is accountable for the fragmentation, reassembly of fragments, IPv6 header compression, broadcast headers and handling of the mesh addressing. In the field of safety monitoring applications, IPbased WSNs are more vigorous and can timely and efficiently observe the occurrence of disasters in order to diminish losses. IP technology is of an immense importance in WSNs. As an extension of mobile IPv6 (MIPv6) protocol, NEMO [23] is standardized by IETF, used to hold up the network mobility; mobile router (MR) can endow with network connection for mobile network. NEMO protocol is based on the development of mobile IP technology. The NEMO network is composed of mobile router, and MNNs, home address (HA). The communication between all MNNs and Correspondent Node (CN) is completed through a bidirectional tunnel between MR and MR-HA. Compared with other mobile network technologies, NEMO has clear benefits in bandwidth, cost, and so on. In [24] Authors proposed a WSN model based on IPv6 over Low power Wireless Personal Area Networks (6LoWPANs) in mobile sensing application scenarios. Wireless mesh sensor network (WMSN) infrastructure and Network Mobility (NEMO) protocol are deployed to ensure the continuity of the communications. In [25, 26], the authors has proposed the IPv6 enabled mobility framework to advance the user mobility experience. Utilizing NEMO we can endow with a flexible network integration mechanism across Wi-Fi, WiMax, and UMTS systems vertically. The flexible approach rise above the restrictions of different networks access denial when nodes move using two operations: Policy enforced handover management and Dynamic handover implementation. NEMO has been deployed to enable WSN with improved mobility experience [27]. The network, which MR and MNNs initially register when they are not moving, is marked as their home network. While MR and MNNs are attached to their home network, MR is assigned a home address (MR-HA), and MNNs are assigned IP addresses with a common mobile network prefix (MNP). When MR with the mobile nodes moves into a foreign network, the MR will configure a care-of-address (CoA) through receiving the route advertising (RA) message from the Internet access router (AR), and then MR informs the new CoA and MNP to its MR-HA. Two bindings; that are between new CoA and MR-HA and between MNP and MR-HA can then be set up, and a bidirectional tunnel between MR-HA and MR is established. When the packet destined for MNNs arrives at the home network, the MR-HA intercepts it and sends it to the mobile router with new position [28] [29]. In NNRO, all MRs of the NEMO configure a CoA with topological significance through Dynamic Host Configuration Protocol (DHCP) in WMSN based on 6LoWPAN [30]; they are straightforwardly registered to CN. Multiple MRs form a tree hierarchy in which the root MR is called the top-level MR (TLMR). Each MR has IPv6 addresses which connects to TLMR through the IPv6 address and endows with host routes in nested NEMO internally. The data packets are sent to the authorized IPv6 address of the NEMO through the route. The new processes evade multiple encapsulations of data packets while dipping the communication complexity between two sensor nodes in the similar mobility group. In addition, [31] provide mobile access router (MAR) for the nested network to complete the transformation of DHCP request [32].

9. Research Challenges:-

6LoWPAN is a protocol classification to facilitate IPv6 packets to be carried on top of low power wireless networks, particularly IEEE 802.15.4. The notion was born from the scheme that the Internet Protocol could and should be applied to even the smallest of devices. The initial goal was to define an adaptation layer – "IP over Foo" to deal with the requirements forced by IPv6, such as the increased address sizes and the 1280 byte MTU. The ultimate design takes the concepts or theories employed in IPv6 to fashion a set of headers that allocate for the resourceful encoding of large IPv6 addresses/headers into a smaller compressed header – sometimes as small as just 4 bytes, while at the same time allowing for the utilization of various mesh networks and supporting fragmentation and reassembly where needed. It concludes with open problems and challenges for further development and research. There are still a number of areas to be explored and investigated. The 6LoWPAN Task Group is continuing to probe the areas of Neighbor Discovery (determining the IPv6 network prefix, local routers, and other network configuration parameters), Secure Neighbor Discovery, Service Discovery "to automatically locate other sensors and controllers and available higher layer services", Security "applying IPsec to these small nodes is problematic", and Life Cycle Management "how are the nodes bootstrapped, how is the network commissioned, and maintained, how are updates applied to the embedded codes", as well as the development of new 6LoWPAN header types. Along with these, the area of proficient route over protocols designed for these low power networks is of an intense interest and a novel working group "RSN- Routing for Sensor Networks" may be formed. Last but not least is the question of how to mix the mesh under and route over mechanisms. 6LoWPAN does not work out all of the problems and issues related to sensor networks and low power RF applications. It does endow with a diminutive, unwavering, well understood, and open beginning upon which to build prototypes, pilots, test-bed networks and devices which can be used to explore these areas of research. With the maturation of wireless sensing technologies, the mobile sensing communication systems are extensively applied and set out on a comprehensive scale. The claim for information and mobility businesses anticipates that some of the fixed and mobile nodes in wireless sensor network are composed of a collection of subnets as a whole, while the whole can move and access the Internet seamlessly. It is vital that we require mobility mechanisms/schemes to prop up the mobile of a subnet terminal and single terminal. E.g. mobile personal area networks where the sensor networks are organized in vehicular objectives such as automobiles, trains, and aircraft [33]. Currently, the research for IPv6 subnet mobility is lacking basic studies. A lot of technical details required to be further enhanced. Routing optimization issues comprise nested multilink, multilayer, reliability, safety and many other internal problems; those problems significantly restrict the sensible deployment of the network. Therefore, the network mobility is essential to be explored to work out the existing problems ISRN Sensor Networks of NEMO and to accomplish further performance optimization of mobility management technology; it is vital to put forward new routing algorithms for next generation IPv6 sensor networks. Other imperative research topics are interoperability between dissimilar wireless systems, availability and meeting real-time assurances where latency is a significant stricture to take into consideration.

Conclusion:

Although 6LoWPAN is not as widely known as some other standards such as Zigbee, 6LoWPAN uses IPv6 and this alone has to set it aside from the others with a distinct advantage. With the world migrating towards packet data, a system such 6LoWPAN offers many advantages for low power wireless sensor networks and other forms of low power wireless networks. So the winner will be the end user like you and me. The losers will be ZigBee, Z-Wave and all the others that are trying to trade wireless remote controlled AC-Plugs and other objects for our Smart Home. Because of its tawdriness and expediency, 6LowPAN exhibits an enormous market foreground. Any equipments which entail the characteristics of low price, low power, low-rate and solid deployment, may possibly be realized by 6LowPAN technology, particularly in the Wireless HART, industrial wireless domain, and ISA100.11a standard all exploit 6LowPAN to pull off reassembly fragmentation and routing optimization. For that reason, when 6LowPAN technology is completely practicable and decidedly persistent, it must bring immense expediency to people's work and life.

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