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Design and Implementation of 6lowpan Using Coap in Internet of Things

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Abstract;- **IPv6-enabled low-power wireless personal area networks of smart objects (6LoWPANs) play an important part in the Internet of Things (IoT), especially on account of the Internet integration (IPv6), energy consumption (low-power), and ubiquitous availability (wireless). This paper presents our experience of designing and implementing 6LoWPANs for developing IoT applications. The performance evaluation provides a comprehensive analysis on several communication aspects between 6LoWPANs and regular IPv6 networks such as energy consumption, network performance, and service communication.**

Keywords: CoAP,6LoWPAN,IPv6,Internet of Things(IoT)

1. INTRODUCTION

The most important requirement of IoT is to provide connectivity between devices to attain a seamless end-to-end D2D communication for success of IoT.IoT contains a set of moving as well as stationary components, multiple issues arise in the development of routing protocols where these devices will intercommunicate with each other.Internet of Things (IoT) allows people and things to be connected anytime, anyplace, anything and anyone ideally using any path/network and any service.The main objective of IoT is to build highly interconnected system where devices will be the users of the internet. IoT consists of Internet connected objects like RFIDs, Sensors, Actuators, Instruments and smart appliances.It is Context aware communication and computing .It mainly works with IPv6 rather than IPv4.Powered mainly by Sensor Nodes(Motes) which are low cost , small size and power efficient.It is Real Time Guarantee.

2. 6loWPAN DESIGN

IPv6 enabled low power wireless personal area networks of smart objects(6LoWPANs) play important role in IoT.
The performance evaluation provides a comprehensive analysis on several communication aspects between 6LoWPANs and regular IPv6 networks such as energy consumption, network performance and service communication.6LoWPAN is used to make IP run over IEEE 802.15.4 networks.
The 6LoWPAN internetworking architecture is made up of 6LoWPANs, regular IP networks (IPv4, IPv6), and routers.

The overall architecture is presented in Figure 1 in which 6LoWPAN is an IPv6 subnet of smart objects sharing a common IPv6 address prefix (the first 64 bits of an IPv6 address). These smart objects can play the role of host or router to create a mesh network. 6LoWPAN is connected to regular IP networks through an edge router. The edge router forwards data packets between the 6LoWPAN and backbone IPv6, while handling IPv6 compression and neighbor discovery.Communication between 6LoWPAN smart objects and IP hosts in other networks happen in an end-to-end manner, just like between any regular IP nodes. Each 6LoWPAN smart object is identified by a unique IPv6 address, and is capable of sending and receiving IPv6 packets.

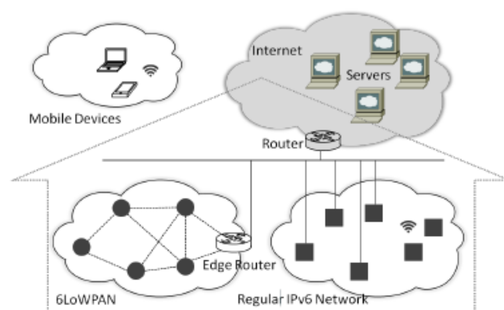

Fig1: 6LoWPAN Internetworking Architecture.

6LoWPAN smart objects can communicate with either of the regular IPv6 hosts, servers on the Internet, or personal users' devices. Smart objects support ICMPv6 traffic (ping),and use the User Datagram Protocol (UDP) as a transport. Since the payload and processing capabilities of smart objects are extremely limited to save energy, application protocols are designed to use a simple binary format over UDP such as Devices Profile for Web

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Services (DPWS) and Constrained Application Protocol (CoAP).

3. 6LoWPAN IMPLEMENTATION

We use the latest update of Contiki OS 3.x (version2015/02/16) with _IP protocol stack to implement IPv6 networking functionalities for the 6LoWPAN nodes. TI MSP430 toolchain on Ubuntu is used to compile the programs for CM5000 motes. These programs all configure the smart objects to use radio channel 26, ContikiMAC for duty cycling mechanism, router mode to create a mesh network, and MAC addresses to auto generate their IPv6 addresses (e.g., MAC 00:12:74:00:13: cb:2d:a6 for IPv6 aaaa::212:7401:1:101 address). On top of that, several modules are developed to provide different functionalities to the smart objects such as energy profiling, UDP server, and CoAP server.

4. CoAP DESIGN

CoAP is designed exclusively for smart objects to replace HTTP and can be easily translated to HTTP for a transparent integration with the Web, while meeting the smart object requirements such as multicast support, very low overhead, and publish/subscribe model. Since CoAP is not native to the Web protocols, a CoAP/HTTP proxy is a common approach to provide HTTP-based APIs for CoAP services. We mainly use CoAP to implement the Web application. The request/response message sizes and latency of CoAP and HTTP transactions.
CoAP messages apparently smaller than HTTP due to the the use of simplified headers compare to HTTP headers though the difference is at hundred kb. The round-trip time of CoAP and HTTP request are not much different and considered to be transparent to user's experience. Compared to previous releases, our experience with Contiki OS 3.x indicates that IP performance has been improved considerably. Besides, there are several useful libraries with Contiki OS such as Erbium CoAP, Web server, file system, and Shell. Contiki OS programming experience is very effective with protothreads for multi-threading and event-driven applications. Our experience suggests Contiki OS is very robust and can be the universal operating system for smart objects. There are several candidate protocol for application layer in IoT including HTTP, CoAP, DPWS, XMPP, MQTT, and AMQP. Among which, DPWS and CoAP are mostly close to common Web architecture aiming to bring functionalities of smart objects (data and events) to the Web in the form of services. By following Web design principles (REST, SOA), these services can acquire open Web standards to enable them to understand the Web languages and protocols, denoted as smart object services. CoAP follows REST architectural style, compromising a minimal subset of REST along with mechanisms of resource discovery, subscription/notification, and security measures for smart objects. It is similar to HTTP and can be easily translated to HTTP for a transparent integration with the Web, while having very low overhead. It also supports multicast and publish/subscribe model. The CoAP protocol provides a technique for discovering and advertising resource descriptions via CoAP endpoints using CoRE Link Format of discoverable resources. As standardized by IETF, CoAP is showing suitable for smart objects as well as getting attention from the community. There are many CoAP implementations available not only for smart objects (e.g., Erbium 5 for Contiki OS, libcoap for TinyOS, and SMCP 6 for embedded systems) but also for powerful servers (e.g., Java Californium 7), Web browser (e.g., Copper 8), and mobile platform (e.g., nCoAP). This protocol is showing an excellent choice to meet event-driven requirements from IoT application. A secure mechanism for CoAP transaction is expected to explored more to make it widely usable in real-life applications.

5. CoAP IMPLEMENTATION

CoAP (Constrained application protocol) is designed exclusively for smart objects to replace HTTP(Hyper text transfer protocol). Contiki OS is used with cooja simulator for implementation in IoT. It supports for multiple topologies and data rates between 20kbps to 250kbps. 6LoWPAN is used to make IP run over IEEE 802.15.4 networks. IEEE 802.15.4 is lightweight protocol which is known as Zigbee in IoT. IEEE 802.15.4 is small packet size -128 byte including MAC,103 bytes of payload.
Using CoAP protocol in cooja, the Contiki network simulator results are:

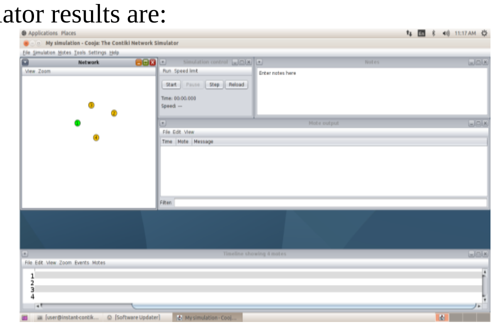

Fig2: Creating motes and start simulation control

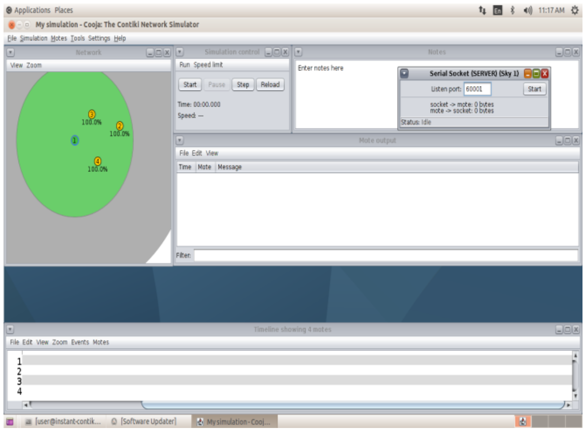

Fig 3: Set mote ids ,mote type and address ip

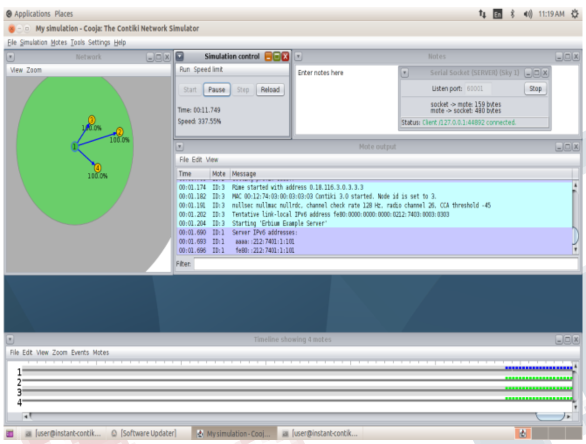

Fig 4: Start serial socket server

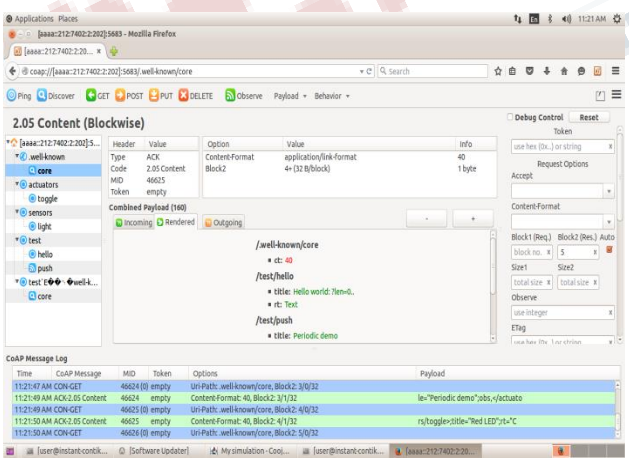

Fig 5: Connect to browser with router address coap://aaa::212:7401:1:101

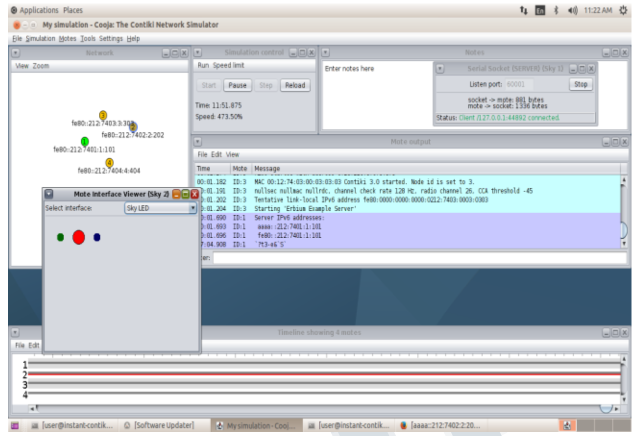

Fig 6: Mote interface viewer for sky mote2

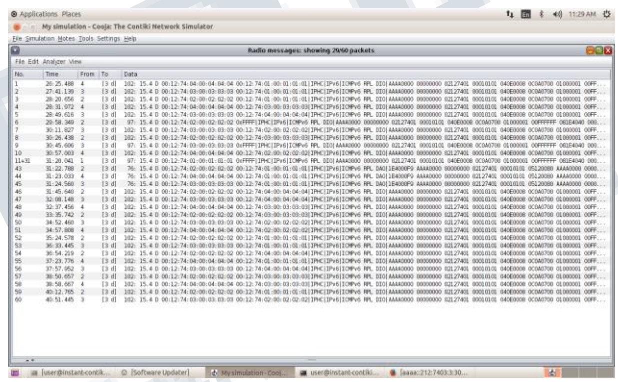

Fig 7: Radio messages of packets between the motes

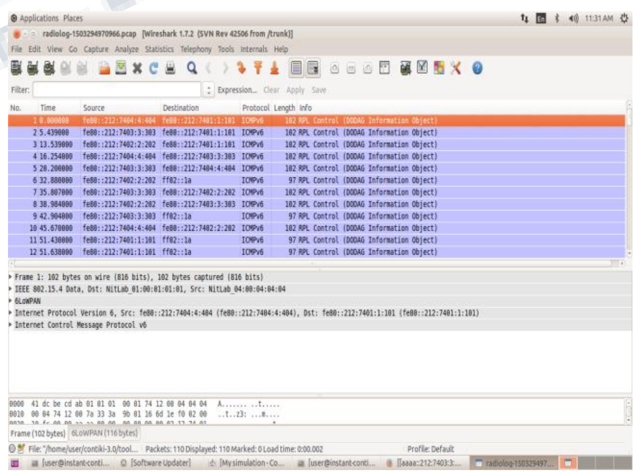

Fig 8: Results of Source and destination motes using 6LoWPAN

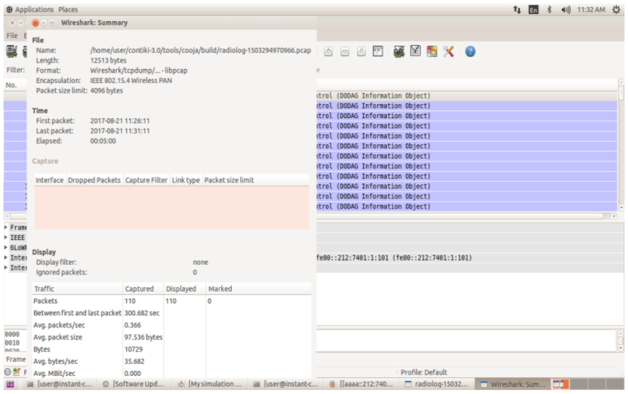

Fig 9: Summary of total packets captured and displayed

6 . FUTURE WORK

Implementation of RPL and other routing protocols and compare each protocol to know which protocol performance is the best one.

7. CONCLUSION

In IoT, research work was focused on implementation of 6LowPan using CoAP .Further ,there are other algorithms that can be implemented in IoT and compare their performance based on a set of network parameters.

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