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An Improved Approach for secure communication over wireless sensor networks in Home automation system using Thread protocol

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Abstract— With the quick evolution of the Internet of Things, the research community's interest is rising in device-to-device communication. This research paper mainly focuses on the wireless sensing network, Thread protocol Technology (Low power, low data-rate embedded networking stack) for device-to-device communication. Thread is an IPv6-based mesh networking protocol designed as a reliable, low-power, secure and scalable networking solution for connecting things to the IoT. It also enables self-organization and self-healing networks.

Keywords- Wireless sensing network, Home automation, embedded networking stack.

1. INTRODUCTION

Stand out amongst the most dynamic regions of innovation advancement is Wireless Communication within recent memory. The change of what has been supporting voice communication into a mode for supporting different administrations leads improvement in innovative zones, for example, the transmission of information, content, pictures, and recordings.

Subsequently, new remote limit's interest began developing at an extremely fast pace similarly as in 1990s interest for wire line limit expanded. Step by step, Increasing assortment of easy to understand boundless remote innovations and more extensive accessibility of open source devices for substance age, interactive media empowered terminals has lead energized user centric systems, which results into a requirement for productive structure for system. ^[1]

There has been a move to mobile cell communication from settled, results into Network Planning and Optimization related administrations coming in to sharp core interest. Because of advancement of remote access, innovation comes to about its fourth era. In the last fifteen years, Wireless systems and mobile have made enormous development. Presently days, numerous mobile telephones are furnished with a WLAN connector. Other than their 4G, 3G, WLAN, and Bluetooth connectors, numerous mobile telephones will have WiMAX connector sooner rather than later, On one side, Using IP for both 2.5G and 3G Public Land . ^[2]

2. Characteristics of Thread Protocol

Open standard protocol – Thread
is associate information processing primarily

based wireless networking protocol. It carries IPv6 packets primarily through 6LowPAN.

- Simple for customers to use – The installation of a Thread network is easy and intuitive for users. Users will add, authorize and take away devices onto the network victimization sensible phones or computers through a couple of easy steps.
- Secure – Thread networks square measure secure and encrypted. Thread uses smartphone-era authentication schemes and AES encoding to shut security holes that exist in different wireless protocols. solely approved devices will be part of the network.
- Power-efficient – Thread is meant to be battery friendly and needs little energy to work. Devices expeditiously communicate to deliver an excellent user expertise, nonetheless still run years on the littlest of batteries.
- No single point of failure - Devices operating in a very Thread network produce a mesh. This provides resiliency and removes any single purpose of failure.
- Designed to support a large style of product for the home: appliances, access management, climate management, energy management, safety, and security.[3]

3. Working of Thread Framework

Thread is an open IP based networking standard which is designed specifically for connected home appliances. It is based on the IEEE 802.15.4 MAC and physical layer operating at 250 kbps in the 2.4 GHz band. Thread uses simple protocol for forming, joining and maintaining the network.

Devices cannot join the thread network if they are unauthorized and the communications are unencrypted.

Thread is constructed on 6LowPAN (Low power Wireless Personal space Networks) that lets IPv6 packets to be sent and received over wireless networks. this permits even tiny devices to be connected to the net and so truly produce the net of Things.[4]

Below area unit some highlights of the Thread design.

- Built on well verified, existing technologies
- Uses 6LoWPAN (Low power Wireless Personal space Networks) and carries IPV6 knowledge packets natively
- Designed with a replacement security design to form it easy and secure to feature and take away product
- Supports 250+ devices per networks.
- Designed for terribly low power operation
- Legacy free style

4. Architecture of Thread Framework

The Thread design is made from ground up keeping device to device communication in mind. Since devices area unit making a mesh, one explicit amiss device (called host) cannot bring the complete Thread network down.

This is very similar to how the internet is made resilient – remember that it was designed to keep up communication while parts of it are failing. Moving to a mesh network topology makes home networks internet-grade.'

Typical Thread Network with single Border Router

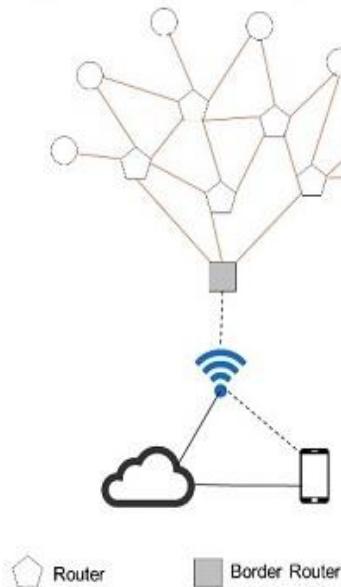


Figure: Typical Thread network with single Border Router

There could be three types of devices in a Thread network – border router, router and host or end devices.^[5]

Border Routers:

A border router is a specific type of router that provides connectivity from the 802.15.4 network (detailed information on this in the next paragraph) to adjacent networks on other physical layers .Border routers offer services for devices at intervals the 802.15.4 network, including routing for off-network operations.

There is also one or a lot of border routers in a very Thread network.Multiple border routers facilitate build redundancy and failover capability.In a single border router setup, if the

border router goes down, then the entire Thread mesh network also goes down.So for resiliency multiple border routers should be used, where if a border router is down, the other one can still continue and as a whole the Thread network still remains functioning.[6]

Routers:

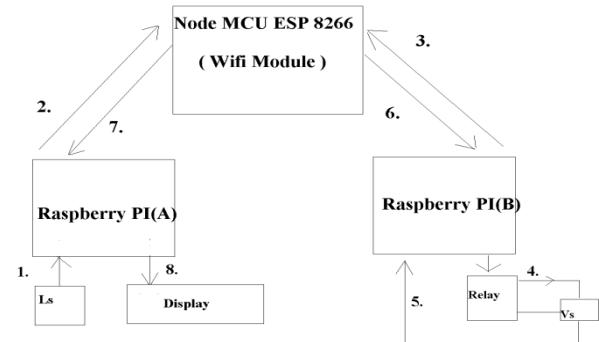
Routers provide routing services to network devices.Routers additionally offer connection and security services for devices attempting to affix the network. Routers are not designed to sleep, whereas hosts or end devices may enter a sleep-mode. [7]

Host:

Hosts(also referred to as sleepyheaded finish device s) area unit the top devices and sensors that area unit connected to the Thread network.

They communicate only through their parent router and cannot forward messages for other devices. [8] Thread has tremendous promises in home automation space.

5. Experimental network



6. Demonstration

Thread network protocol is a new technology. This thread network is used to home connectivity to internet of things. Internet protocol version 6 (IPv6) is used for routing device-to-device communication within an IEEE standard 802.15.4 wireless Personal Area Network (PAN) network. Thread is designed as power efficient, easy to use, and secure and every device in thread network is IP based devices. Main focus of the thread network is home connectivity to internet of things. Maximum number of nodes can be connected is 250. Operating band is 2.4 GHz. Public-key cryptography is used for security purposes. Low power consumption is also a good feature of the thread network.

Evaluation

Typical Thread Stack for IoT



IEEE 802.15.4 MAC

IEEE 802.15.4 PHY / Physical Radio

Typical TCP/IP Web Stack

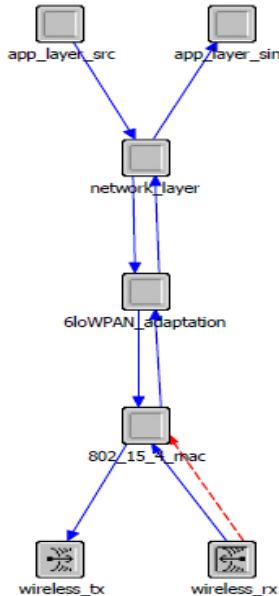
Application Layer (HTTP, DHCP, DNS, TLS/SSL)

Transmission Layer (TCP, UDP)

Internet Layer (IPv6, IPv4, IPSec)

Link Layer (Ethernet, DSL, ISDN)

7. COMPARISON



	Z-Wave	ZigBee	Thread
Operating range	100 feet	35 feet	100 feet (theoretical)
Max no. devices	232	65,000	250-300
Data rate	9.6-100 kbps	40-250 kbps	250 kbps
Frequency	908/916 MHz (U.S.)	915 MHz/2.4 GHz	2.4 GHz
Network type	Mesh	Mesh	Mesh
Needs hub?	Yes	Yes	Yes

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8. CONCLUSION

Though home automation is Associate in Nursing previous field, Google and Nest are trying to disrupt this space with Thread and they had a successful start. The new open normal Thread

protocol would facilitate device makers specialize in their product instead of disbursal time on network protocols.

The manner in which TCP/IP stack has been one among the explanations of the internet's success, Thread is also exposed to try to be the same for home automation.

Implementation of Thread protocol was challenging since there was lack of support and documentation. Additionally, challenges posed by OPNET 14.5 tool made implementation and results collection complex. Looking into OpenThread can be a good option to use for hardware implementation as it provides certified full stack software implementation.

Hence, implementation time can be reduced drastically. The challenge, however, is to porting Open Thread on top of a simulator framework, which has to be looked into.

9. FUTURE SCOPE

In this era of a digital and more connected world, various factors and demands triggered the emergence of wireless sensor networks (WSN).

a. Escalation of computing and electronic devices

in the lives of people due to swift advancement in semiconductor technology and miniaturization.

b. Exponential growth in the processing power of micro-controllers.

c. Advancement and convergence of wireless communications, digital electronics and electro-mechanical systems technology.

d. Signal sensing and conditioning integration into small sensor nodes capable of measuring and storing data through complex processing techniques.

e. Meteoric growth and advancement of wireless technologies, mainly for low-power and short range applications.

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