IOT Device Reliability in a Wireless Domain

Priyanka Krishnamurthy

Department of Electrical Engineering, San Jose State university, San Jose, California 95192.

Introduction

Internet of things [IOT] is a network of uniquely identifiable physical objects accessed through the internet. Analyst predicts approximately a $200 billion market for M2M and IOT Industry by year 2020 .

IOT applications are widespread and it brings important health and safety functionality to a home network. The project studies the impact of entertainment and consumer data on health and safety related IOT devices. Wireless sensor network is a key technology enabling IOT, connects a number of sensors, actuator nodes and devices to the network.

There is no standard protocol for IOT. Companies form groups to work on R&D on IOT devices and have implement their own standards.

Thread is a networking protocol that creates communication standard between household devices. Thread depends on Ipv6 over Low power Wireless Personal Area networks. Google, Samsung, ARM , Freescale Semiconductors along with others worked on thread.

Open Interconnect Consortium formed by Intel, Atmel, Dell, Samsung target smart homes and office solution. Qualcomm, Linux foundation formed AllSeen Alliance with other big players like Cisco, Microsoft, LG among other members. AllJoyn provides tool for connecting and maintaining devices on Wi-Fi network. Manufacturers can use the framework and create custom apps for devices with control and notification services

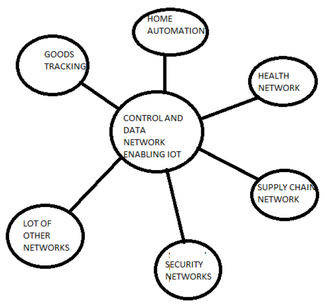
Methodology

CHARACTERISTICS AND APPLICATIONS :

- Interconnectivity, Heterogeneity, Scalability

APPLICATIONS

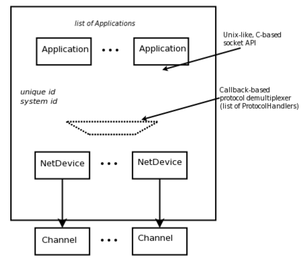
Health monitoring , wearable electronics, home security devices, Kitchen and electronic appliances



Methodology

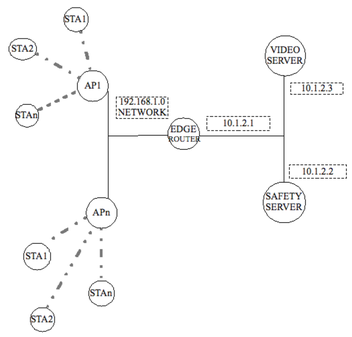
NETWORK SIMULATOR

Network Simulator 3 [NS3] is an open source discrete-event network simulator used for research and development. NS-3 is a C++ object system and is built as a library which is statically or dynamically linked to C++ program. NS-3 provides various models on packet flow in a data network and supports models involving Wi-Fi, WiMAX. It has models on current research areas like 6LOWPAN, LTE and Wi-Fi models. NS-3 simulation research supports both IP and non-IP based networks.



TOPOLOGY

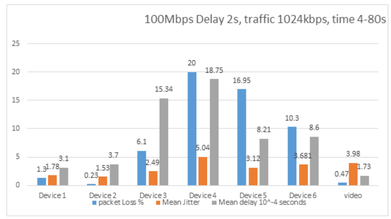
The topology has a home network connected to the outside network . The home network consists of Wi-Fi Devices. The devices can be sensors, health monitoring devices, entertainment and other consumer appliances which are connected to the wirelessly. The topology consists of edge node. This connects the internet and the home network. The internet consists of a video server and a safety monitoring server. The devices in the home network send continuous data to the safety monitor. The video server sends stream of data to the home network.



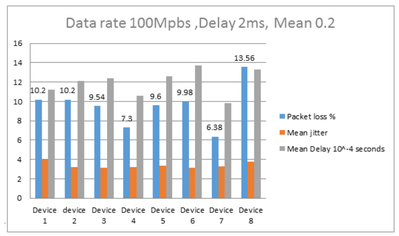
Certain applications are used in NS3 to generate traffic. The traffic generators used are Evalvid and On-Off application.

Results

Waf is used to build the code. The topology was tested for different network parameters such as data rate, delay on home network side and external network side. The number of access points and stationary points are configurable. The safety devices send data randomly over time period of 4 to 80 seconds using Poisson distribution process. The video server sends a file to a device on the home network. The video is sent in streams and the server takes around 75 seconds to send the data to a device in the home network.



Wireshark is the tool used to analyze the .pcap file generated by the code. The number of packets sent and received by the end to end points, mean jitter and delay is calculated using flow monitor module.



The graphs indicate the end to end packet loss, mean jitter and mean delay of the devices in the network for data rate 100Mbps with delay of 2seconds. The devices send data to the safety monitor server at a random interval depending on the probability of distribution.

As the graphs indicate the packet loss is distributed. It differs from one device to another although their functionality is the same. The packet loss is more when more devices send data in a short period of time. For this particular setup 7 is the optimal devices which send data at 1Mbps data rate to the server with probability distribution of 0.2 mean. The packet loss depends on the rate at which the safety devices send data. The packet loss also depends on video traffic .

Summary

The packet loss is more when the safety devices are modeled to send data for short duration of time.. When the devices send data over a longer duration of time, the packet loss was distributed among all devices.

From the above experimental result we see that the data loss can be high if there is congestion in the network which makes TCP protocol more suitable for safety devices.

Key References

[1] Internet of Things – From Research and Innovation to Market Deployment. Authors: Ovidiu Vermesan and Peter Friess.

[2] NS-3 Doxygen tutorial

[3] NS-3 Google groups

[4] Yeonghun Nam; Jong-Hong Park; Jong-Moon Chung, "Performance analysis of cooperative content delivery in wireless IoT networks,"*Consumer Electronics (ISCE 2014), The 18th IEEE International Symposium on*, vol., no., pp.1,2, 22-25 June 2014

[5] Terdik, G.; Gal, Z., "Advances and practice in Internet of Things,"*Cognitive Infocommunications (CogInfoCom), 2013 IEEE 4th International Conference on*, vol., no., pp.435,440, 2-5 Dec. 2013

[6] Whitepapers and networking magazines .

Acknowledgements

The author wish to thank Prof .Morris Jones who has been of immense support and help throughout the duration of this project. She is very thankful to the Electrical Engineering Department Chair Dr. Ray Chen and Dr. Tri Cauhoo for their support during the master`s studies.