Introduction and background, including highlights (if any) from lit review (1-2 min.)

Research question (1 min.)

Research design and methods (5 min. max)

Data sources and selection Findings (10 min.) [this should be your main focus]

Recommendations/implications (2-5 min.)

Summary and conclusion (1-2 min.)

Introduction, hello everyone, welcome to my presentation for the defence. I prepared 20 slides for the topic. It should take around 20 minutes.

The research topic of my thesis is Bluetooth Low Energy Based CoAP Communication in IoT. What I did is doing research on how to use the constrained application protocol in BLE. The subheading shows I proposed an architecture to implement the CoAP in WPAN which includes the BLE.

//content

In terms of content, I put the related works after the introduction to explain why I chose to do research in this area.

// introduction

First thing first, in recent years, more and more devices are involved in IoT. The picture shows the number of devices in IoT before 2015. Also, it made predictions in the coming future. Now, we can safely say the number of device has over the number of human population.

In internet of things The CoAP is an important protocol which has extended features of HTTP for example, the HTTP verbs and header attributes. As shown in the picture by default the CoAP is build on UDP and 6lowpan. The 6lowpan is short for IPv6 over Low Power Wireless Personal Area Networks.

//BLE

Think we all agree that the BLE is a very popular technology WPAN. In the latest version 4.2. The Bluetooth has adopted 6lowpan. As you can see in this picture, besides traditional BLE architecture. It has another set of layers on the BLE L2CAP. In this way, it obtains higher data rate and the support of IPv6. Thus technologies like CoAP run it’s default implementation on the latest BLE device.

There are attempts to use CoAP in other WPAN though gateways for different technologies. In those solution, CoAP requests will be convert into other format based on the protocol used in the WPAN.

// problem definition

Therefore, a question pop up in my mind. “Why devices can not directly send CoAP messages to each other without adding extra hardware”.

In my thesis I proposed an architecture to make CoAP work on existing communication protocols for WPAN such as BLE and NFC.

Meanwhile, BLE is used to explore how to overcome limitations of underline technologies.

// Problem

Goal 1. A general method to identify Non-IP based devices.

Goal 2. An architecture to support CoAP communication in BLE.

Goal 3. A background service to support multiple apps.

Goal 4. An interface to support other WPAN technologies.

//Architecture

9: The proposed architecture consists of two layers: Application layer & Network layer. The application layer provides friendly interface & hide detail implementation at network layer.

10. in the process component of application layer, there are processors to handle received messages & senders to send messages.

There are 5 general behaviors node be defended for a WPAN node.

11.

As I mentioned, detail implementation of underline technologies is placed in the network layer. And I use BLE in this research. In BLE the device who broadcast itself we say it’s a server. The one who try to connect others we say it’s a client. In the proposed communication mechanism, once the connection is created, both side will exchange supported APP’s information which is called announcement. The announcement consists of APPID and USERID. By exchange announcement, the other side always know how many APPS are running at the remote device. After announcement exchange both sides can send messages.

12.

In order to send CoAP message in BLE where the maximum packet size is 20 bytes. I proposed a protocol. As you can see the first 4 bytes are used as header, it consists of message TYPE APPID and USERID.

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I proposed 4 experiments to test performance of the architecture.

The first experiment is sending headers with different intervals to test the performance of constantly sending messages in a period.

The second experiment is sending long CoAP messages. It can test the performance of cut and assemble data.

The third experiment is round trip

The fourth experiment test the performance to support multiple apps.

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In experiment 1, headers are send out with different interval time. From the chart we can get three information. First, the average send time is around 100ms. Second, there are some heartbeat-like pattern happens regularly (interval time for BLE, if nothing need to send the system need to wait for a certain period of time). Third, some random fluctuations happen from time to time. (bad performance of Android implementation)

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In experiment 2, different size’s CoAP message are send out. We can see that in the chart no heartbeat-like pattern detected. This is due to the communication channel is continuity send data out without any wait time.

16.

The experiment three is round trip test. Here we found the time cost of a round tip is fluctuating.

This can be the evidence of bad performance of Android implementation.

17.

The latest experiment is try to get the performance of supporting multiple APPs. During the experiment, the system gets the total time game between send the first data and receive the latest data. Them divide by 100. From, the chart above, we know the competition of sending queue cause the average time of sending all messages are fluctuating.

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From the four experiments, we get four conclusions.

19.

A general method to identify Non-IP based devices.

An architecture to support CoAP communication in BLE.

A background service to support multiple apps.

An interface to support other WPAN technologies.

20.

In conclusion, the proposed an architecture to enable COAP communication in WPAM

* A general method to identify Non-IP based devices.
* An architecture to support CoAP communication in BLE.
* A background service to support multiple apps.
* An interface to support other WPAN technologies.

Although the research result has been published by IEEE[8] [9], further works need to be done for better performance.

21.

* Data Rate: try to use synchronize method to send data
* Availability: add cache
* Cross-Platform: add iOS solution
* Underlying Technology: other WPAN technologies
* Security: encrypt data.