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Summary

The main goal of this week was to examine the performance of jamming using Canopy. At the beginning of this week, preparing outdoor experiment was done. To build test environments, ESP32 was used to send LoRa packets. The directionality of the paper was changed, so use cases of LoRaWAN were investigated. According to directions, parts of the paper written before the subject was changed were rewritten. The second experiment was done on Thursday for the outdoor test.

What 454P completed this week:

- Conduct experiment of jamming in the roof-top of KNOY

  An outdoor test was conducted on senet and RAK, which are gateways. While using Three canopies at once, the problem happened that each Canopy offset the other. A canopy uses a directional antenna, so it can not send radio signals to narrow degrees. Therefore, just two Canopies were used. As a result, jamming for connection between the senet gateway and a tester was successful. For jamming performance in a real environment, the next test was conducted using ESP32[1] instead of a tester that had stronger signals. In an industrial site, ESP32 is a standard method for LoRaWAN. While the second experiment was conducted, 2 Canopies were not working due to a power supply problem.

  For this reason, ESP32 was jammed with only a set of Canopies which consisted of a client and a server. As a result, the borderline of jamming was 2 meters. If the distance between a gateway and an ESP32 was shorter than 2 meters, packets could be sent intermittently. However, if the distance was longer than 2 meters, any packets could not be sent. This experiment showed the effect of jamming on distance. The reason for this result is that Canopies communicate using TCP protocol. If it uses TCP, signals could have terms for the ACK process. In this short period, ESP32 could send packets.

Fig. 1. Jamming LoRaWAN on the roof of KNOY

- Rewrite the paper

  The main subject of the paper was changed. The prior subject was analyzing the vulnerabilities of LoRaWAN by trying various hacking methods. Novel one analyzed the influence of jamming attacks with canopies in three environments: indoors, outdoors, and close-in. This focused on jamming using Canopy and its performance in various environments. For this reason, parts of the paper written before should be altered. LoRaWAN use cases such as agriculture and medical areas were investigated for the new topic [2]-[8]. Abstract, introduction, and literature review of the paper were modified.

- Set up the four ESP-32 to test the jamming

  To set up the environment of the experiment, ESP-32 needed to send many packets to The Things Network(TTN)[9] server to calculate the Packet Delivery Ratio(PDR). There were various tutorials for setting ESP-32[10]-[12]. Repeated tests were required to set up four ESP-32 devices. However, there were several problems with setting up ESP-32. The first tutorial was just for LoRa, not for LoRaWAN. The second tutorial needed EUI to make enrollment, but the device did not have EUI on its website[13] because it needed to be updated. Following the final tutorial, sending packets could be done. Therefore, four ESP-32 could send 100 uplink packets to the TTN server.

Things to do by next week

- New gateway which is Kona micro lite[14] should be set for indoor test.
- Experiment will be conducted in farm which simulates the real environment for LoRaWAN.
- Indoor experiment will be conducted considering the medical areas.

Problems or challenges:

While trying to send a packet using uplink to The Thing Network, there was a problem finding their device EUI. During experiments for jamming using 3 Canopy, radio signals from Canopy offset each other. In addition, the subject of the paper was thoroughly changed. There was a need to find new papers and rewrite abstract and chapter 1 and 2.

While conducting experiments in outdoor environments, there were problems, unlike indoor ones. Power supplies did not work correctly, and the client could not connect to the server. For the next outdoor experiment, more variables need to be considered.

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