LoRa IoT Sensors in Low Power Wide Area Network (LPWAN)

Abstract:

Low-power WAN (LPWAN) is a wireless wide area network specification that interconnects low-bandwidth, battery-powered sensors with low bit rates over long ranges.

Created for machine-to-machine (M2M) and internet of things (IoT) networks, LPWANs operate at a lower cost with greater power efficiency than traditional mobile networks. They are also able to support a greater number of connected devices over a larger area. Most LPWANs have a star topology where each sensor connects directly to common central access device called Gateway.

To meet the challenges of long range, low power consumption and secure data transmission, the sensors are based on LoRa Technology and on LoRaWAN media access control (MAC) layer protocol that manages communication between LPWAN sensors and the Gateway.

In very large areas, LPWAN is likely separated to clusters and have a LoRa Gateway per cluster. Each cluster Gateway relays the LoRaWAN messages up to the LoRa Network Server.
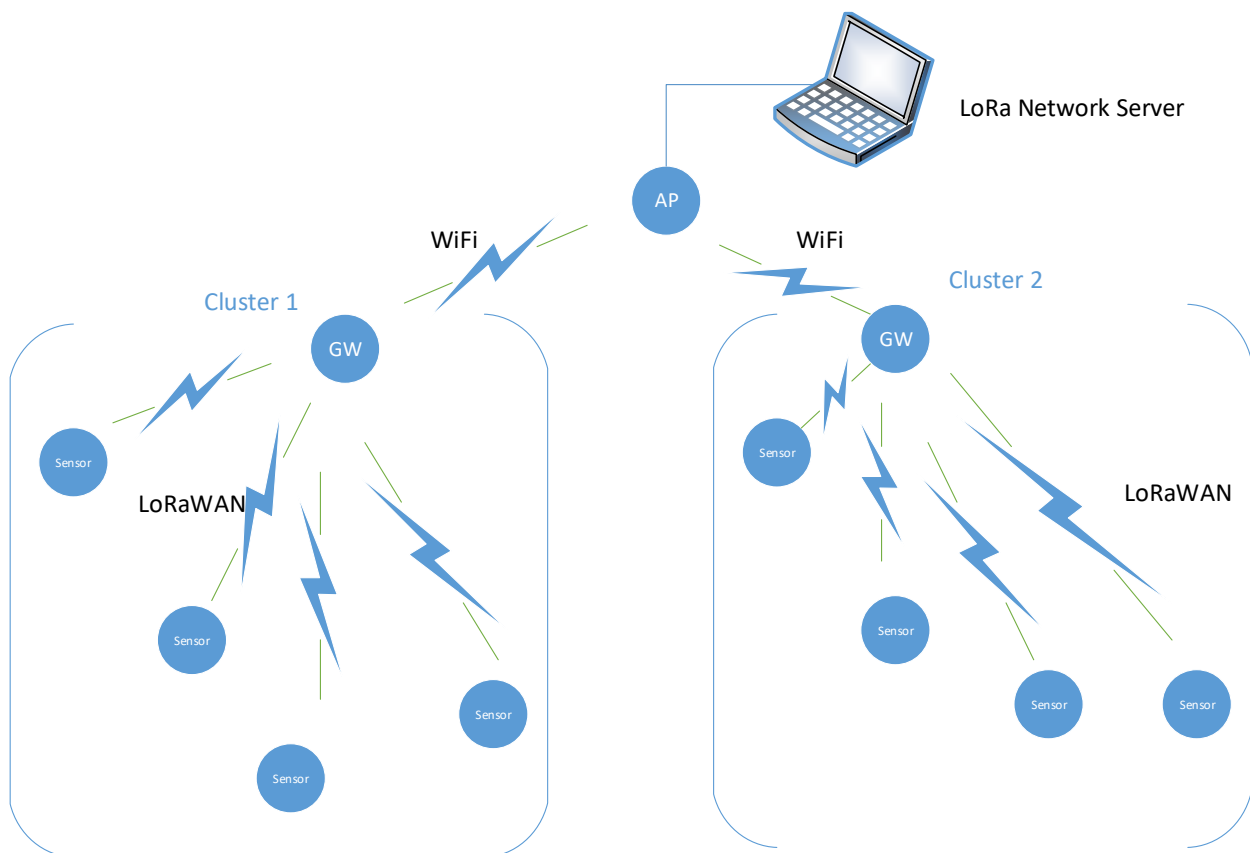
Goals:

1. Learn about LoRa and LoRaWAN.
   Refer to:
   https://www.lora-alliance.org/
   https://www.link-labs.com/blog/what-is-lorawan
   https://books.google.co.il/books?id=iSE6DwAAQBAJ&pg=PT108&lpg=PT108&dq=LoRaWAN+system
   s+can+receive+eight+messages+simultaneously&source=bl&ots=4uDTCW0rVm&sig=IIcolgkwCe0EiS
   RtFfqegns2cy0&hl=iw&sa=X&ved=0ahUKEwje2qS777nZAhVP26QKHU4pCbIQ6AEIJjAA#v=onepage&
   q=LoRaWAN%20systems%20can%20receive%20eight%20messages%20simultaneously&f=false

2. Raise development environment for the P-NUCLEO-LRWAN1 LoRa sensor board from
   STmicroElectronics:
   a. Refer to: http://www.st.com/en/development-tools/software-development-
      tools.html
   b. Refer to: https://www.mbed.com/en/ - It allows to compile on-line and has examples
      how to program the sensor board

3. Bring-up the sensor board
   a. Integrate MAC layer per 802.15.4e-2011 . Refer to:
      http://ecee.colorado.edu/~liue/teaching/comm_standards/2015S_zigbee/802.15.4-
      2011.pdf
   b. Ensure metering and Sleep/Wakeup functionality

4. Build LoRa gateway using Raspberry-PI 3 and P-NUCLEO-LRWAN1 LoRa sensor board. Refer to:
   https://www.youtube.com/watch?v=Ya-QlEaonLU

5. Create a Peer to Peer LoRaWAN connection between sensor and gateway including
   Sleep/Wakeup times. Refer to: https://www.rs-online.com/designspark/rel-assets/ds-
   assets/uploads/knowledge-items/application-notes-for-the-internet-of-
   things/LoRaWAN%20Specification%201R0.pdf

6. Raise LoRa Network Server – Refer to https://www.loraserver.io/

7. Implement LoRa packet forwarder in the LoRaWAN GW. This program will forward RF packets
   received by the GW to the LoRa network server through a IP/UDP link, and will RF packets that are
   sent by the server. Refer to: https://github.com/Lora-net/packet_forwarder

8. Raise 2 clusters sensors network, where each operates in a different frequency channel.
   Implement in the LoRa network server association algorithm that will choose the best GW
   for a certain sensor according to: SNR and number of already connected sensors.

Requirements:

Introduction to Networking (236334)

C Programming

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