



LoRaWAN at CERN vs pandemics: 1:0

Christoph Merscher

Introduction

Foreseen problems and their solutions

Other

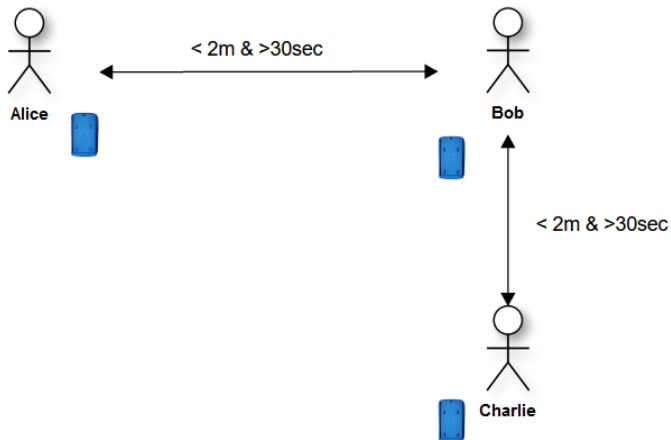
Conclusion

Introduction

Note

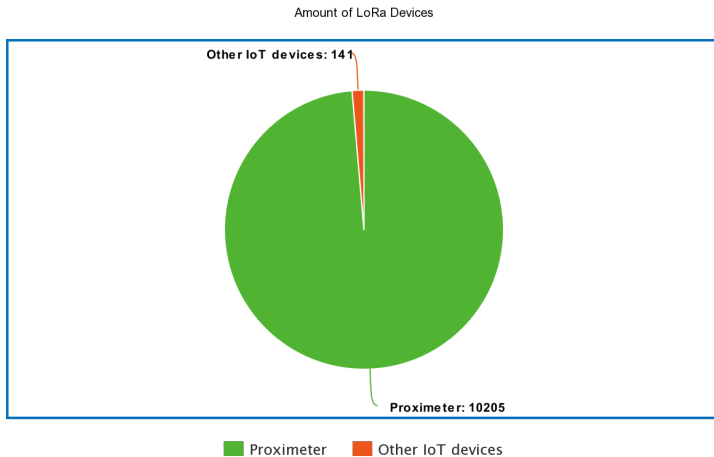
This is a continuation of the HEPIX talk LoRaWAN and proximeters against Covid from 18 March 2021.

- Proximeter - Quick reminder



Foreseen problems and their solutions

What happens when all devices are on site



What happens when all devices are on site

- **Problem:** At peak times (in the morning between 8 and 9:30) a lot of data packets were sent. Too much for the network to handle.
- **Solution:** Install more gateways, time joins in a way that not all devices tries to join at the same time.

LoRa being used in a hacky way

LoRaWAN projects should work without download and also without ACK.

LoRa being used in a hacky way

- **Problem:** Proximeter projects uses ACK on every package to ensure that a message has arrived.
- **Solution:** Decrease the SF to SF8, store messages on the device if a ACK is not received, install more gateways, minimize amount of messages by bringing together what can be brought together

What happens when other devices pollute the network

LoRaWAN use public frequencies in Europe:
EU863-870

What happens when other devices pollute the network

- **Problem:** Since the frequencies are open it happens that messages are received by a gateway which are not LoRa messages.
- **Solution:** Unfortunately there is no silver bullet. Keep monitoring the incoming messages and check the logs of the gateways and the network server.

What happens if one or several services are down

The network depends on different systems:

- MQTT
- Redis
- PostgreSQL

The network itself can also be divided into two parts

- Network server
- Application server

What happens if MQTT is down

- **Problem:** Messages are sent successfully from the LoRa device to a LoRa gateway but the gateway cannot forward it to MQTT.
- **Possible solution:** Having a queue on the Gateways, gateway bridge with queue, avoid down time as good as possible by using a MQTT cluster

What happens if MQTT is down

Our Solution:

- Use Rabbitmq with MQTT plugin
- Use Rabbitmq in a cluster



What happens if Redis is down

- **Problem:** Messages cannot be stored (temporarily) in a Redis database. Device information (such as device address) are lost.
- **Solution:** Use Redis in a cluster to avoid down time.

What happens if PostgreSQL is down

- **Problem:** Application server cannot get messages however messages are not lost.
- **Solution:** To reduce downtime of the service have a PostgreSQL cluster

What happens if the network server is down

- **Problem:** No endpoint subscribe to the MQTT topic, messages are not received neither deduplicated. However, messages are not lost.
- **Solution:** Use a cluster of network servers to avoid down time of the service

What happens if the application server is down

- **Problem:** Network server cannot forward messages to the application server. Messages does not arrive to the desired endpoint. Nevertheless, messages are not lost.
- **Solution:** Use a cluster of application servers to avoid down time of the service

What happens if the network server and/or application server is down

Our Solution:

- Use a cluster of network server and application server
- Each combination network server / application server installed on one server
- Use a load-balancer
- Use the same databases for all servers

Other

Software packages

- REST-API (with FastAPI) using MALT-Authentication was required
- IoT - CLI for executing common tasks
- Parser for registering more devices at once

Support

- Collect meta information of sent messages (sometimes more ≥ 30000 per day)
- Gather gateway information (almost 50 currently installed)
- Monitor gateways
- Analyze meta-information to counter attack errors and duty cycle violation

Conclusion

- 100% reliability cannot be reached
- Load balancing and clustering necessary to make the network more reliable
- Proximeter help to log encounters
- The LoRaWAN networked helped to limit the spread of the virus at CERN as much possible
- Lessons learned that help to improve the network for more applications to come



home.cern