# Infocom World 2022

**Title of talk: "Enablers and Scenarios for a Maritime – Multihop Architecture: The 5GROUTES Case"**

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# Outline

- Maritime Communication

- Use case

- Achievements

# Ferry as a test platform

# Main Target

- **Aim to enhance connectivity and quality of service via 5G technology**

- 5G connectivity during ferry trip

  - Satellite connection

  - 5G NR and Core on ferry communication infrastructure

- Test environment for freight and passenger use cases

  - Quality of service

  - For freight: IoT connection for trucks during the ferry trip

  - For passengers: more capacity and faster connection

  - For ship: capacity and IoT connectivity

# Use Case overview

Aim is to test **continuous connection** during the road-ferry trip. The UC focuses on freight transportation, where an FSU is tracking cargo through IoT sensors.
FSU is connected to the ferry communication infrastructure and it shares **location, temperature, video and time** data to backend systems via 5G ROUTES communication infrastructure. This data is used to analyze the QoS of connectivity. Aim of the tests is to monitor and measure the quality of service during the ferry trip, with various connectivity setups.

Also an **mMTC load simulation** tests during the ferry trip, where smart phones are used to generate a large amount of TCP data streams to test server. Aim is to execute this scenario continuously during the ferry trip.



5G

IoT

700 MHz
3,5 GHz

700 MHz
<35 km

3,5 GHz

700 MHz
<35 km

# mMTC testing
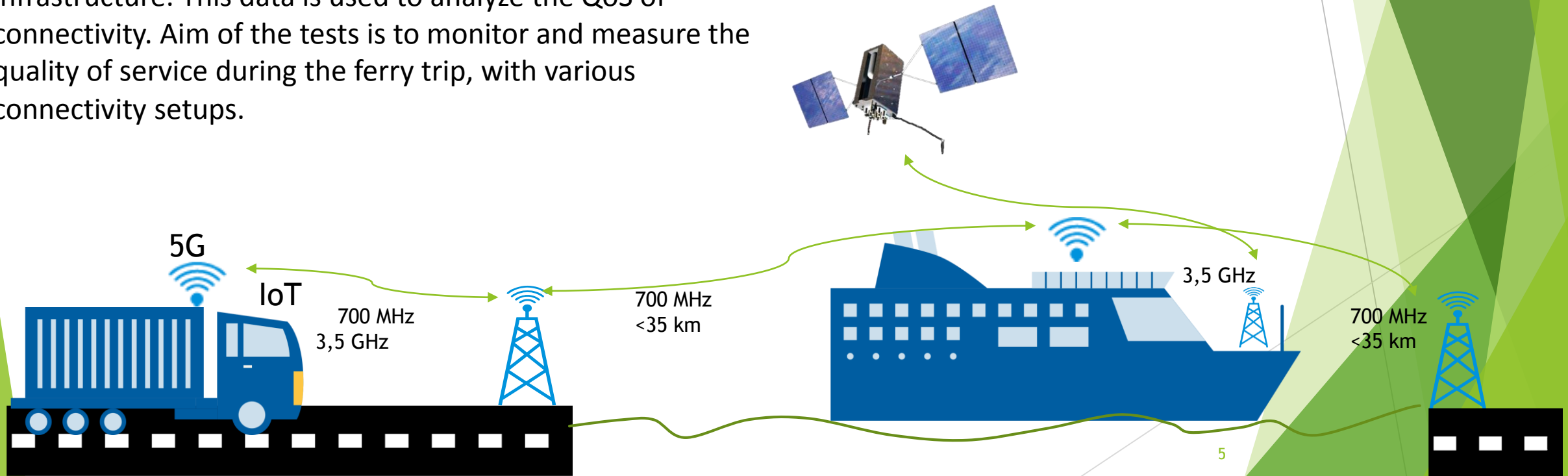
## Simulating massive amount of low bandwidth datastreams over 5G internet

- Assumes real life harbour could have 10 000 containers with IoT device, and 1000 trucks each having 10 IoT device packages
- Each device would be transmitting status and position every 60 seconds
- Thus there would be 333 messages per second, or 29 million messages per day
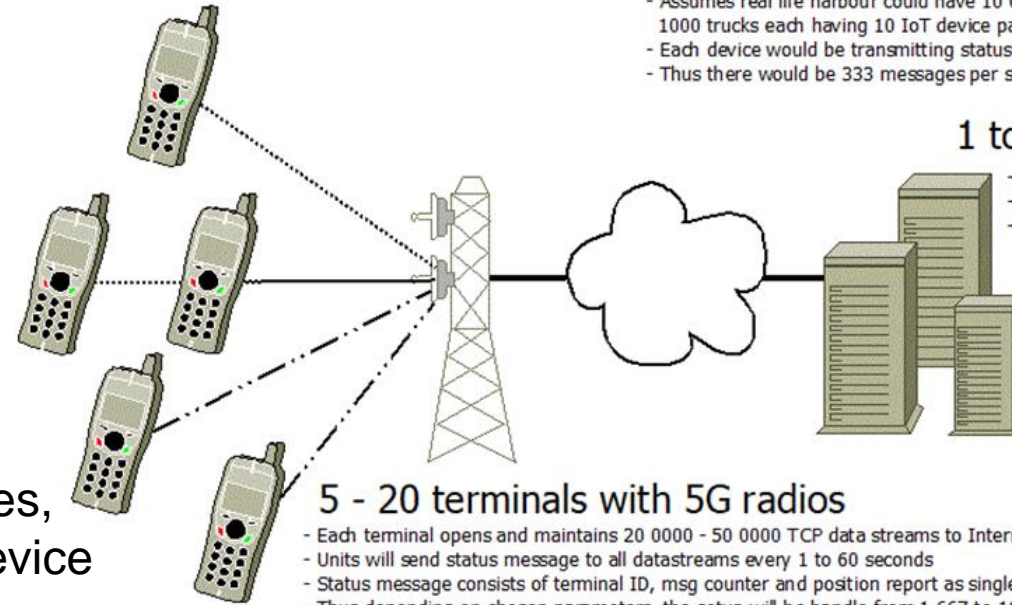
### 1 to 20 Internet Cloud servers

- Each server listens to test specific TCP port(s)
- Accept and maintain TCP streams with clients
- Records all connections and timestamped messages

### 5 - 20 terminals with 5G radios

- Each terminal opens and maintains 20 0000 - 50 0000 TCP data streams to Internet test servers
- Units will send status message to all datastreams every 1 to 60 seconds
- Status message consists of terminal ID, msg counter and position report as single TCP packet
- Thus depending on chosen parameters, the setup will be handle from 1 667 to 1000 000 messages per second.
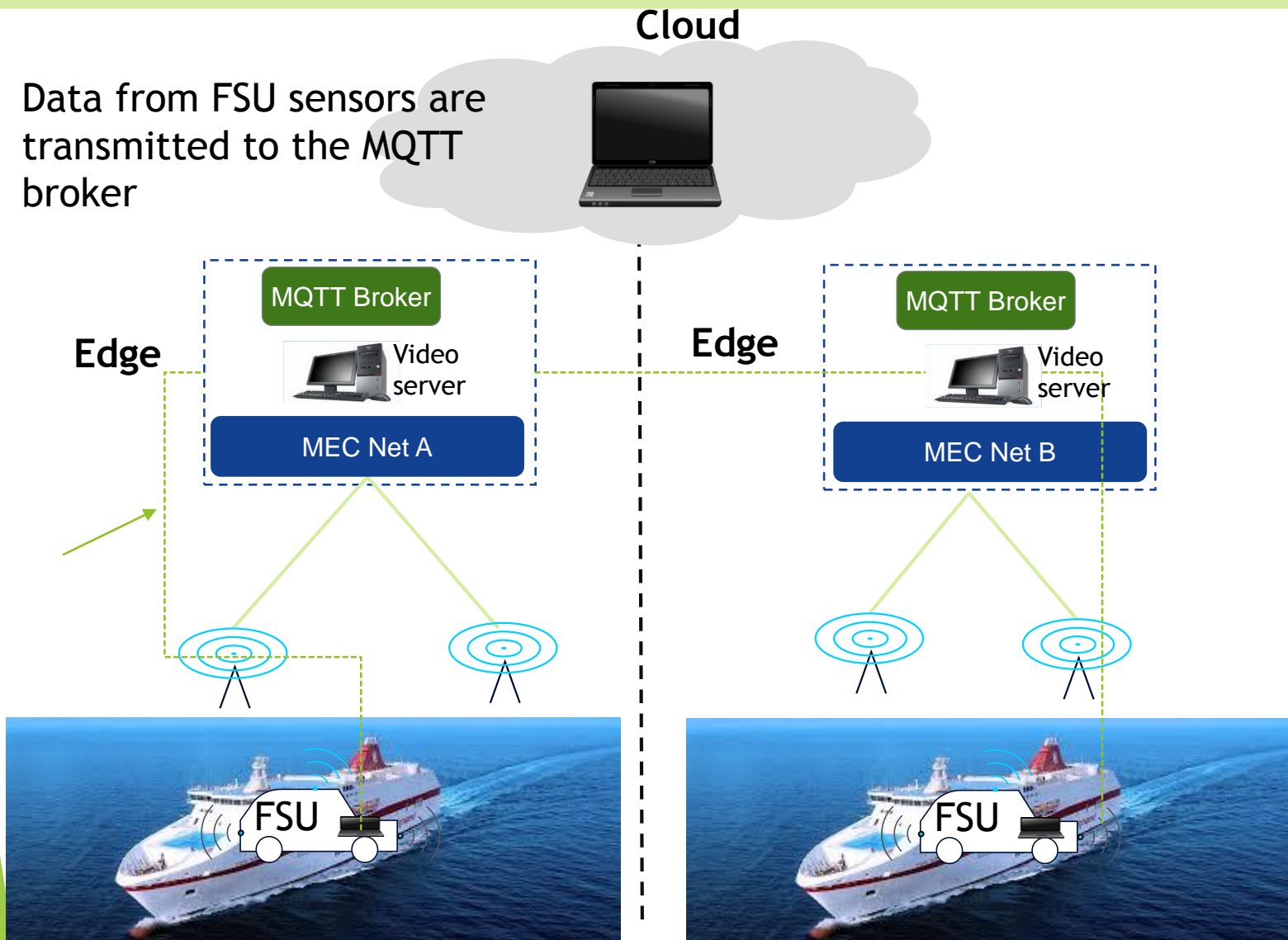
❏ **mMTC tests**
   - ❏ Each device is monitored every 5 minutes, leading to 288 messages per day per device (60/5 * 24 = 288).
   - ❏ 20 000 thousands devices would then generate 5.76 million messages per day, or 67 messages per second.
   - ❏ Simulation assumes 1000 trucks, each having 10 IOT devices, with additional 10 000 monitored cargo containers in the harbor area. Then total IOT device count is 20 000.

**5G Specificities**
❏ mMTC capability to support increasing number of IOT devices

# Communication with cloud

Data from FSU sensors are transmitted to the MQTT broker

**Cloud**

**Edge**

**Edge**

MQTT Broker

MQTT Broker

Video server

Video server

MEC Net A

MEC Net B

FSU
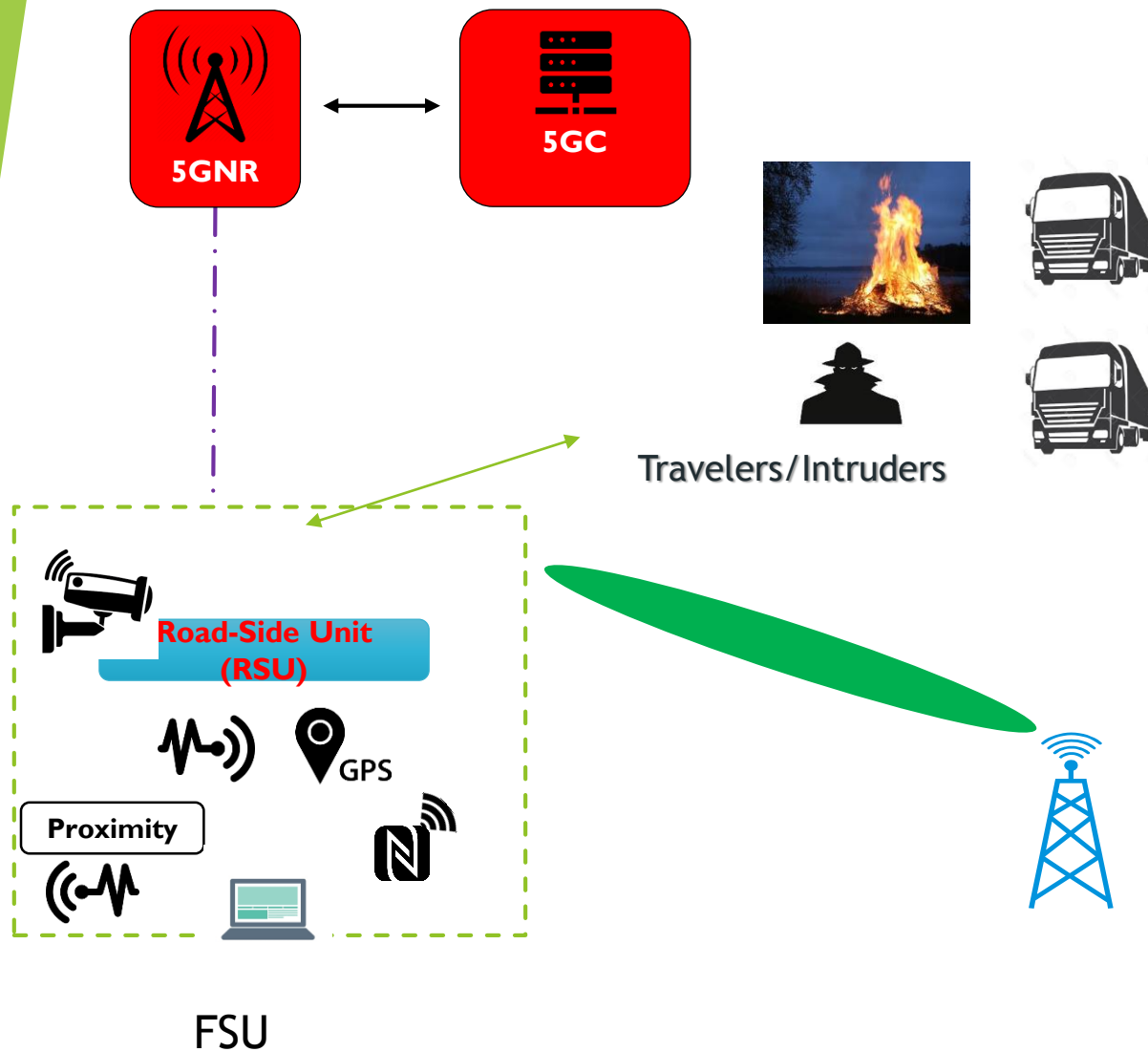
FSU

**Service Continuity**

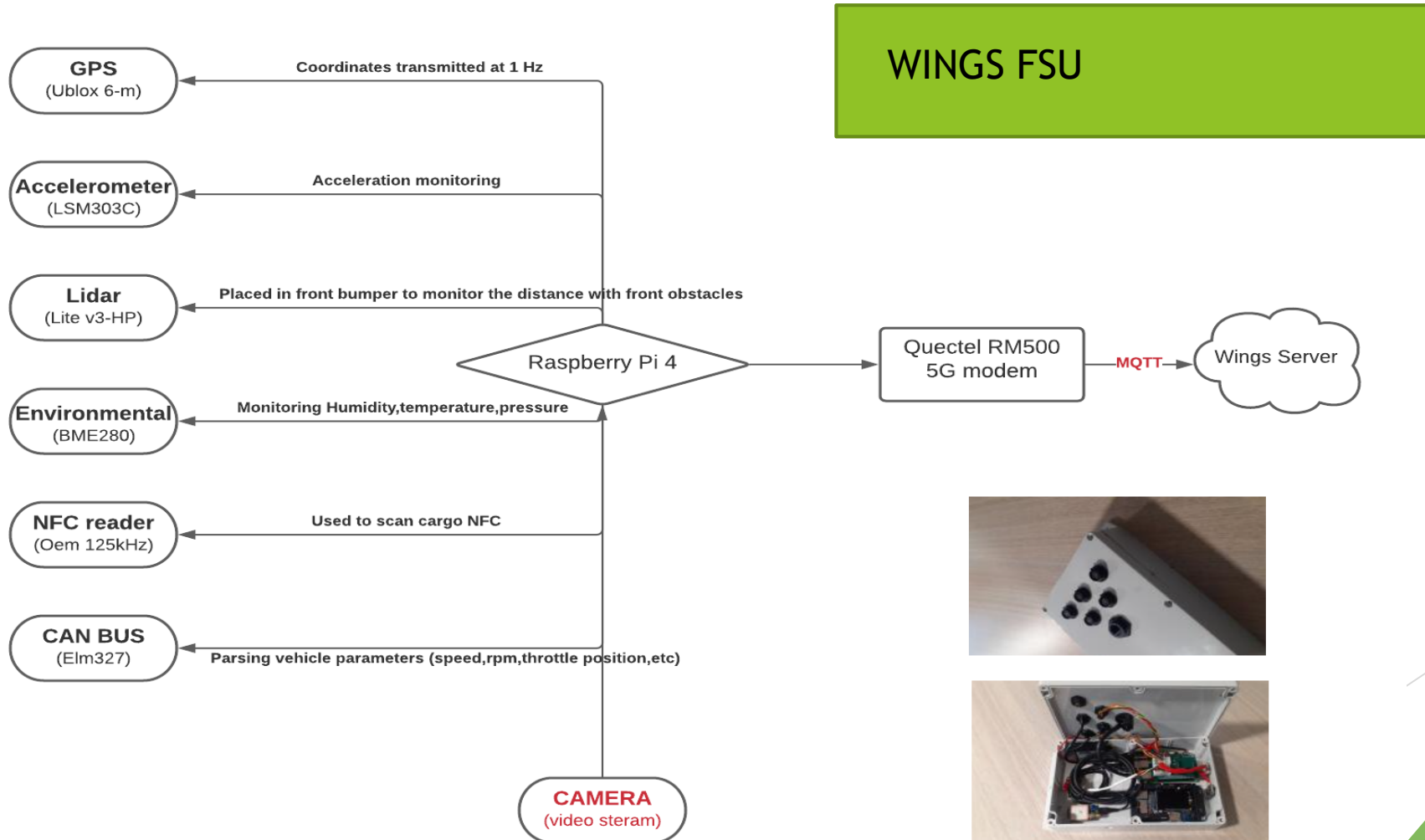- Data from FSU are transmitted to MQTT broker via the 5G network
- FSU is testing people movement in the ferry cargo

# Ferry Side unit (FSU)

**5GNR**

**5GC**

**FSU:** This is a unit which is used to identify any person/intruder trying to reach Secure places.
Also FSU is used to identify any fire that could possibly be ignited in the ship.

Travelers/Intruders

**Road-Side Unit (RSU)**

GPS

**Proximity**

FSU

# WINGS gateway installed in the ferry



WINGS FSU

| | |
|---|---|
| **GPS** (Ublox 6-m) | Coordinates transmitted at 1 Hz |
| **Accelerometer** (LSM303C) | Acceleration monitoring |
| **Lidar** (Lite v3-HP) | Placed in front bumper to monitor the distance with front obstacles |
| **Environmental** (BME280) | Monitoring Humidity,temperature,pressure |
| **NFC reader** (Oem 125kHz) | Used to scan cargo NFC |
| **CAN BUS** (Elm327) | Parsing vehicle parameters (speed,rpm,throttle position,etc) |
| **CAMERA** (video steram) | |

Raspberry Pi 4 → Quectel RM500 5G modem —MQTT→ Wings Server

# Conclusions

Contributions with
FSU to test connectivity,
Continuity,
Extreme events

**Thank you!**

**George Agapiou**

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