



University of Cagliari, Italy

DIEE - Department of Electrical and Electronic Engineering

Self - Configurable IoT Satellite Gateway with QoS Traffic Management

Roberto Puddu Ph.D Student

Department of Electrical and Electronic Engineering (DIEE), University of Cagliari



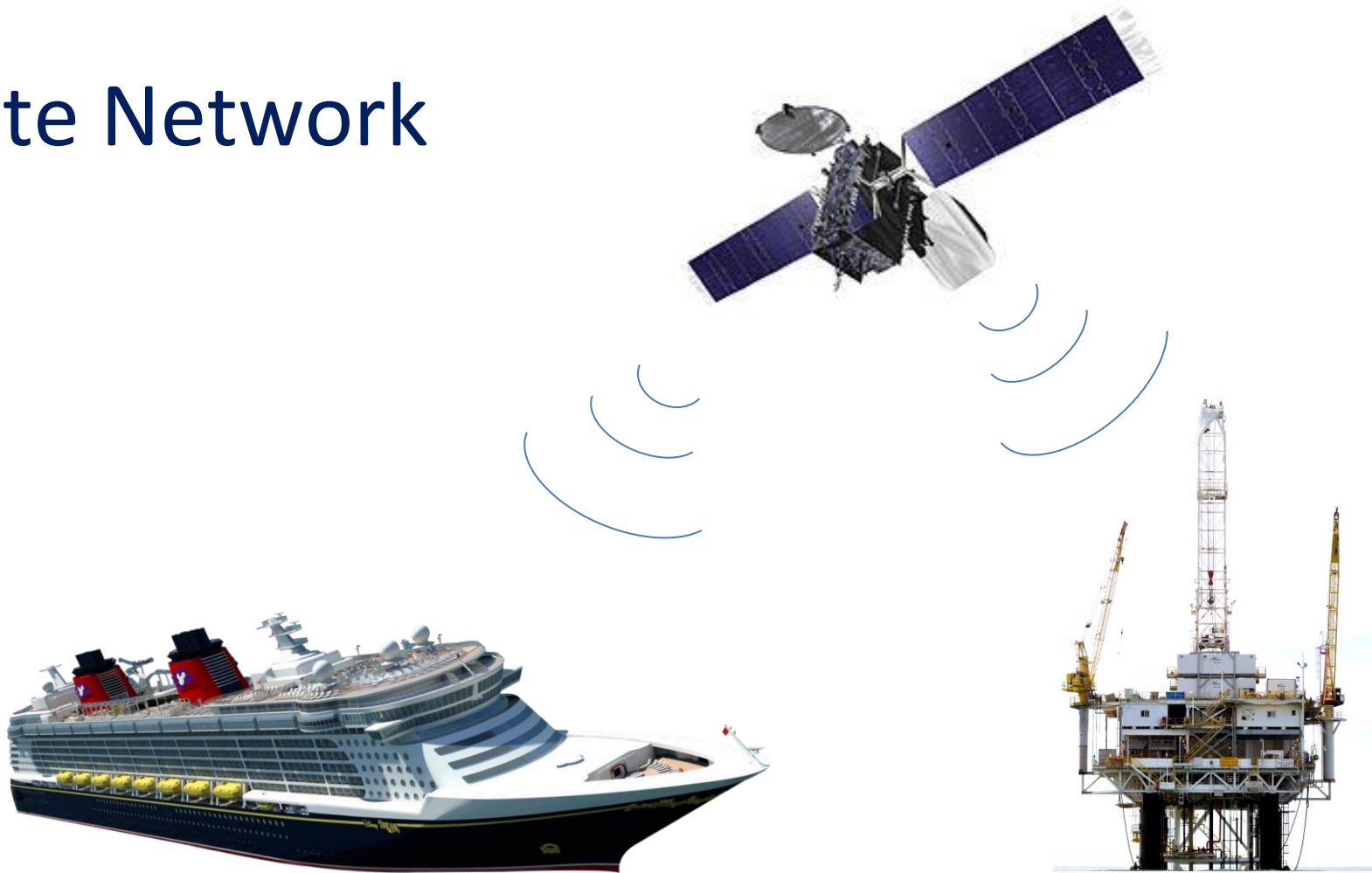
Introduction



Satellite Network

+

IoRT





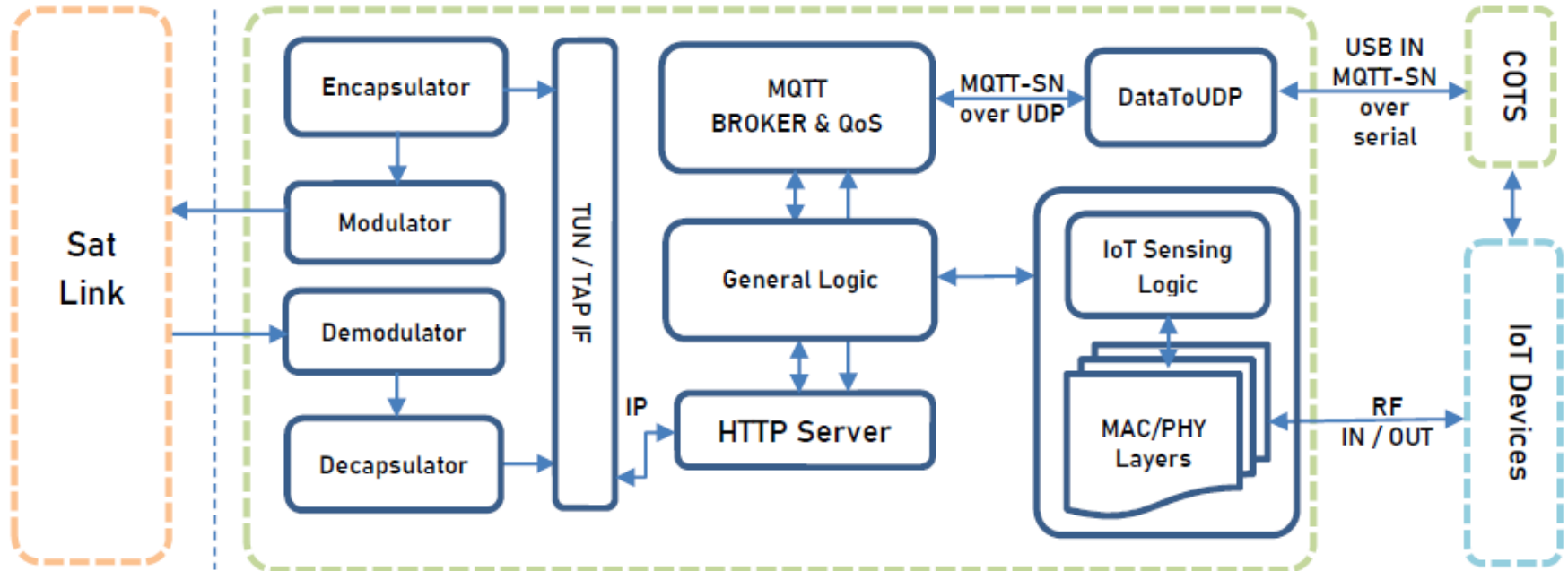
Requirements



- From the Terrestrial side
 - Covering most of the presented protocols and standards.
- From the Satellite side
 - high aggregate throughput with very low transmission probability of packets;
 - effective support of small packages with very low transmission cycle;
 - minimum signaling overhead;



Architecture



Gateway Architecture

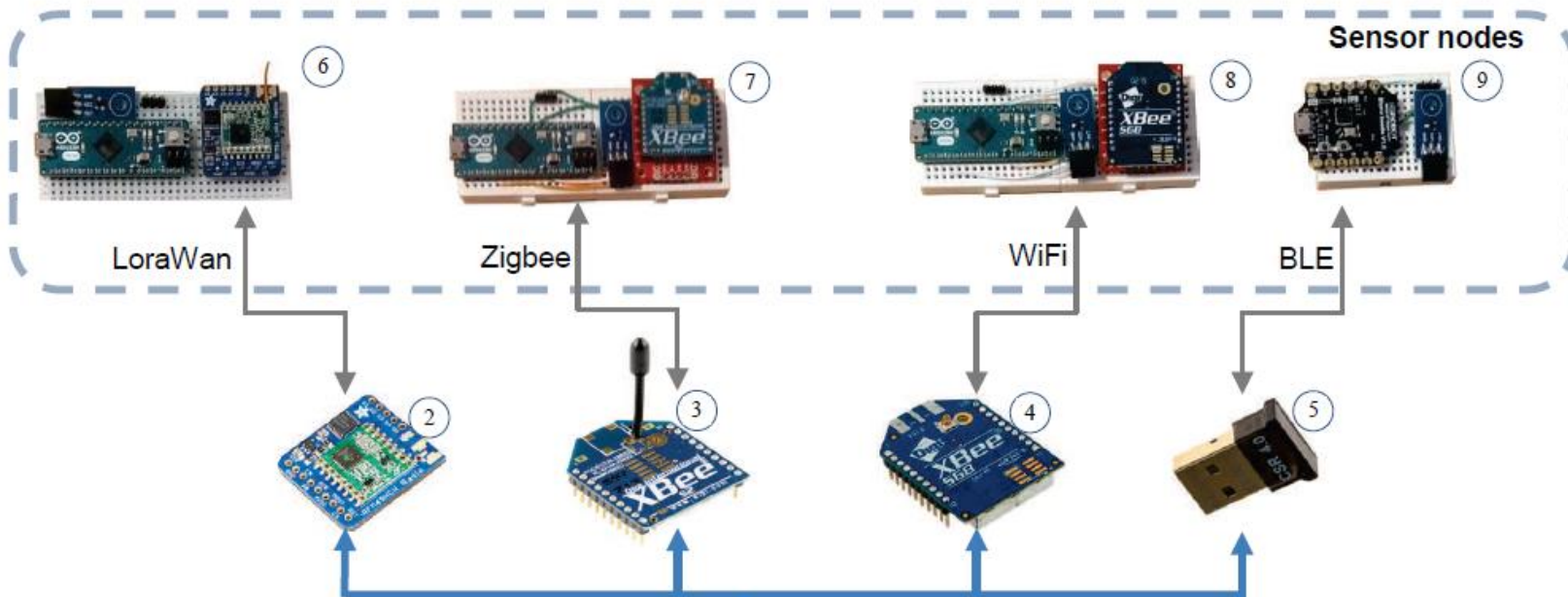
Computational platform

- USRP E320:
 - 2x2 MIMO transceiver (70 MHz to 6 GHz)
 - Xilinx Zynq 7045 SoC
 - Open Embedded Linux OS



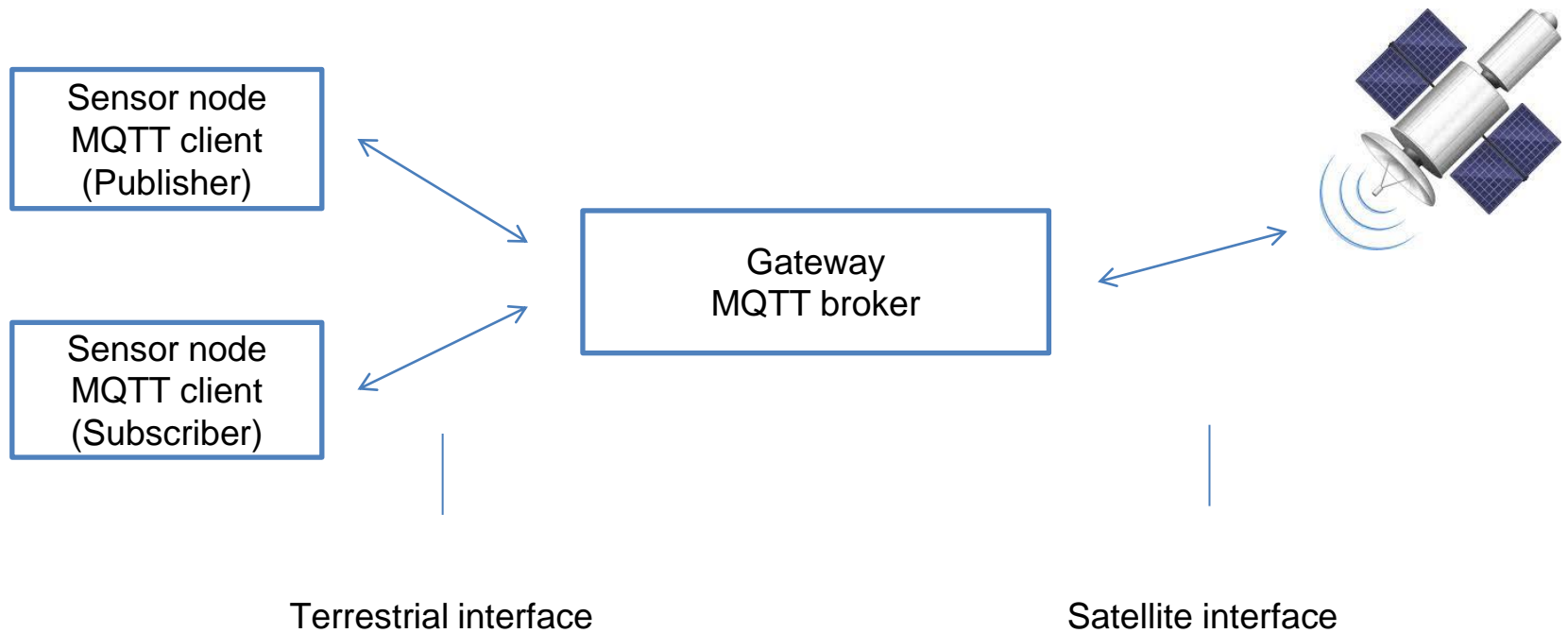
Terrestrial-LoT interface:

- Adafruit RFM95W LoRaWan
- Xbee S2 Zigbee
- Xbee S6B Wi-Fi
- CSR 4.0 BLE





MQTT/MQTT SN





QoS Management in MQTT:

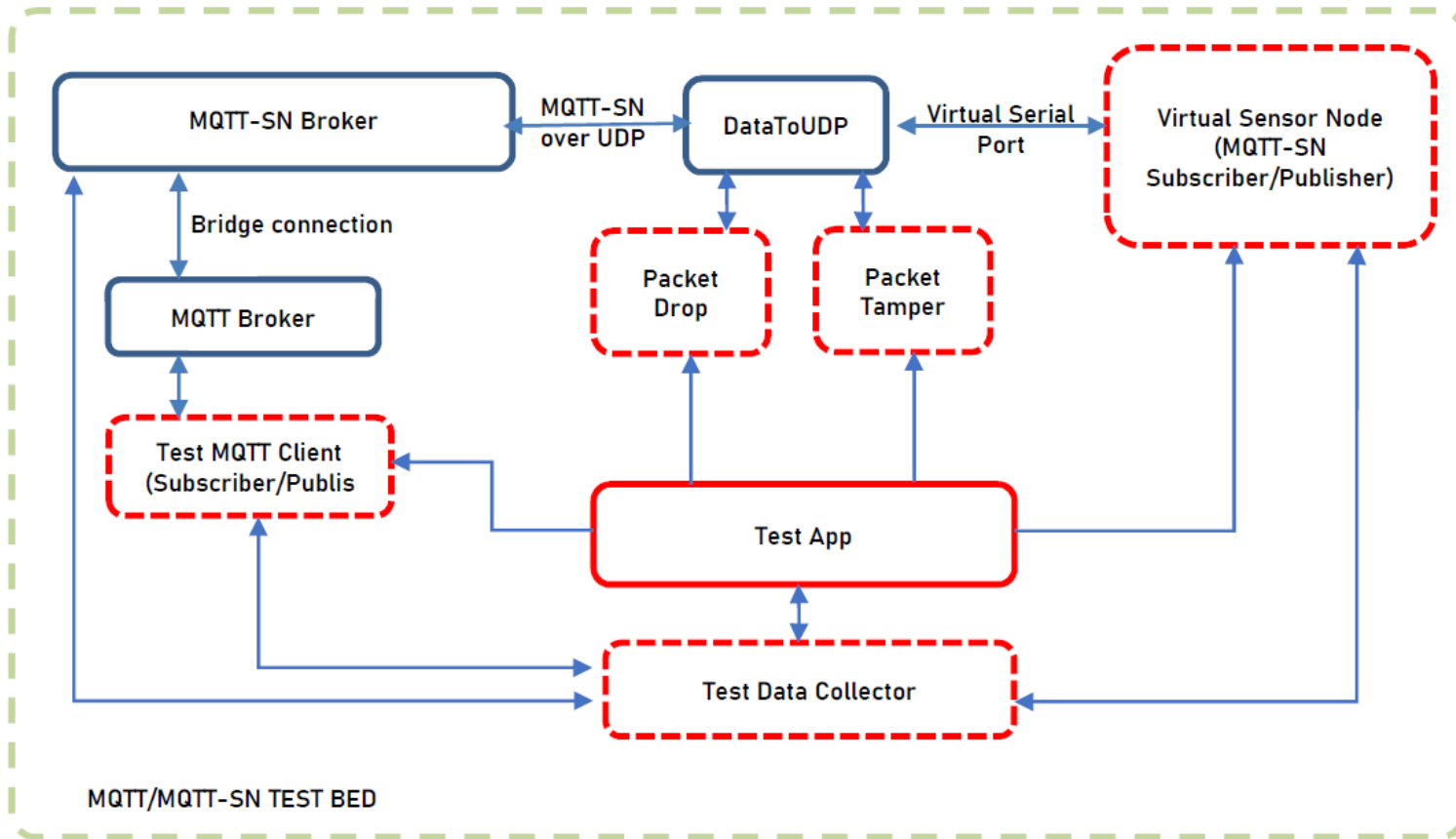
- QoS 0 : At most once
- QoS 1 : At least once
- QoS 2 : Exactly once



Test

● Self-Configuration Test

● MQTT (QoS) Test





Test

JSON file for QoS level 2 test

```
JSON Viewer
├── virtualSensor
│   ├── publish_topic : temperature
│   └── publish_topic_value : 30
├── packet_drop
│   └── type : PUBREC
├── test_mqtt_client
│   └── subscribe_topic : temperature
├── expected_packets
│   ├── ignoreConnectionPackets : true
│   ├── virtualSensor
│   │   ├── sent
│   │   │   ├── 0 : PUBLISH
│   │   │   ├── 1 : PUBLISH
│   │   │   └── 2 : PUBREL
│   │   └── received
│   │       ├── 0 : PUBREC
│   │       └── 1 : PUBCOMP
│   └── mqtt_sn_broker
│       ├── sent
│       │   ├── 0 : PUBREC
│       │   ├── 1 : PUBREC
│       │   └── 2 : PUBCOMP
│       └── received
│           ├── 0 : PUBLISH
│           ├── 1 : PUBLISH
│           └── 2 : PUBREL
└── test_mqtt_client
    └── received

test_case_mqtt_qos_2_json.txt
1  {
2  }
3      "virtualSensor": {
4          "publish_topic": "temperature",
5          "publish_topic_value": 30
6      },
7      "packet_drop": {
8          "type": "PUBREC"
9      },
10     "test_mqtt_client": {
11         "subscribe_topic": "temperature"
12     },
13     "expected_packets": {
14         "ignoreConnectionPackets": true,
15         "virtualSensor": {
16             "sent": [
17                 "PUBLISH",
18                 "PUBLISH",
19                 "PUBREL"
20             ],
21             "received": [
22                 "PUBREC",
23                 "PUBCOMP"
24             ]
25         },
26         "mqtt_sn_broker": {
27             "sent": [
28                 "PUBREC",
29                 "PUBREC",
30                 "PUBCOMP"
31             ],
32             "received": [
33                 "PUBLISH",
34                 "PUBLISH",
35                 "PUBREL"
36             ]
37         }
38     },
39     "test_mqtt_client": {
40         "received": [
41             "PUBLISH"
42         ]
43     }
44 }
```



Conclusion and future work

- Our gateway represent an interesting starting point for study QoS in IoRT applications.
- Future works:
 - Open field testing
 - QoS improvement with ML



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Thank you for your attention