

Background: MSc in Theoretical CS and AI @ Politecnico di Milano, Italy



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Learning-based network management automation for edge and distributed infrastructures in B5G/6G



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In practice:

- Integrate Network Slicing in LoRaWANs, assuming massive deployments
- Design Management and Orchestration Loops for the technology, possibly using AI. This entails monitoring & analysis, anomaly detection, traffic prediction, reconfiguration



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Testing framework

Developed LoRaWAN simulator + ChirpStack virtual server

Fig 1. Collision between two packets

```
Packet (29 bytes) sent by ED38 at +3586.32s
TX data: SF = 10, Frequency = 868.3MHz, TxPower = 14dBm
RX data:
(GW1) RSSI: -132.823dBm, Outcome: INTERFERED with SNIR: -0.237329dB
      and SIR margin per SF: [inf,34.7805,inf,-4.59465,inf,inf,]
(GW2) RSSI: -134.549dBm, Outcome: UNDER_SENSITIVITY
(GW3) RSSI: -145.027dBm, Outcome: UNDER_SENSITIVITY
(GW4) RSSI: -149.373dBm, Outcome: UNDER_SENSITIVITY
(GW5) RSSI: -149.276dBm, Outcome: UNDER_SENSITIVITY
(GW6) RSSI: -144.691dBm, Outcome: UNDER_SENSITIVITY
(GW7) RSSI: -133.932dBm, Outcome: UNDER_SENSITIVITY

Packet (30 bytes) sent by ED1099 at +3586.44s
TX data: SF = 10, Frequency = 868.3MHz, TxPower = 14dBm
RX data:
(GW1) RSSI: -132.735dBm, Outcome: INTERFERED with SNIR: 1.9946dB
      and SIR margin per SF: [inf,inf,inf,-4.0054,inf,inf,]
(GW2) RSSI: -138.944dBm, Outcome: UNDER_SENSITIVITY
(GW3) RSSI: -147.08dBm, Outcome: UNDER_SENSITIVITY
(GW4) RSSI: -149.775dBm, Outcome: UNDER_SENSITIVITY
(GW5) RSSI: -148.229dBm, Outcome: UNDER_SENSITIVITY
(GW6) RSSI: -141.745dBm, Outcome: UNDER_SENSITIVITY
(GW7) RSSI: -130.377dBm, Outcome: INTERFERED with SNIR: 5.46082dB
      and SIR margin per SF: [inf,inf,inf,-0.539184,inf,inf,]
```

Fig 2. Packet duplication

```
Packet (28 bytes) sent by ED191 at +3593.94s
TX data: SF = 11, Frequency = 868.1MHz, TxPower = 14dBm
RX data:
(GW1) RSSI: -133.446dBm, Outcome: RECEIVED with SNIR: 4.84403dB
      and SIR margin per SF: [47.3554,inf,inf,38.3595,inf,inf,] after +823.313ms
(GW2) RSSI: -149.444dBm, Outcome: UNDER_SENSITIVITY
(GW3) RSSI: -149.631dBm, Outcome: UNDER_SENSITIVITY
(GW4) RSSI: -145.327dBm, Outcome: UNDER_SENSITIVITY
(GW5) RSSI: -134.562dBm, Outcome: RECEIVED with SNIR: 13.1862dB
      and SIR margin per SF: [50.143,inf,inf,48.4198,inf,inf,] after +823.315ms
(GW6) RSSI: -133.299dBm, Outcome: RECEIVED with SNIR: 17.6391dB
      and SIR margin per SF: [53.6377,inf,inf,53.6611,inf,inf,] after +823.313ms
(GW7) RSSI: -144.676dBm, Outcome: UNDER_SENSITIVITY
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```
Total number of packets sent: 5214, outcomes distribution:
RECEIVED: 91.868%
INTERFERED: 8.11277%
NO_MORE_RECEIVERS: 0.0191791%
BUSY_GATEWAY: 0%
UNDER_SENSITIVITY: 0%

Network Goodput: 287.898 b/s
Network Throughput: 313.464 b/s

Average number of duplications per received package: 1.10793
```

Fig 3. Simulation end results

