DSME-LoRa: A flexible MAC for LoRa

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Peter Kietzmann, Thomas C. Schmidt, Matthias Wählisch

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Motivation: LoRaWAN and LoRa
Motivation: Limitations of LoRaWAN

- Restricted downlink rate
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- Unbounded end to end latency
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- Restricted downlink rate
- Unbounded end to end latency
- Lack of peer to peer communication
- Mandatory infrastructure backhaul
IEEE 802.15.4 DSME

- Peer to peer or Cluster-Tree topologies
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- Peer to peer or Cluster-Tree topologies
- Contention Access Period (CAP): CSMA-CA
- Contention Free Period (CFP): Guaranteed Time Slots (GTS)
- Highly configurable and flexible
  - Nº of Superframes, Superframe duration, Beacon interval
Can DSME overcome LoRaWAN limitations to enable direct communication between LoRa nodes?
DSME-LoRa: PHY mappings

- 16 channels in the EU868 band
- SF7, CR4/5, BW125 (typical LoRaWAN settings)
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- CAP uses only one channel
  - 10% duty cycle
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- CSMA-CA uses LoRa Channel Activity Detection (CAD)
Evaluation
Simulation environment

- Omnet++ 6.0
  - with INET framework
Simulation environment

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- OpenDSME
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- FLoRA
- Only the LoRa Radio model
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- **DSME-LoRa** adaptation layer
Simulation scenario

- Single hop peer to peer network with sensors (S) and actuators (A)
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- Each sensor transmits unconfirmed data to a subset of actuators
  - At an exponential rate
  - In a dedicated GTS
Simulation scenario

- Single hop peer-to-peer network with sensors (S) and actuators (A)
- Each sensor transmits unconfirmed data to a subset of actuators
- At an exponential rate
- In a dedicated GTS time slot
- Size of the subset of actuators is defined as $ApS$ (Actuators per Sensor)
Simulation scenario

- 4 Superframes per Multi-superframe
- ~32 seconds Multi-superframe duration
- Slot schedule repeats every 28 slots
## Simulation results

<table>
<thead>
<tr>
<th>ApS [#]</th>
<th>1</th>
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- Only depends on TX interval and ApS, not on network size
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Average time to completion [s] for different simulation scenarios

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- Compliant with duty cycle regulations

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- IPv6 over DSME-LoRa
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Future work

- IPv6 over DSME-LoRa
  (adapt concepts by the IETF 6TiSCH group)
- DSME-LoRa on real hardware
  (port OpenDSME to RIOT-OS)
Thank you!

DSME-LoRa implementation: [github.com/inetrg/dsme_lora](https://github.com/inetrg/dsme_lora)

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