Are Group Acknowledgements Worth Anything in IEEE 802.15.4 DSME: A Comparative Analysis

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5th Conference on Cloud and Internet of Things

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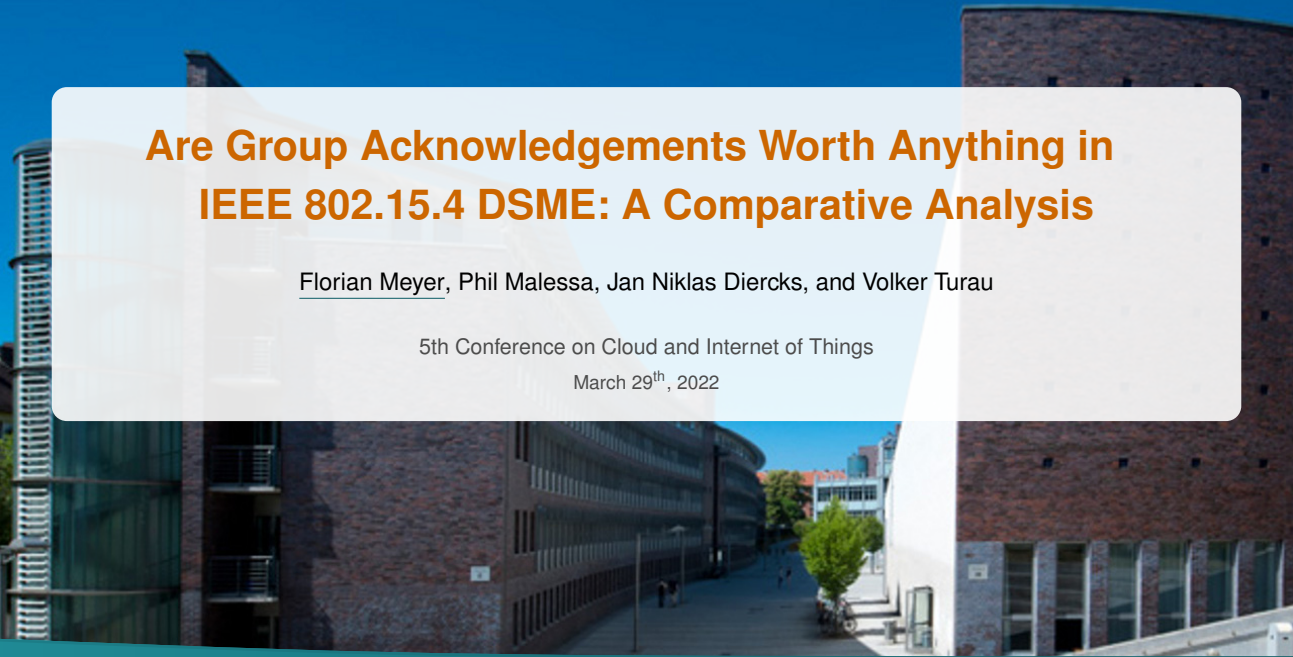

Institute of Telematics
Hamburg University of Technology
TUHH

Motivation

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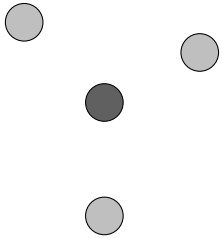

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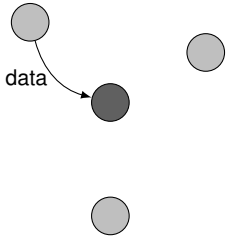

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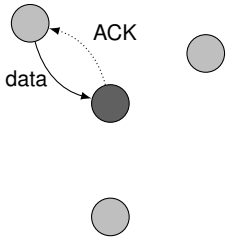

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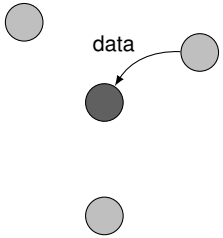

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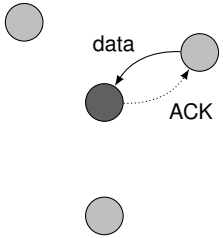

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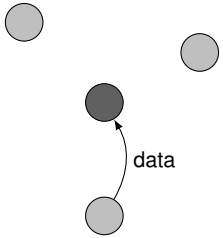

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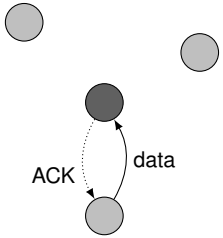

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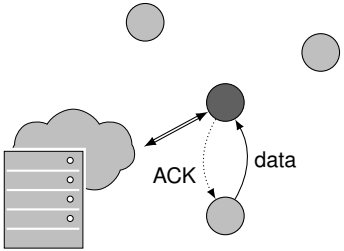

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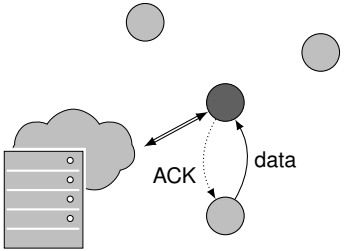

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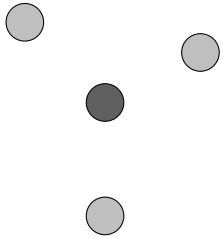

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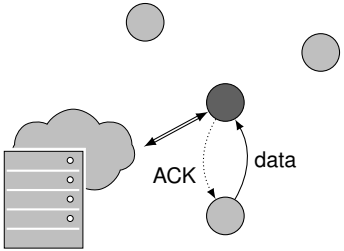

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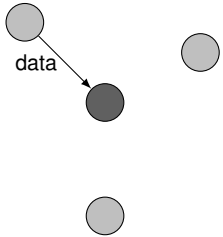

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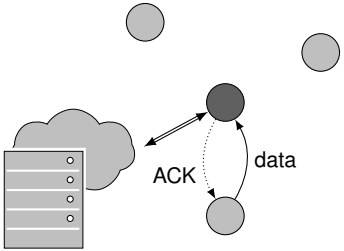

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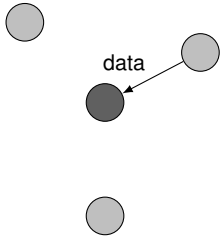

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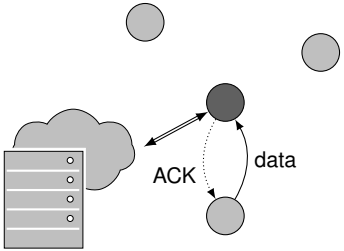

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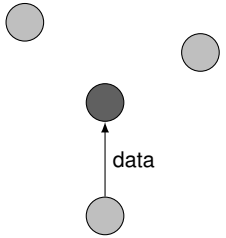

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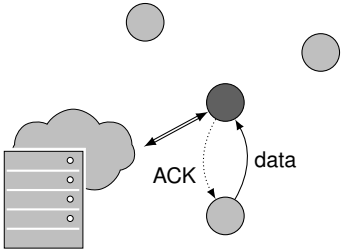

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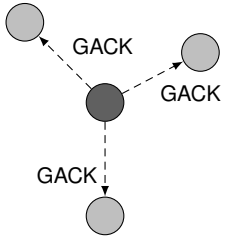

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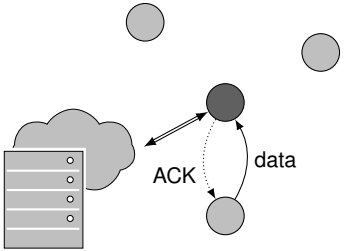

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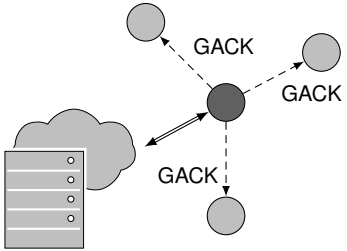

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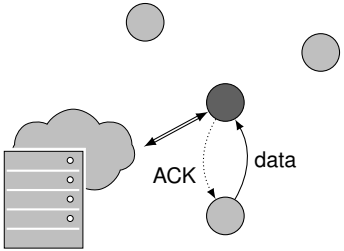

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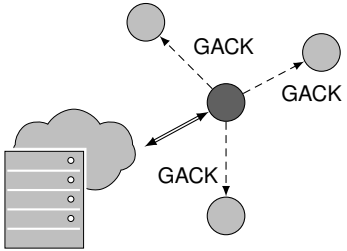
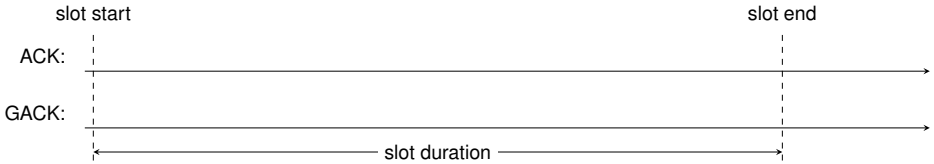


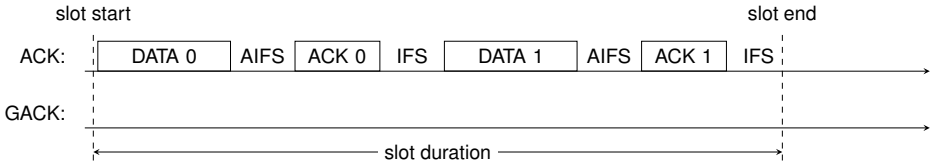
Research Question

Are group acknowledgements a valid alternative to regular ACKs in IEEE 802.15.4 DSME?

Discussion of GACKs



Discussion of GACKs



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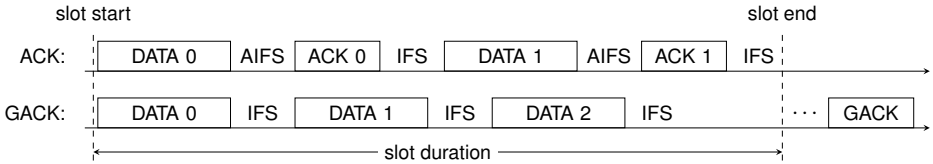

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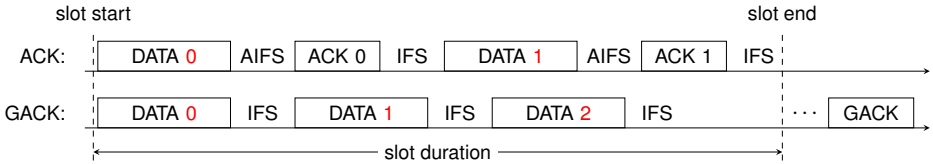

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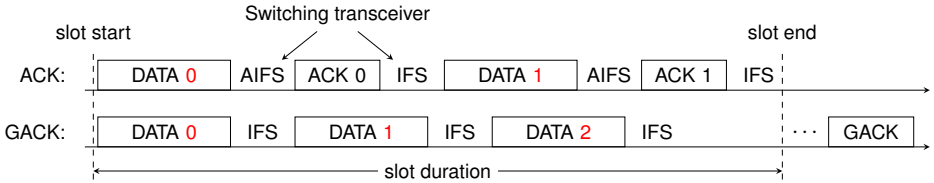

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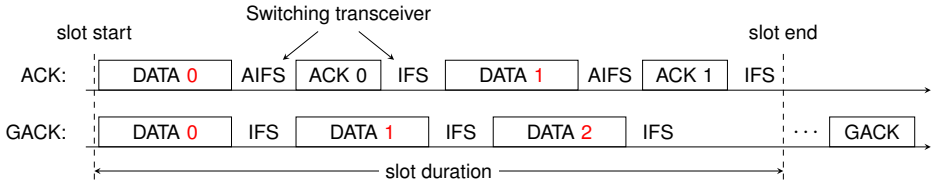


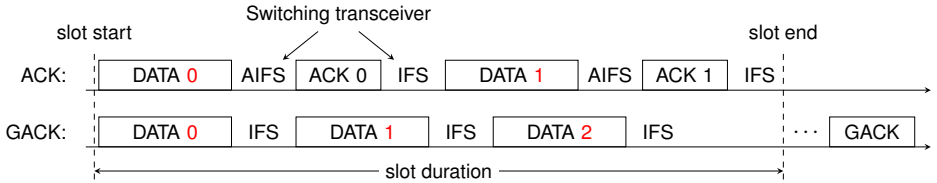
Advantages:

- increased throughput
- reduced energy consumption

Disadvantages:

- increased acknowledgment delay
- increased storage overhead

Discussion of GACKs



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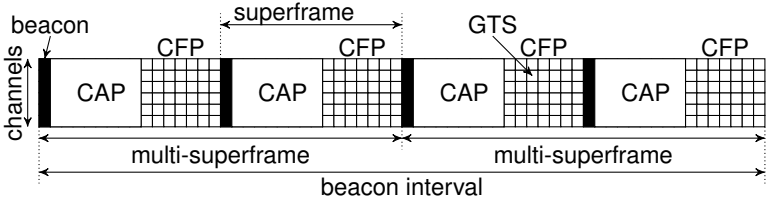
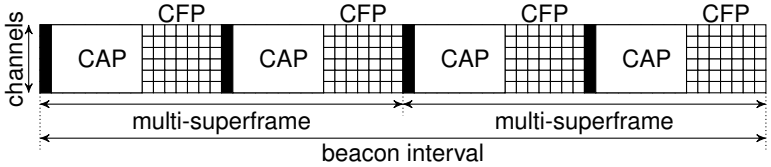
Challenge

When should GACKs be transmitted?

GACKs in DSME

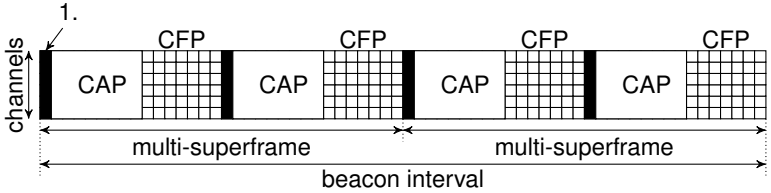


GACKs in DSME



GACKs can be transmitted ...

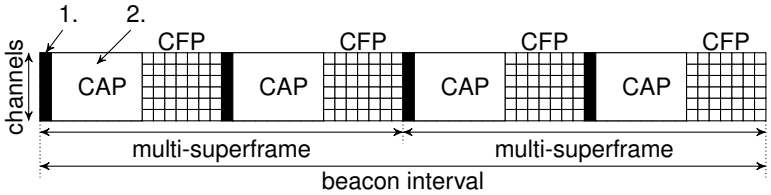
GACKs in DSME



GACKs can be transmitted ...

1. ... piggybacked in beacons (GACK-BEACON)

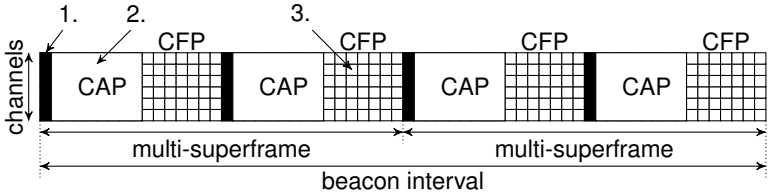
GACKs in DSME



GACKs can be transmitted ...

1. ... piggybacked in beacons (GACK-BEACON)
2. ... during the CAP (GACK-CAP)

GACKs in DSME



GACKs can be transmitted ...

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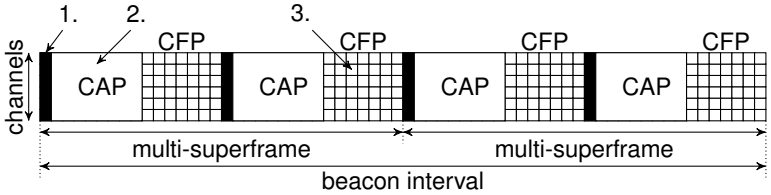
3. ... during dedicated GTS (GACK-GTS)

GACKs in DSME



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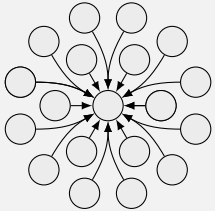
2. ... during the CAP (GACK-CAP)
3. ... during dedicated GTS (GACK-GTS)

GACK-GTS:

- altered slot allocation handshake
- universal GACK frame structure
- GAO determines GACK slots per multi-superframe

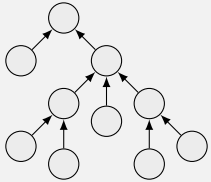
Scenario Description

Best-case:



- 19 nodes
- 1 B payload
- multiple packets per slot

Average-case:



- 31 nodes
- 1 B to 116 B payload
- multiple packets per slot

Worst-case:

- 10 nodes
- 116 B payload
- single packet per slot

Scenario Description

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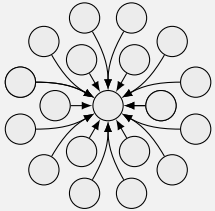

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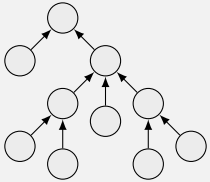

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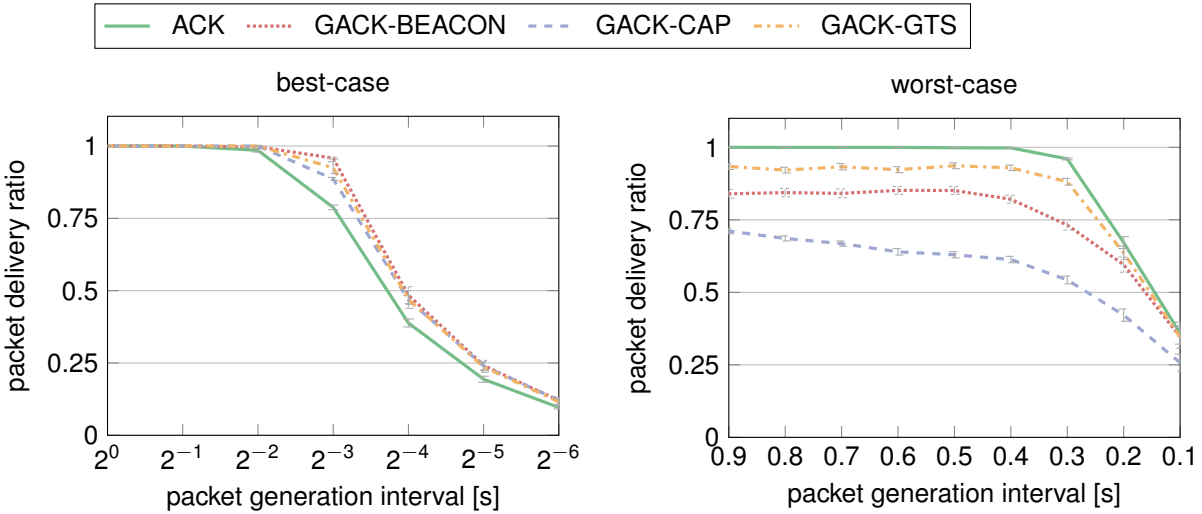
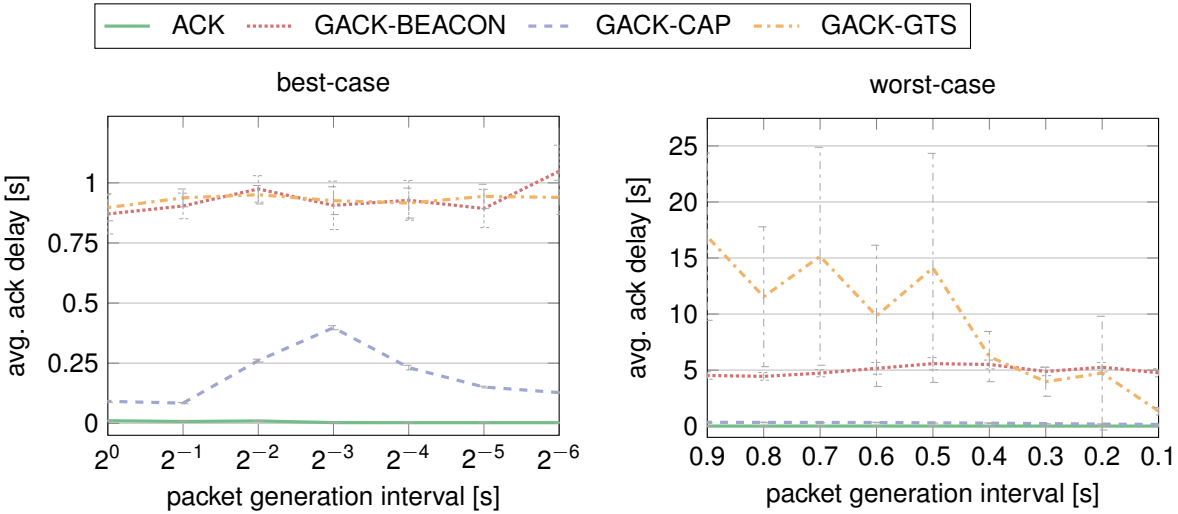
Simulative Evaluation - Reliability



Simulative Evaluation - ACK Delay



Conclusion and Outlook

- GACKs only feasible in best-case scenarios
- At least 15% reduced reliability in other scenarios
  - $\Rightarrow$ GACKs not worth the implementation effort

Future work:

- Block acknowledgments
- Verification in large hardware deployments

Are Group Acknowledgements Worth Anything in IEEE 802.15.4 DSME: A Comparative Analysis

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Theoretical Evaluation