An Efficient approach to Multisuperframe tuning for DSME networks

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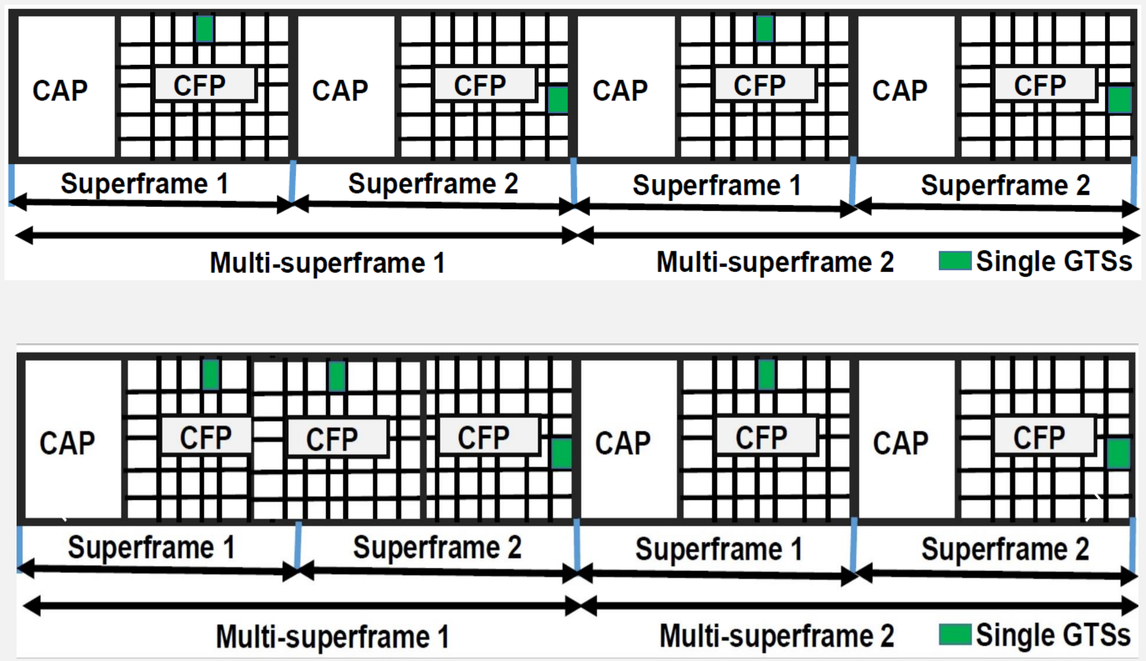
DSME

- Deterministic Synchronous Multichannel Extension, a key time critical MAC behaviors of IEEE 802.15.4e suitable for low power industry applications
- Features: multichannel extension with Channel hopping and Channel adaptation techniques
- Supported by the Multisuperframe structure with a collection of superframes that use CAP (Contention Access Period) and CFP (Contention Free Period) for non critical and critical applications respectively

Multichannel functionalities

- The legacy IEEE 802.15.4 provided only 7 guaranteed timeslots to support time-critical communication.
- DSMEs Multichannel Access provides possibilities of accommodation over 16 channels over 7 timeslots.
- Additionally, DSME also provides special techniques like CAP reduction with which all the superframes in a Multisuperframe can be replaced with CFP except for the first.
- However the number of superframes accommodated in a Multisuperframe depends on the parameter MO – Multisuperframe Order



CAP reduction in Multisuperframe 1 for MO = 2

Problem

- In accordance to the standard MO and CAP reduction primitive which are defined at the start of the network which can result in some adverse results
  - **Case 1:** need for more guaranteed timeslots than what is available by CAP reduction and multi-channel access.
  - **Case 2:** wastage of guaranteed bandwidth by providing more guaranteed slots than needed.

Solution

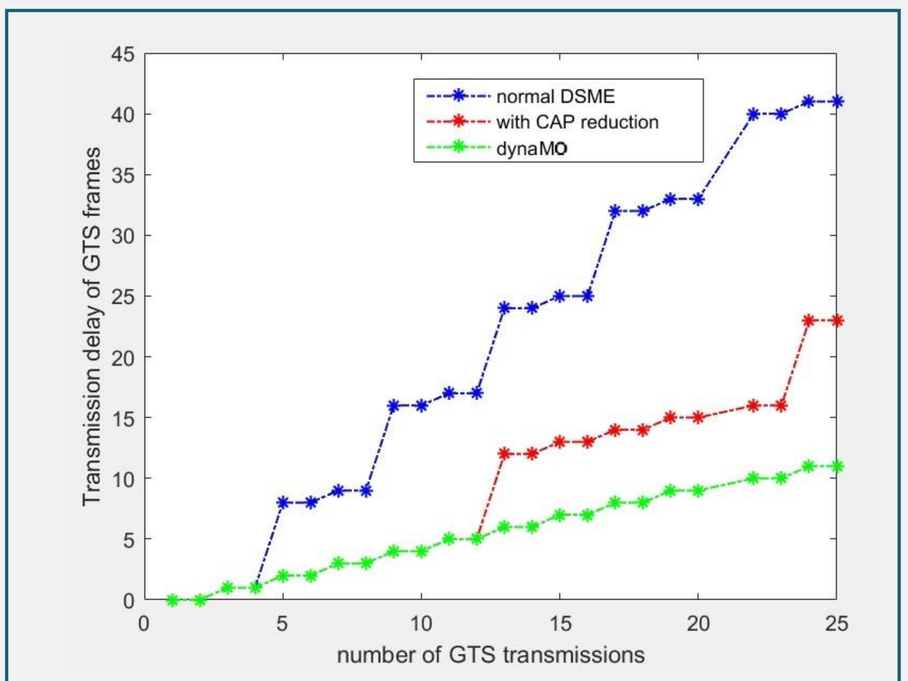
- This problem can be averted by making a self aware DSME network that knows the size of the schedule and tune its MO and CAP reduction primitive accordingly.
- The new Multisuperframe order will be based on the number of transmissions for the GTSs, and will be issued through an Enhanced Beacon at the end of every Multisuperframe.

Contributions and Future works

- Mathematical model on delay under CAP reduction under normal/dynamic scenarios.
- We modelled delay analysis for three cases :

Case i: a normal DSME network with no CAP reduction implemented
Case ii: DSME network with CAP reduction but with a fixed MO,
Case iii: DSME network with a dynamic MO that changes with the addition of nodes in the network.

- It can be understood that with a Dynamic change in MO we can reduce the delay by 5-30 %
- we intend to use Markov chain models to study the behaviours of these GTS allocations and provide stability analysis for the overall network.



Comparison of Delay

References

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[2] A. Farhad, Y. Zia, and F. B. Hussain, “Survey of dynamic super-frame adjustment schemes in beacon-enabled IEEE 802.15. 4 networks: An applications perspective,” Wireless Personal Communications

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