

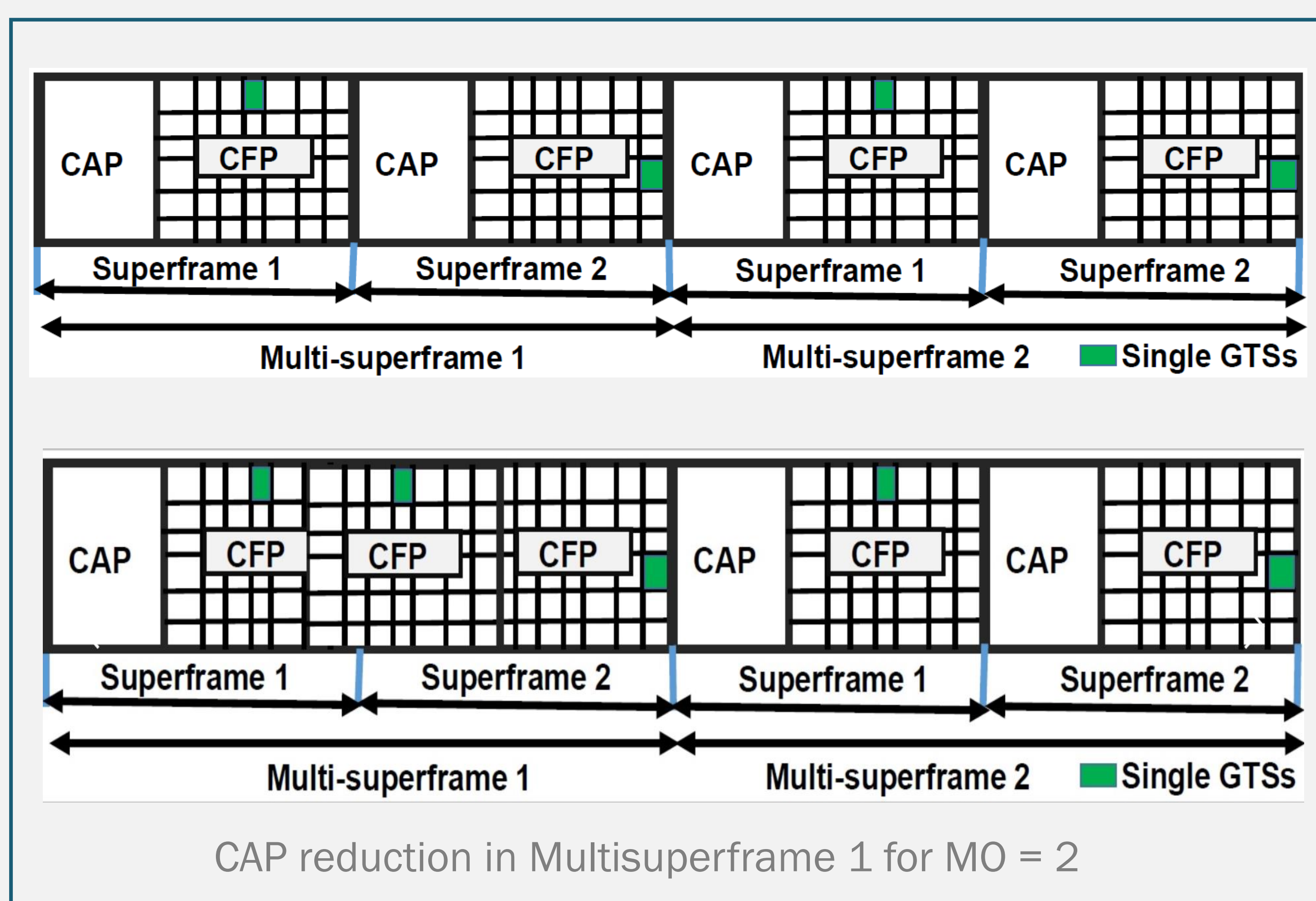
# An Efficient approach to Multisuperframe tuning for DSME networks

## 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



## Problem

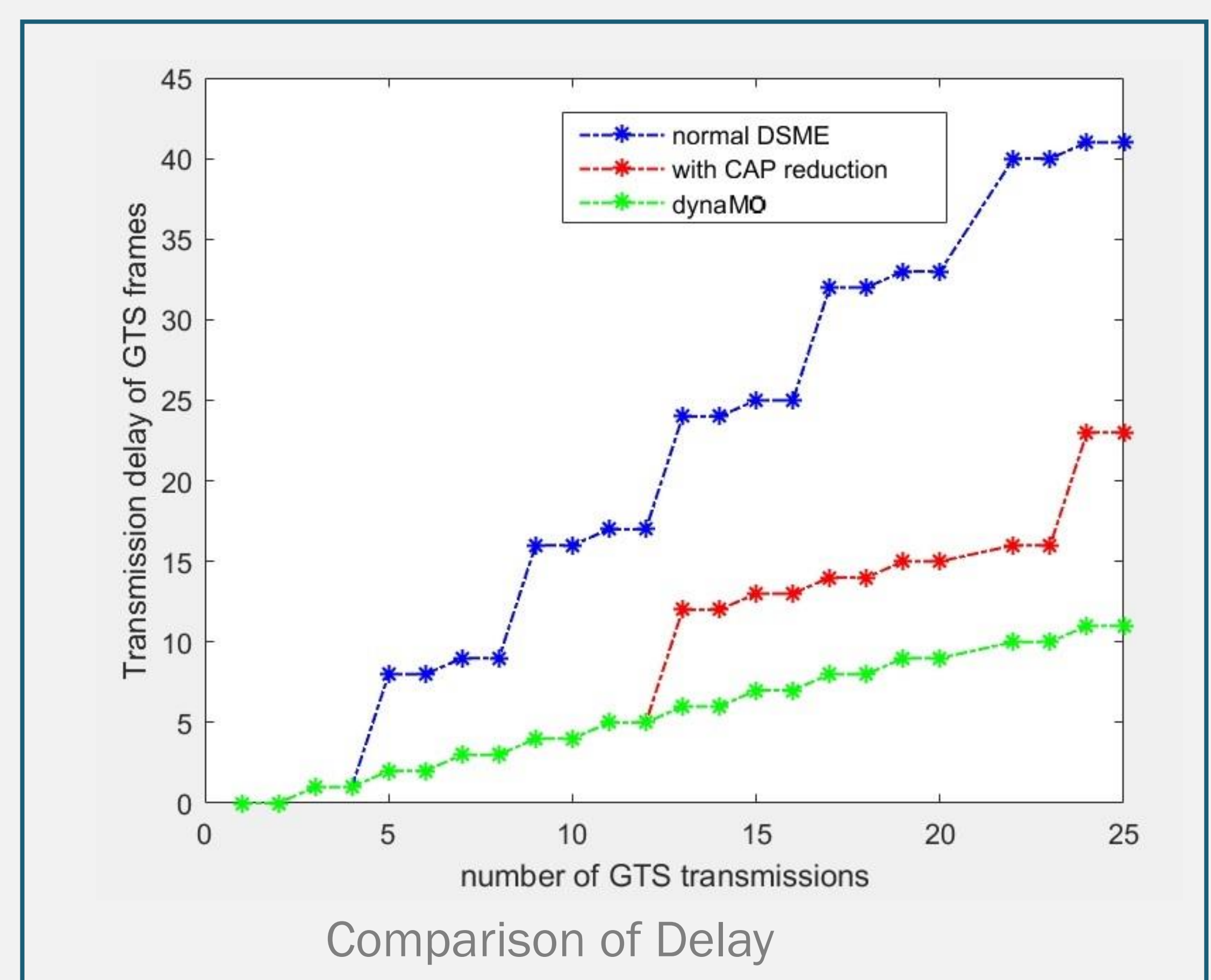
- In accordance to the standard MO and CAP reduction primitive which are defined at the start of the network which can result in some adverse results
- **Case 1:** need for more guaranteed timeslots than what is available by CAP reduction and multi-channel access.
- **Case 2:** wastage of guaranteed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



## References

- [1] H. Kurunathan, R. Severino, A. Koubaa, E. Tovar et al., "Worst-case bound analysis for the time-critical mac behaviours of IEEE 802.15. 4e," in 13th IEEE International Workshop on Factory Communication Systems Communication in Automation (WFCS 2017). 31, May to 2, Jun, 2017, 2017.
- [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