Optimization of TTEthernet Networks to Support Best-Effort Traffic

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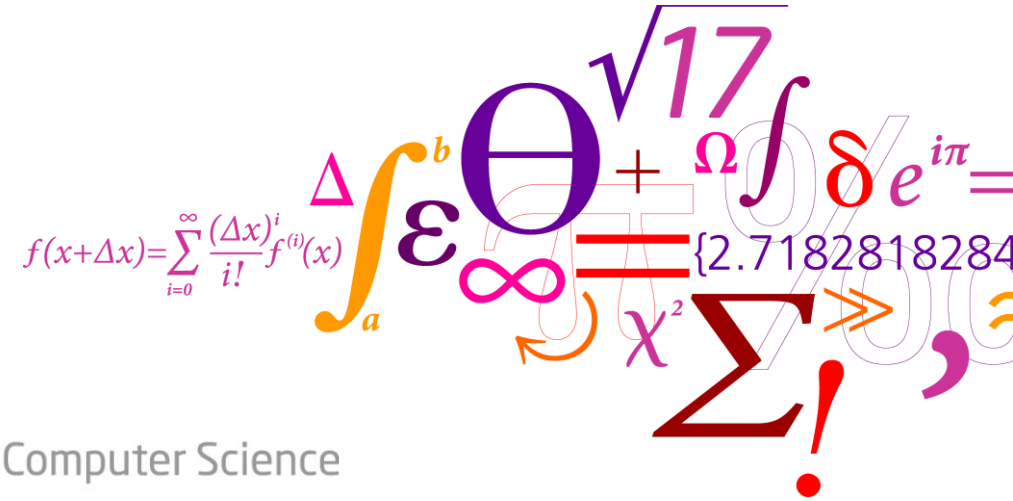

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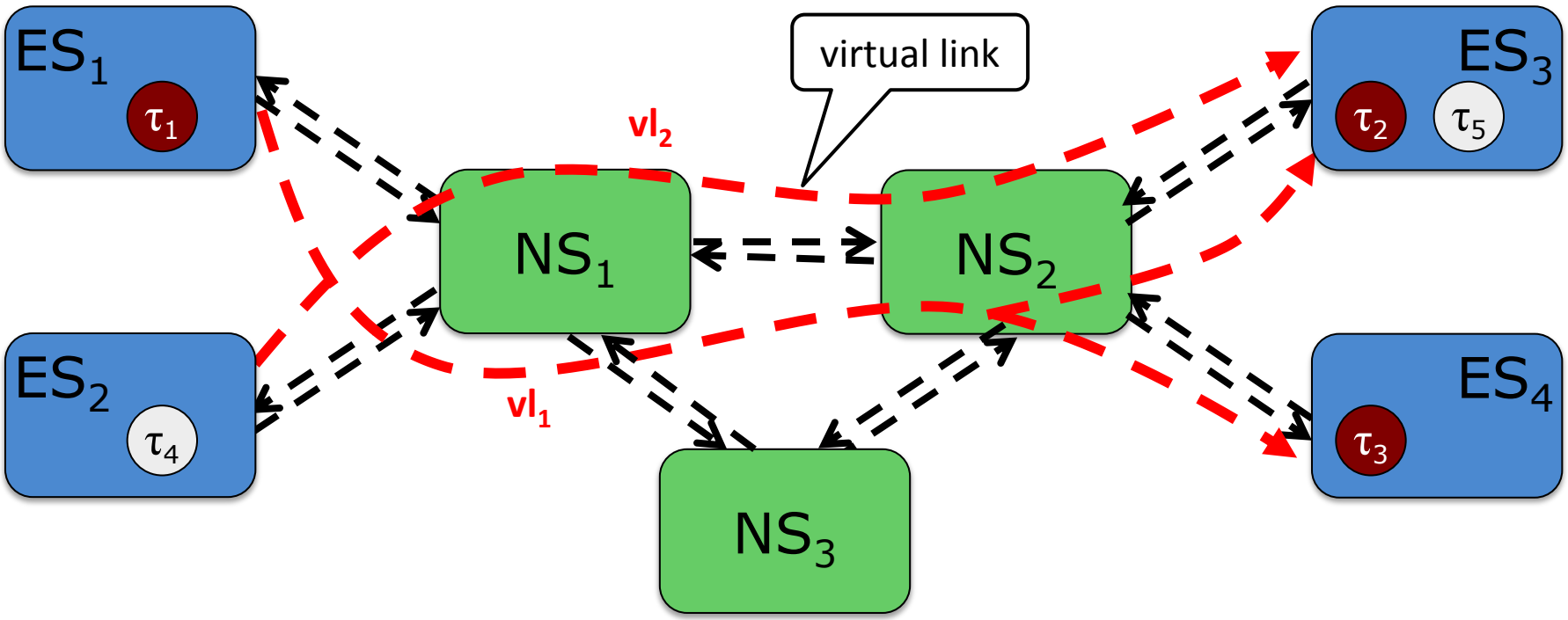
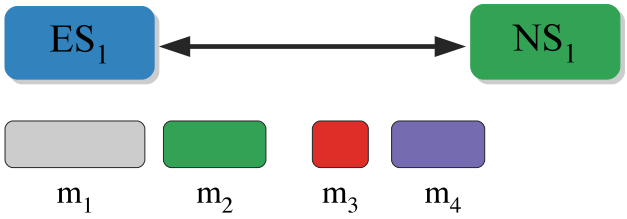
TTEthernet



- Traffic classes:
  - synchronized: Time Triggered (TT)
  - unsynchronized
    - Rate Constrained (RC) – ARINC 664p7 traffic class
    - Best Effort (BE) – no timing guarantees

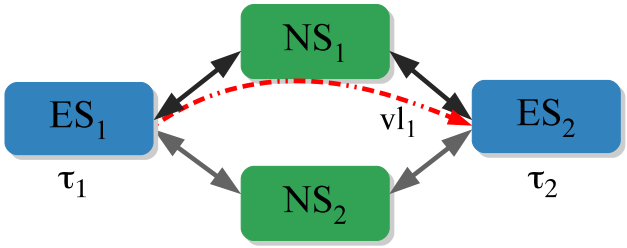
Design optimization problems: overview

Scheduling TT frames



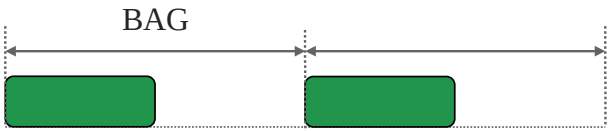
- Deciding the schedules of TT frames in ES and NS devices

Routing



- Deciding the routing of virtual links

Bandwidth for RC VLs

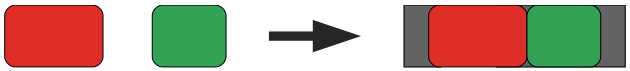


- Deciding the Bandwidth Allocation Gap for RC VLs

Fragmenting

- Deciding if and how to split messages before transmission

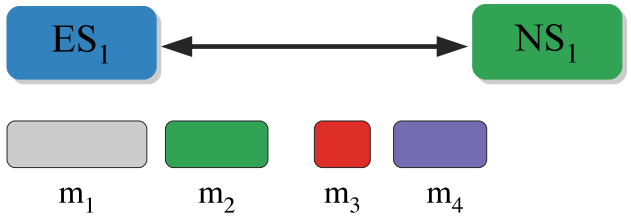
Packing



- Deciding which messages to pack into a frame

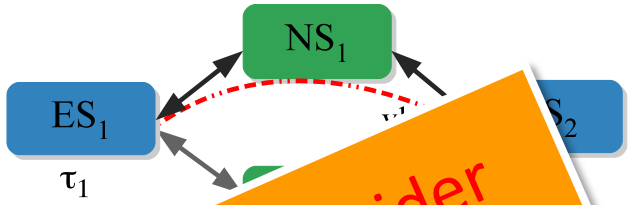
Design optimization problems: overview

Scheduling TT frames



- Deciding the schedules of TT frames in ES and NS devices

Routing



- Deciding the routing of virtual links

Bandwidth for RC VL

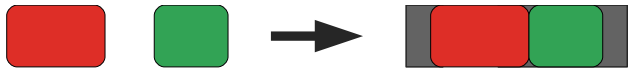
Does not consider BE traffic

- Deciding the Bandwidth Allocation Gap for RC VLs

Fragmenting

- Deciding if and how to split messages before transmission

Packing



- Deciding which messages to pack into a frame

What is new

- BE traffic model.

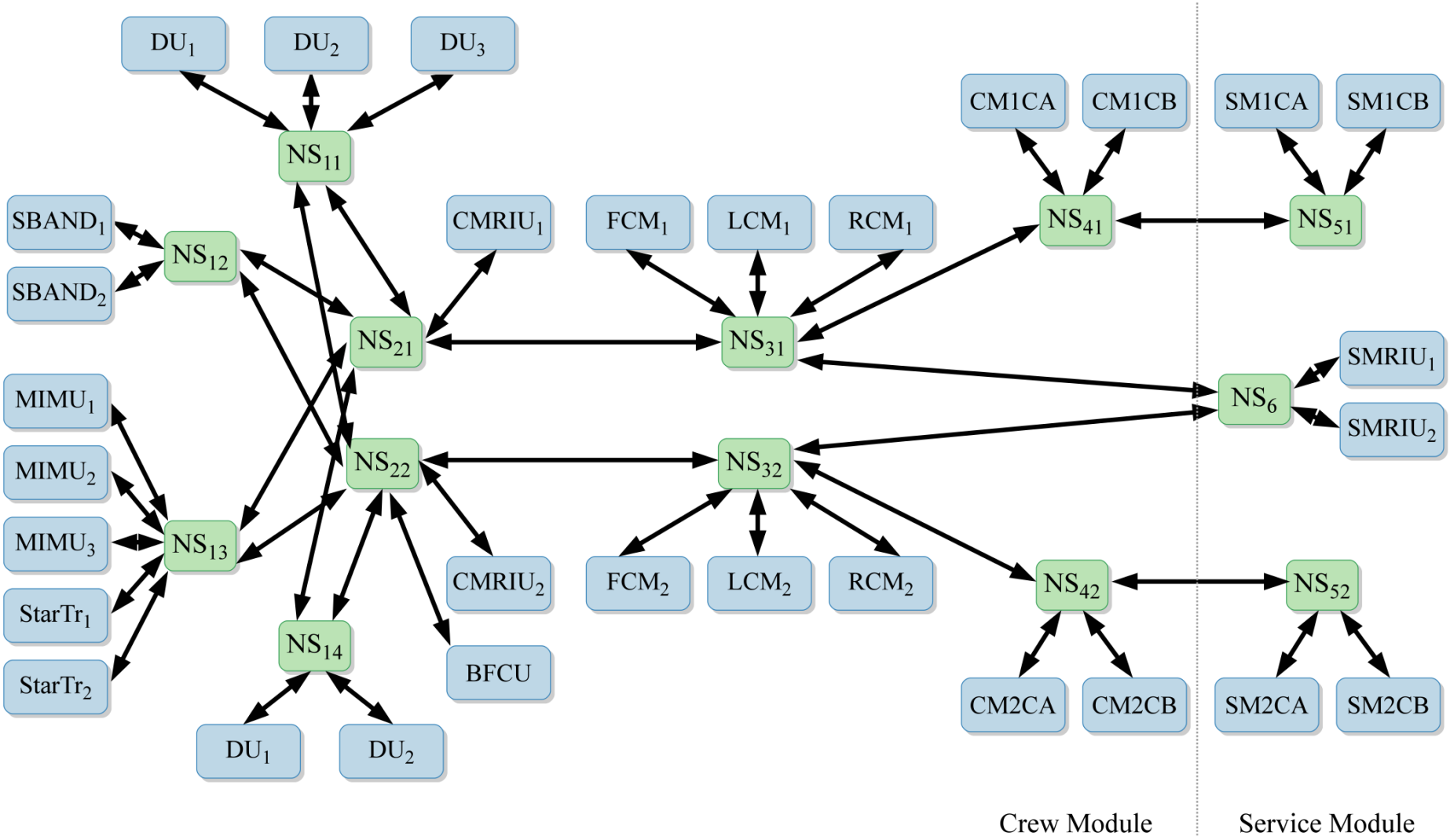
$$BW_{Req}(m_i) = \frac{m_i.size}{m_i.period}$$

- New cost function.

$$Cost = \begin{cases} c_1 = \sum_i \max(0, R_{f_i} - f_i.deadline) & c_1 > 0, f_i \in \mathcal{M}_{TT} \cup \mathcal{M}_{RC} \\ c_2 = \sum_j \max(0, BW^{BE}_{Req}(l_j) - BW_{Avail}(l_j)) & c_1 = 0 \ and \ c_2 > 0 \\ c_3 = \sum_j (BW^{BE}_{Req}(l_j) - BW_{Avail}(l_j)) & c_1 = 0 \ and \ c_2 = 0 \end{cases}$$

- Moves for BE frames.
  - Reroute
  - Packing

Evaluation


DU1
DU2
DU3
NS11
SBAND1
SBAND2
NS12
CMRIU1
FCM1
LCM1
RCM1
CM1CA
CM1CB
SM1CA
SM1CB
NS41
NS51
NS21
NS31
MIMU1
MIMU2
MIMU3
StarTr1
StarTr2
NS13
NS22
NS32
NS6
SMRIU1
SMRIU2
CMRIU2
FCM2
LCM2
RCM2
NS42
NS52
NS14
BFCU
DU1
DU2
CM2CA
CM2CB
SM2CA
SM2CB
Crew Module
Service Module

Future work

- Implement the optimization as a heuristic-based.
- Improve BE traffic model.
- Evaluate the optimization on more test cases.

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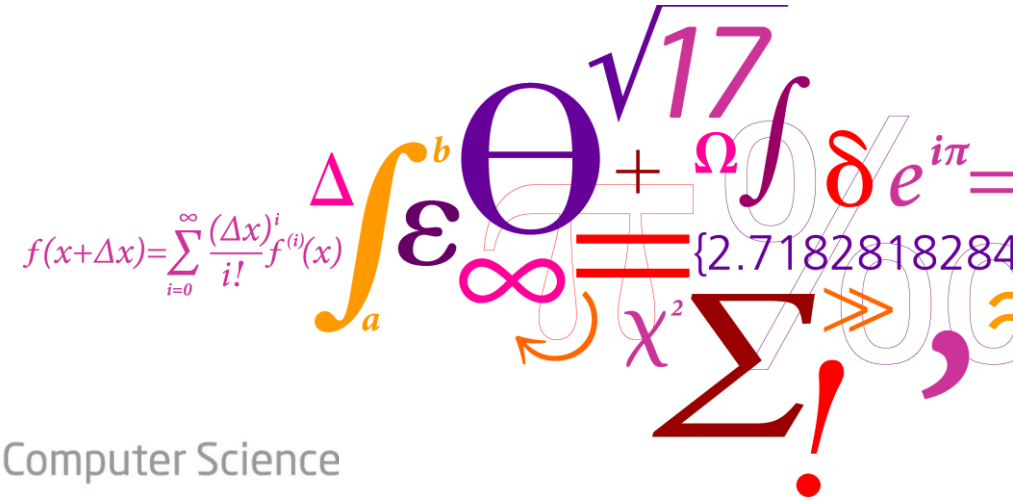

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