ATS
Current Work

Johannes Specht, University of Duisburg-Essen

Status

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Short Summary

- First WG draft is in progress
- Goal: **Draft as complete as possible**, i.e. no stub clauses, no big changes needed afterwards
- Special Topic: Informative Delay Analysis Framework for ATS

Challange

- A Delay Analysis Framework has been published in 2016
  https://ieeexplore.ieee.org/abstract/document/7557870/
- ATS Evolved - Most important:
  IEEE 802.1Qcr allows real-world implementation inaccuracies
- The Delay Analysis Framework should take these into account!

This Slidedeck

- Description of Inaccuracies
- Current work of the Editor

Delay Analysis 2016

$$d_f^{max} \leq \max_{\forall f' \, in \, Q(f)} \left(\frac{\sum_{i \in H} b_i^{max} + \sum_{i \in S} b_i^{max} + l_{f'}^{min} + \max_{i \in L}(l_i^{max})}{R - \sum_{i \in H} r_i} + \frac{l_{f'}^{min}}{R} \right)$$

Max. over all streams in the traffic class of f in the receiving bridge

Interference by all competing streams In at the sending bridge (not only The ones in the same class like f).

S&F

Term	Description
d_f^{max}	Max. per hop delay of a stream *f*.
$\sum_{i \in H} b_i^{max}$	Sum of max. burstiness (i.e., *Committed Burst Size* parameters) of streams with a higher priority than *f'*.
$\sum_{i \in S} b_i^{max}$	Sum of max. burstiness of stream *f* and all streams with priority level equal to the priority level of *f'*.
$\max_{i \in L}(l_i^{max})$	Maximum frame length of all streams with a lower priority level than *f'*, including all non-ATS lower priority traffic classes.
$l_{f'}^{min}$	Minimum frame length of stream *f'*.
R	Link speed.
$\sum_{i \in H} r_i$	Sum. of max. data rates (i.e., *Committed Information Rate* parameters) of streams with a higher priority than *f'*.

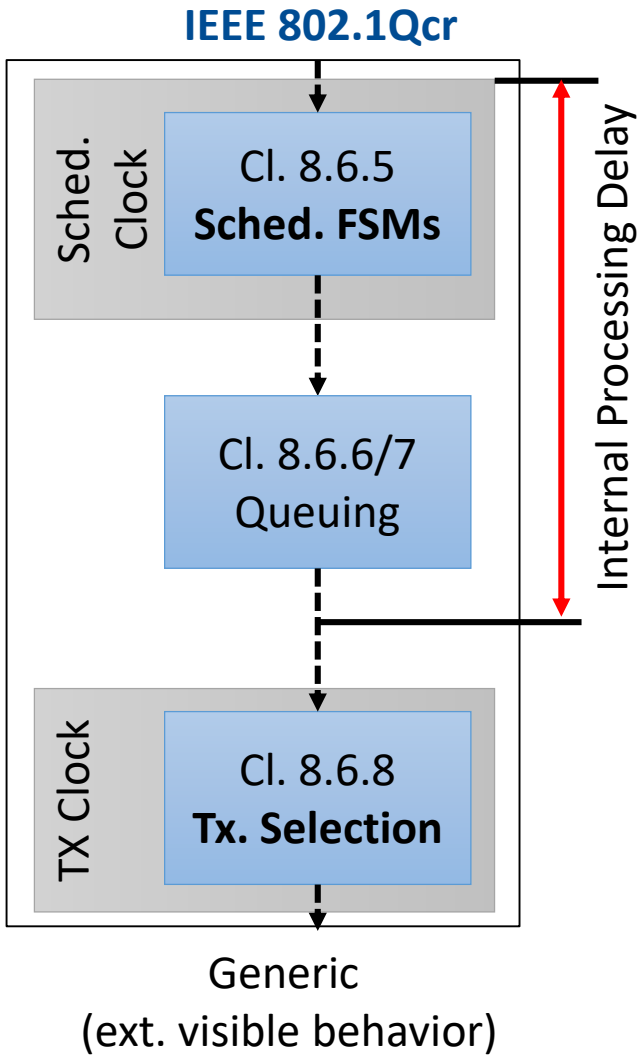
Description

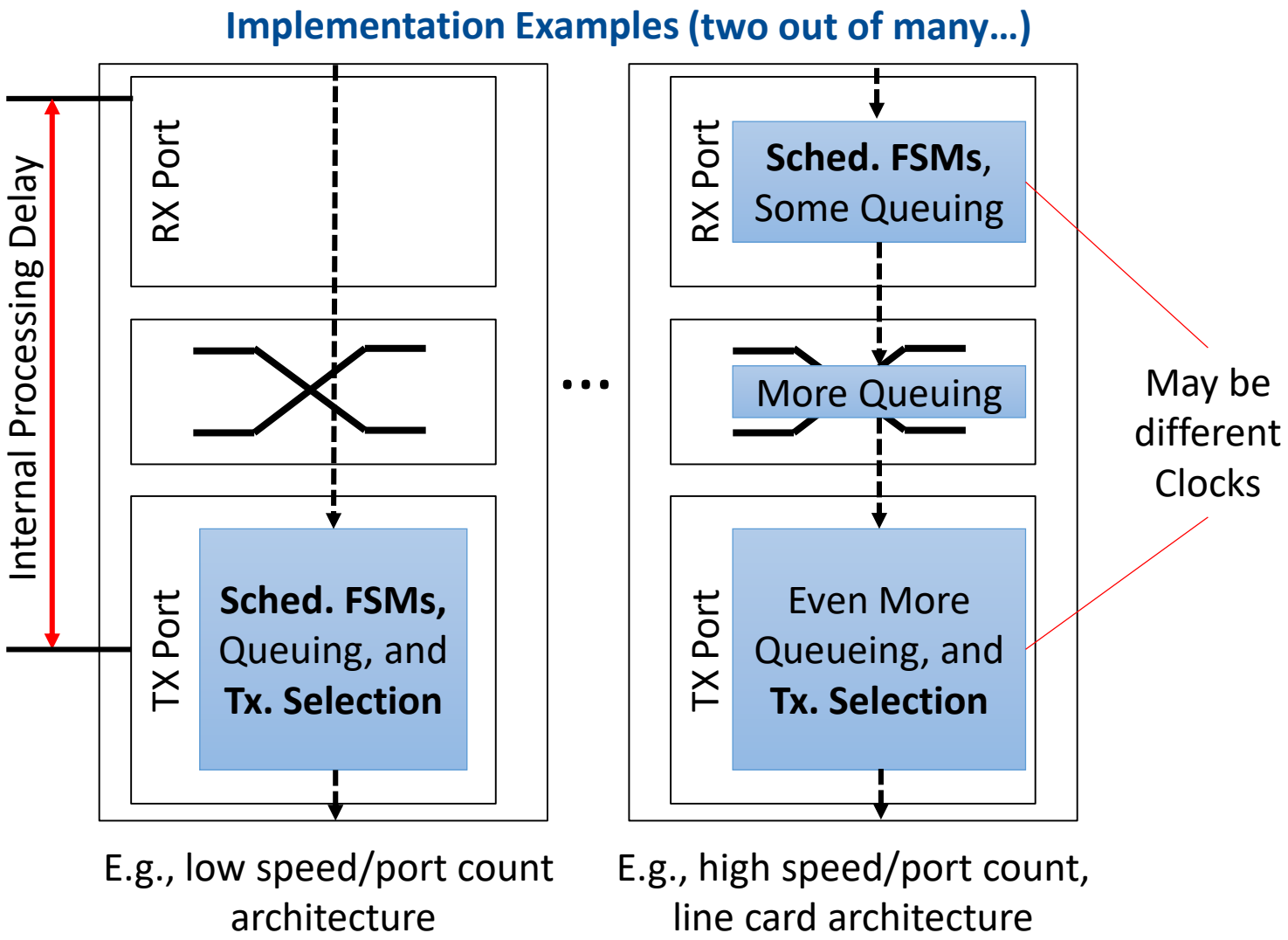
- Single hop delay bound from a sending bridge to a receiving bridge
- End-to-end: Sum of single hop delay bounds
  Note: Simplified equation for the last hop

What is missing: Inaccuracies (the new stuff!)

- *Link Delays*
  Often rather small
- *Device Internal Processing Delays*
  Implementation dependent – implementations may vary significantly
- *Clock Inaccuracies*
  ATS entities in a bridge may be placed in different clock domains - in terms of digital logic, not in terms of 802.1AS or similar (!)

802.1 Qcr Model and Implementation



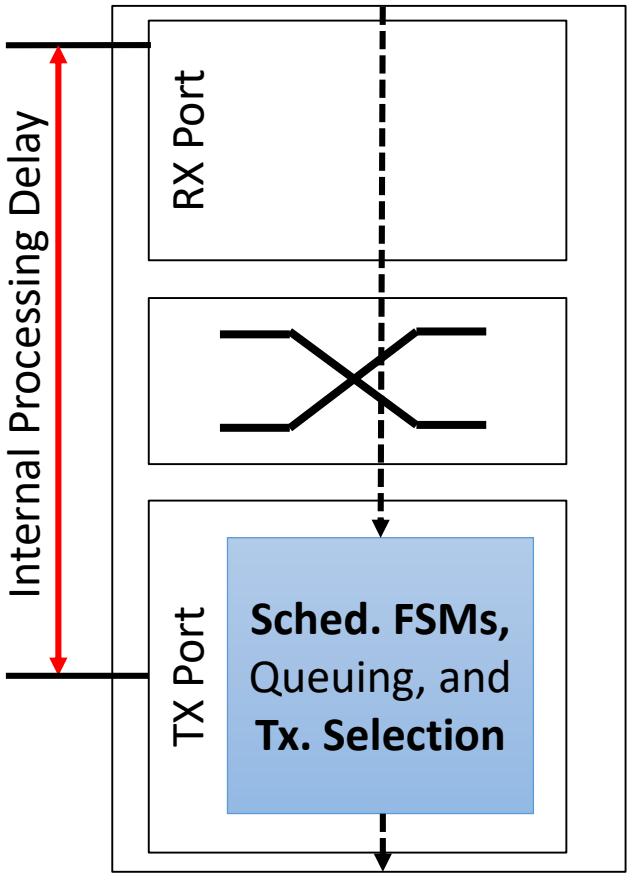


On Inaccuracies: Delays

$$d_f^{max} \leq \max_{\forall f' \, in \, Q(f)} \left(\frac{\sum_{i \in H} b_i^{max} + \sum_{i \in S} b_i^{max} + l_{f'}^{min} + \max_{i \in L}(l_i^{max})}{R - \sum_{i \in H} r_i} + \frac{l_{f'}^{min}}{R} \right)$$

Rather trivial: Link and Processing Delays

- Max. Processing delay added to the per hop delay bound
- Max. Link delay added to the per hop delay bound
- I.e.: new d_f^{max} = old d_f^{max} + both delays



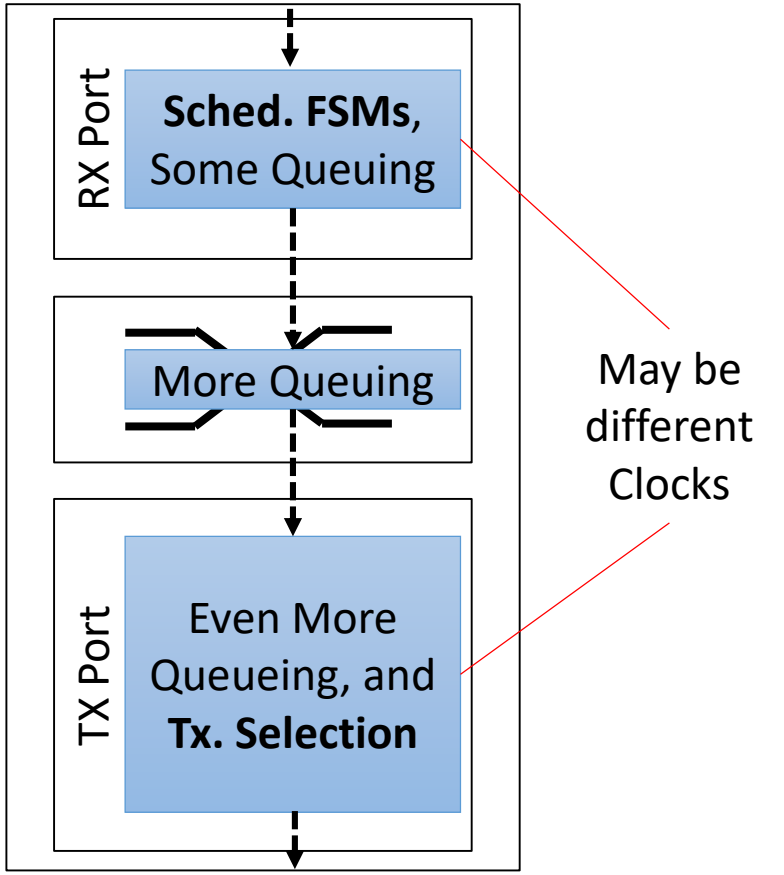
Inaccuracies: Clocks

Non-trivial: Clock Inaccuracies (Work in Progress)

- *Sched. Clock* and *Tx Clock*: Offsets and Drifts
  - Ok in IEEE 802.1Qcr, as long as the maximum offset is bounded
  - Assumed to be a desirable degree of freedom for implementers (i.e., no “very accurate” device-internal sync. mechanism needed)
- Inaccuracies can deform traffic envelopes, as enforced by shaping

→ Several questions:

- One time, two times, three times?
- Interaction with processing above delays?
- Does one absorb the other?
- Packet Ordering/Race Conditions?



Clocks: Obtaining Answers

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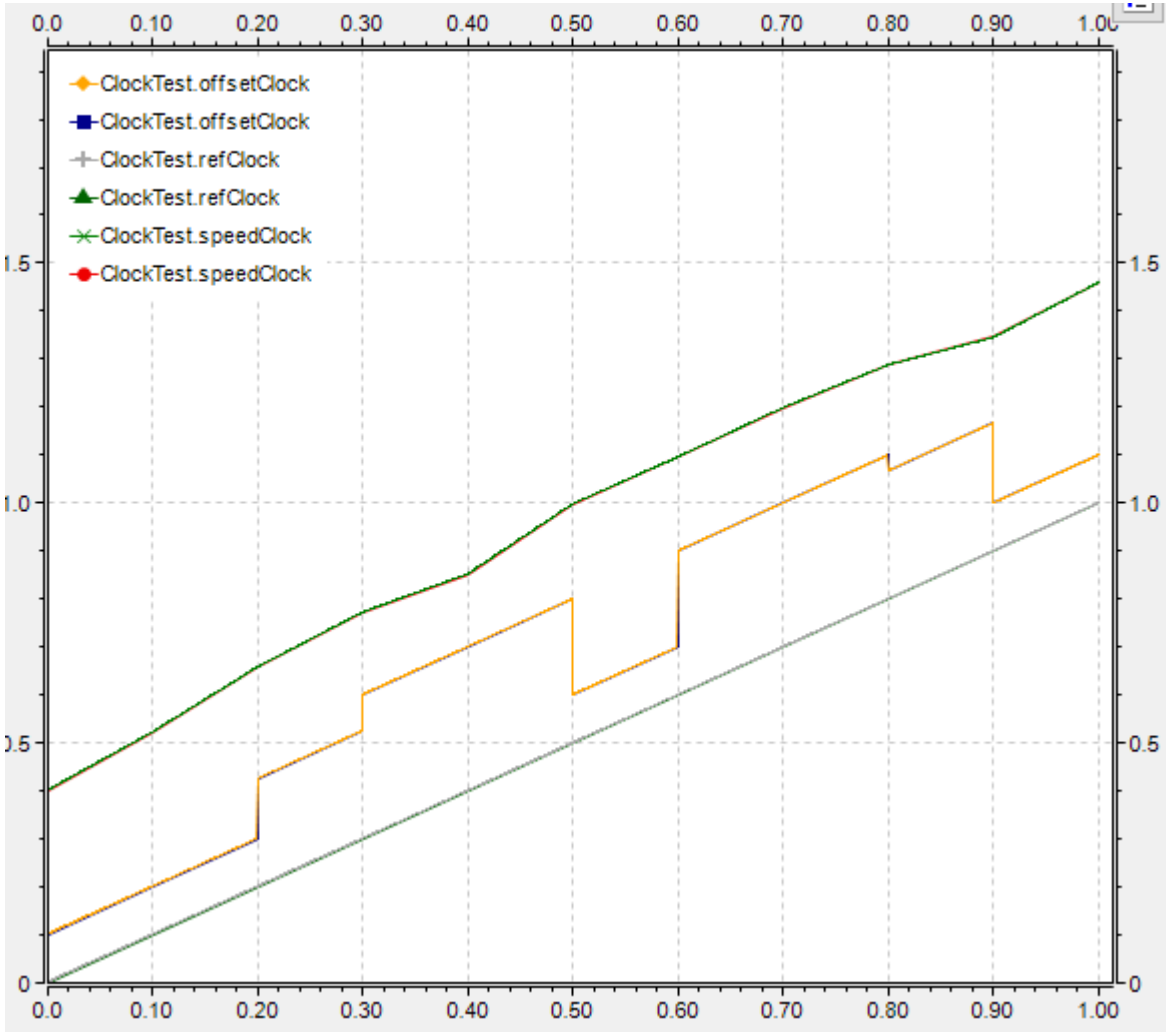
Math. Analysis

- Formal proofs (i.e., Guarantees)
- Implies abstraction

Simulations

- NO Replacement for Analysis, but …
- … Validation: “Abstraction…Gaps?”
- … Supportive: “How to proof?”

→ Feedback for math. Analysis



Math. Analysis and Simulation In Progress

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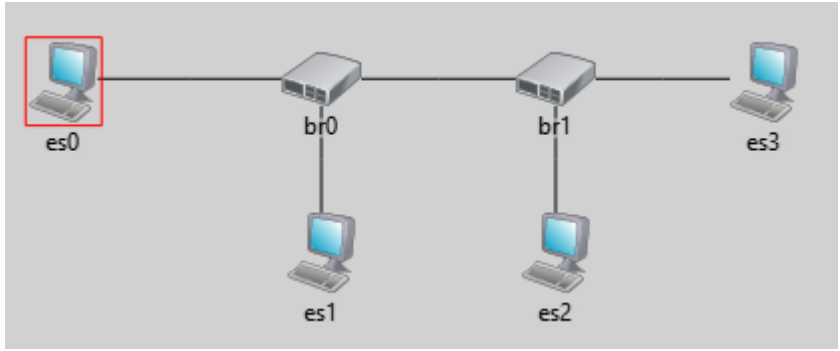
Math Analysis

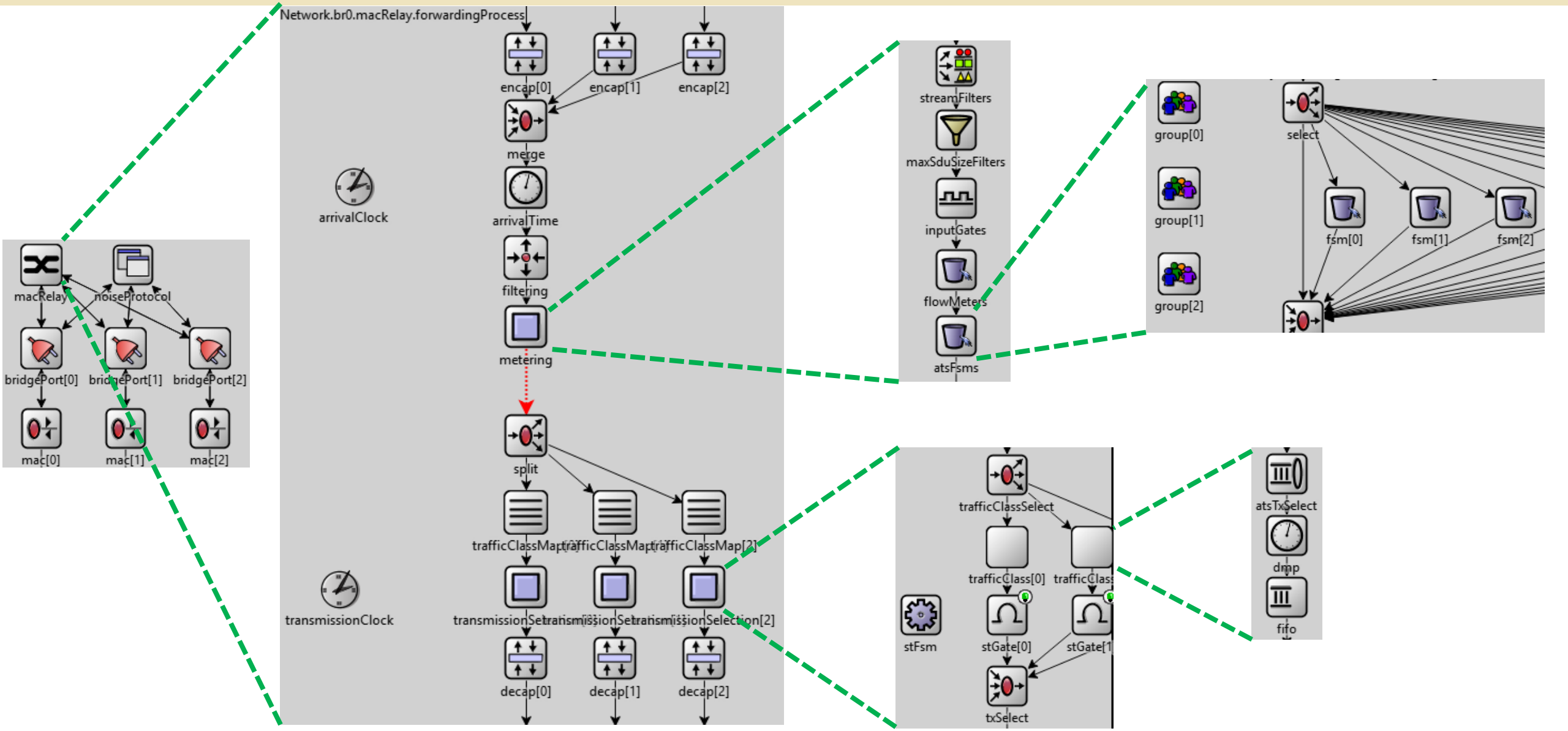
- A good guess is there ;)
- Working towards a proof
- May affect “AssignAndProceed(…)”

Simulation close to IEEE 802.1Q

- Based on 802.1Qcr/Q-Rev 2018
  – not based on
    - UBS/ATS 2016 Models
    - Old IEEE 802.1 Std. Models
    - Particular Implementation Models
    - …
- More 802.1Qcr: Full data plane model
- Implementation inaccuracies (like clocks):
    - Flexible submodule placement/ordering
    - Replacement by “imperfect” versions



Bridge Model in a Nutshell



Thank you for your Attention!

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Questions, Opinions, Ideas?

Johannes Specht
Dipl.-Inform. (FH)

Dependability of Computing Systems
Institute for Computer Science and
Business Information Systems (ICB)
Faculty of Economics and
Business Administration
University of Duisburg-Essen

Schuetzenbahn 70
Room SH 502
45127 Essen
GERMANY
T +49 (0)201 183-3914
F +49 (0)201 183-4573

Johannes.Specht@uni-due.de
http://dc.uni-due.de