Time-Triggered Ethernet for in-vehicle networks

Related Work

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Anwendungen 2 – 18. June 2008

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Motivation

Source: Mercedes

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Motivation

- increasing demands for efficiency on in-vehicle communication
- compliant with rigid real-time constraints
- flexible support for weakly constrained traffic
- significant importance for safety, reliability or comfort

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Problem Statement

- Wide variety of products for real-time Ethernet
- No analysis yet that proves feasibility for in-vehicle networks
- No simulation tools for in-vehicle Ethernet networks

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Retrospect of previous Work

- Approaches to real-time Ethernet (Automation Industry)
- Technology overview:
  - Time-Triggered
  - Token based
  - Bandwidth limiting
- Overview real-time Ethernet products and projects

[1]

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Retrospect of previous Work

Choice of Time-Triggered Ethernet [2] by TTTech:

- Standard Ethernet protocol extension
- best-efforts network traffic and hard real-time traffic on same wire
- well scaling, can satisfy further requirements on bandwidth
- protocol adds timeslots to standard Ethernet
- synchronization to a global timebase

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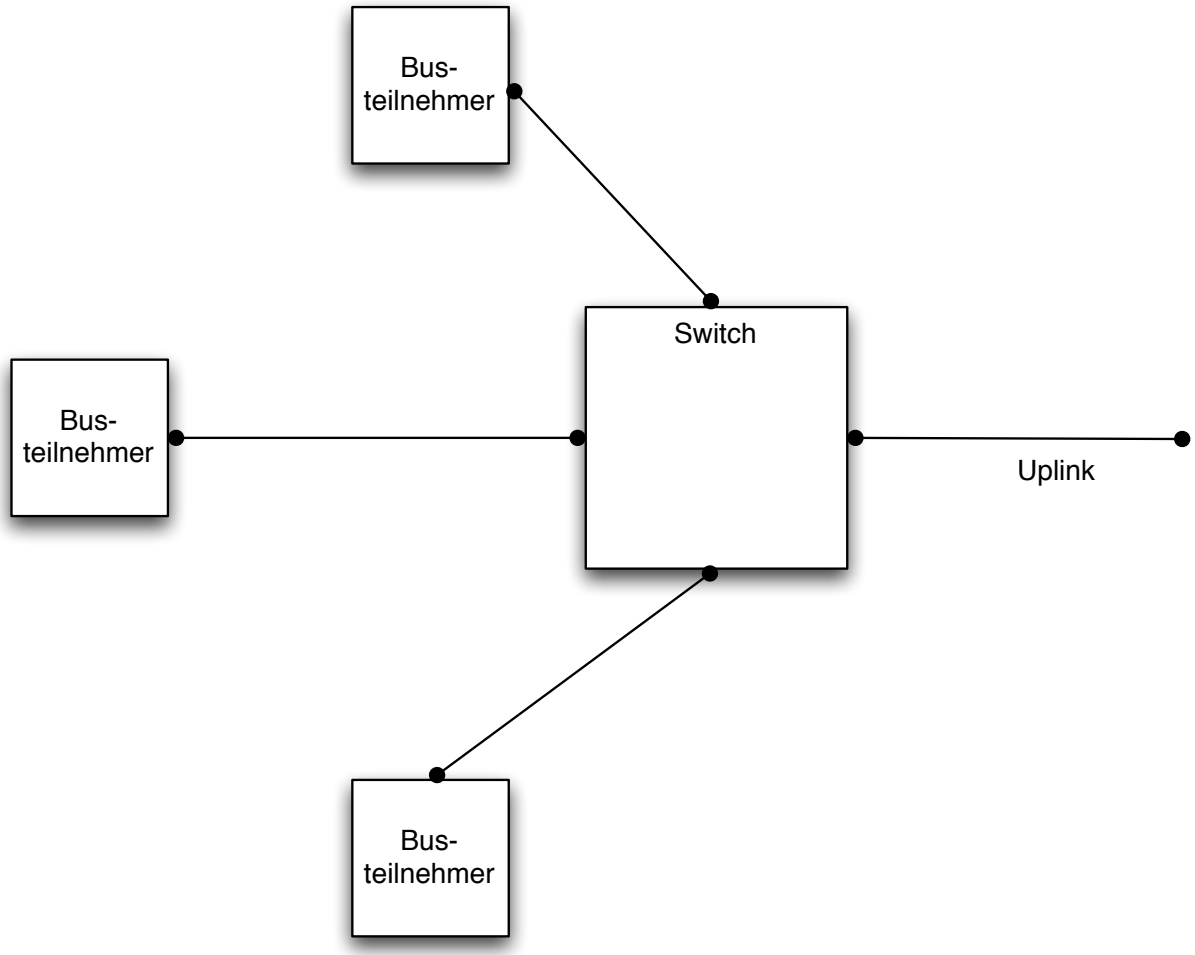
TDMA in TTEthernet



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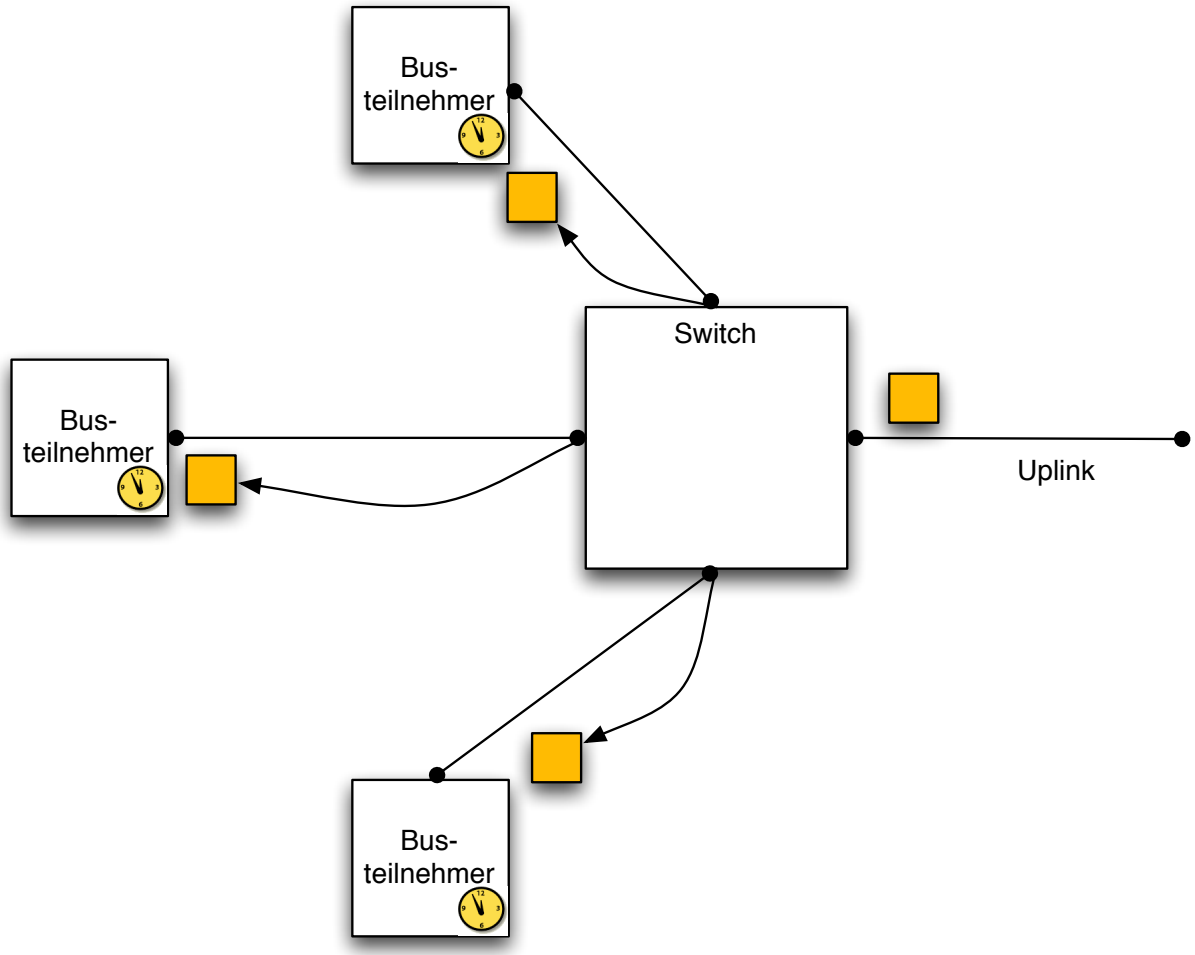

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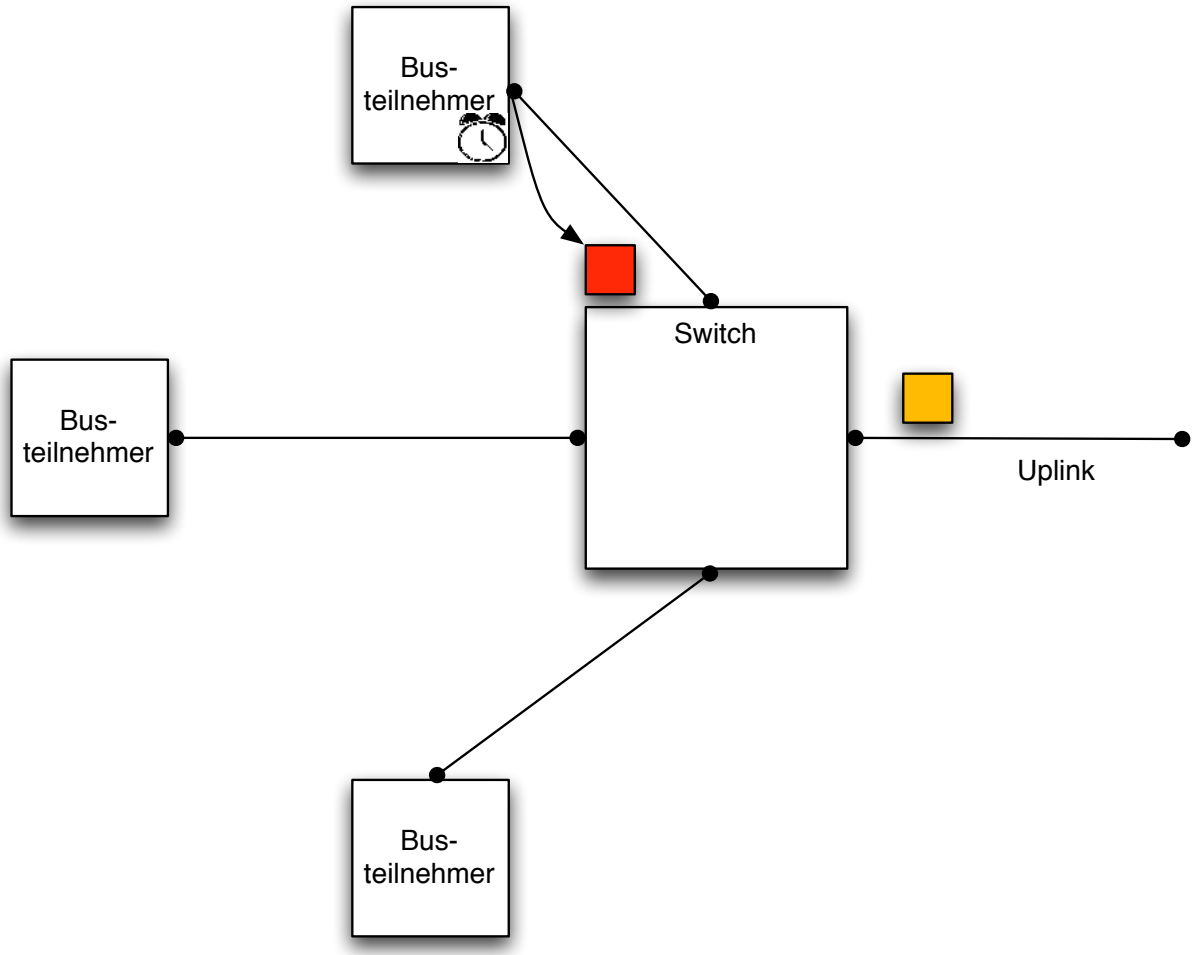

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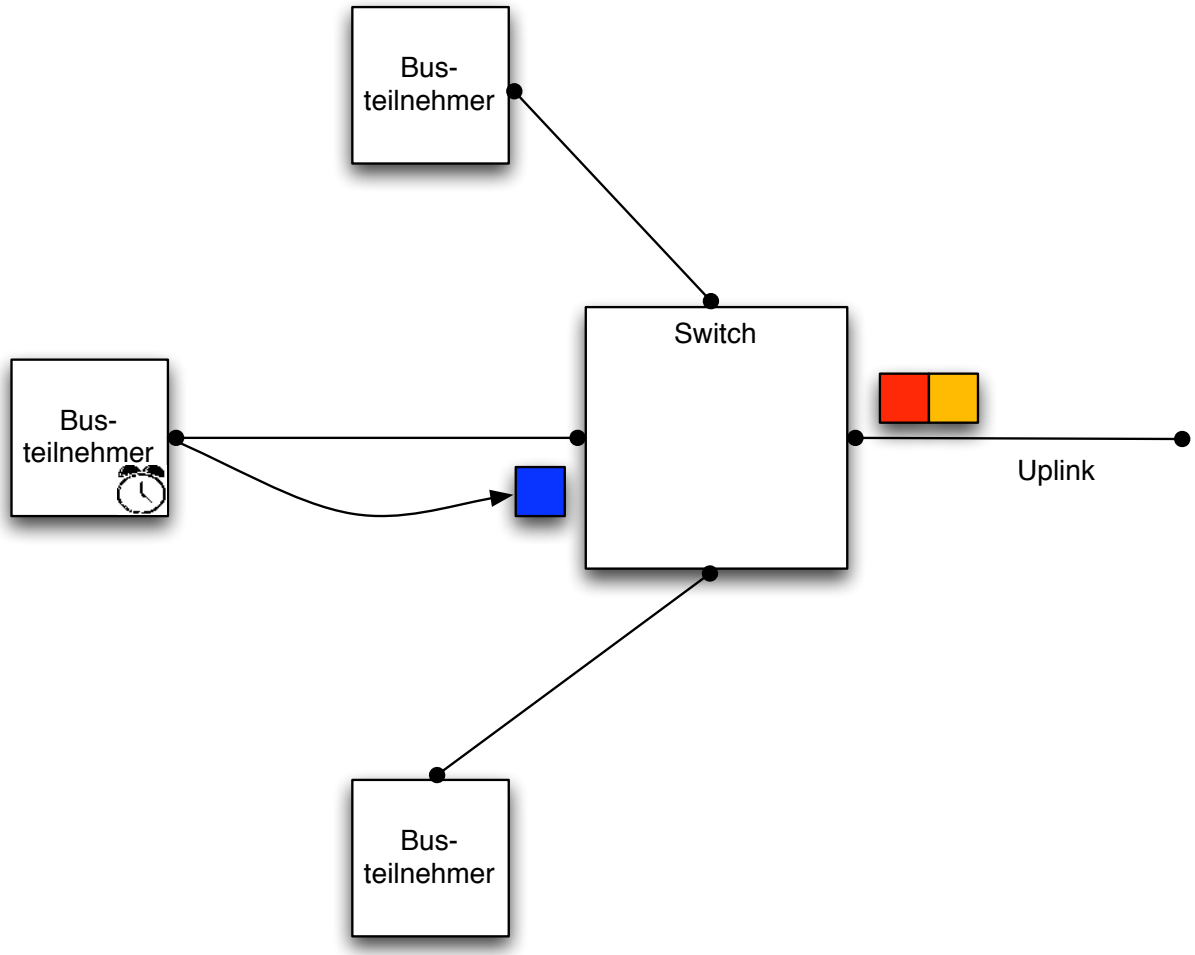

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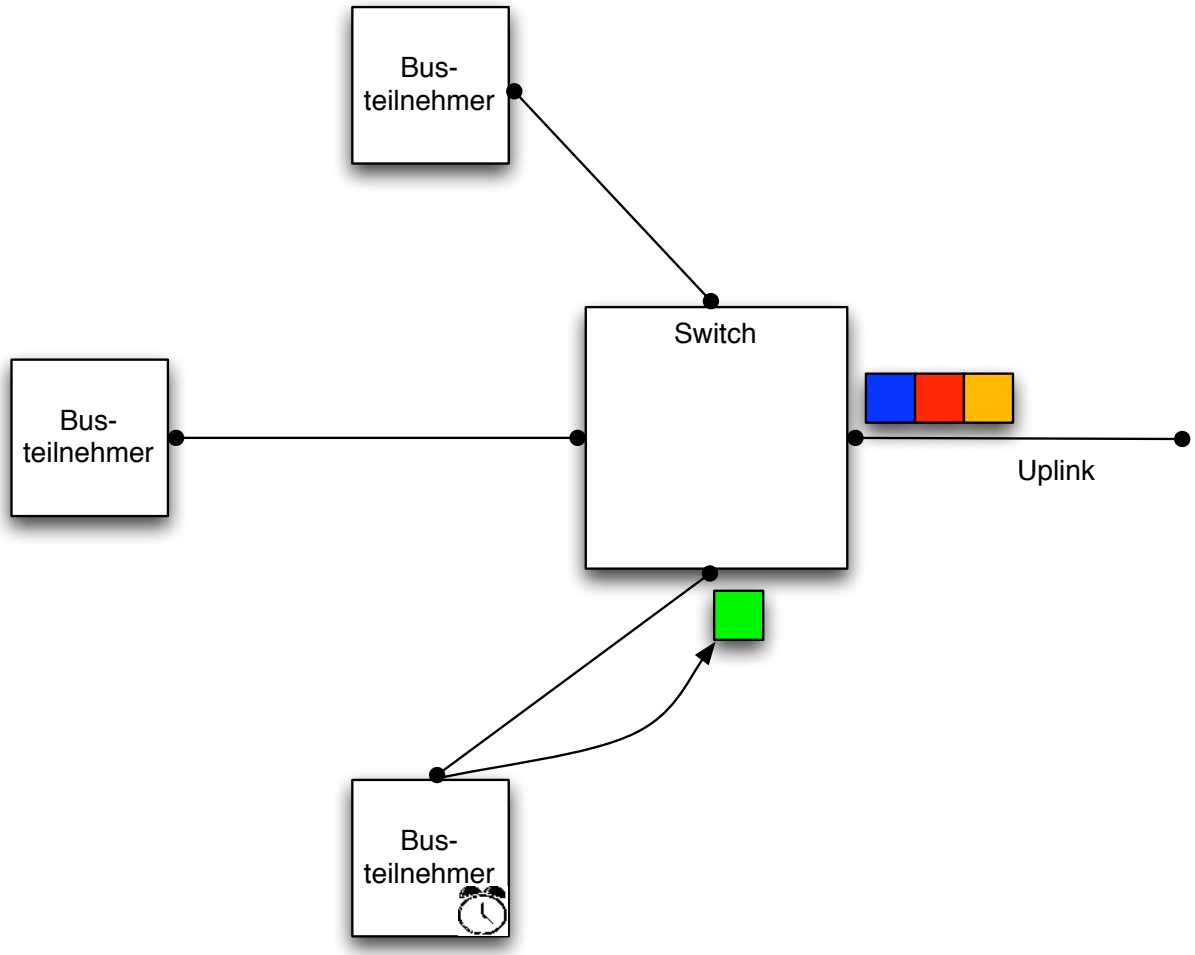

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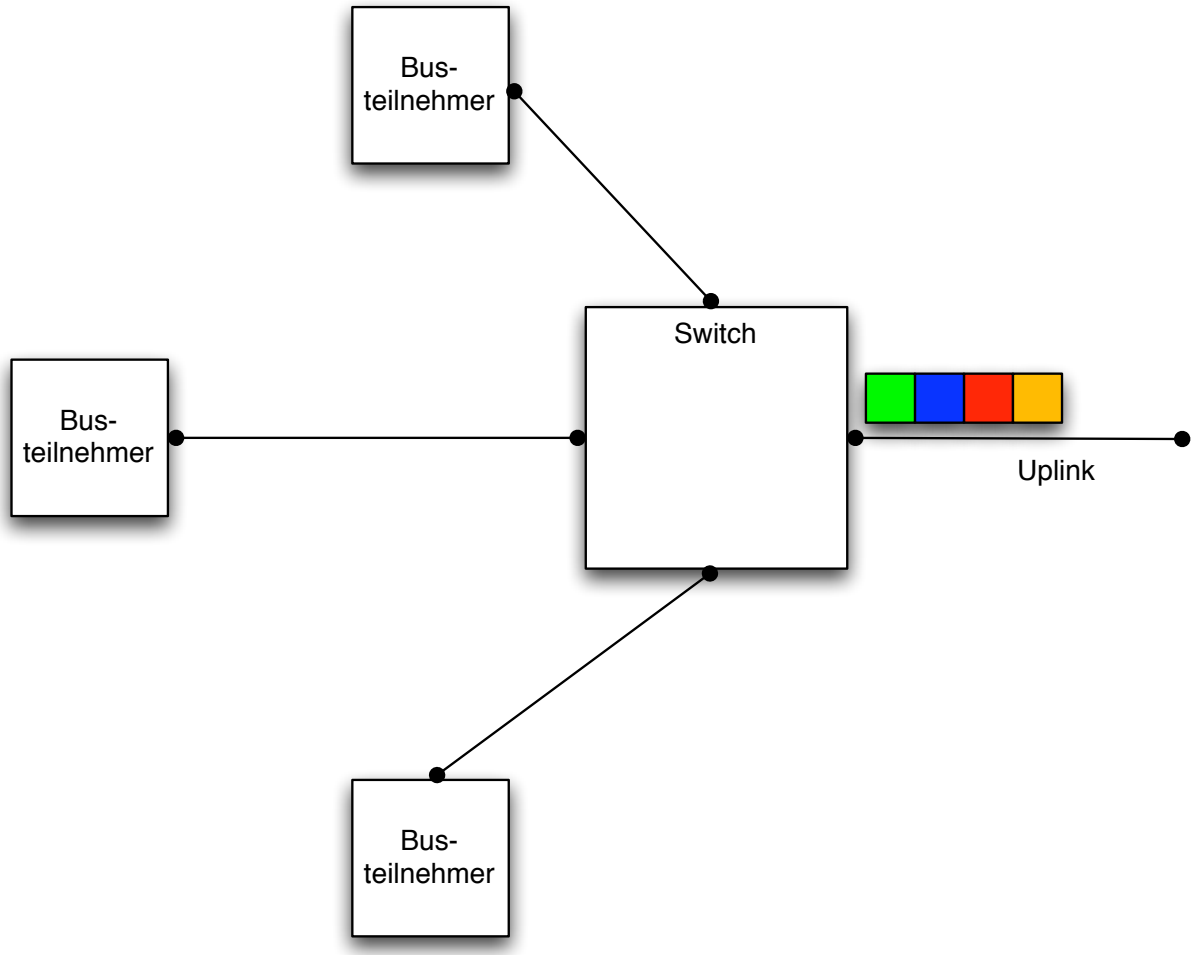

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TTEthernet current state

- Basic features are formally proven to work correctly
- There was no feasibility analysis for in-vehicle networks yet
- There are no simulation tools yet

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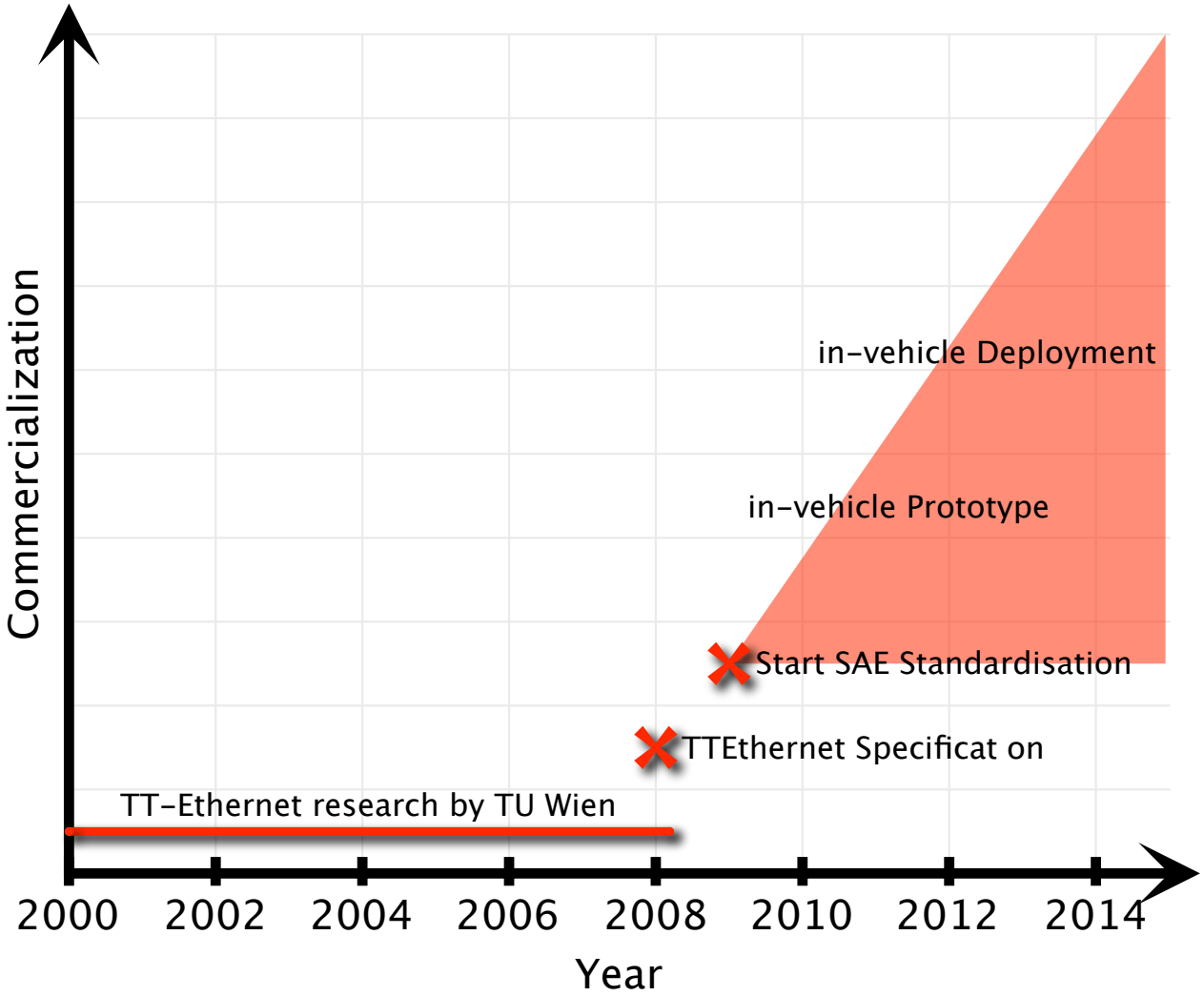
Positioning of TTEthernet
Progress of Commercialization



Current State of my Work

- Based on AW1 choice of TTEthernet for further work [1]
- Deeper induction into TTEthernet
- Ordering of TTEthernet evaluation system
- Comparing Time-Triggered Ethernet with FlexRay
  - Submitted paper [3] for the 5th Workshop of the GI/ITG-Workinggroup “Messung, Modellierung und Bewertung von Rechensystemen (MMB)” [4]

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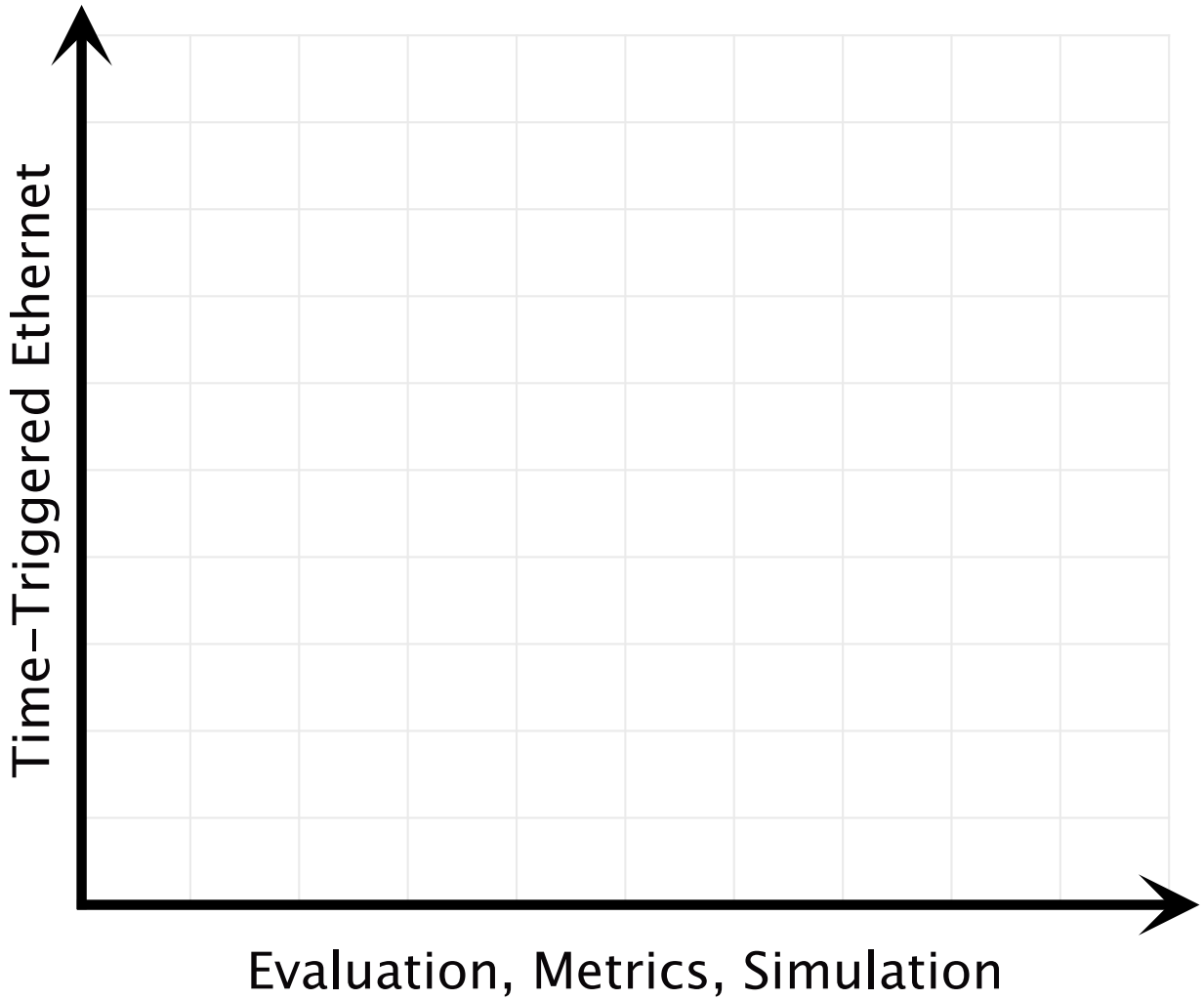
Scheme for Classification



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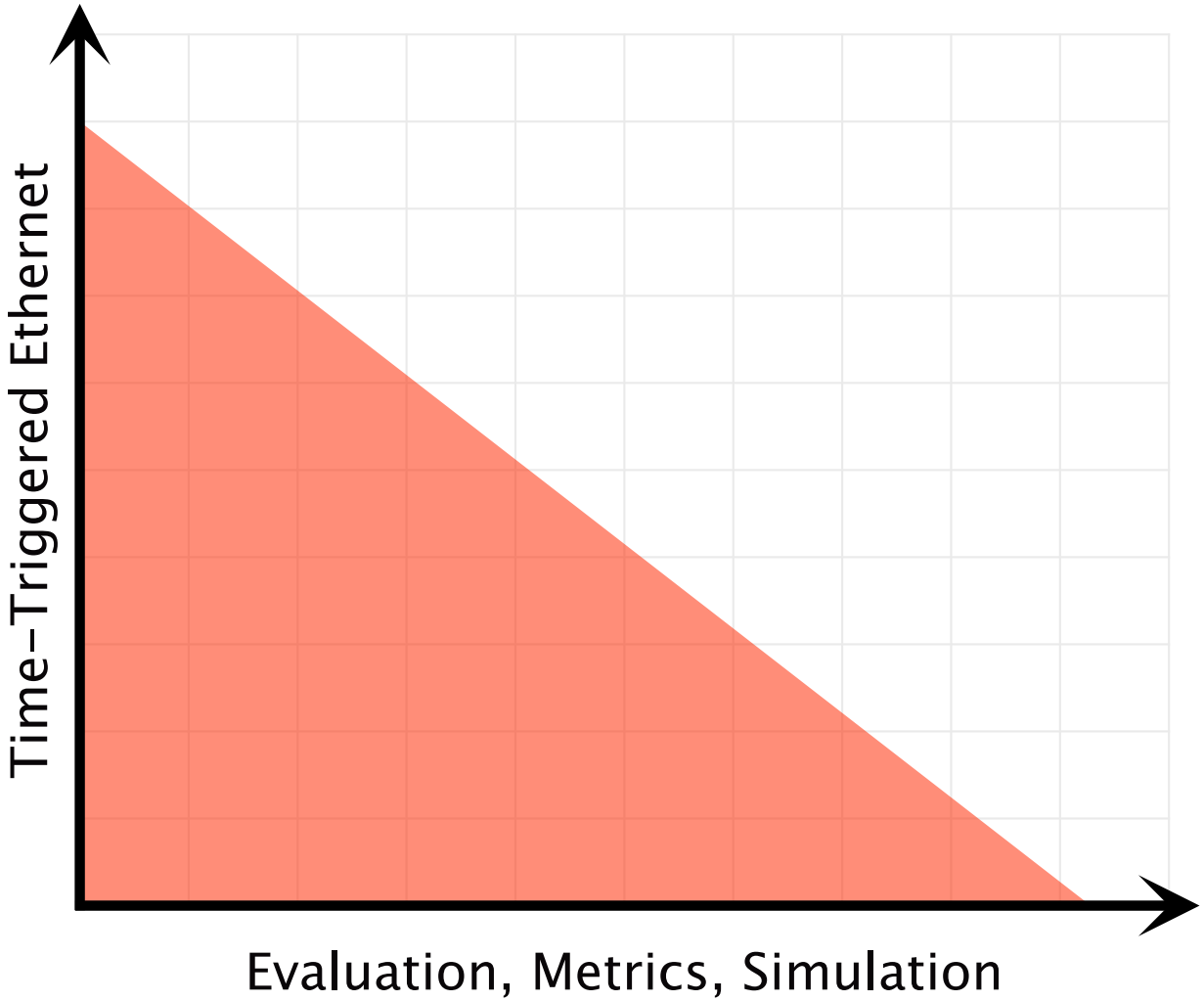

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Approaches to Realtime Ethernet

- TTEthernet
- Profinet
- SynqNet
- Ethercat
- Powerlink
- SERCOS

[1]

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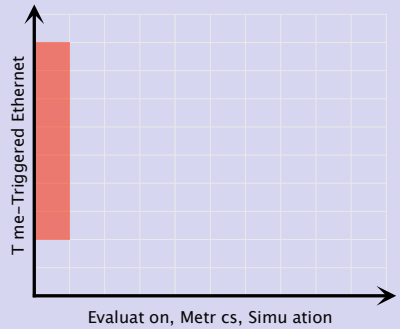

Analysis

- ABB AS Corporate Research Center - performance analysis of EtherCAT and PROFINET IRT [5]
  - transfer analysis for common metrics
  - transfer formal notation of calculated results

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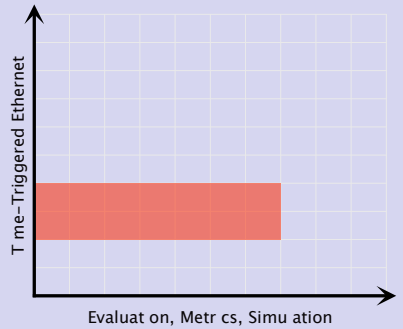

- SAE - AS-2D Time Triggered Systems and Architecture Committee (AS 6802) [6]
- VDI-Gesellschaft Fahrzeug- und Verkehrstechnik (VDI-FVT) - Fachbereich Fahrzeugelektrik/-elektronik [7]

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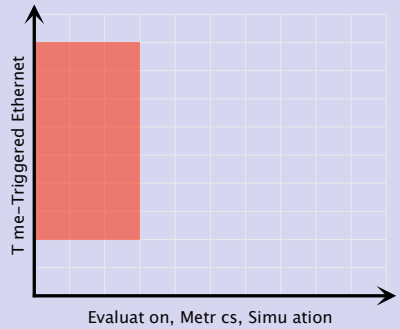
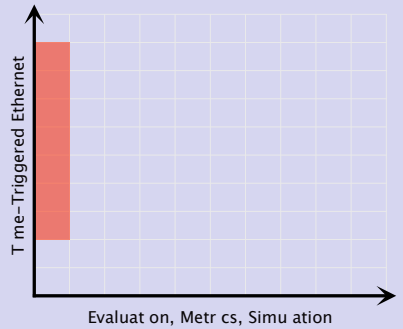


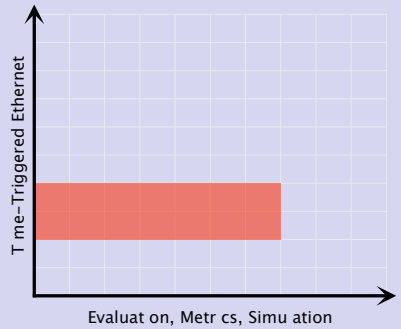
Relevant improvements of Real-Time Ethernet

- TT-Ethernet by TU Wien [8]
- Real-Time Crossbar proposal (F. Dopatka and R. Wismüller) [9]



Analysis

- Real-Time Ethernet Networks Simulation Model [10]
  - Work of Halmstad University (Sweden)
- Forschungszentrum Jülich PROFINET analyses [11]



Working Groups and Conferences

- IEEE - Vehicular Technology Society [12]
- ACM - SIGCOMM - Data Communication [13]
- International IEEE Symposium on Precision Clock Synchronization for Measurement, Control and Communication (ISPCS) [14]

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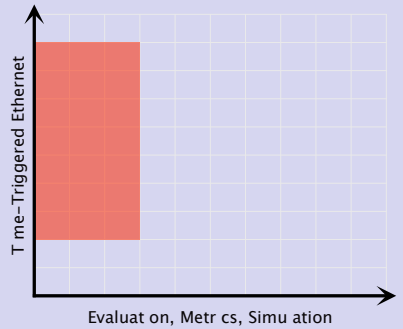

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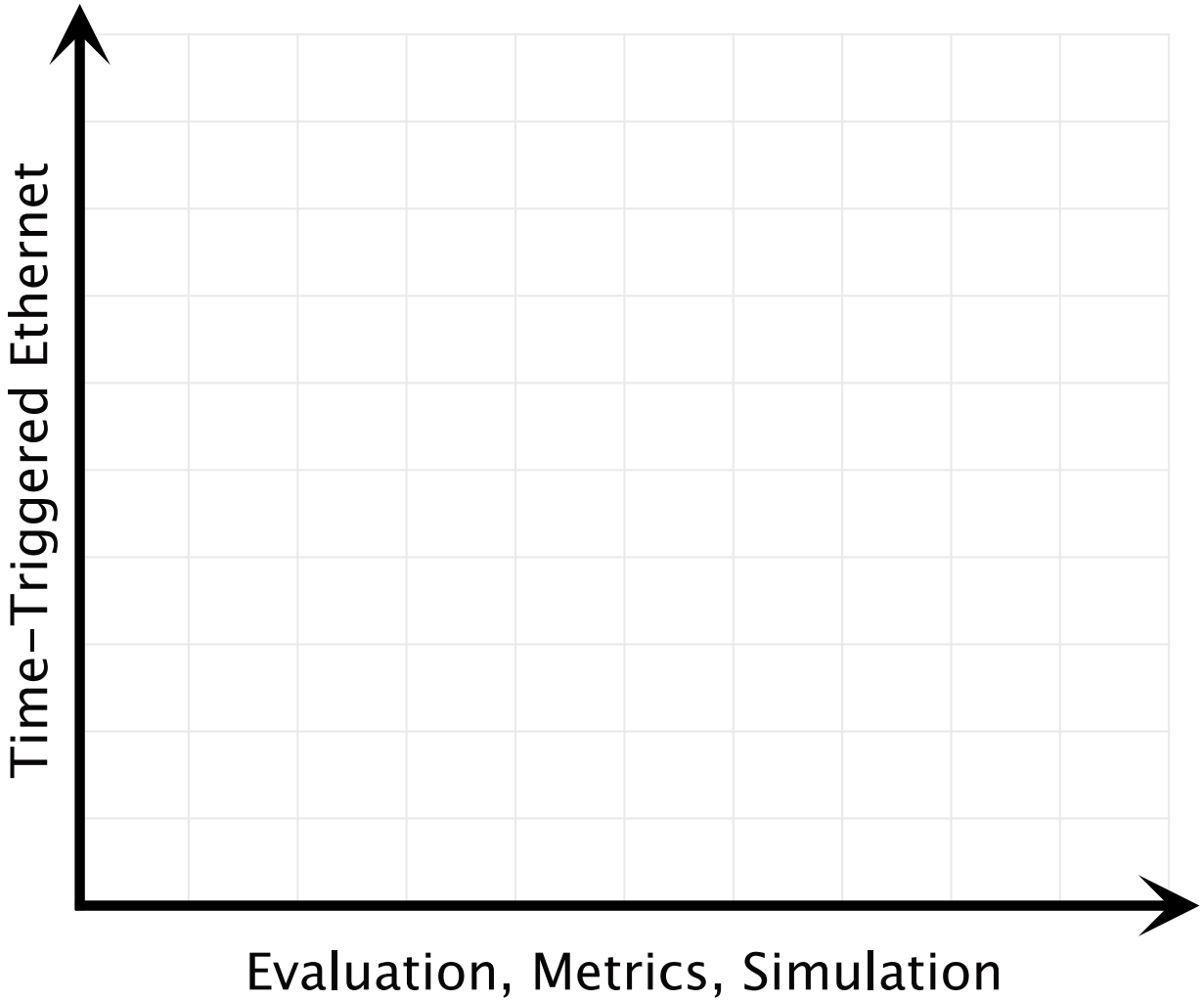

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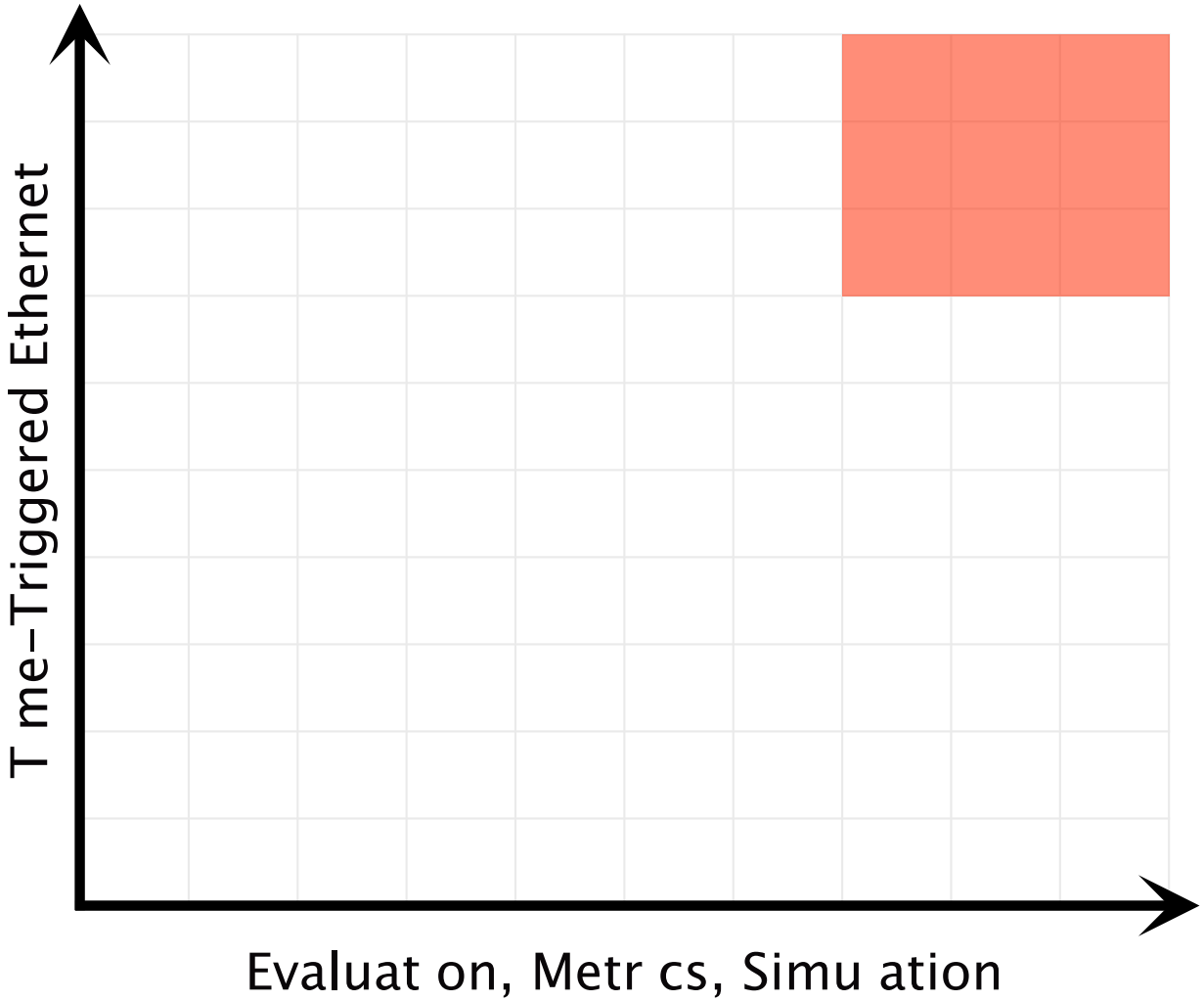

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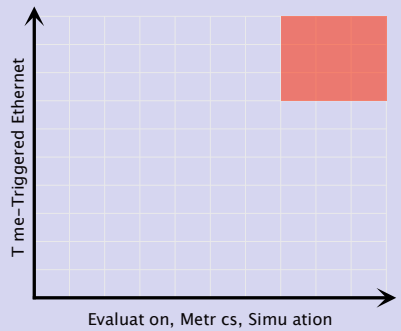
My Approach:

- Build simulation model for TTEthernet in-vehicle network
- Implementation of TTEthernet in OMNet [15] (Projekt 2)
- Simulation of in-vehicle networks with common data and topologies
- Analysis of TTEthernet for common in-vehicle related metrics



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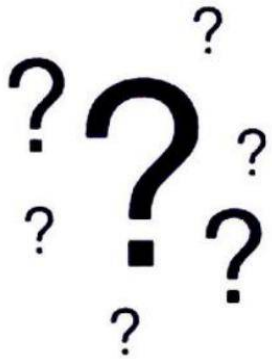
Thanks for the interest



May I answer your questions?

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