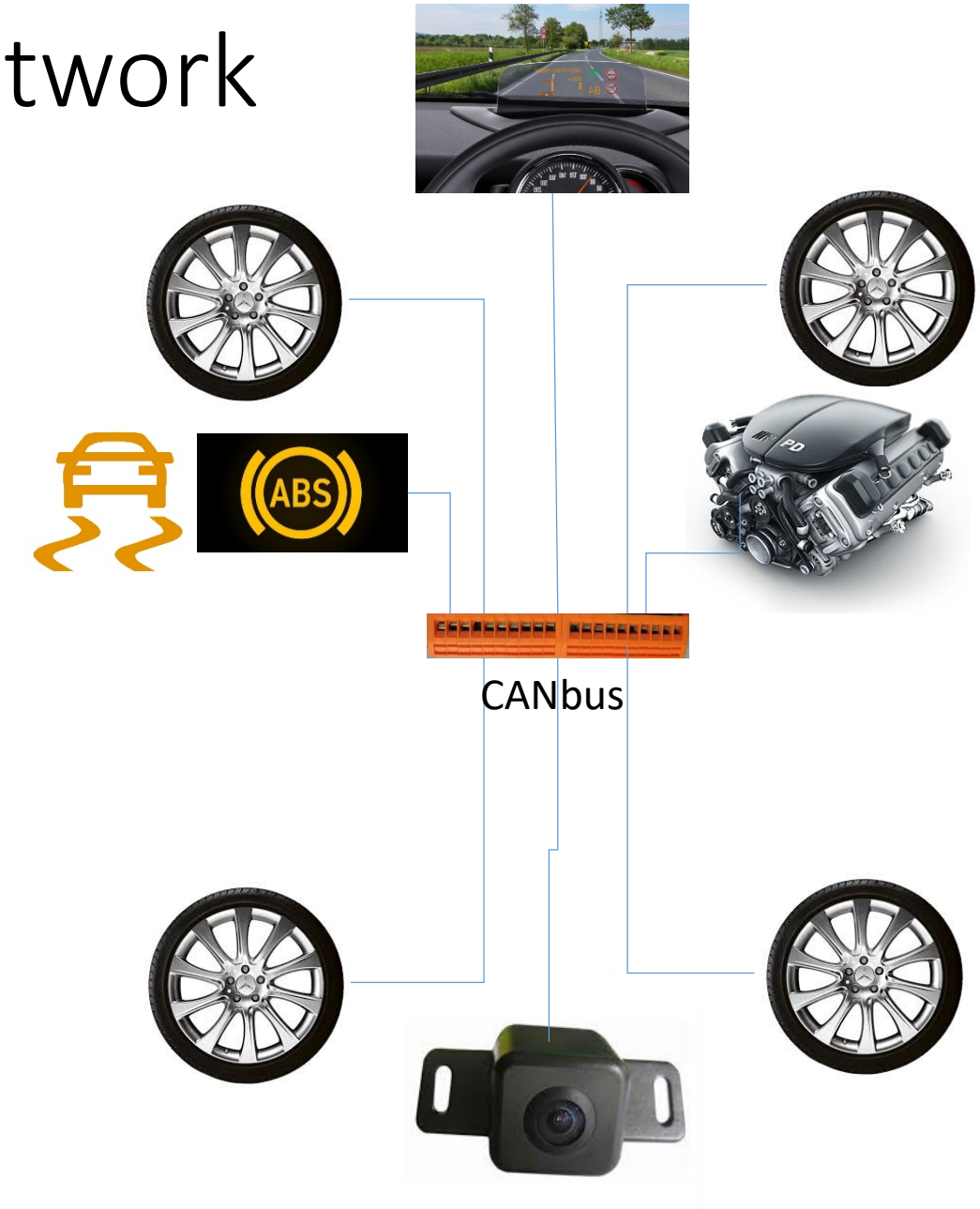
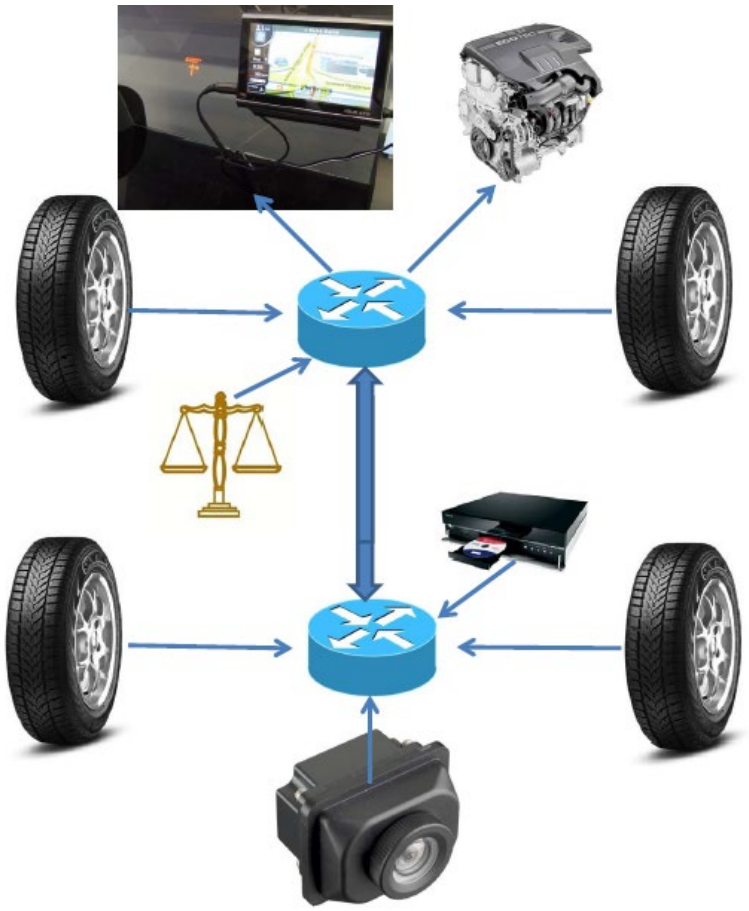
Distributed Realtime Systems

Mini project

In-car CANbus network



In-car Ethernet network



Network Architecture

Network elements

- 1MBps CANbus
- W{1,2,3,4}: wheel sensors measuring wheel position for ABS and EPS.
- EPS: Electronic Stability Controller
- EC: Engine Controller
- HUD: Head Up Display
- MM: Multimedia system
- RC: Rear Camera

Transmission pattern

- W{1,2,3,4} -> ESP
- ESP -> EC
- MM -> HUD
- RC -> HUD

Traffic characteristics CANbus

Flow	Period / Mean period	Packet Size	Pattern
W(1-4)	10 mS	20B	Periodic
ESP	10 mS	8B	Periodic
RC	40 mS	1400B	Poisson
MM	40 mS	1400B	Poisson

Traffic characteristics Ethernet

Flow	Min/Mean Cycle Time [ms]	Size [B]	Priority	D/P
W1	2	20	1	D
W2	2	20	1	D
W3	2	20	1	D
W4	2	20	1	D
ESP	20	8	1	D
RC	2	1400	2	P
Multimedia	2.5	1400	3	P

Assignment task 1

- Create a DNC/RTC arrival-model of the periodic external traffic sources of the in-car network (choose arrival curve types and determine parameters)
- Create a DNC/RTC model for your communication network (Identify network elements, select curve types and parameters)
- Guess initial parameters for token bucket filters (for the Poisson traffic sources) and include parameters in the DNC/RTC model.
- Determine arrival curves for outputs of token bucket filters and include in the DNC/RTC model.
- Compute max backlogs and max waiting times for all flows for the (non)deterministic part of the network
- Encode the network model in TrueTime.
- Simulate with TrueTime to obtain estimates of mean and max queue lengths as well as mean and max waiting times.

Assignment task 1 (Ethernet)

- Create a DNC/RTC arrival-model of the periodic external traffic sources of the in-car network (choose arrival curve types and determine parameters)
- Create a DNC/RTC model for your communication network (Identify network elements, select curve types and parameters)
- Assume all nodes are connected to a 100MbpS Ethernet.
- Guess initial parameters for token bucket filters (for the Poisson traffic sources) and include parameters in the DNC/RTC model.
- Compute max backlogs and max waiting times for all flows for the (non)deterministic part of the network
- Encode the network model in NS3.
- Simulate with NS3 to obtain estimates of mean and max queue lengths as well as mean and max waiting times.

Assignment task 3

- Select a suitable queueing model for Token Bucket input queues.
- Compute mean queue lengths, mean waiting times and packet drop probabilities for input queues.
- Compare results with simulated and measured results from previous assignments.

Assignment task 4

- Identify safety critical components in the car network.
- Assume every component fails with a failure rate $0.5\ h^{-1}$.
- Compute the safety related failure rate for the car as a whole.
- Compute the probability that a safety related fault has appeared before the car is 10 years old.
- Suggest a redundancy architecture to improve failure rate.
- Compute the (time dependent) failure rate for the redundancy architecture.
- Compute the probability that a safety related fault has appeared before the car is 10 years old (for the redundancy architecture).