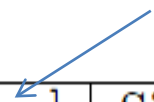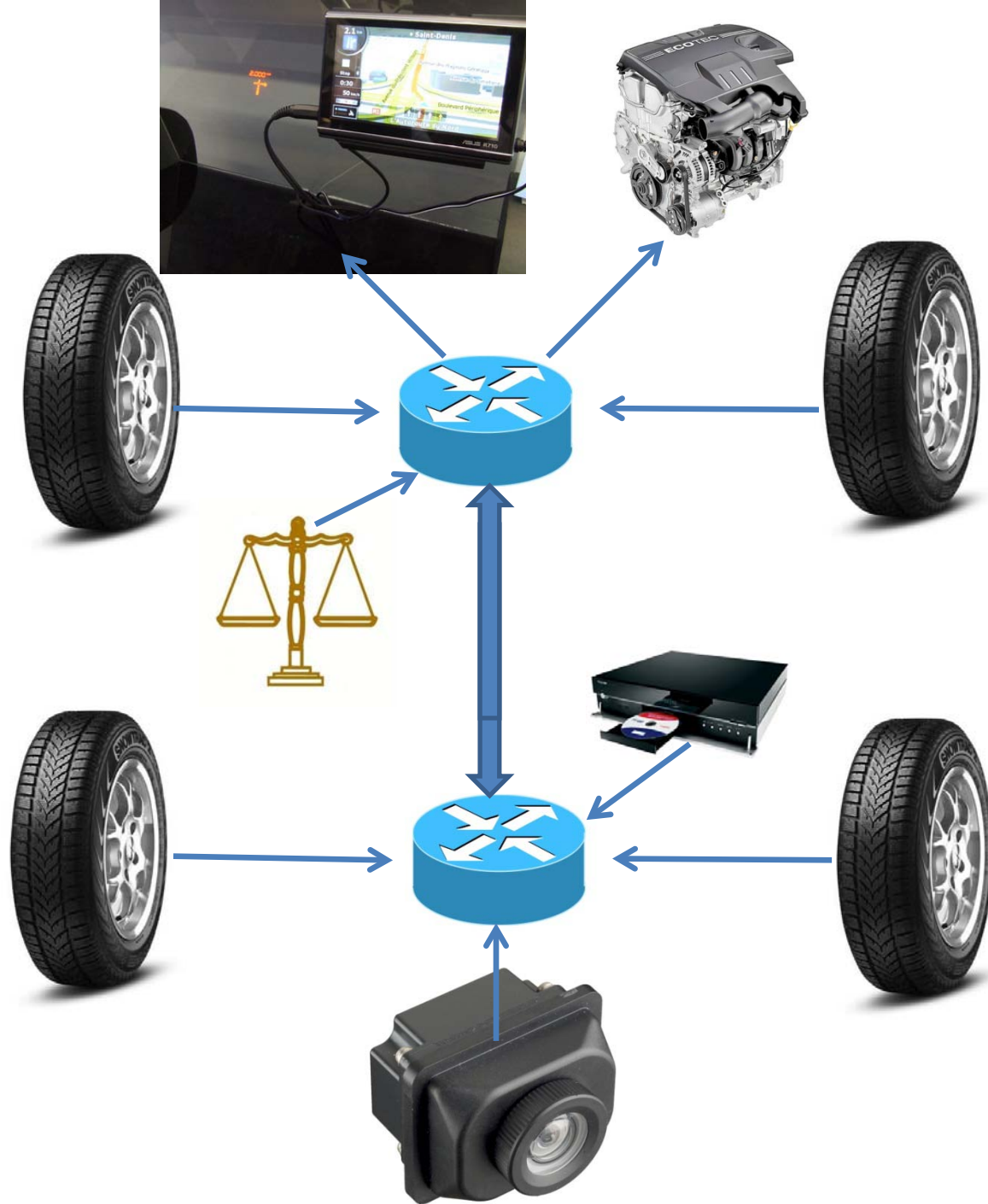# Distributed Realtime Systems

Mini project

Definitions

- W{1,2,3,4} are wheel sensors each measuring at a wheel.
- ESC is the Electronic Stability Controller
- EC is the Engine Controller
- HUD is the Head Up Display
- Multimedia is the multimedia system
- RC is the Rear Camera

The ECU's send to each other as follows:
- W{1,2,3,4} -> ESC
- ESC -> EC
- Multimedia -> HUD
- RC -> HUD

Traffic characteristics

X 20 for CANbus

| 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

D: deterministic (periodic)

P: Poisson

Poisson traffic is token bucket filtered

Switch model

- Switch fabric is assumed infinitely fast
- Only store and forward delay in input queues
- When stored packets are moved instantly to output queues
- Queueing disciplines affect only output queues
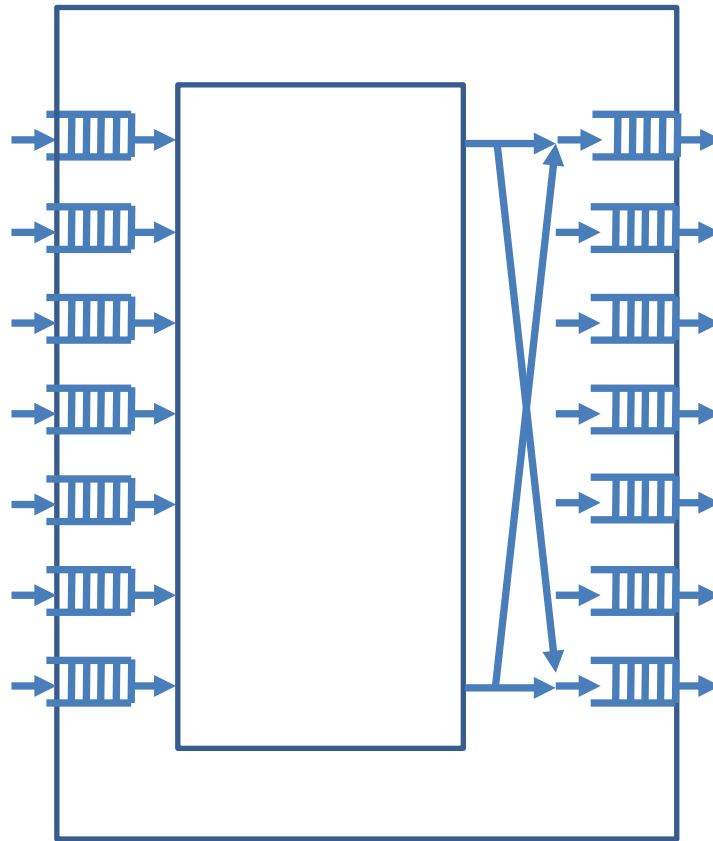
Questions (1a)
(solve either 1a or 1b)

- Create a DNC/RTC arrival-model of the periodic external traffic sources of the in-car network.
- Assume all nodes are connected to a switched 10MbpS duplex ethernet. Switch is assumed to employ FIFO scheduling on the output port.
- Encode your model in RTC or CyNC
- Compute max backlogs and max waiting times for all the deterministic part of the network.
- Select parameters for token bucket filters for the Poisson traffic sources and include these sources in the DNC/RTC model.
- Compute mean queue lengths, mean waiting times and packet loss probabilities for the token buckets.
- Encode the network model in OmNet .
- Simulate to obtain estimates of mean and max queue lengths as well as mean and max waiting times.
- Compare simulation results with previously computed results.

Questions (1b)

- Create a DNC/RTC arrival-model of the periodic external traffic sources of the in-car network.
- Assume all nodes are connected to a 1MbpS CANbus.
- Encode your model in RTC or CyNC
- Select parameters for token bucket filters for the Poisson traffic sources and include these sources 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.
- Compute mean queue lengths, mean waiting times and packet loss probabilities for the token buckets.
- Simulate to obtain estimates of mean and max queue lengths as well as mean and max waiting times.
- Compare simulation results with previously computed results.

Questions (2)

- Assume faults happen only in switches and each switch is non ageing with a failure rate of $1/2E6$ hour^{-1}

- Assume the lifetime of the remaining part of the car is uniformly distributed in [5,15] years.

- Compute the probability that a switch fails within the lifetime of a car.

- Compute equivalent probabilities for cases where one and two switches are duplicated.