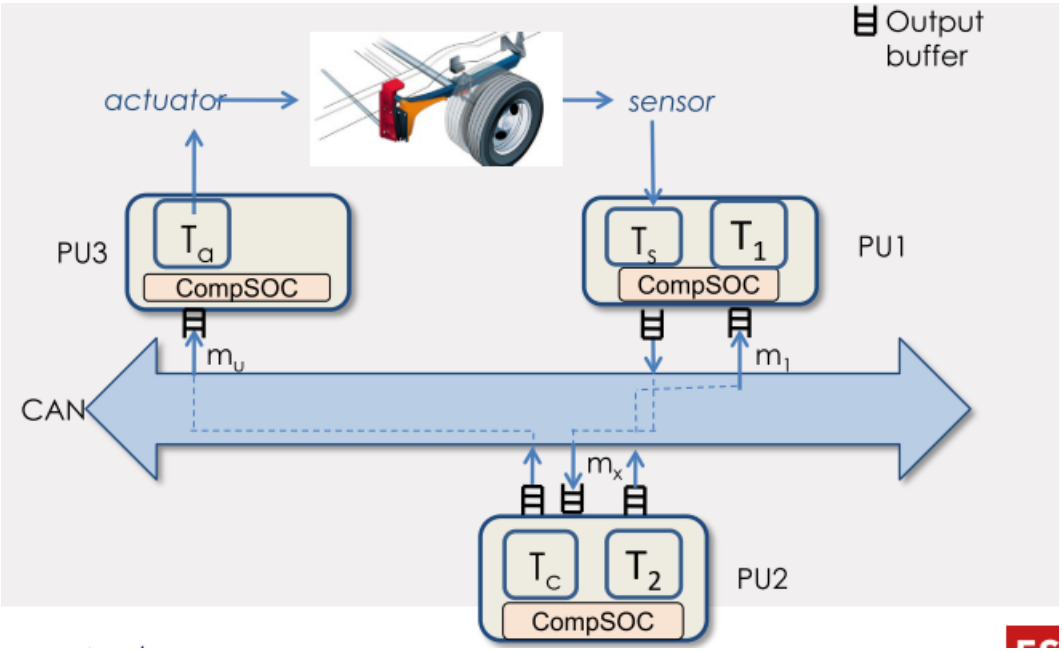
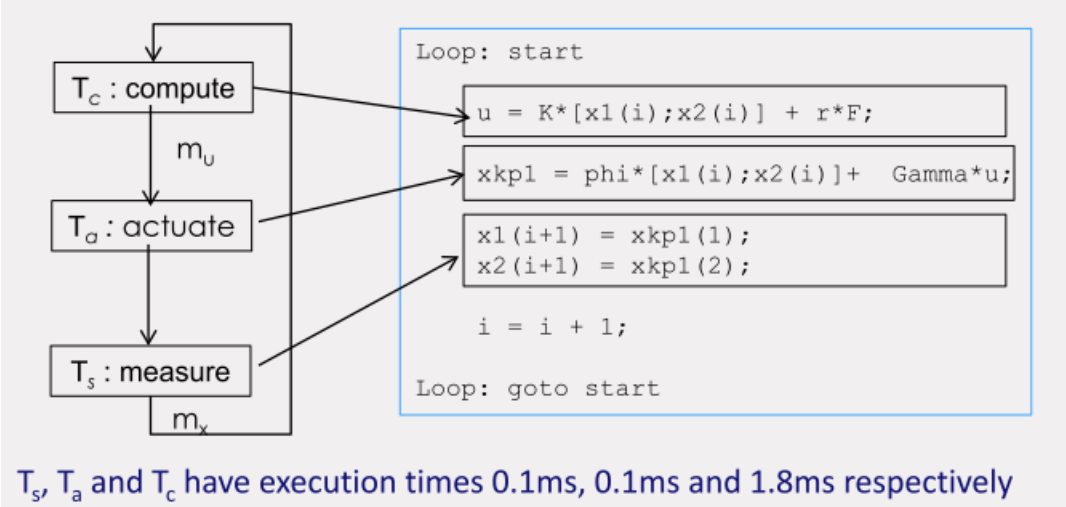
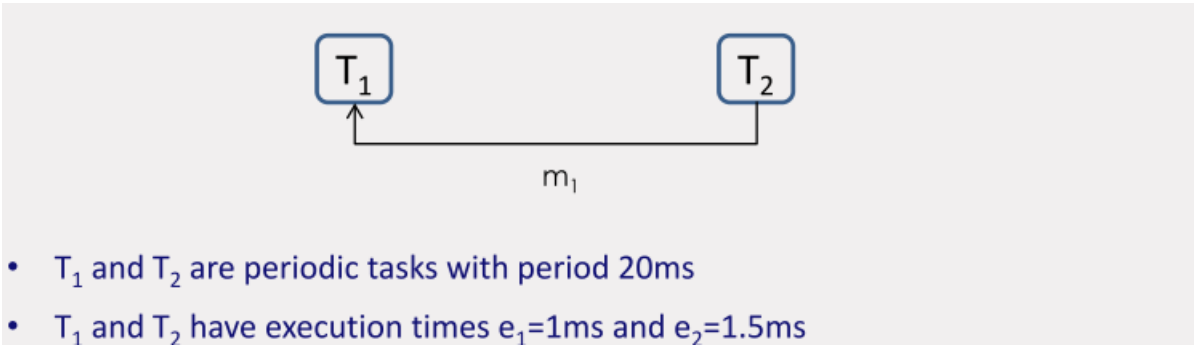
3_4_DCS_Design_Case

Background

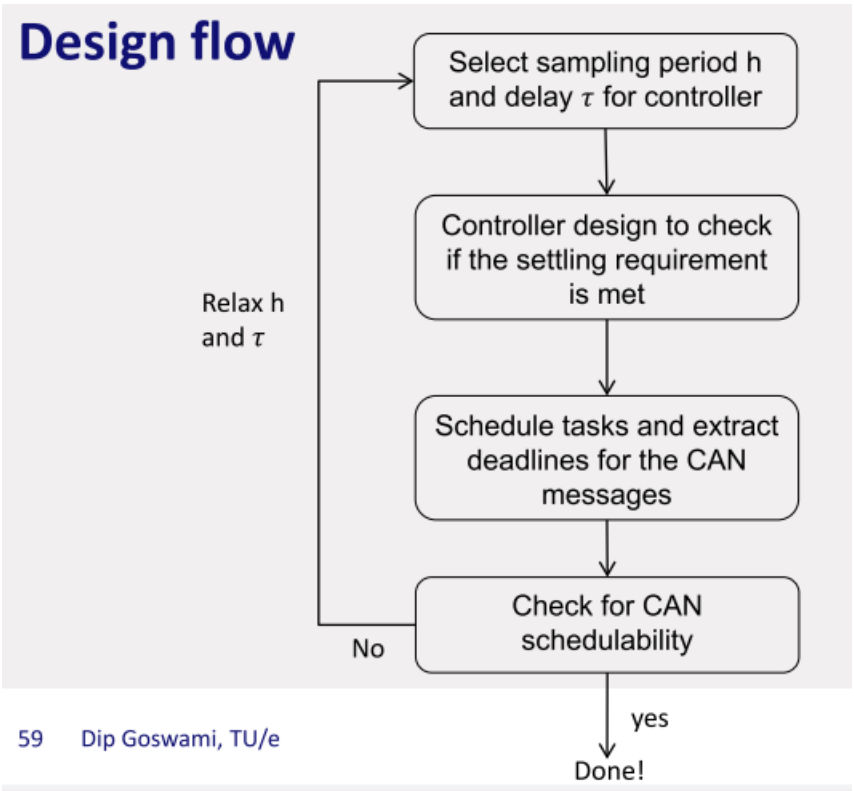






CAN Solution

Design flow



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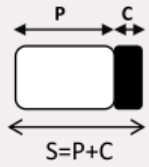
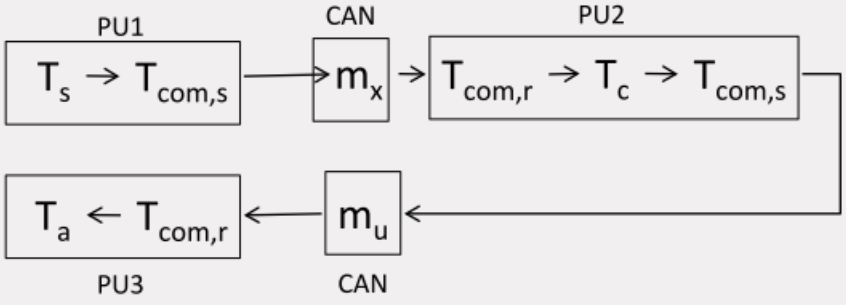
- PU1, PU2 and PU3 are globally synchronous; but asynchronous with CAN bus
- N =4
- P = 2ms
- C = 0.5ms
- W = 4*2.5ms = 10ms



m_u has a transmission time of 0.5ms over CAN bus

m_v has a transmission time of 1ms over CAN bus

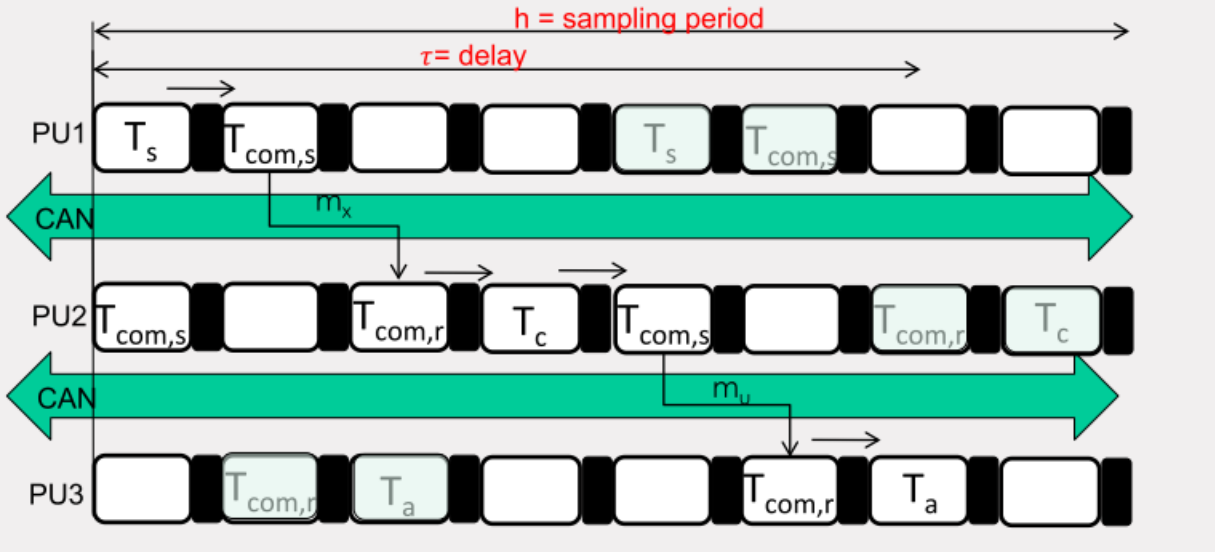


- m_1 has a transmission time of 0.5ms over CAN bus
- Communication tasks for sending and receiving messages T_{com} have an execution time of 0.2ms and $\tau_{bit} = 0.0000001sec$
- The end-to-end deadline from the start of T_2 to end of T_1 is 20ms

Selection of Sampling Period and Delay

- Sampling period to be multiple of 10ms makes sense since CompSOC TDM wheel length 10ms.
- The **shortest sampling period** in that sense is $h = 10ms$.
- From schedulability on CAN perspective, we should try to choose a longer sampling period
- Then we will try $h = 20ms$

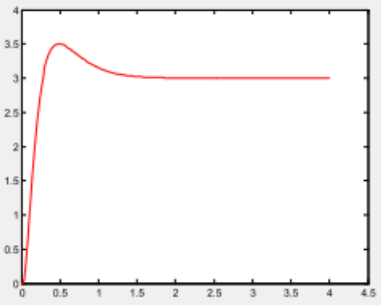
Scheduling for Control Tasks



- The sampling is performed every alternate time wheel of length $10ms$. Sampling period $h = 20ms$.

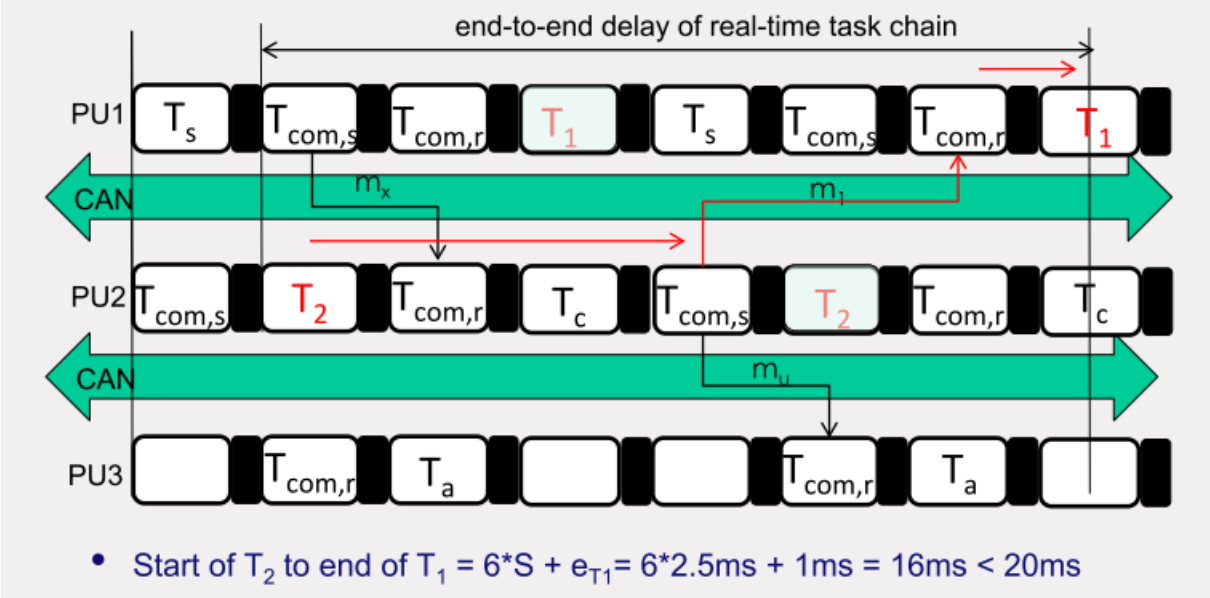
Controller Design

(0.7, 0.7, 0.9, 0.92, 0.92)
→ settling time<1.5s and
U_{max} = 13.8601

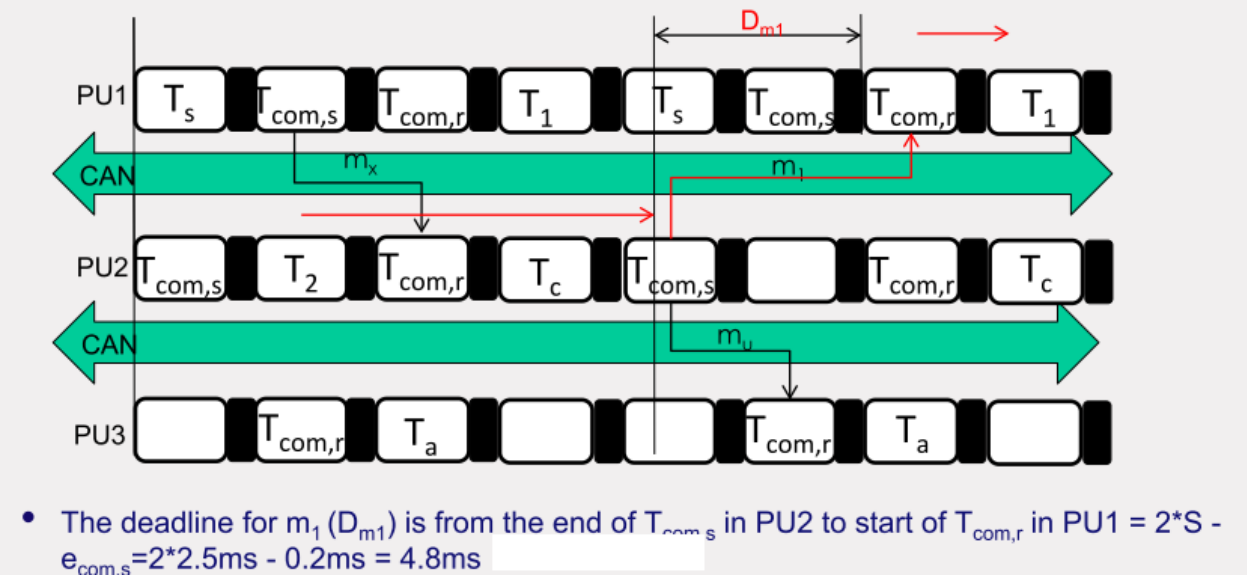


We choose h =20ms and τ = 15.1ms; poles= (0.7, 0.7, 0.9, 0.92, 0.92)

Scheduling the Real-Time Tasks

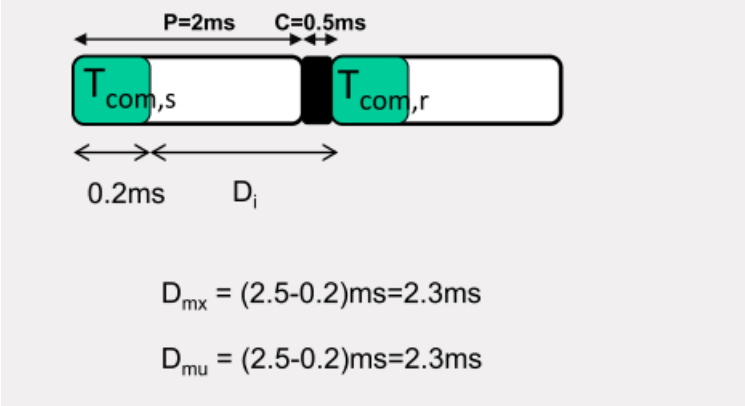


CAN real-time message deadline



time enough

Extracting the CAN control message deadlines



enough for CAN transmission

message	p_i (ms)	D_i (ms)	e_i (ms)	priority
m_x	20	2.3	1	1
m_u	20	2.3	0.5	2
m_1	20	4.8	0.5	3

$R_{mx} = 1.5ms < D_{mx}$

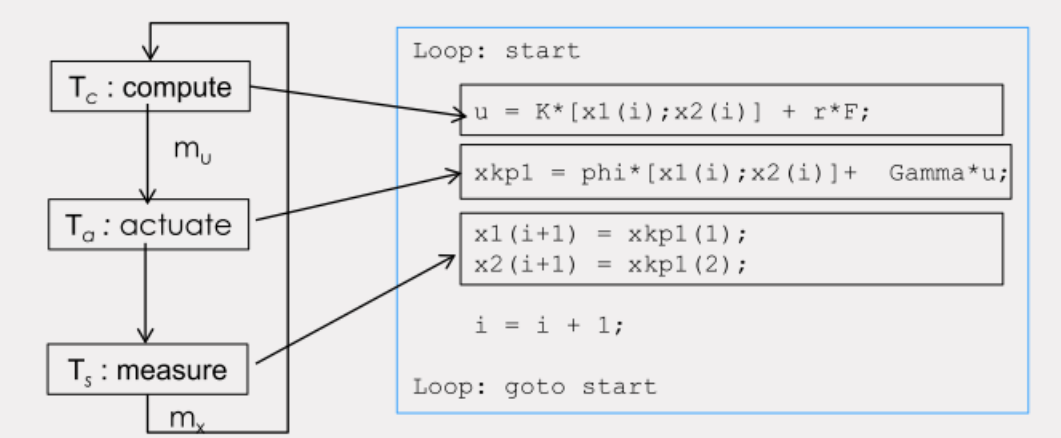
$R_{mu} = 2.00ms < D_{mu}$

$R_{m1} = 2.00ms < D_{m1}$

FlexRay Solution

Only Static Segment Solution

With Dynamic Segment Solution



T_s, T_a and T_c have execution times 0.1ms, 0.1ms and 1.8ms respectively