Queue-exchange Mechanism to Improve the QoS in a Multi-stack Architecture

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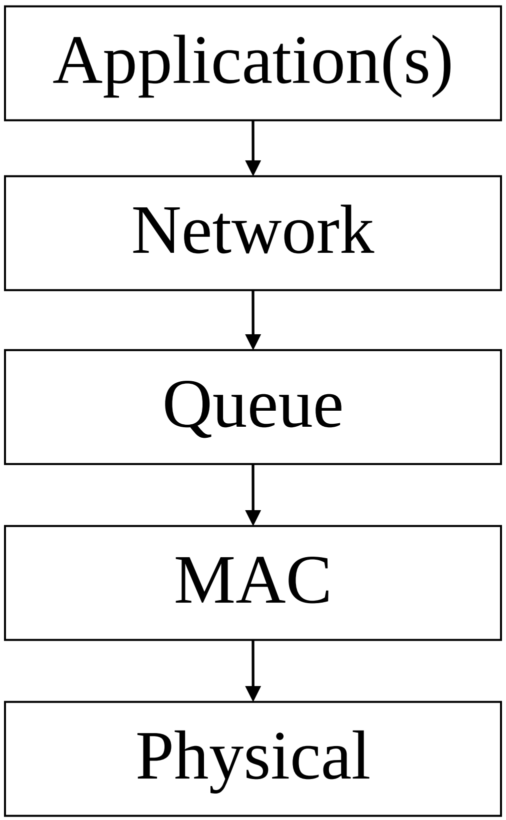
Outline

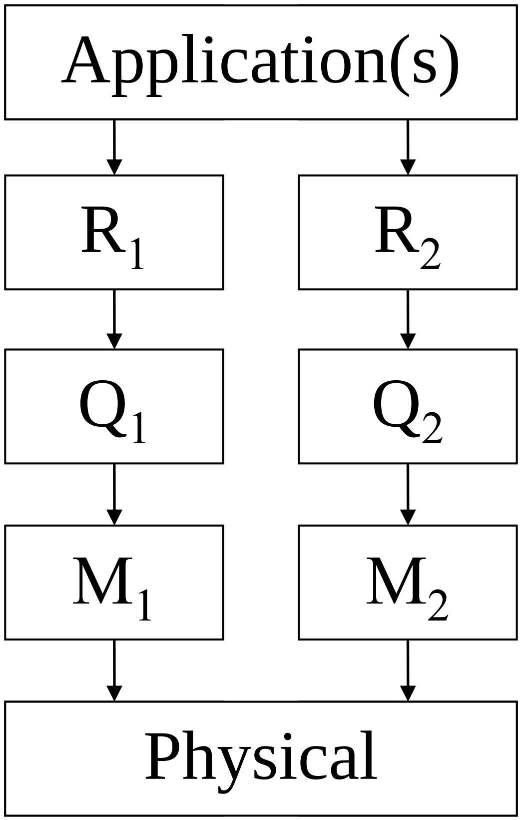
- Mono-stack v/s multi-stack architectures
- Queue-exchange mechanism on a mutli-stack architecture
- Integration in MaCARI
- Evaluation
- Conclusion

Mono-stack architecture



- OSI model = traditional network stack
- Single stack
  - One routing protocol
  - One MAC protocol
- One QoS for one traffic

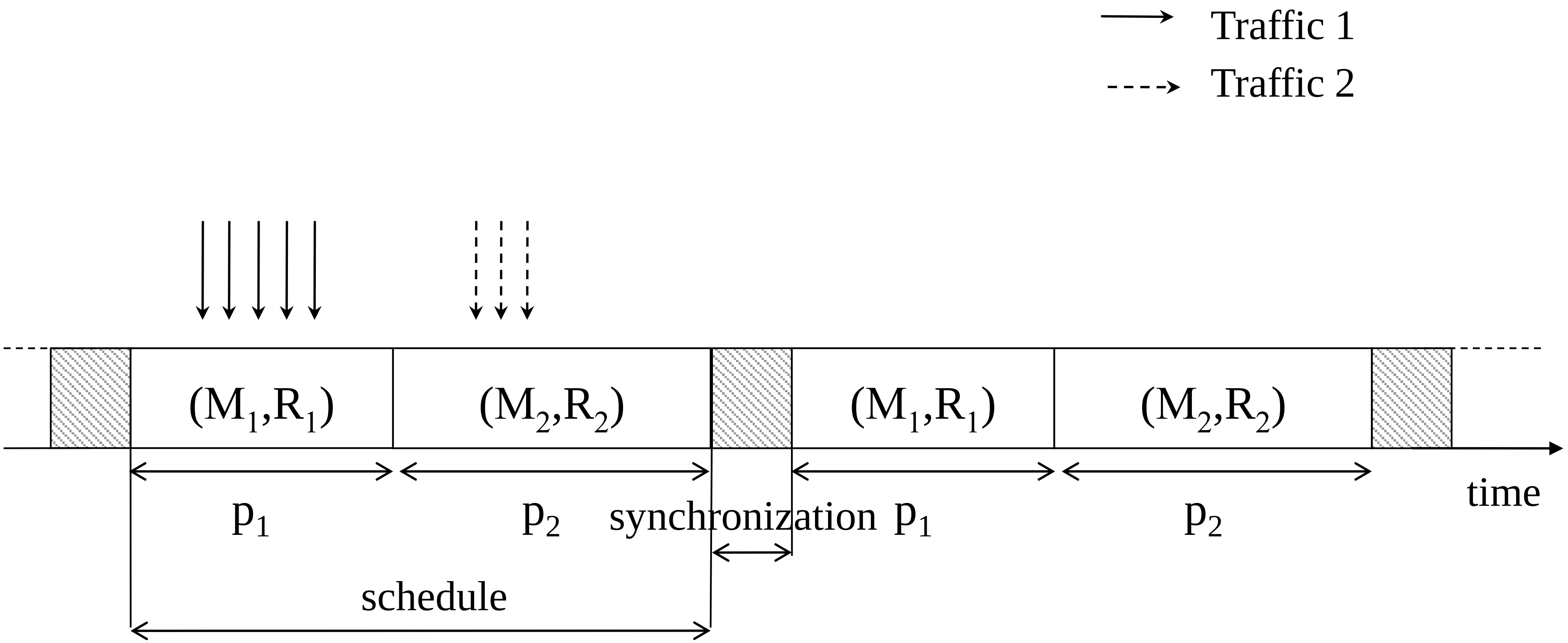
Multi-stack architecture



- Several network stacks
- Several QoS (one per stack)
- One traffic per stack

Multi-stack architecture

- Periodic cycle

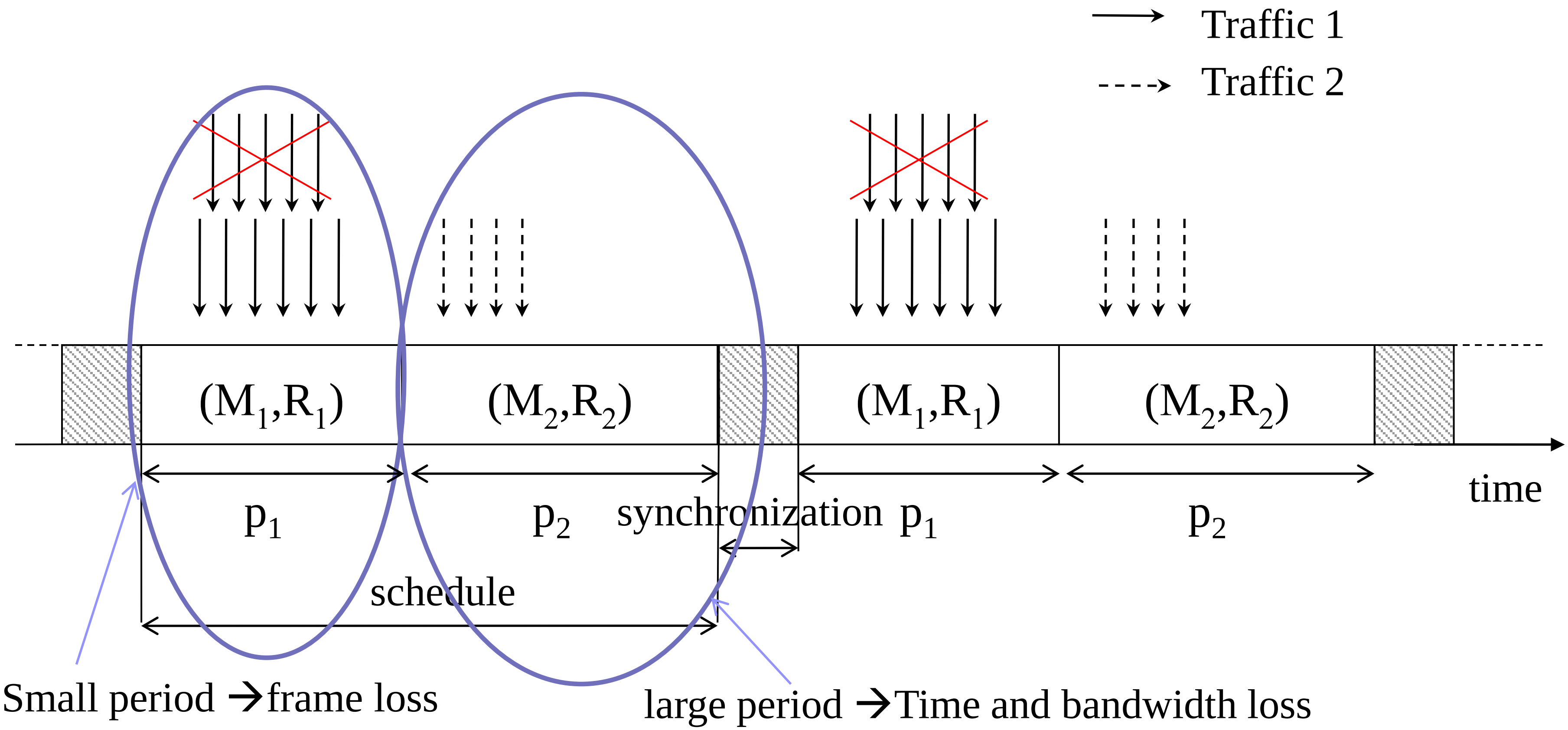


Multi-stack architecture

- Examples:
  - IEEE 802.15.4/ZigBee
    - Stochastic MAC (slotted CSMA/CA) and AODV
    - Deterministic MAC (guaranteed time slots) and hierarchical routing protocol
  - MaCARI:
    - Stochastic MAC (slotted CSMA/CA) and optimized hierarchical routing protocol
    - Deterministic MAC (TDMA) and hierarchical routing protocol

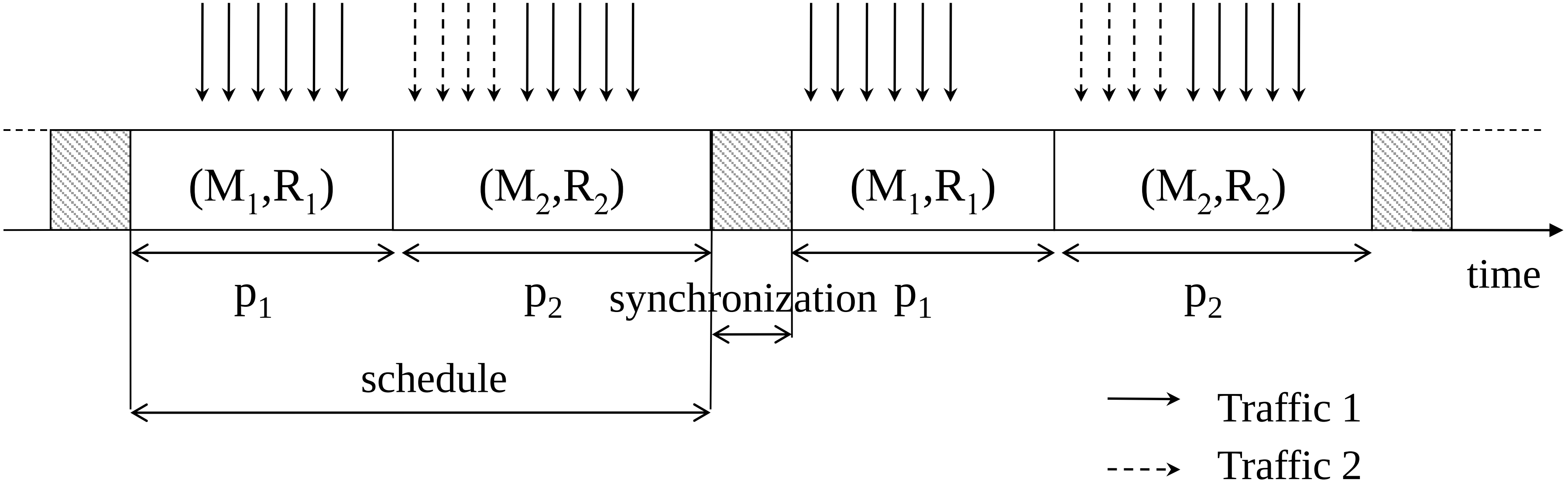
Multi-stack architecture

- Problem:
  - Dimensioning of the periods

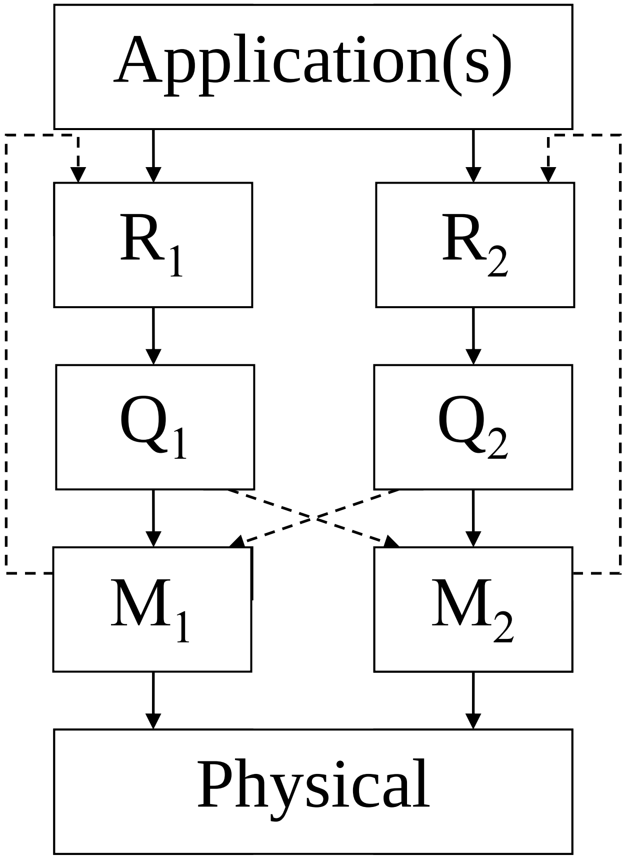


Multi-stack architecture

- Solutions:
  - Dynamic dimensioning? greedy and complicated
  - Queue-exchange mechanism

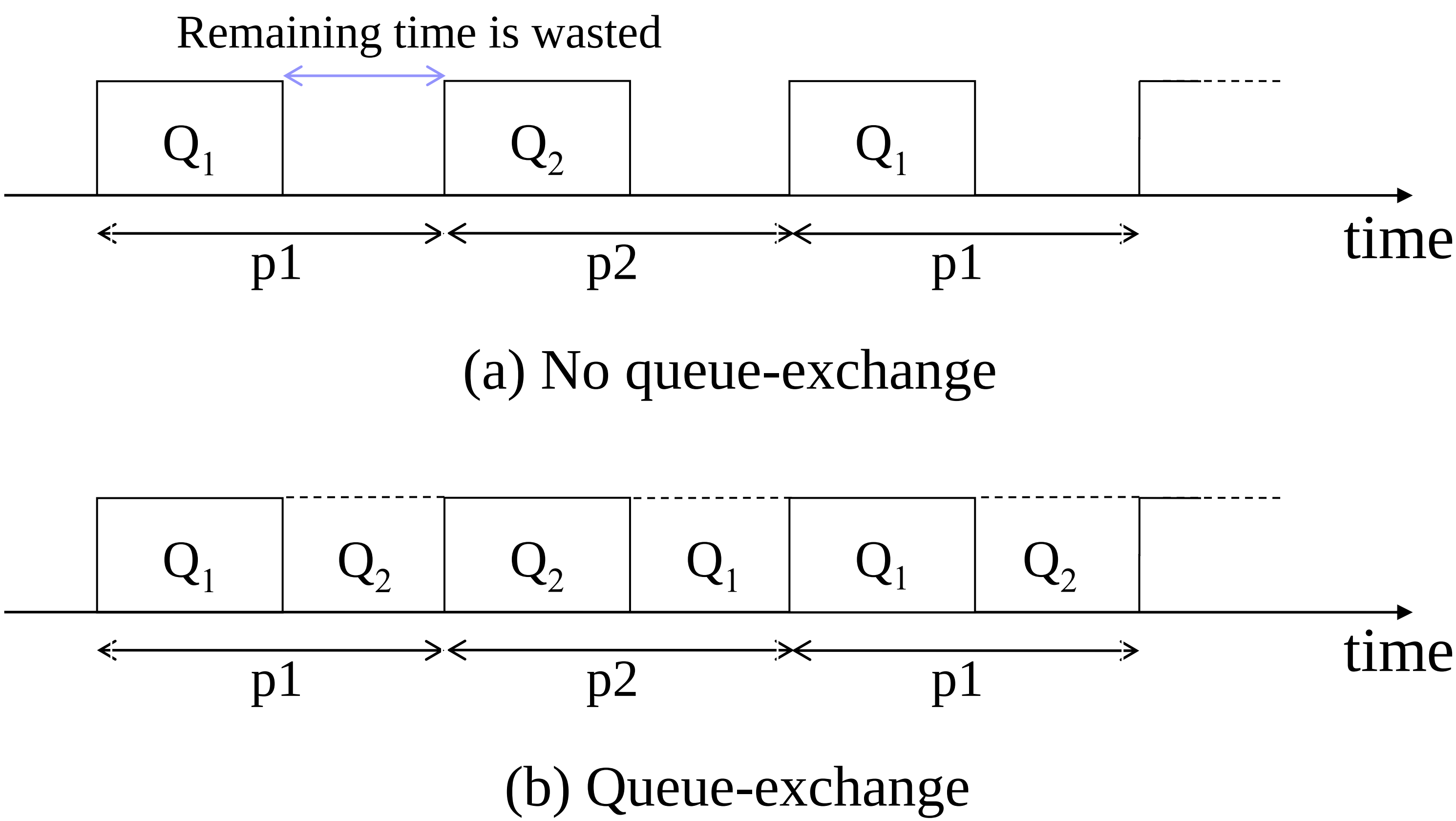


Queue-exchange mechanism



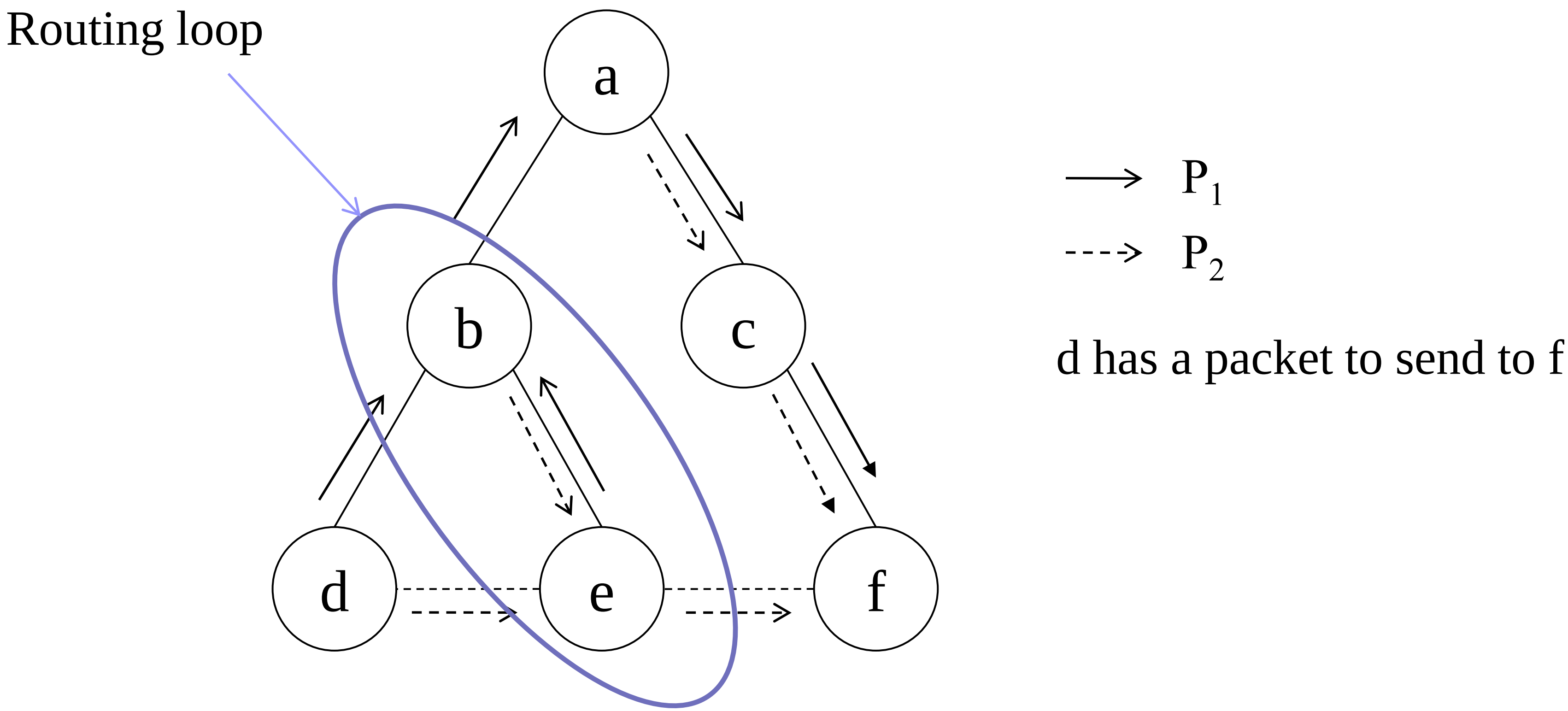
- Cross-layering MAC-Network
  - e.g: current time in p_1:
    - Q_1 empty → M_1 can process traffic 2
    - M_1 tests if next hop of the frame is not active, then M_1 asks R_1 to compute the new next hop

Queue-exchange mechanism



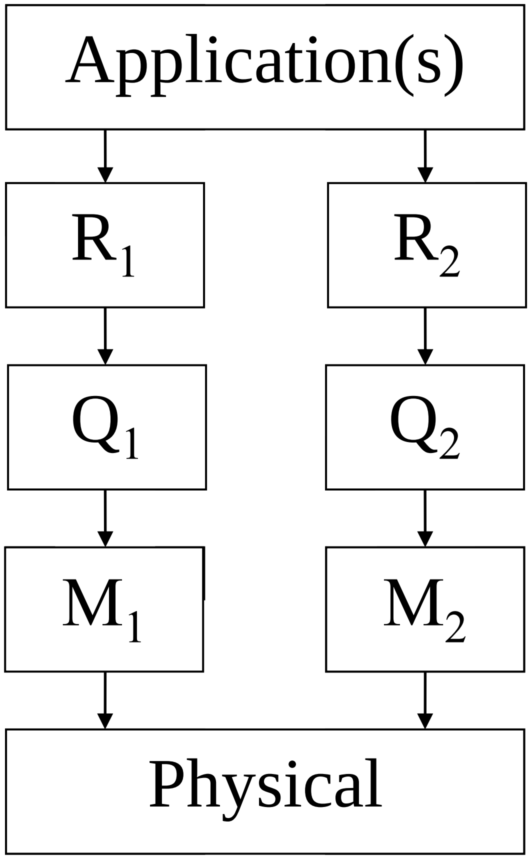
Queue-exchange mechanism

- Drawback: Routing loops can occur in the network



Integration in MaCARI

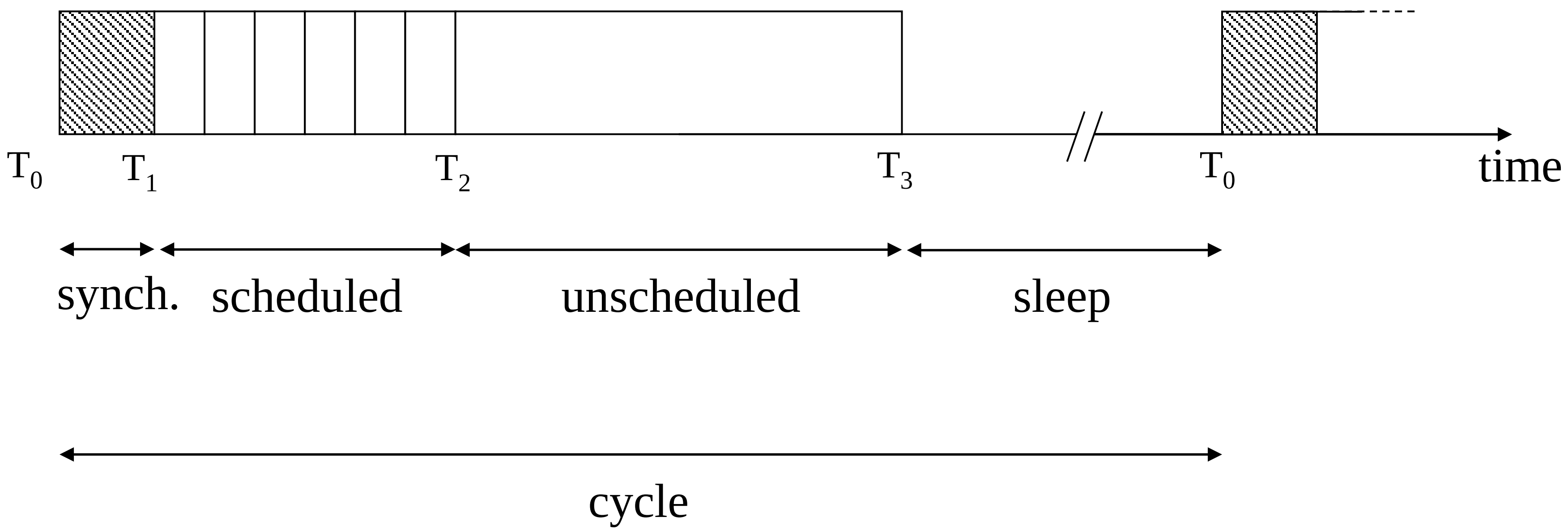
- MaCARI stack



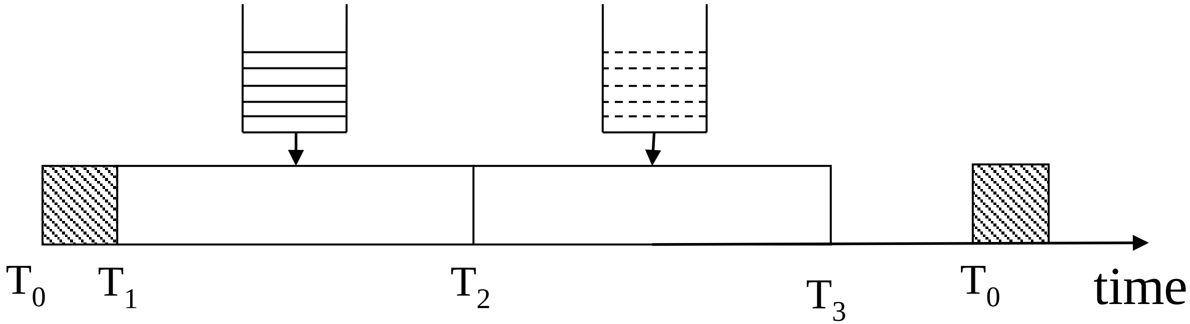
- (M_1,R_1): (TDMA,hierarchical routing protocol)
- (M_2,R_2): (Optimized hierarchical routing protocol, slotted CSMA/CA)

Integration in MaCARI

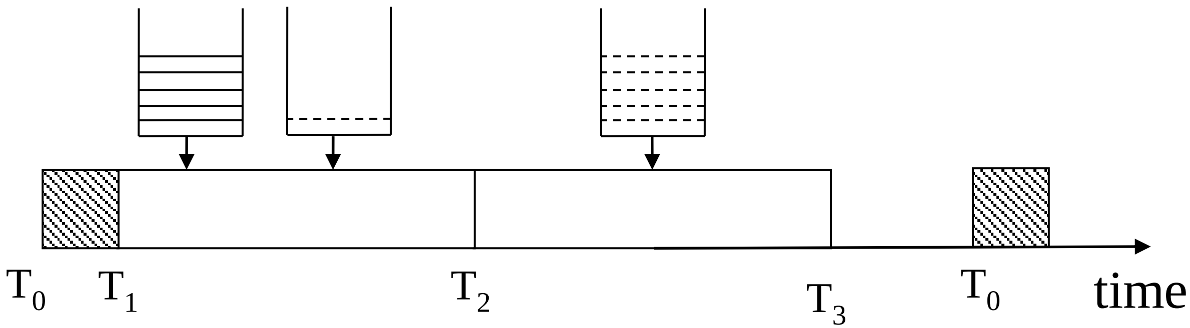
- MaCARI global cycle



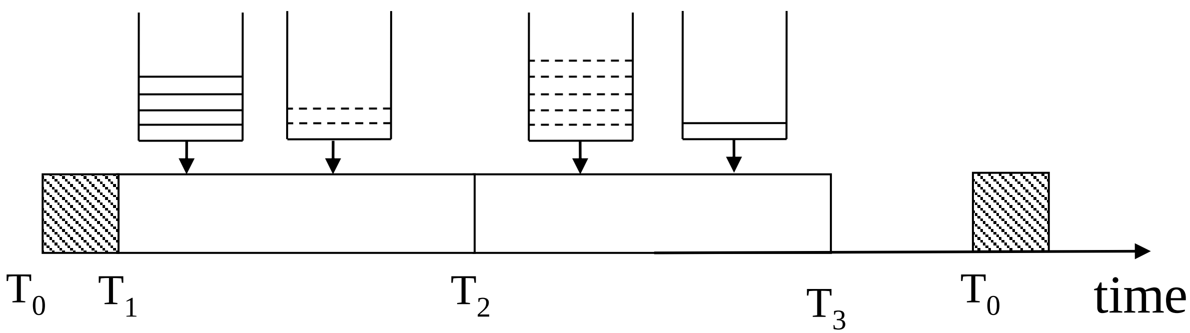
Integration in MaCARI



(a) scenario 1: MaCARI without queue-exchange



(b) scenario 2: MaCARI with queue-exchange in one way



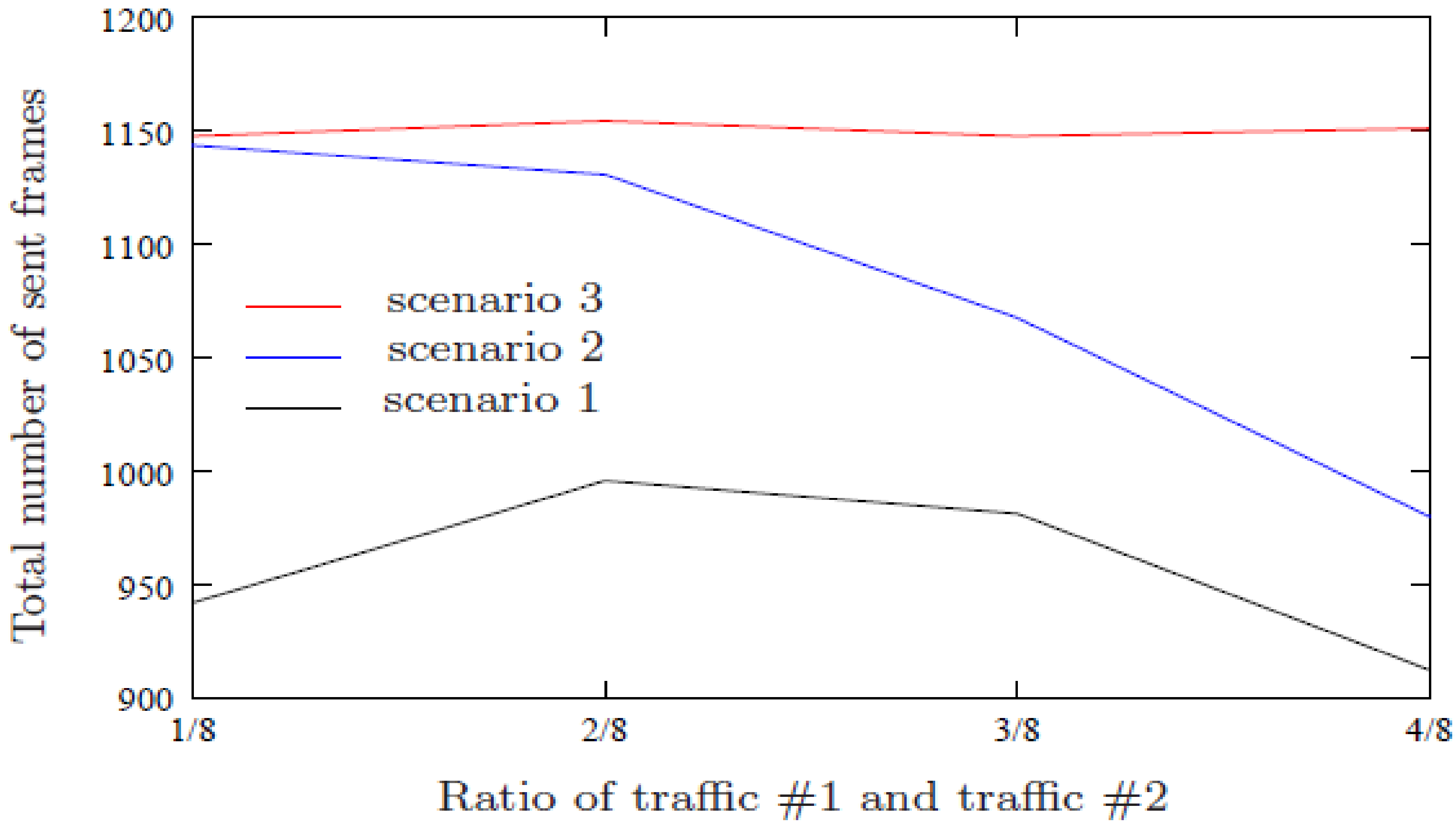
(c) scenario 3: MaCARI with queue-exchange in both ways

Evaluation

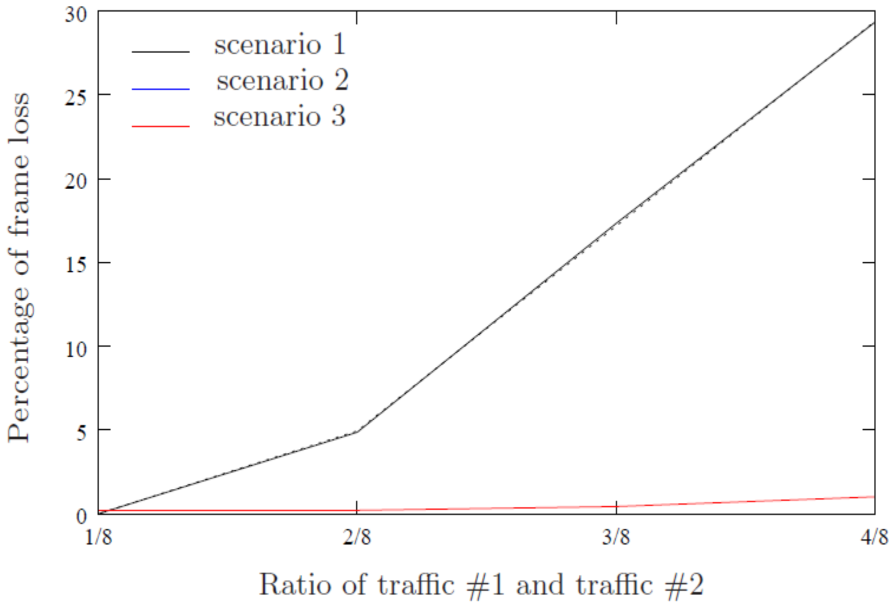
- NS2 simulations
- 40 routers randomly spread over a 30m x 30m
- ITU indoor propagation model
- Tree topology: $L_m = 6$, $R_m = 4$, $C_m = 4$
- Global cycle = 4s
  - $[T_0 ; T_1] = 248$ ms
  - $[T_1 ; T_2] = [T_2 ; T_3] = 1.28$ s
- 2 types of traffic

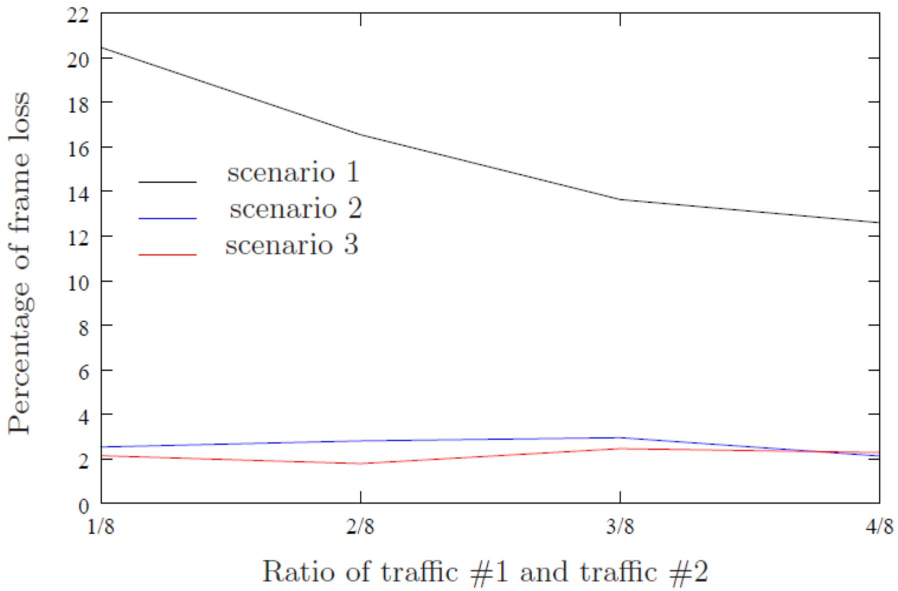
Goodput

Gain up to 21%



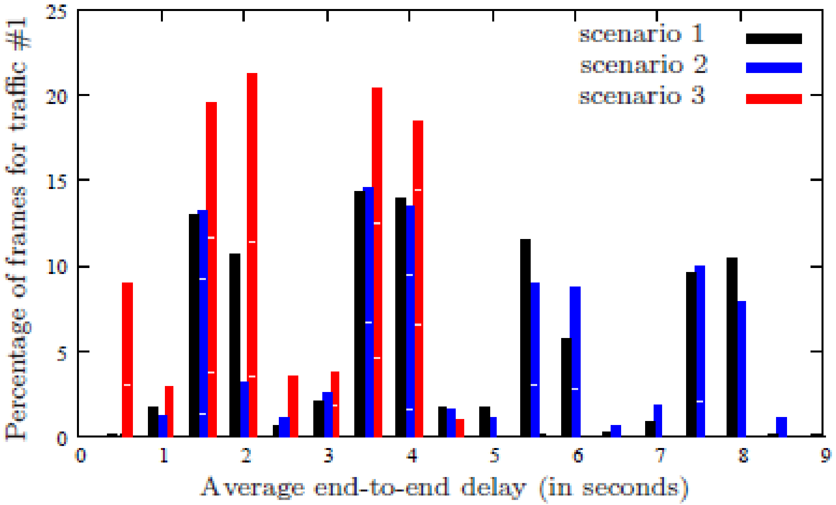
Frame loss

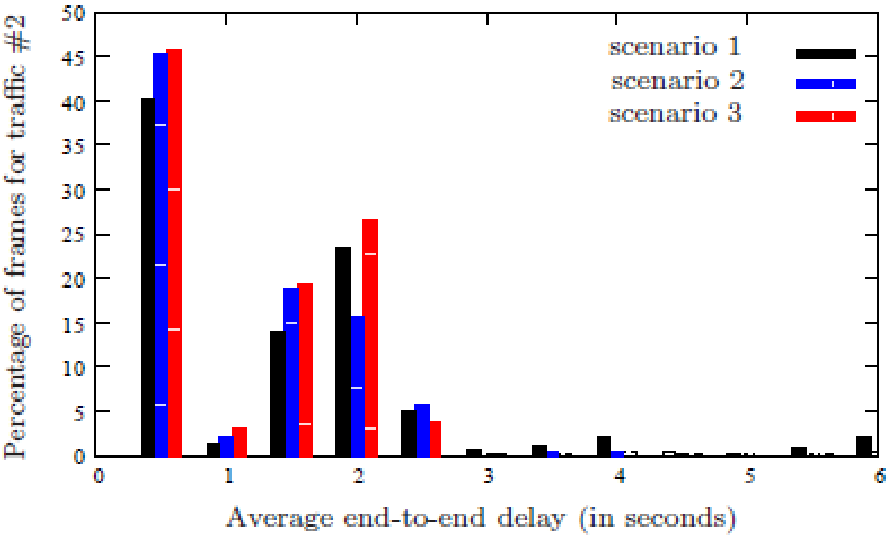




- Traffic 1
- Traffic 2

End-to-end delay





- Traffic 1
- Traffic 2

Conclusion

- Multi-stack architectures
  - Mitigate QoS
  - Dimensioning problem yielding to large delay
- Solution:
  - Queue-exchange mechanism
    - Dimensioning not crucial anymore
    - Traffic delay decreasing

Questions?