Institut für
Kommunikationsnetze

Improving Delays in IEEE 802.17 by Global Coordination

Harmen R. van As, Jon Schuringa
Vienna University of Technology, Austria

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Content

① **Current situation**

- Weaknesses of the current IEEE 802.17 MAC Protocol
- Superior performance of CQMA (Cyclic Queueing Medium Access)
- Adaptation of the original CQMA to work with the current MAC
- Combined properties

② **Operation of the combined MAC protocol**

- Global fairness coordination
- Operation principles
- Medium access control
- Local access scheduling

③ **Conclusion**

Current Situation (1)

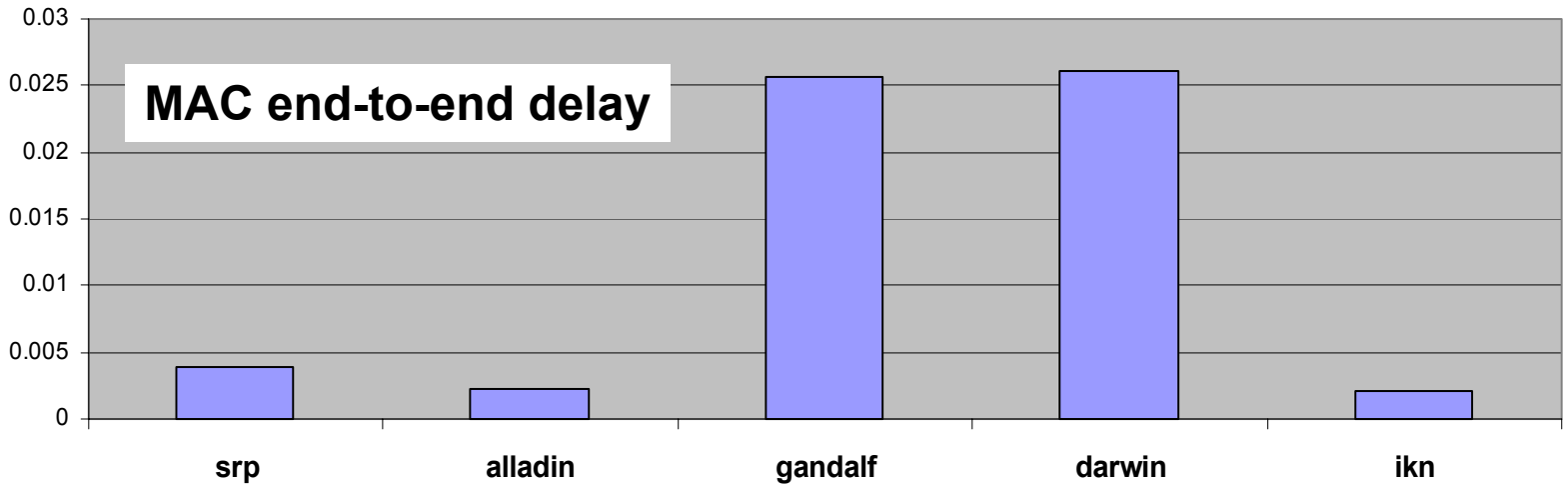
① **IEEE 802.17 MAC Protocol now well-defined (Clauses 5, 6 and 9)**

② **Weaknesses of the current IEEE 802.17 MAC Protocol**

- Reactive instead of proactive
- Large transit buffers required
- **High MAC end-to-end delays**
- Many parameters to be set
- Many messages on the medium
- Single instead of multi choke operation preferred due to cost
- Only source fairness possible
- Not designed for single ringlet operation (reconfiguration, fault)
- Partially unpredictable performance behavior

Current Situation (2)

③ **Superior performance of the IKN MAC-protocol CQMA (Cyclic Queueing Medium Access) shown many times**



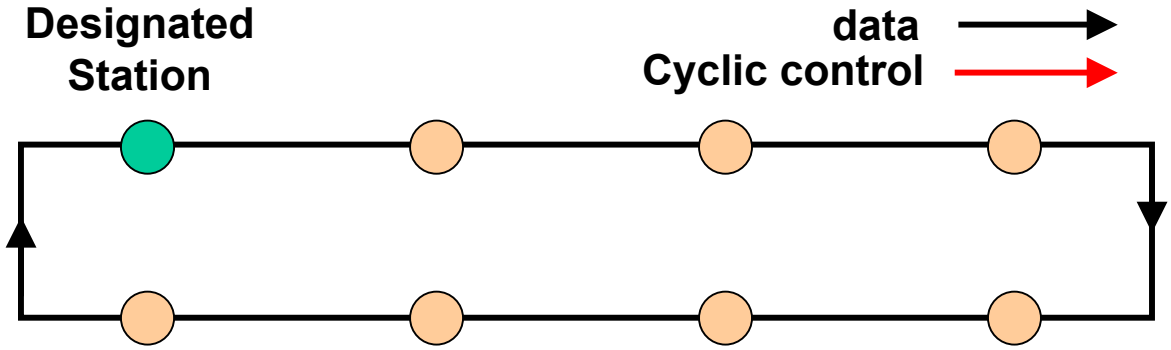
④ **Original CQMA adapted to work with the current MAC while improving its weaknesses**

Current Situation (3)

⑤ **Combined properties**

- High throughput (as before)
- **Proactive**
- Predictable scheduling
- Size of transit buffers depends on scheduling
- **Low MAC end-to-end delays**
- Fewer parameters to be set
- Fewer messages on the medium
- Fewer measurements to be made
- **Multi-choke operation becomes standard**
- **Selectable source or flow fairness**
- Optimal for single, dual, and multiple ringlets
- Heterogeneous link speeds intrinsically supported
- Predictable performance behavior

Global Fairness Coordination



Fairness control cycle

- Fairness control for each ringlet
- Fairness control and data flow in same direction
- Fairness control for traffic class C and exceeding part of class B
- Results are cycle fairness rates for each station (source fairness) or fairness rates for each source-destination flow (flow fairness)
- Designated station periodically starts the fairness control cycle, where the designated station is determined as in Token Ring or FDDI
- Control cycle consists of three phases: Information, calculation, remaining capacity advertisement
- Control and data access operate overlapped

Operation Principles (1)

Initialization of fairness control cycle

- Empty table is generated by the designated station
  Two entries per station: link capacity demand and remaining link capacity
- Designated station changes mode of table: information, calculation, remaining capacity advertisement
- Each station keeps a copy of the table

1) Information exchange round:

Each station
- adds its demand on each link
- adds the link capacity of its outgoing link
- subtracts its own agreed capacity on each link (Class A and B guaranteed)
- forwards the table and keeps a copy

Operation Principles (2)

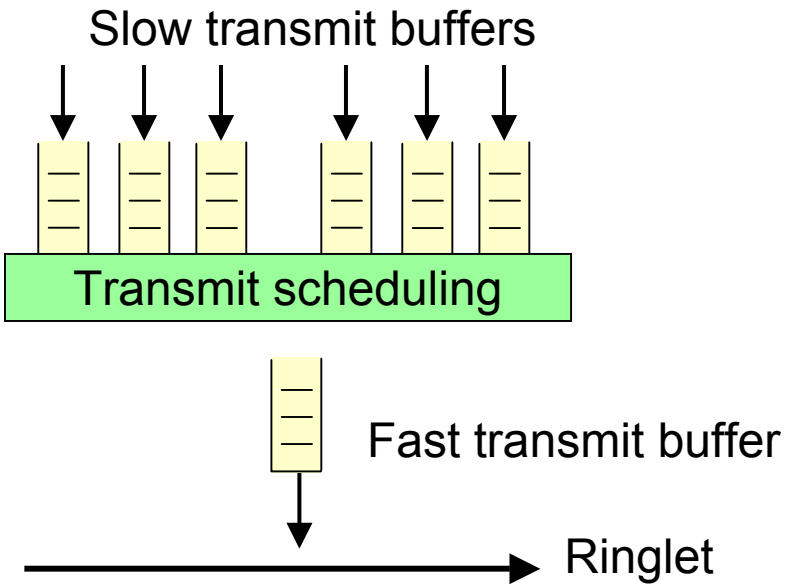
2) Calculation round:

Each station
- calculates its fairness rate on each bottleneck link
- frees up the capacity on all links according to bottleneck flows
- knows reserved and greedy access rates on each link
- forwards the table and keeps a copy

3) Remaining capacity round:

Each station
- receives the remaining capacity on each link
  (this is for extra greedy access)
- forwards the table and keeps a copy

Medium Access Control



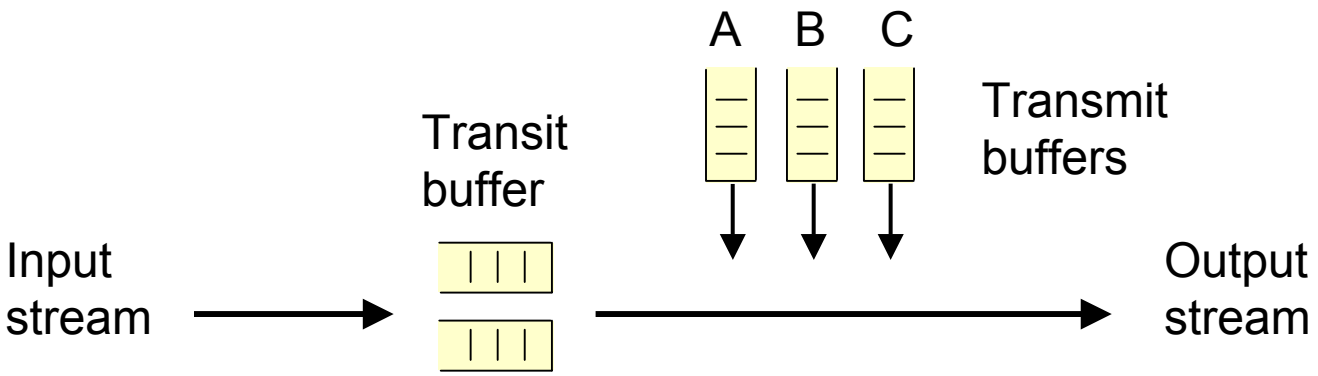
Medium access control

Global knowledge of the link status in the current fairness cycle

Medium access is either greedy or reserved
- Greedy access for a destination over links that are no bottleneck
- Reserved access for a destination passing at least one bottleneck

Stations know their own rates to each destination

Local Access Scheduling



Local access scheduling

Transit buffer has always priority

Except
- Class A has precedence over B and C
- Class B guaranteed has precedence over B_{excess} and C

Transit buffers remain rather empty due to global coordination

Conclusion

① **Inclusion of the adapted CQMA protocol allows**

- to improve delay performance considerably
- to reduce transit buffer size
- to perform local scheduling predictably
- to operate always in the multi-choke mode
- to select between source or flow fairness
- to simplify operation
- to deal with heterogeneous link speeds in an easy way

② **More detailed explanation is given in a companion presentation**

③ **Detailed description (as Clause 9 proposal) is posted separately**

④ **Recommendation**

- to evaluate the proposal
- to come to a final decision in the November 2002 meeting