Coexistence problem of 802.11s Congestion Control

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Abstract

Congestion Control is an optional feature of [2]. It shall avoid stalling of Mesh WLAN when neighboring MPs have no capacity left. The applied backpressure algorithm solely works when all devices along the Mesh path apply to its rule. In presence of legacy stations the mechanism fails. Due to congestion detection, the devices that use Congestion Control become totally dominated by surrounding devices that do not apply Congestion Control. Our simulation results show the needs for additional methods to segregate the Mesh WLAN from other networks.

Congestion Control Simulation results

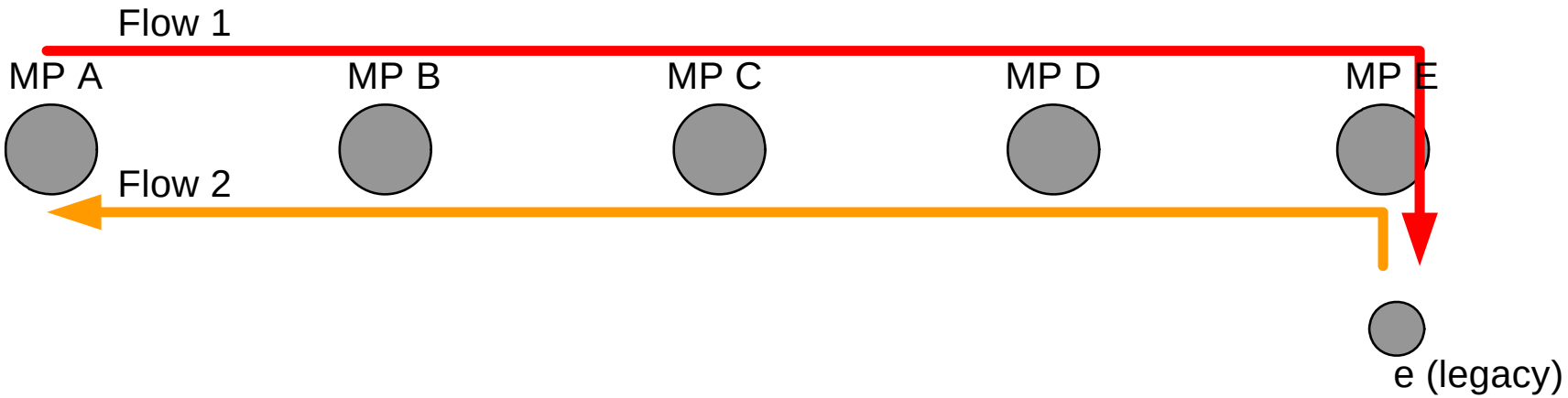
- **Document IEEE802.11-05/0568r0**
  - One scenario for throughput evaluation
    - String topology
    - No complex set-up
  - All MPs apply Congestion Control
  - No entities without Congestion Control capability present
    - No coexistence problem with legacy devices (stations etc.)
    - Exclusive channel for Mesh WLAN assumed

Enhanced simulation scenario

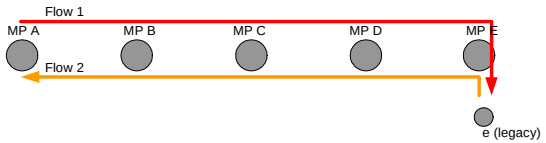
- **Current Congestion Control scheme implemented**
  - Simulation environment WARP2, see [1]
  - Implementation according to [2]
- **Enhanced Scenario**
  - Associated legacy station uses the same frequency channel
  - All entities use EDCA for medium access
  - All MPs implement Congestion Control scheme
  - “Legacy” station does not implement congestion control
  - Same algorithm & parameters as in original set-up

Single station associated with Mesh WLAN

- **Legacy station (e) is source or sink of traffic**
- **MP A operates as gateway (Mesh Portal, MPP) to the Internet**



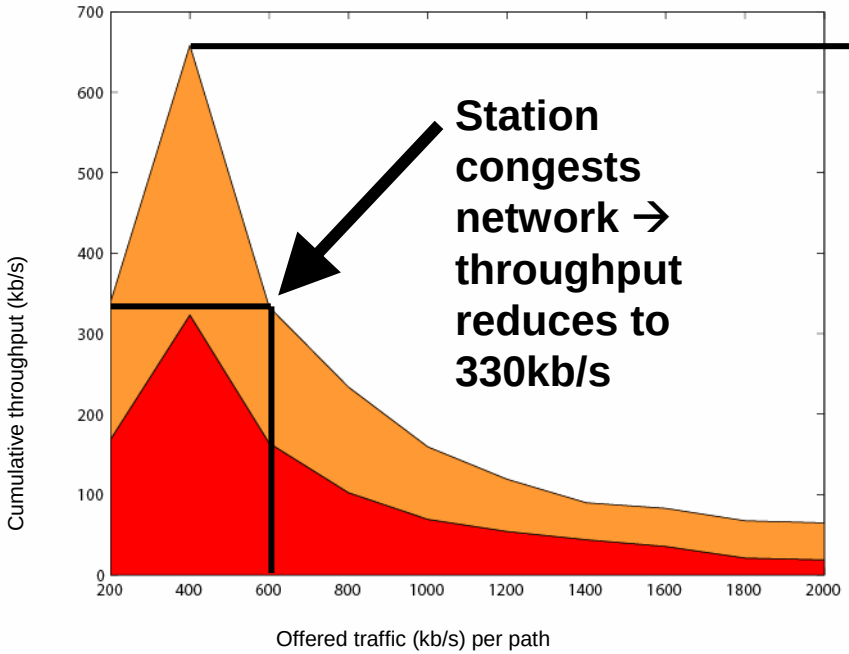
Simulation result

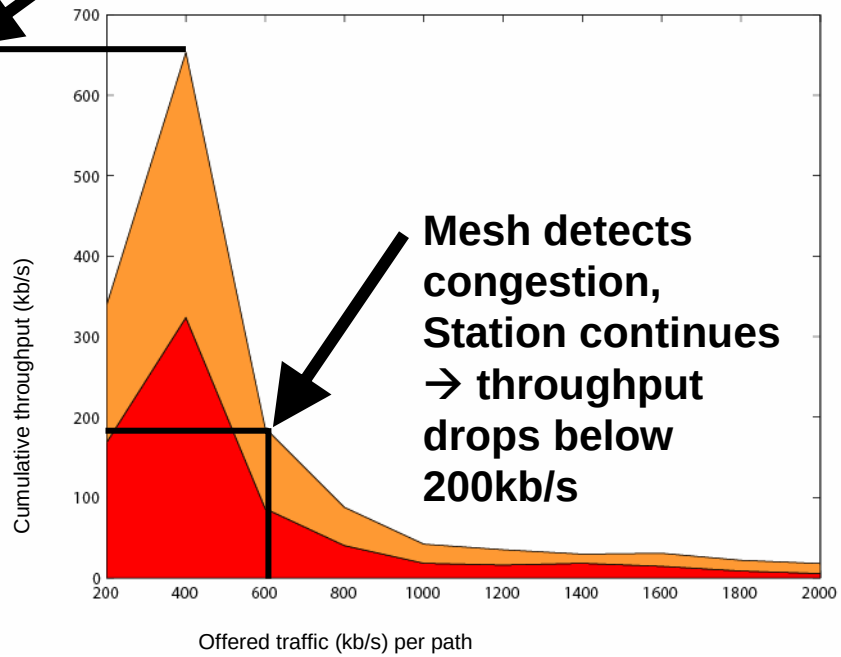


- **Mesh WLAN aware of congestion control**
- **BSS and Mesh share same channel**

- **Station unaware of congestion control**

Similar maximum (650kb/s) system throughput (Saturation)



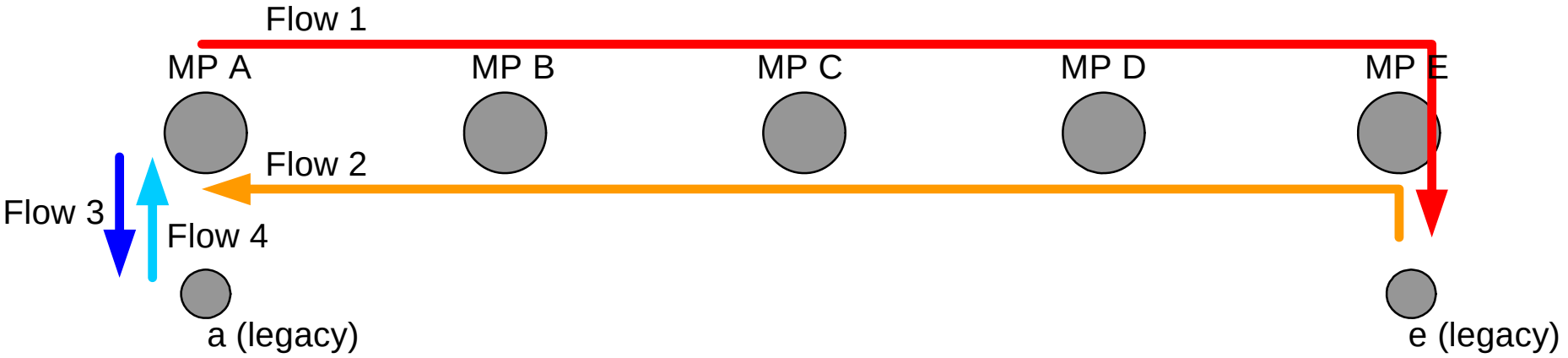


Without Congestion Control

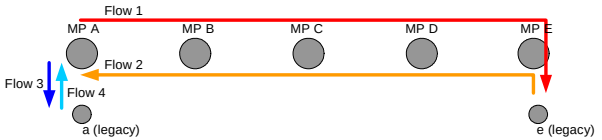
With Congestion Control

Two stations associated with Mesh WLAN

- **MP A operates as gateway (Mesh Portal, MPP) to the Internet**
- **Legacy station (e) is source & sink of traffic**
  - Uses five hops to connect to Internet (MP A)
- **Legacy station (a) is source & sink of traffic**
  - Uses single hop to connect to Internet (MP A)



Simulation result



- **Additional single hop link (Station a)**

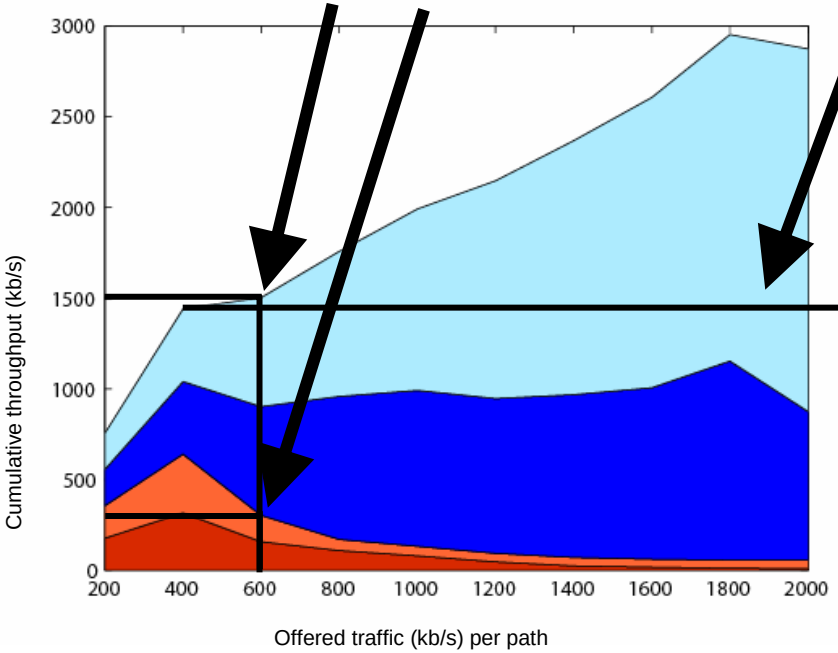
Stations compete for medium → system throughput hardly reduced → single hop link dominates five hop link

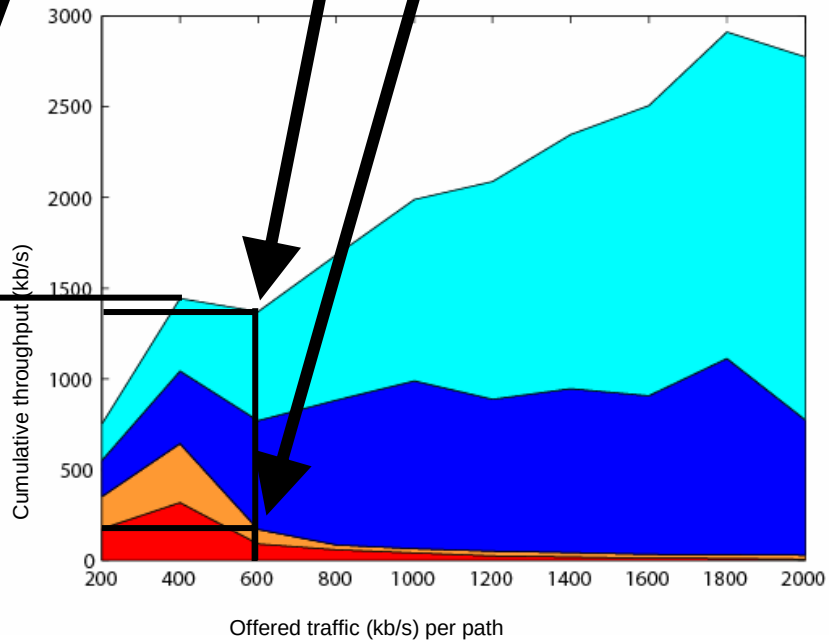
Five hop link suffers from congested network → system throughput hardly reduced → single hop link dominates five hop link

Similar maximum (~1800kb/s) system throughput (Saturation)

Station congests network → system throughput hardly reduced → five hop link dominates (~1800kb/s)

Congestion Control used in Mesh WLAN → reduces capacity for five hop link → single hop link totally dominates





Without Congestion Control

With Congestion Control

Conclusion

- **Congestion Control does not work in presence of non-supporting entities**
  - Legacy stations ignore Congestion Control messages
  - Mesh Points defer from channel access more often due to Congestion Control announcements
    - Stations have even more capacity left
    - MPs have even less capacity left
  - No traffic segregation possible
    - Mesh & BSS traffic need to share the wireless medium
    - Mesh needs more capacity as it forwards the BSS traffic
- **Mechanism to silence legacy (Congestion Control unaware) stations needed**

References

[1] 11-05-0600-03-000s-mesh-networks-alliance-proposal.ppt

[2] IEEE P802.11s/D0.03