

NCA PQ:
Network Coding-Aware Priority Queueing
for UDP Flows over COPE

Hülya Seferoğlu, Athina Markopoulou
University of California, Irvine

Muriel Médard
Massachusetts Institute of Technology

presented by

Anh Le
University of California, Irvine

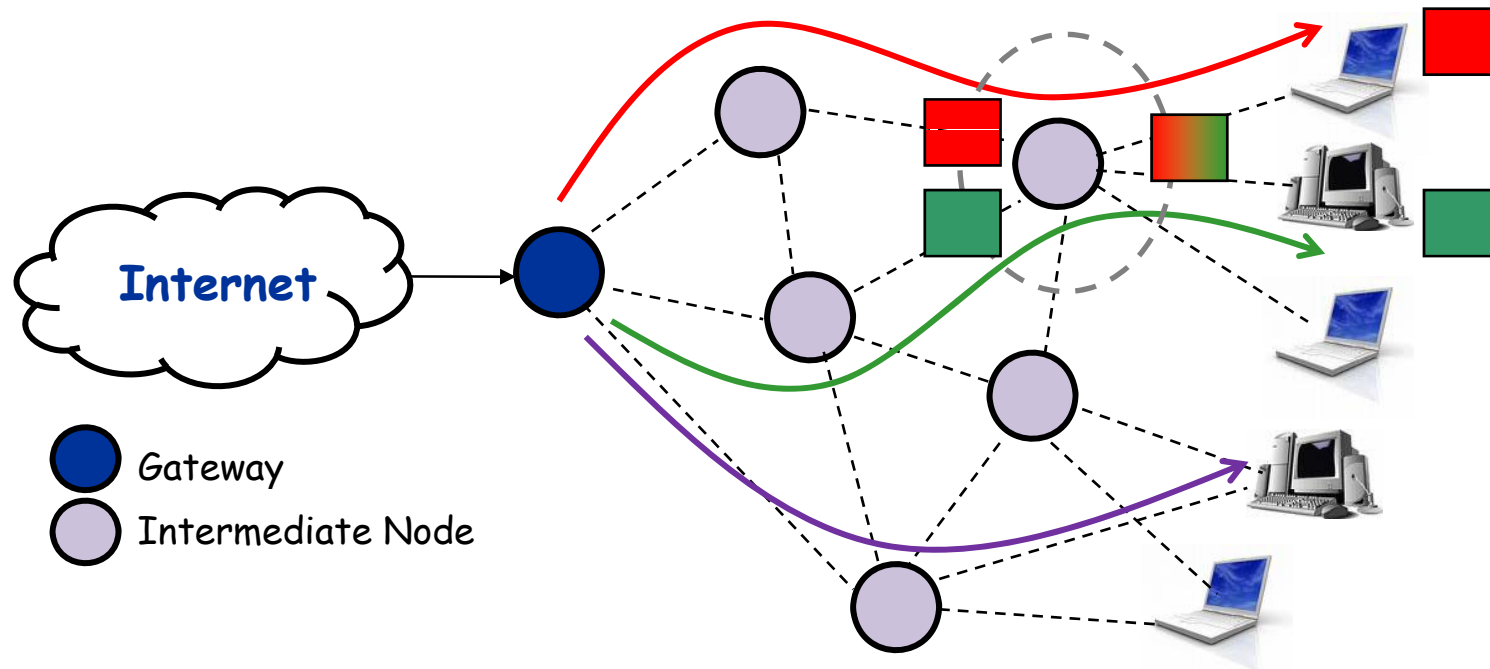
Outline

1. Background and Motivation
2. NCAQM and NCAPP
3. NC Aware Priority Queueing
4. Performance Evaluation
5. Conclusion

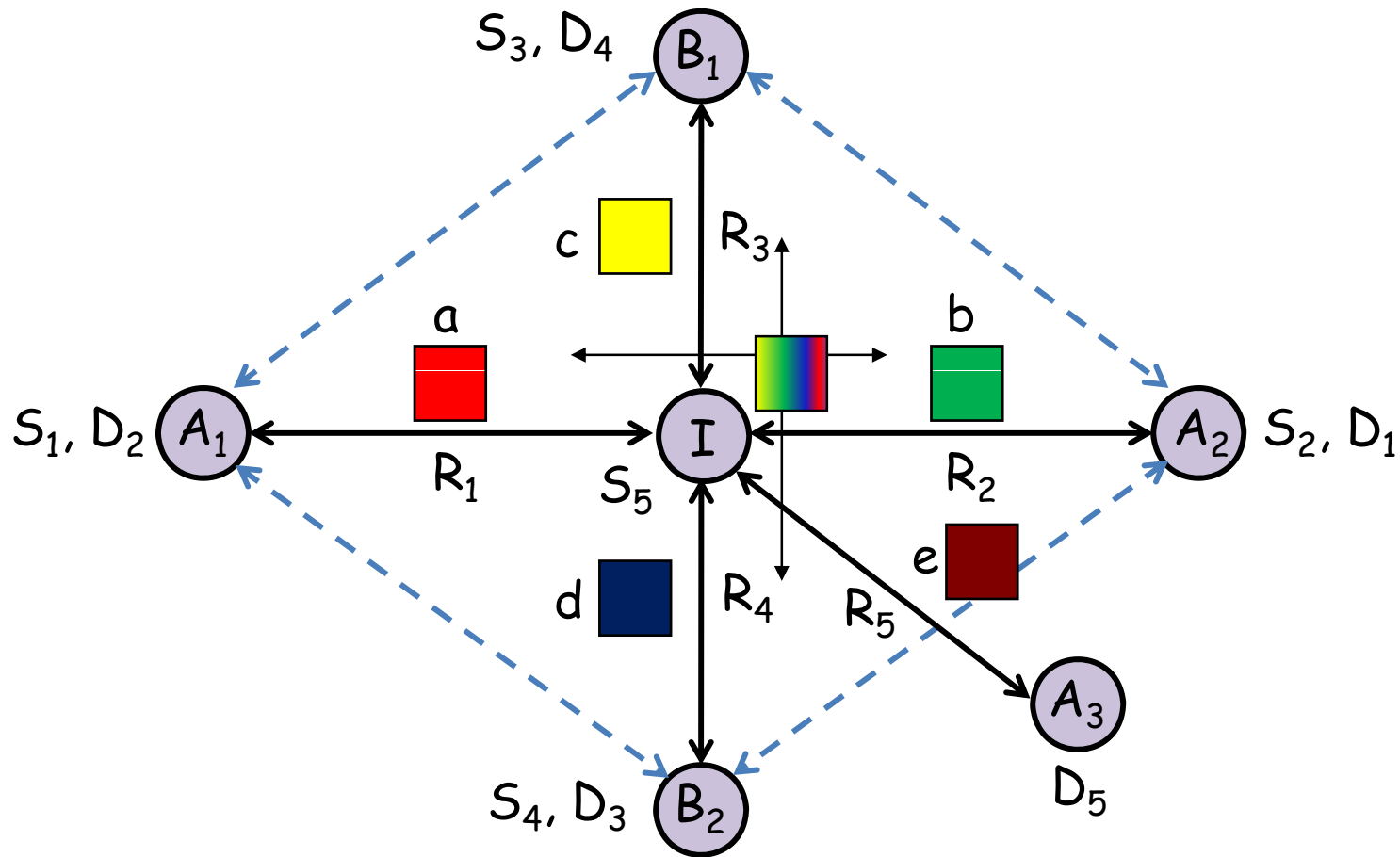


Network coding across unicast sessions over multihop wireless networks

- Constructive, one-hop schemes are used in practice
 - COPE: Katti et. al., "XORs In The Air: Practical Wireless Network Coding," [Sigcomm'06, ToN'08]



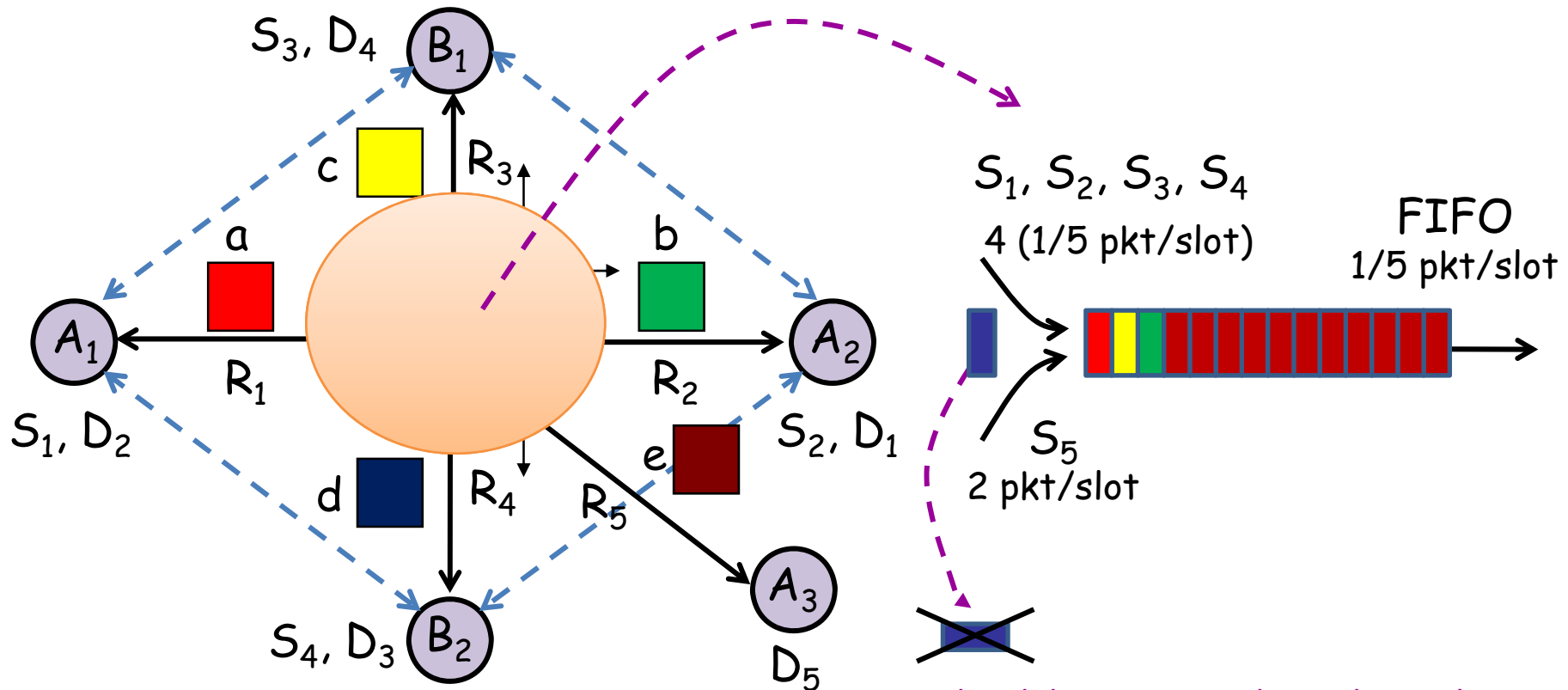
Network coding across unicast sessions over multihop wireless networks



UDP over COPE does not fully exploit the NC potential

Motivation

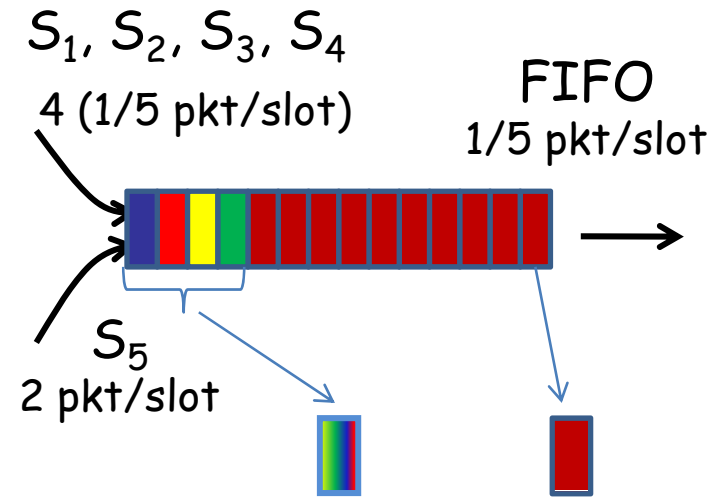
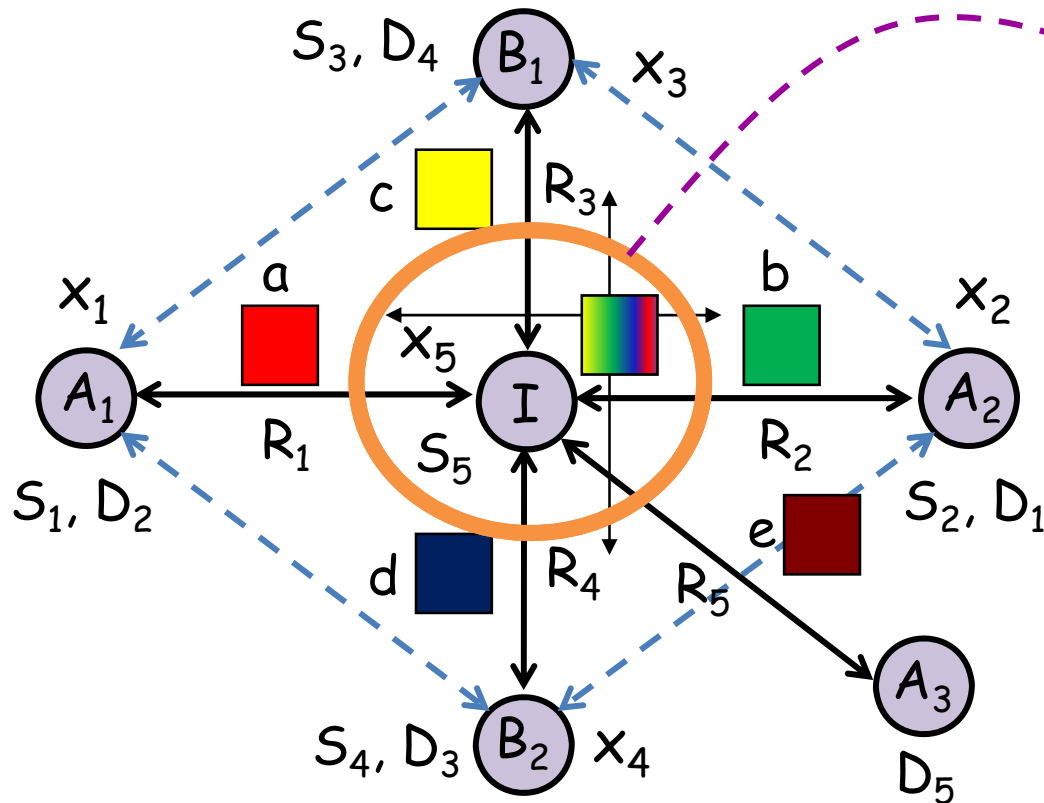
Lack of end-to-end congestion control



Bandwidth is wasted on the uplink
Can be used to transmit network
coded packets in the downlink

Motivation

Coded packets: more valuable



Coded packets are more valuable
Should be treated preferentially

Outline

1. Background and Motivation
2. NCAQM and NCAPP
3. NC Aware Priority Queueing
4. Performance Evaluation
5. Conclusion

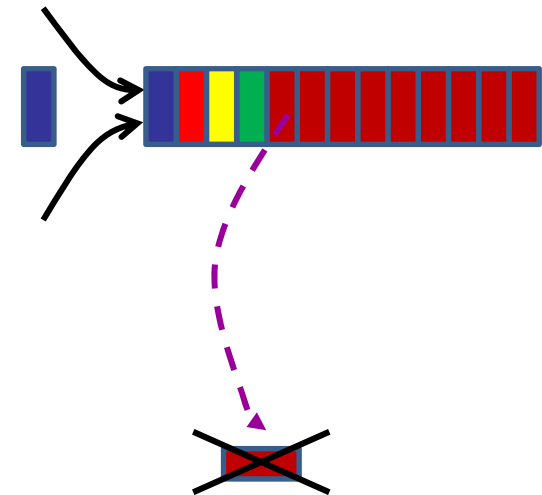


NCAQM

Network Coding-Aware Queue Management

Maintaining queues and packet transmission

- Store network coded packets instead of uncoded packets
- Keep track of hyperarc queues
- Packet scheduling is according to FIFO queue



Rate Control and Packet Dropping

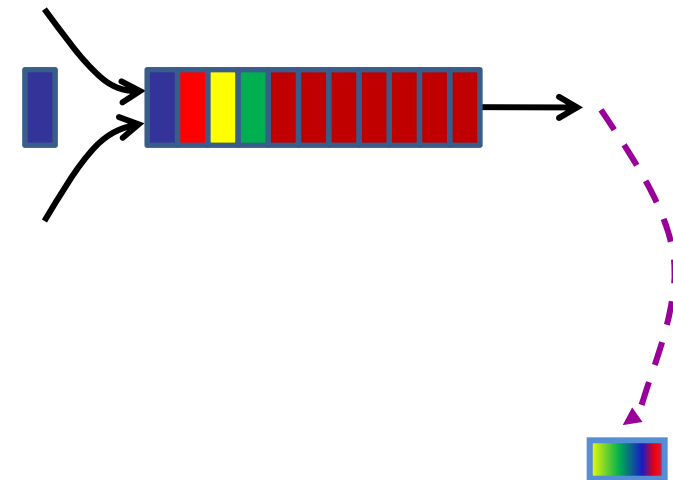
- Upon congestion. Calculate Q_i^s :
 - Determine hyperarc queues that flow s is dominating
 - Sum the number of packets of flow s over these hyperarc queues
- Drop an uncoded packet from the largest flow

NCAPP

Network Coding-Aware Packet Prioritization

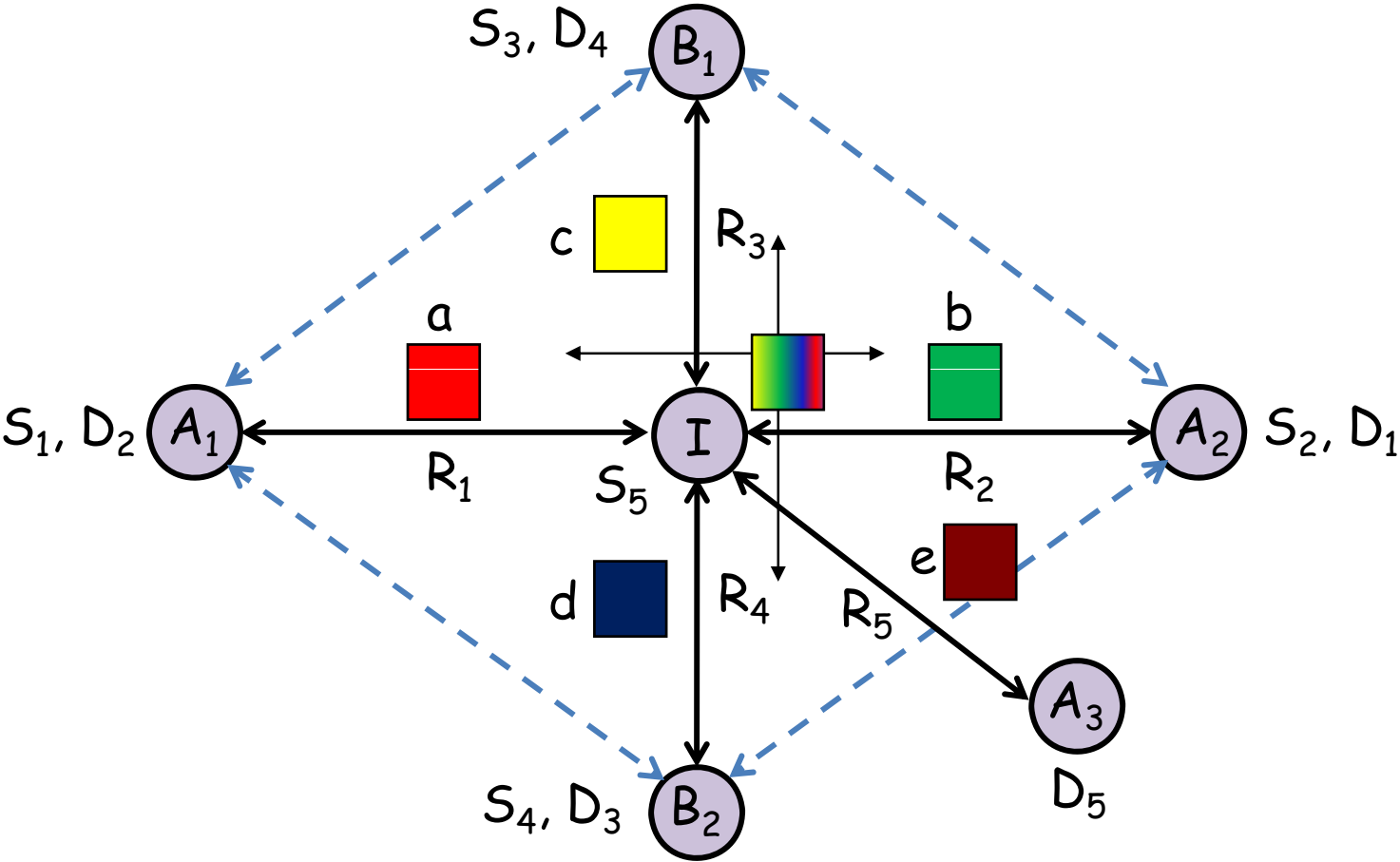
Packet Prioritization

- Packet of flow k carries β_k packets
 - Not network coded $\rightarrow \beta_k = 1$
 - Network coded combines two flows $\rightarrow \beta_k = 2$
- Give β_k more transmission opportunity to flow k .



NCAPP

Network Coding-Aware Packet Prioritization



Coded packets are transmitted 4 times faster

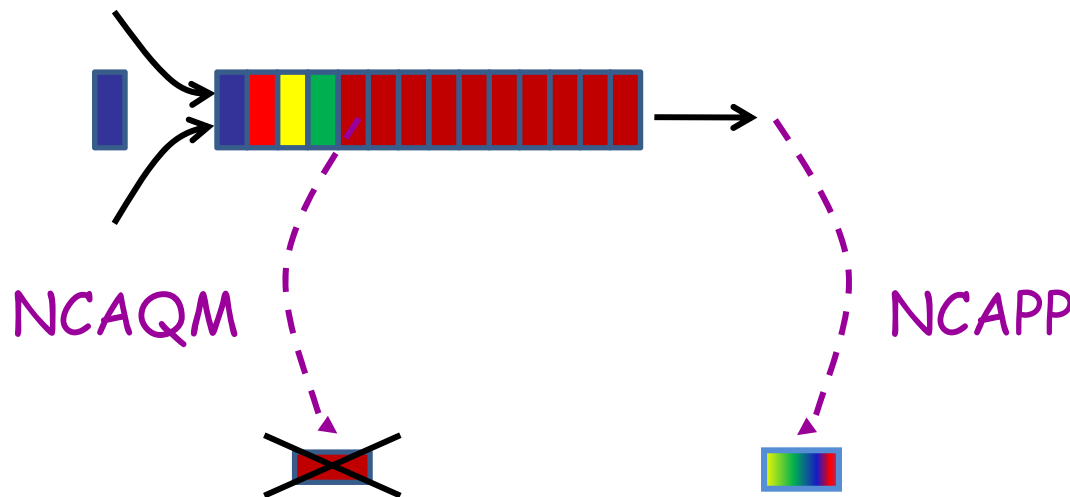
NCAPQ: NCAQM + NCAPP

Network Coding-Aware Priority Queueing

- Use NCAQM without any changes
- Updates on NCAPP:
 - When a node gets transmission opportunity , it transmits a packet from flow k with probability

$$p_k = \frac{R_k \beta_k}{\sum_{k=1}^K R_k \beta_k}$$

Drain rate of the k th flow



NCAPQ:NC-Aware Priority Queueing

Implementation summary

	NCAPQ Functionality
Queue management	<ul style="list-style-type: none">• Store network coded packet• Packet dropping
UDP	No change
MAC	Packet Prioritization (+802.11)

Minimal and intuitive

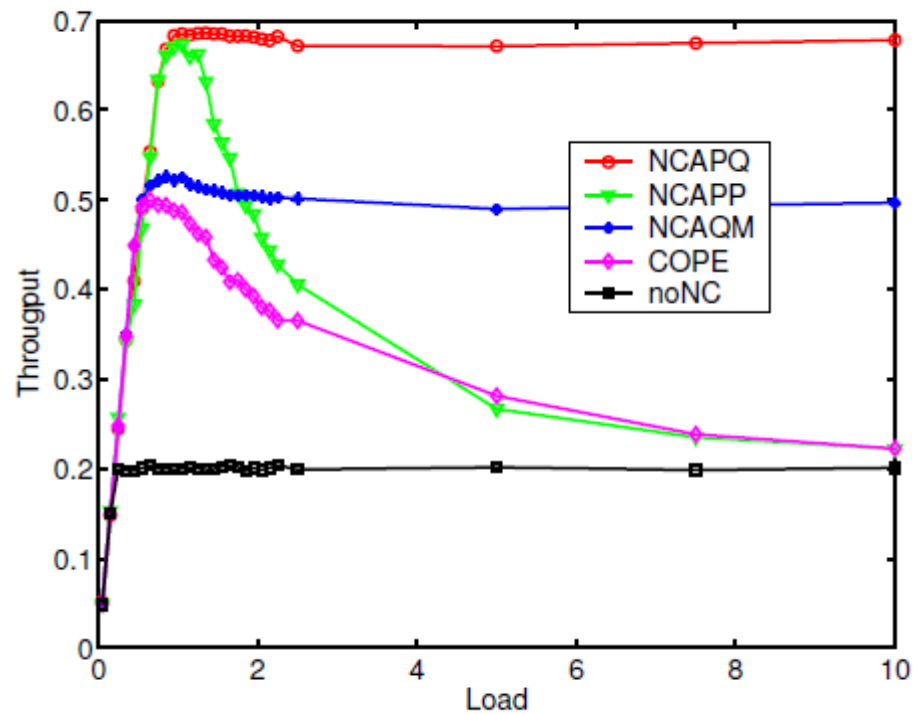
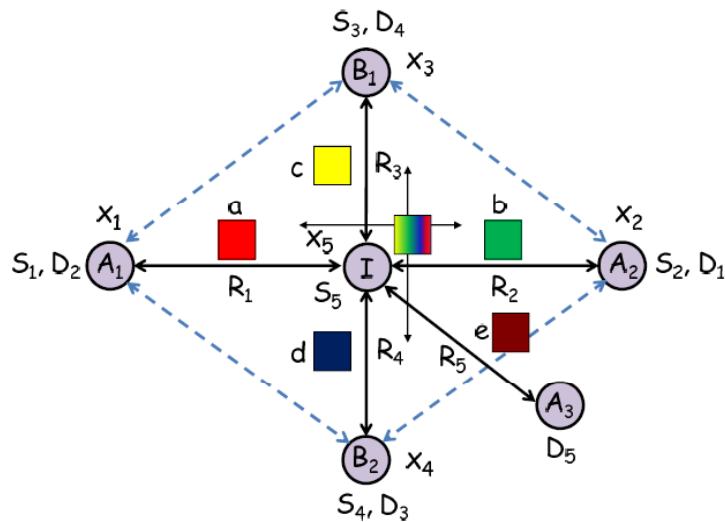
Outline

1. Background and Motivation
2. NCAQM and NCAPP
3. NC Aware Priority Queueing
4. Performance Evaluation
5. Conclusion



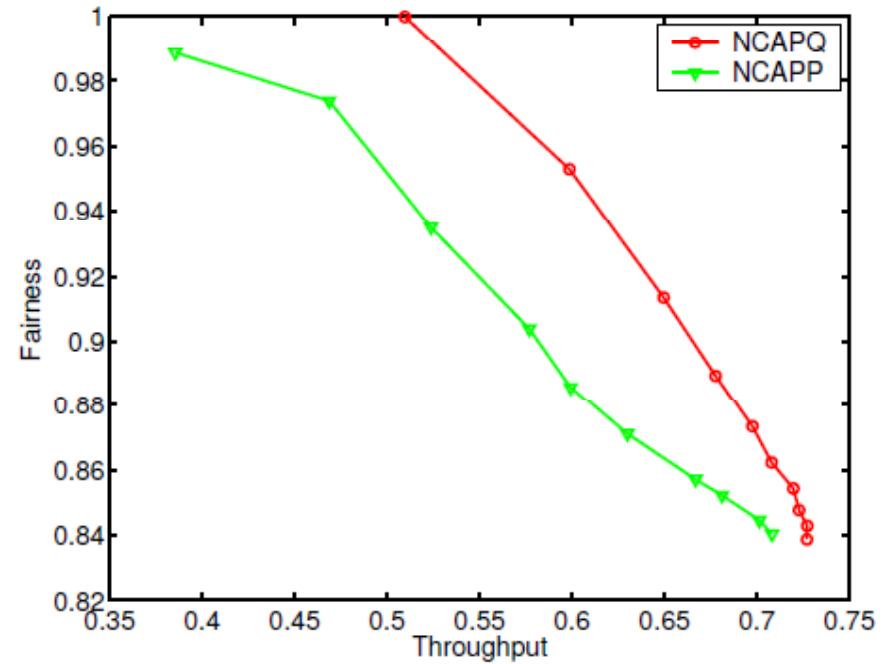
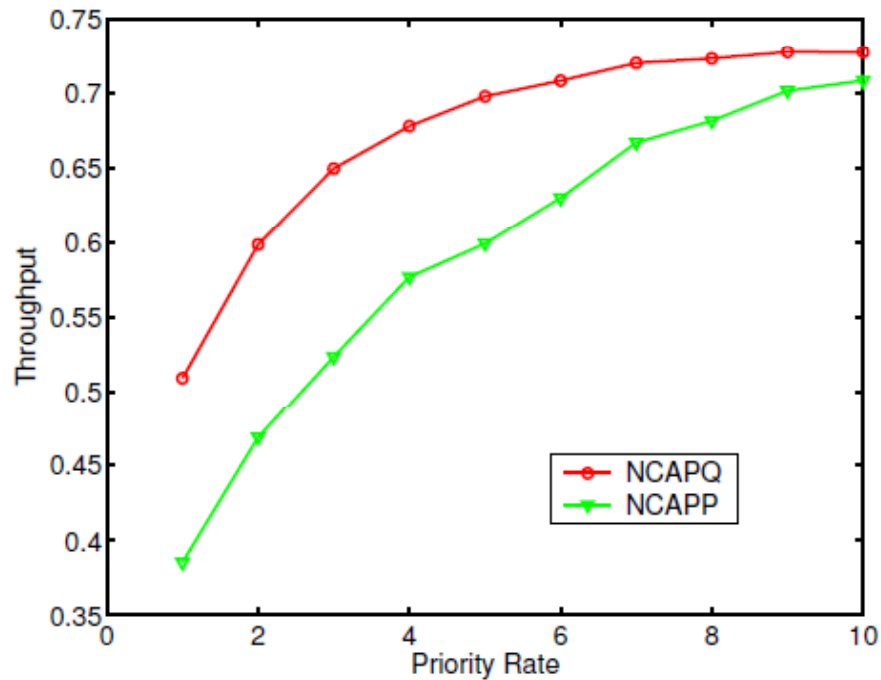
Performance evaluation

Numerical simulations - throughput vs. load



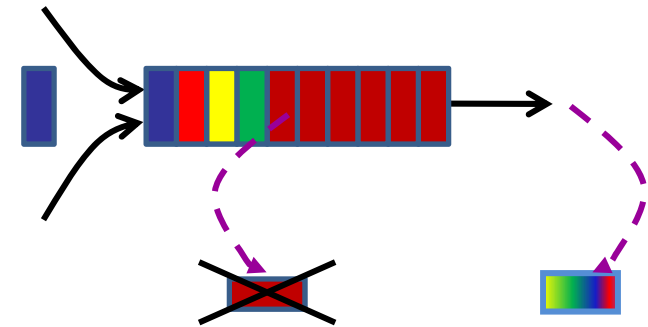
Performance evaluation

Numerical simulations - effect of prioritization



Conclusion

- Improve performance of UDP flows over coded wireless networks (COPE)
- NCAPQ: Compared and combined NCAQM and NCAPP
- NCAPQ improves throughput
 - COPE (by a factor of 10)
 - NCAQM and NCAPP (by a factor of 2)
 - Without significant loss in fairness



Questions?

hseferog@uci.edu

<http://newport.eecs.uci.edu/~hseferog/>