

Network Coding in Wireless Mesh Networks

Save Airtime by Mashing Packets

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Introduction (1)

Master thesis on network coding in mesh networks:

- Inspired by the COPE coding scheme from MIT CSAIL¹.
- Integrated network coding in batman-adv.
- Performance evaluated in a real wireless network.
- Working title: CATWOMAN
(Coding Applied To Wireless On Mobile Ad-hoc Networks).

¹S. Katti et al., *XORs in The Air: Practical Wireless Network Coding*

Introduction (2)

PhD to continue the work:

- Contribute with code to batman-adv.
- Build a static test-bed and mesh-usbs.
- Implement other concepts from Network Coding (RLNC).

Network Coding Basics: XOR'ing Data

Basic Principle of Network Coding

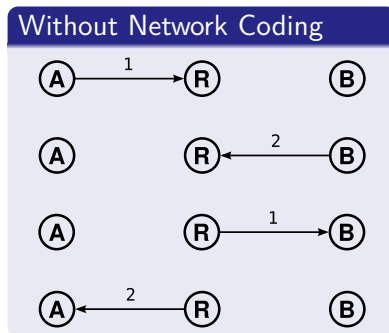
Let network nodes process and combine packets, instead of simply forwarding them.

Simple XOR example:

$$(P_1 \otimes P_2) \otimes P_2 = P_1$$

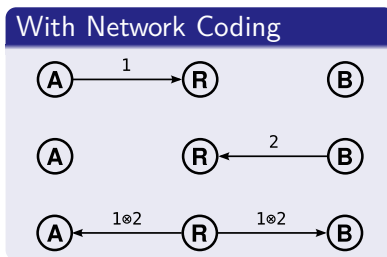
The Alice and Bob Topology - Without NC

- Node *A* sends packet 1 to node *B*.
- Node *B* sends packet 2 to node *A*.
- They both relay traffic through node *R*.



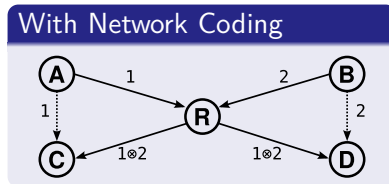
The Alice and Bob Topology - With NC

- Node *A* sends packet 1 to node *B*.
- Node *B* sends packet 2 to node *A*.
- Node *R* combines packet 1 and 2.



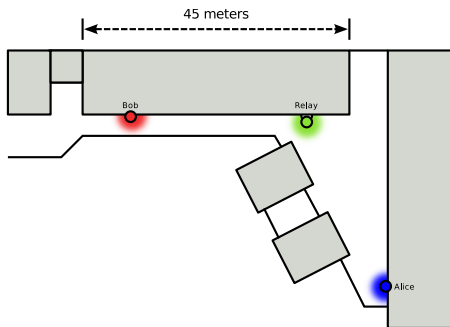
The X Topology

- Node *A* sends packet *1* to node *D*.
- Node *B* sends packet *2* to node *C*.
- They both relay traffic through *R*.
- Node *C* overhears packet *1*.
- Node *D* overhears packet *2*.

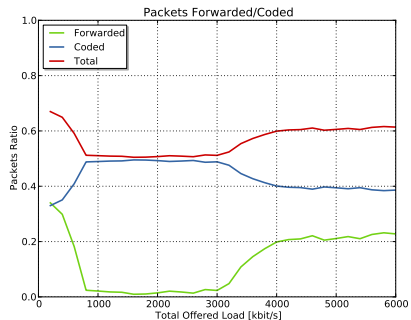
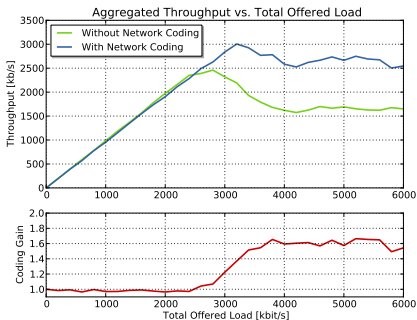


Test Network

Three nodes placed in large atrium on campus.

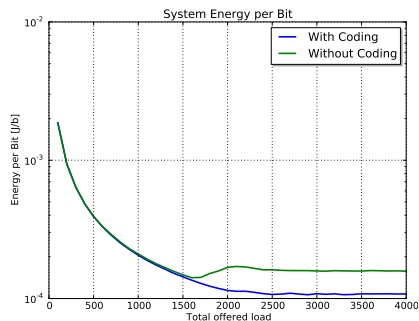
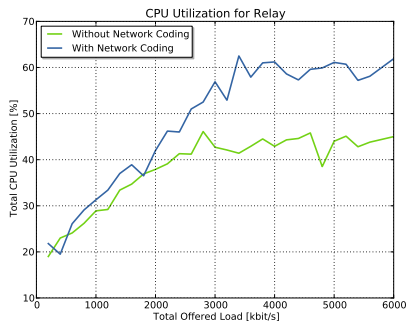


UDP Traffic (1)

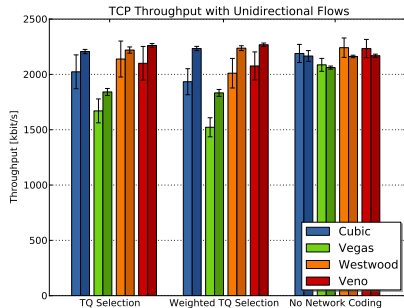
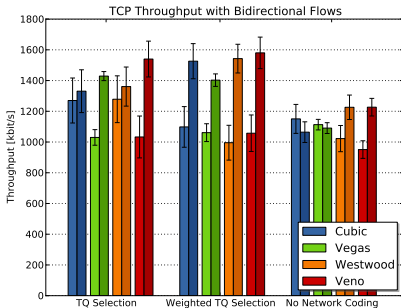


UDP Traffic (2)

XOR is not that expensive. . .



TCP Traffic



Status

Benefits:

- Coding works
- Throughput gain for UDP
- Little gain for TCP
- XOR is cheap enough

Drawbacks:

- Increased delay when not congested.
- High code complexity.
- "Random data" in the air.

Feedback

Questions, comments, ideas, notes of caution?