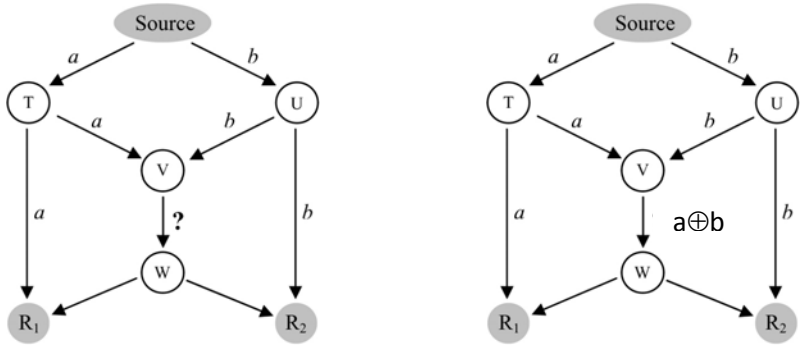
Topic 1. Network coding in mesh networks

Project description: Network coding is a new technique for efficient and robust delivery of packets in computer networks. The canonical example to demonstrate the idea of network coding can be found in Figure 1. In the example, a source node sends multicast messages to receivers R1 and R2. Each link is of unit capacity. Using conventional routing, it is impossible to send 2bit/sec information to both sinks (Figure 1(a)). In contrast, with network coding (Figure 1(b)), this is in fact possible. Another example is given in the wireless environments for multiple unicast flows. In [4], we have considered another form of topologies where network coding can be applied in wireless networks.



1. (b)

Figure 1 Illustration of network coding

The objective for this project is to implement network coding modules and evaluate their performance in wireless mesh networks. Two teams will be working jointly with each group focusing on one subcomponent.

1. Port Click DSR router and enhance it with link quality metrics WCETT; Evaluation of performance in mesh setting (3 people)
2. Extension of COPE code and enhance it with dynamic coding decision based on link quality metrics (3 people)
3. BFLY coding without route optimization (3 people)
    a. Determination of BFLY structure via HELLO messages
    b. BFLY coding/decoding
4. Joint testing and experiments

Reference:

1. Sachin Katti, Hariharan Rahul, Wenjun Hu, Dina Katabi, Muriel Medard and Jon Crowcroft, *"XORs in the Air: Practical Wireless Network Coding"*, ACM SIGCOMM 2006, Pisa, Italy, September 2006.
2. COPE code: http://piper.csail.mit.edu/software/cope.tgz
3. Click modular router: http://pdos.csail.mit.edu/click/

4. Soji Omiwade and Rong Zheng and Cunqing Hua, Butterflies in the mesh: lightweight localized wireless network coding, in *Proc. of Fourth Workshop on Network Coding, Theory, and Applications (Netcod)*, 2008.
5. Click DSR http://pecolab.colorado.edu/html/dsrClick.html
6. R.Draves, J.Padhye, and B.Zill, Routing in Multi-radio, Multi-hop Wireless Mesh Networks, ACM MobiCom, Philadelphia, PA, September 2004.

Topic 2. VOIP Traffic generators and analyzer

Project description: The focus of this project is to design a VOIP traffic generator and analyzer that can be used to study the performance of QoS-aware network protocols. The traffic generator program runs on multiple nodes and generates VOIP like packet streams. The traffic generator can take a set of input parameters such as the number of flows, distribution of on- off- durations etc [1]; or it can replay an captured voice flow preserving the header information. If multiple source nodes are used, a controller is needed to coordinate/dispatch the VOIP streams at different sites. Each packet should be RTP packets containing the necessary control information regarding the VOIP flows. The traffic analyzer computes the delay, jitter, loss rate of the VOIP flows and also save the audio into a file for replay.

This project should be carried out by a team of 4 students. The end goal is a successful demonstration of the implementation.

Topic 3 . WiFi Tracker

Project description:

WiFi networks are ubiquitous. However, since it operates in the ISM bands, co-existing devices (e.g., Zigbee, Bluetooth) or networks can potentially disrupt the operations of a WiFi network. Several solutions exist that use a network of WiFi sniffers or spectrum analyzers to infer faults in a WiFi network. In [1][2][3], packet or physical level traces are collected and merged and analyzed as a central location. In this project, we consider a light version of WiFi sniffers, where regular users (as opposed to dedicated sniffers) record packets received, transmitted and sniffed opportunistically. The network time protocol and packet reception are used for synchronization. Finally, the packet traces are uploaded opportunistically to a central server, which runs merger and diagnosis application.

Two teams will work collaboratively on this project each responsible for one subcomponents:

1. Trace collection (3 people)
2. Trace merging and analysis (2 people)

Reference:

1. Analyzing the MAC-level Behavior of Wireless Networks, SIGCOMM 200.
2. Jigsaw: Solving the Puzzle of Enterprise 802.11 Analysis. In Proc. of ACM SIGCOMM, Sept. 2006.
3. Automating Cross-Layer Diagnosis of Enterprise Wireless Networks, Yu-Chung Cheng, Mikhail Afanasyev, Patrick Verkaik, Peter Benko, Jennifer Chiang, Alex C. Snoeren, Stefan Savage, and Geoffrey M. Voelker , ACM SIGCOMM, Kyoto, Japan, August 2007