

# Research in Wireless Mesh Networks

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## Experimental Characterization

### Motivation

- Need for accurate physical characterization of mesh environment
- Lack of mesh testbeds without background traffic and interference
- Account for physical layer issues not addressed in simulation
- Need for topological trade-off assessment: radios per node, hops, channel assignment, communication flows, antenna proximity

### Experimental Setup

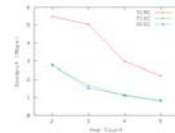
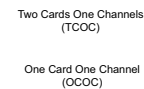
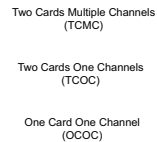
- IEEE 802.11b ORINOCO AP-2000
- ORINOCO Classic Gold PC Cards
- 8 Laptops running Fedora Core 3
- Wireless Distribution System running between access points
- Experiments performed in an interference free environment
- Goodput calculated with the average of five 20 second TCP bulk data transfers from end to end
- 4 Access Points in a linear topology
- Multi-Channel, Multi-Hop Tests
- 5 dBi gain antennas elevated 4 ft and separated 4 ft
- 100 ft between APs



### Inferences

- Use Multiple non-overlapping channels whenever possible
- Aggregate goodput remains roughly the same even when number of users increase
- RTS/CTS decreases the goodput and increases RTT of the network
- Multiple hops need to use multiple channels
- Limit the number of hops needed for each flow in the wireless network
- Antenna placement is very very important
- Round Trip Time (RTT) generally decreases when using multiple channels

### Selected Topologies and Results

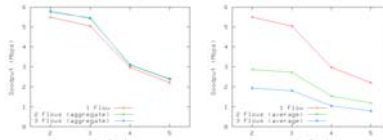


Utilizing non-overlapping on multiple radios gives us a significant performance advantage over a single radio implementation. Channel reuse in one collision domain halves throughput for our testbed.

1 Flow

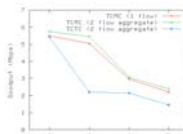
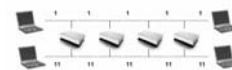
2 Flows

3 Flows

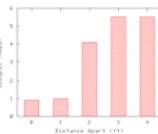


Aggregate goodput increases slightly as the number of separate communication flows (users) increases. The average goodput of a given station is a function of the number of communications flow. Bandwidth allocation is fair across all users at the same distance from a gateway node.

Two Cards Two Channels (TCTC)

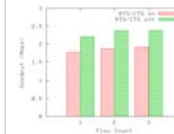


Isolating the WDS path yields lower performance for TCTC than if the single path was shared for TCMC. Radio interference dominates the performance of the testbed.



We checked two-hop performance on orthogonal channels varying the distance between both antennas.

Antennas on non-overlapping channels can still significantly impact one another.



We ran TCMC with one flow and RTS/CTS on and off.

RTS/CTS reduced the performance by about 25%.



## Quail Ridge Wildlife Reserve

### Overview

The Quail Ridge Wildlife Reserve project is an effort to provide a wireless communications infrastructure to the wildlife reserve. The network will benefit on-site ecological research and provide a wireless mesh network testbed for development and analysis. This is a joint project with the UC Davis Natural Reserve System and the Networks Lab at the Department of Computer Science, UC Davis.

### Our Vision

Our vision is a large scale wireless mesh network backbone deployed within the reserve. Various sensor networks would gather temperature, visual, and acoustic data at certain locations. This information would then be passed back to the field station for storage or for further relay over ethernet. The backbone nodes will also serve as access points enabling wireless access at their locations.

### Hardware

- Soekris net4826**
- 2 miniPCI slots
  - 64 MB of Flash Memory
  - 128 MB of RAM
  - 266 MHz AMD Geode SC1100

- Wireless Cards**
- 400mW Atheros 802.11b/g cards

- Antennas**
- 24 dBi Die Cast Directional Antenna
  - Compact Black 7.4dBi Omni Antenna
  - 15.4 dBi 3 Degree Down Tilt Omni

