Net-X: Framework for Multi-channel, Multi-interface Wireless Networks

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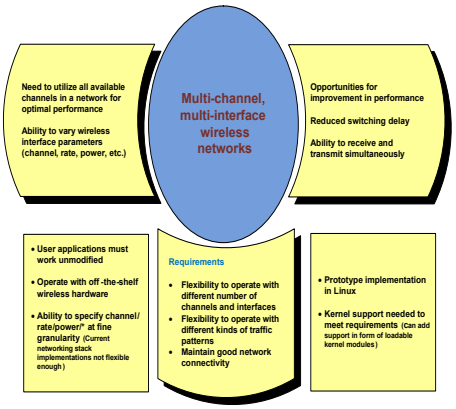
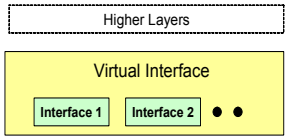
Motivation



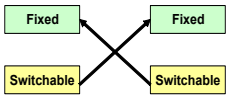
Managing Multiple Interfaces



Linux bonding driver leveraged for interface virtualization

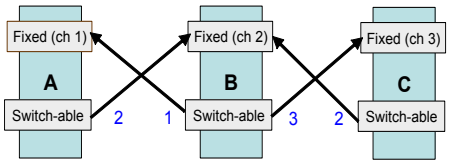
All interfaces of a node share the same IP and MAC address

Channel Assignment



Hybrid channel assignment: Static + Dynamic

Channel assignment locally balanced



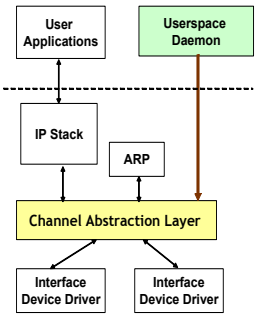
Switch-able interface of B switches to channel 3 when sending to node C, and to channel 1 when sending to node A

Multiple interfaces can simplify protocol design
- Use one interface for receiving data on a fixed channel
- Use second interface for sending data

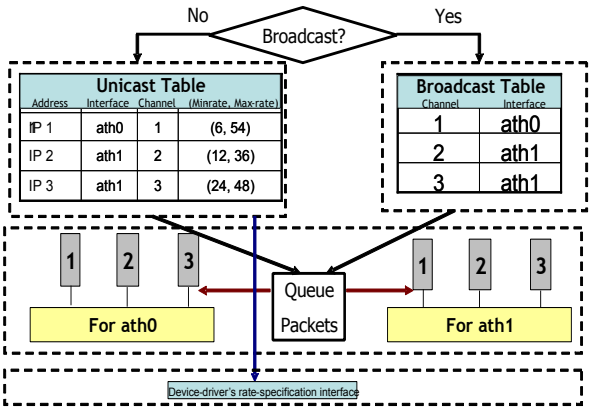
Routing protocol has to distribute routes
- Important for multi-channel networks

System Architecture

Major System Components



Channel Abstraction Layer and Device Driver



Per-channel queues in Channel Abstraction Layer facilitate buffering between channel switches

Testbed Deployment

- Testbed of 20+ network devices
- Linux 2.4 kernel
- Each device has two 802.11a wireless interfaces
- Runs a suite of multi-channel protocols

Rate Control Mechanism

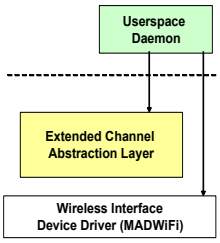
- Rate control directives from higher-layers may be useful
- Desirable to also retain localized adaptation to link-quality
- Two-level rate-control mechanism:
  - Userspace provides broad rate-guideline
  - Local adaptation also performed

Userspace rate-specification

- Unicast communication: (min, max) rate-range
- Broadcast communication: Desired transmission rate

Device driver

- Functions to set min-max for a given MAC destination
- Driver can use its internal rate-adaptation algorithm within valid (min, max) rate-range
- Modified MADWiFi and its SampleRate implementation



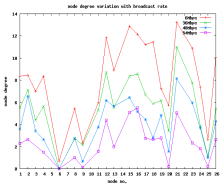
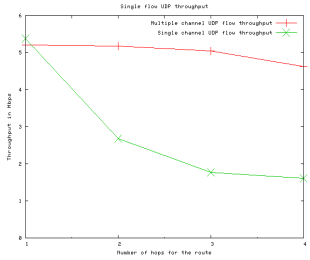


Illustration of use of broadcast rate control for modulation of routing topology

Throughput Measurements



Initial throughput measurements on UDP flows

- Multi-channel UDP throughput shows considerable improvement over single channel throughput
- Multi-channel UDP is capable of maintaining high throughputs over more number of hops

Ongoing/Future Work

- Incorporation of link/channel quality awareness in protocols, and developing improved/alternative protocol architecture
- Testbed analysis using more than two interfaces per node
- Experimentation with multimedia applications (e.g., VoIP)