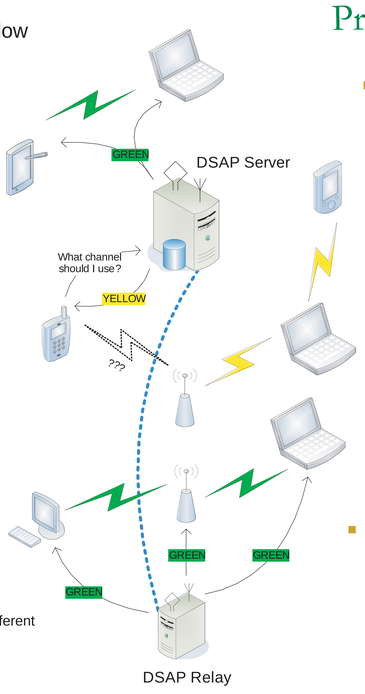
DSAP

A Protocol for Coordinated Spectrum Access

Vladimir Brik, Eric Rozner, Suman Banerjee, Paramvir Bahl
University of Wisconsin at Madison
Microsoft Research

1. Current Spectrum Access

- Uncoordinated: wireless nodes do not follow etiquette rules when accessing the wireless medium.
- Unintelligent: hosts do not have access to global view of the network and do not adjust their access patterns to fit their behavior (e.g. mobility) or policies or network administrators.
  - Suboptimal channel utilization
  - Suboptimal throughput
  - Unnecessary interference
  - Inefficient resource sharing
  - Lack of dynamic configuration



2. Dynamic Spectrum Access Protocol

- DSAP:
  - Use “channel leases” to intelligently manage access to radio spectrum
  - Centralized network management
  - Intended for limited geographical area
  - Allows implementation of administrator-defined policies
  - Provides global view of the network

3. DSAP benefits

- Centralized
  - Effective policy enforcement and violation detection
  - Maintains the “big picture” of network conditions
  - Allows interoperation between spectrum managers of different entities and wide-area spectrum managers
- Lease-based spectrum access
  - Efficient resource sharing
  - Avoid existing interference
  - Avoid creating unnecessary interference
  - Harmonious co-existence of nodes with incompatible protocols
  - Efficient spectrum utilization
- Fine-grained control
  - Per-node configuration granularity
  - Quick reconfiguration in response to change
  - Wide range of configurable parameters (e.g. TX power, PHY protocol)

4. DSAP internals

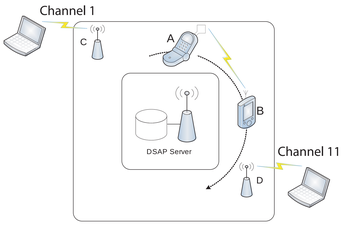
- Protocol Concepts
  - Spectrum Lease
    - Gives a node the right to communicate on a channel subject to certain constraints
  - Policy Database
    - Administrator-defined policies, e.g. higher QoS for a set of nodes
  - Radio Map
    - Map of channel conditions as observed in various parts of the network
- Protocol Entities
  - DSAP Clients
    - Communicate only on channels specified in a lease issued by the server
  - DSAP Server
    - Centralized entity to coordinate spectrum access
  - DSAP Relay
    - Extends range of the DSAP server

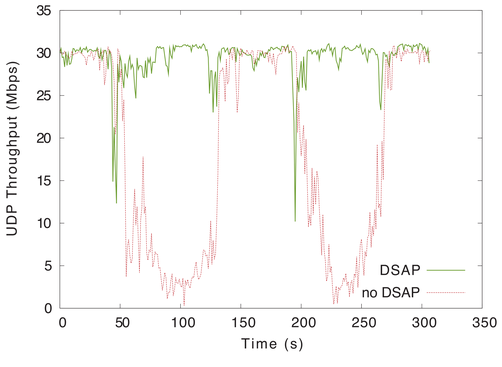
5. Lease Management

- “DHCP for spectrum channels”
- A node may only communicate with another node on a channel for which it has been issued a lease by the DSAP server
- Lease example:
  - Lease ID: 0x0001
  - Channel: 11
  - Protocol: 802.11g
  - Duration: 100s
  - Max. TX power: 400mW
  - …

6. Varying channel conditions

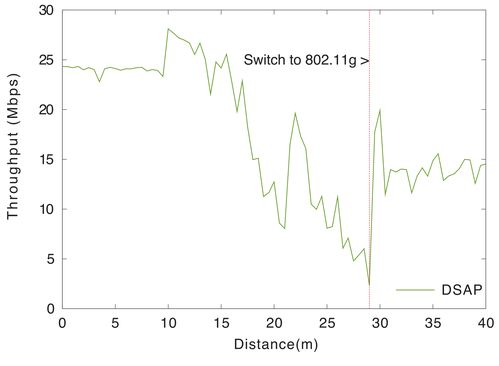
- Mobile nodes A and B move in a circle, in and out of interference ranges of nodes C and D
- DSAP server learns of decreased performance
- DSAP server adjusts communication channel of A and B as necessary to avoid interference





7. Range Management

- Nodes start communication using 802.11a (5.2 GHz) to keep interference in 2.4 GHz range to a minimum
- Nodes move away from each other
- DSAP server compensates for increased distance by changing the wireless protocol to 802.11g



WiNGS Wisconsin Wireless and Networking Systems Laboratory
THE UNIVERSITY of WISCONSIN MADISON
Microsoft Research