

The background of the slide features several sets of concentric circles in a light blue color. One prominent set is centered in the upper right quadrant, while others are partially visible in the top left and bottom left corners. The circles vary in size and opacity, creating a subtle, abstract pattern.

RDCS: Routing Driven Channel Selection in Multi-Radio Ad-hoc Networks

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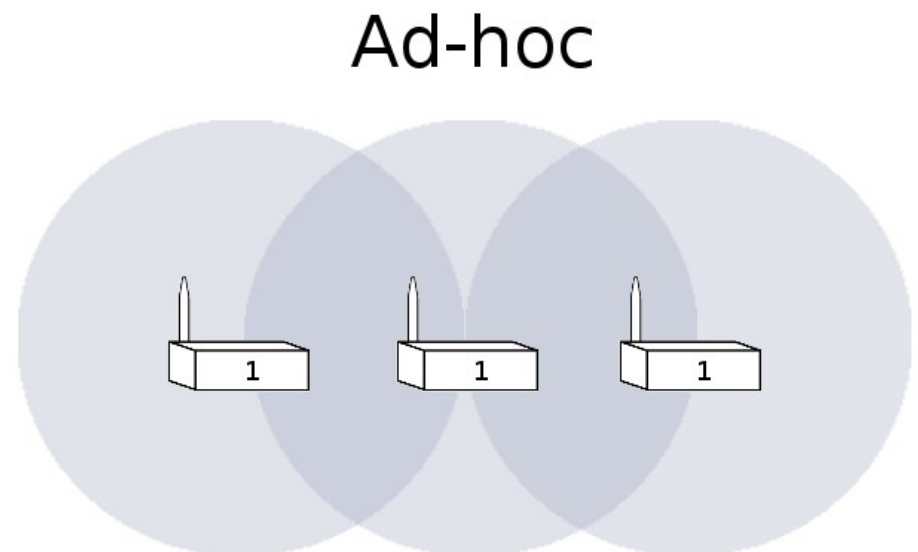
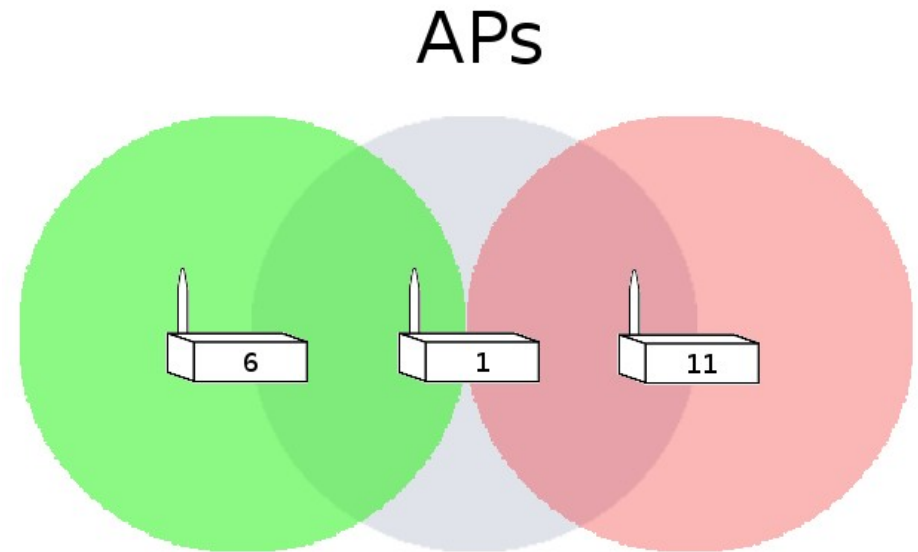
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Introduction: Multi Radio Ad-hoc/Mesh Networks

- Truly wireless 802.11 networks
- Currently APs need a wired connection to the backbone
- Hop transmissions to the backbone
- Applications: municipal city networks, developing world communications
- Static, mains powered, multiple radios
- Problems when hopping transmissions

Multi Hop Performance

- The problem is contention
- Hopping transmissions require nodes to rx then tx – double time
- Single radio ad-hoc networks must share a channel
- I-range is often double the tx-range



Multi Channel MACs?

- Need to use multiple channels to overcome contention
- Why not create a new multi channel MAC?
- New MAC proposed by 802.11s
 - Backed away due to interoperability concerns with existing 802.11
- Must use Ad hoc mode shifting problem to higher layers:
 - Channel Aware Routing
 - Intelligent Channel Selection mechanism
- We chose to use the OLSR routing protocol to base channel selection around

RDCS: Routing Driven Channel Selection

- The goal – dynamically assign channels to interfaces
 - Connected (every node has a working path to other nodes)
 - Minimise interference (reasonably equal usage among channels)
- Channel selection starts with channel masking
 - Find the non mesh APs - Rogue node avoidance
 - Find the band used by co-located radios - Inter-radio interference
 - Ensure no direct neighbour is sharing the same assignment
- Select among remaining channels
 - High values to chans with one or two nodes with High SNRs
 - Low values to chans with many nodes and low SNRs

$$EstBW = \frac{SNR_{avg}}{NoNodes}$$

RDCS: Operation

- Simple Design
 - Interface appears in the routing table – stabilise
 - Interface not in the routing table – reassign new channel
- Works because we are using link state
 - Every node has identical view
 - There will always be agreement between nodes
 - If a route is removed from the routing table because there is a path via a different interface, both nodes will agree on this change.
 - No harm can be done through reassignment because both nodes will always agree on the change

Gateway feature

- Prevent network partitions
- Specify a common gateway

Testbed

- Hardware

- 8 PCEngines ALIX nodes
- AMD Geode 500Mhz
- Dual Mini PCI slots
- Atheros a/b/g CM9's

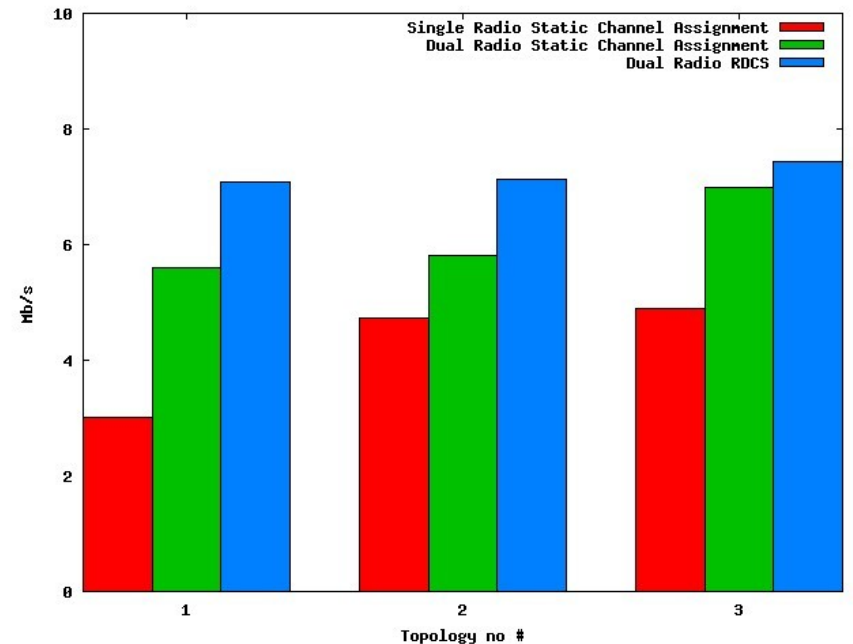
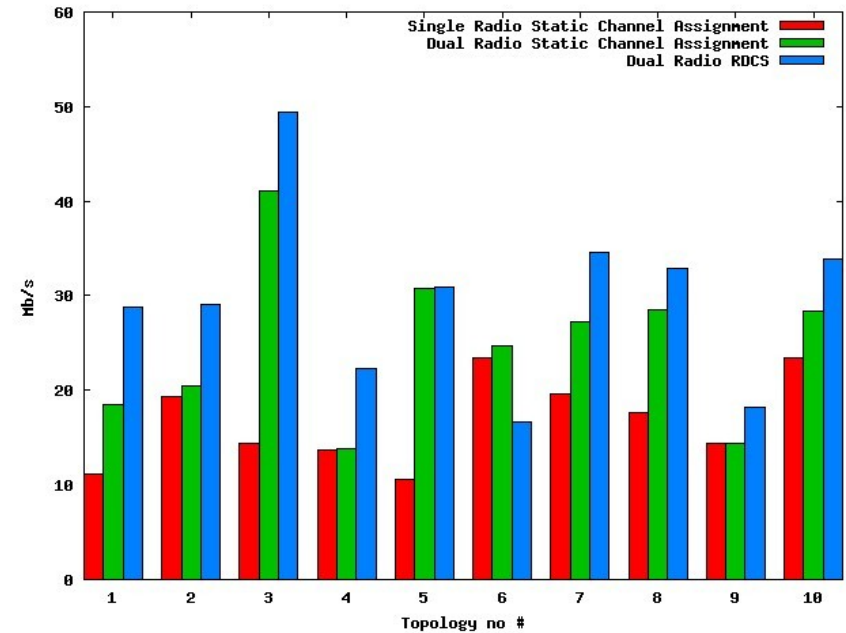
- Software

- OLSR Routing
- MADWiFi wireless drivers
- Voyage Linux OS (CF)



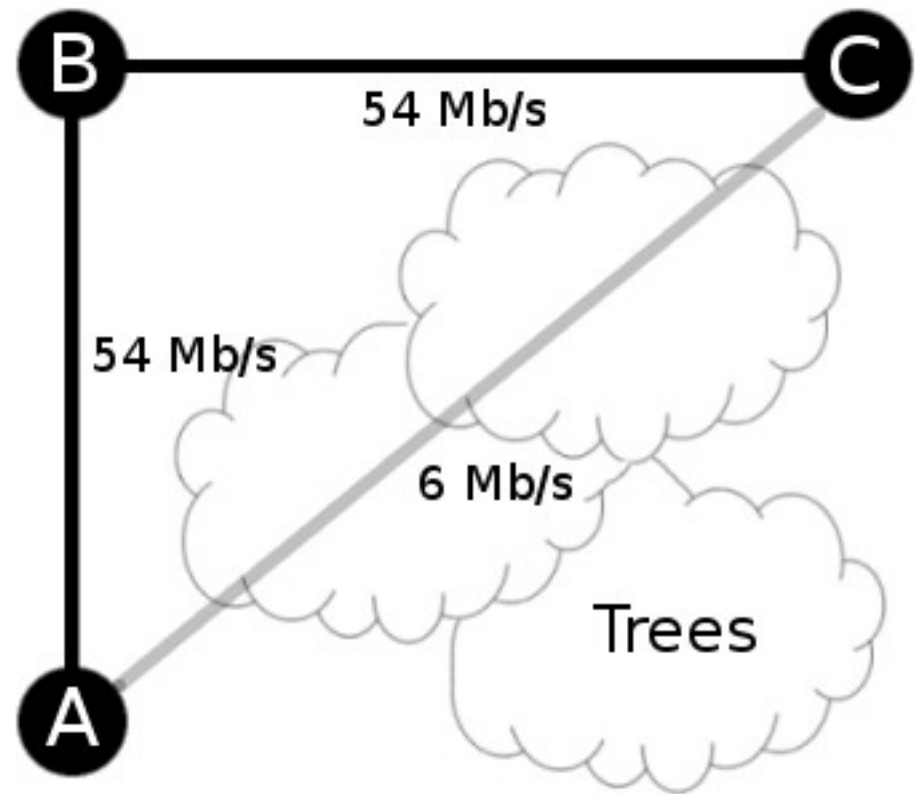
Results

- Gateway based bandwidth tests (top)
 - Internet traffic model
- Distributed traffic test (bottom)
 - P2P file sharing model
- Results are favourable...
 - but not as as was expected
- Biggest problem: routing metric



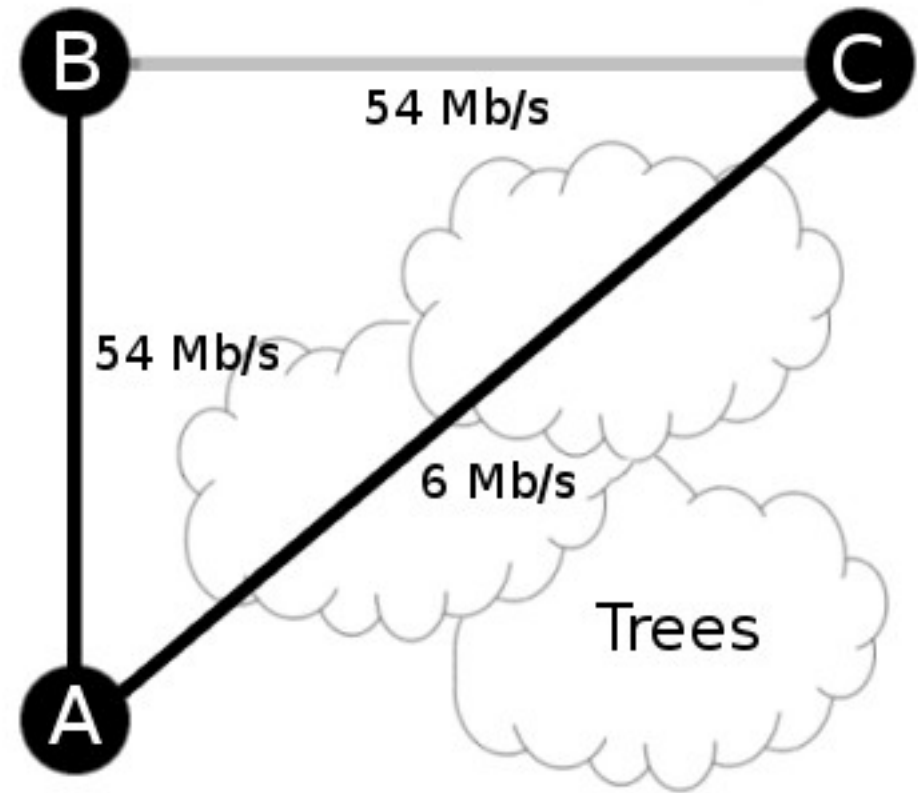
RDCS: Routing Driven Channel Selection

- Routing metric currently used in OLSR is ETX (reliability)
- Remember that channel selections are stabilised or optimised based on the routing protocol
- Diagram on right, shows optimal routes/channel selection for A communicating with C



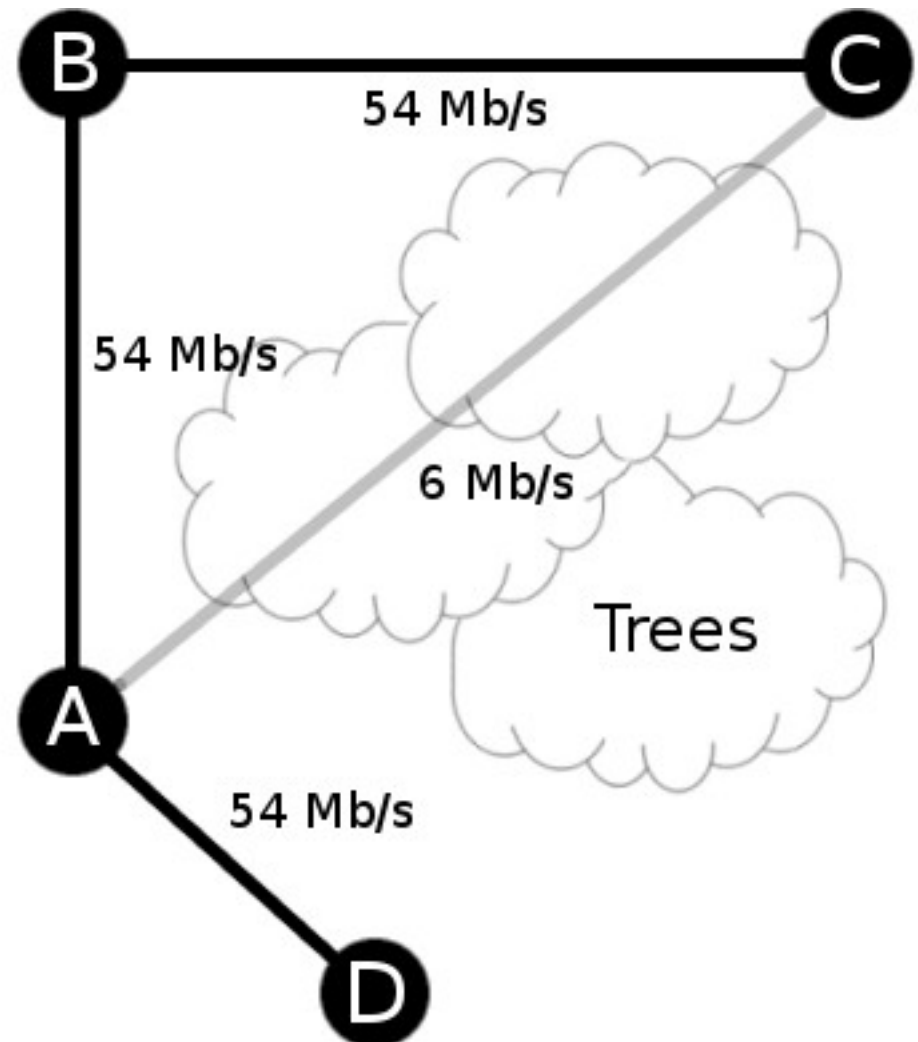
RDCS: Routing Driven Channel Selection

- OLSR has a preference to use these routes.
- As long as the link is reliable at 6 Mb/s
- RDCS may stabilise channel selections that are suboptimal
- If OLSR could incorporate bandwidth



RDCS: Routing Driven Channel Selection

- Might leave a free interface A - D
- Currently RDCS only form stable channel diverse assignments – not necessarily optimal
- Fairness issues
- Had to rate limit each flow at the gateway



Conclusion

- **Future Improvements**
 - Get bandwidth into the OLSR routing protocol
 - Experiment with other routing protocols
 - Fairness issues
 - Scale a bigger testing mesh
 - Might show further gains for RDCS over static CA
- **RDCS works!**
 - Improves performance
 - But how well is dependent on the routing protocol

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Thanks for listening