Cross-Layer Channel-Adaptive Relaying in Mobile Ad Hoc Networks

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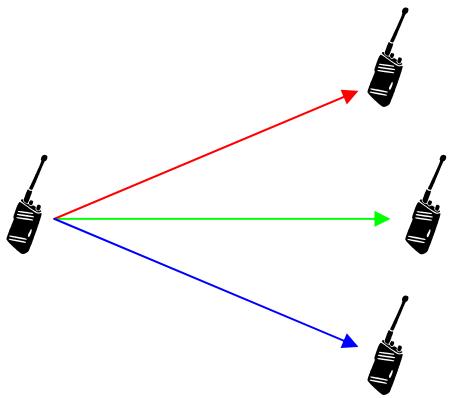
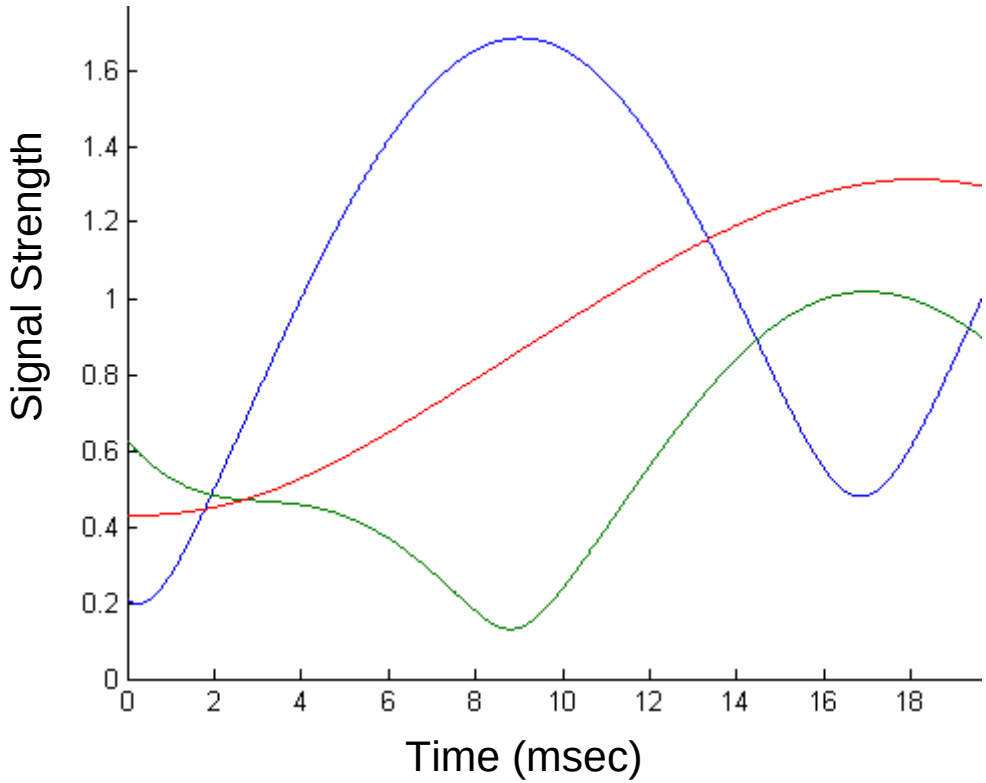
Communication Challenges

- Interference
- Fading
- Time-varying channel



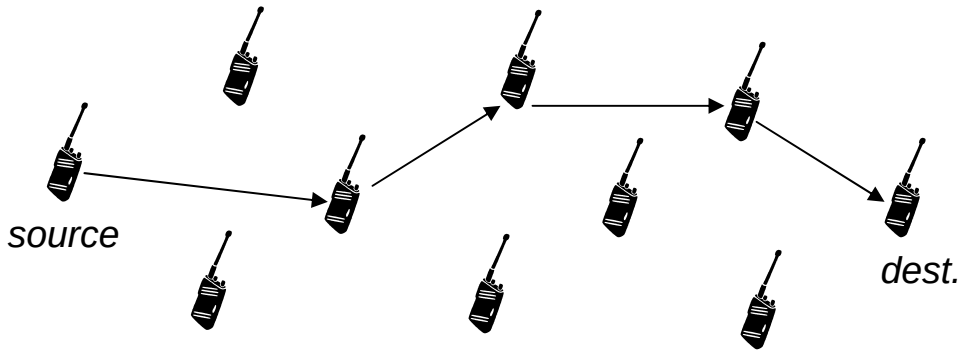


<u>Effects:</u> Unreliable communication, poor performance

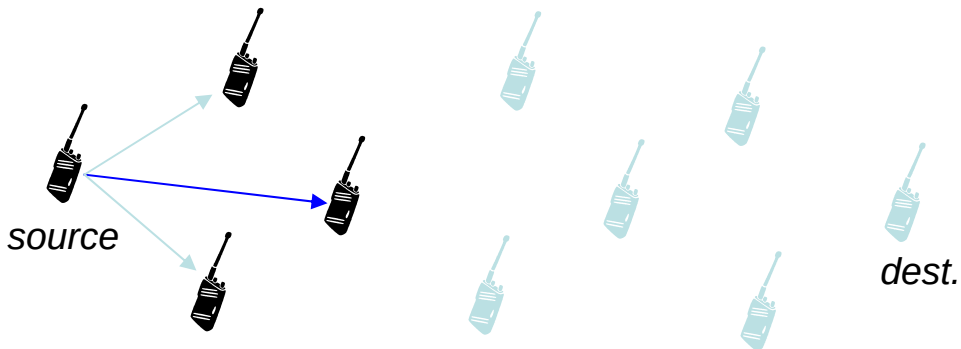
<u>Solution</u>: Use **channel state information** and **spatial diversity** to improve performance.

Technical Approach

- Long-term adaptivity: Routing layer selects next-hop relay(s) based on average channel state and position information (geographic routing).



- Short-term adaptivity: Link layer selects “best” of multiple relay choices based on **current** channel state.



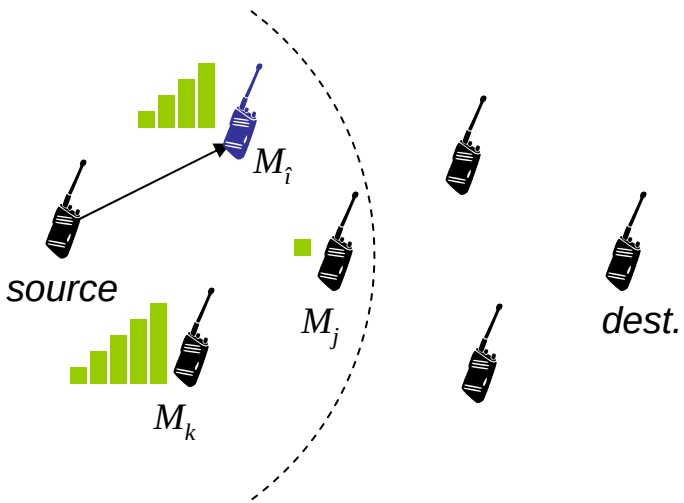
Channel-Adaptive Relay Selection

Long-Term Relay Selection

Maximize *expected* progress per hop

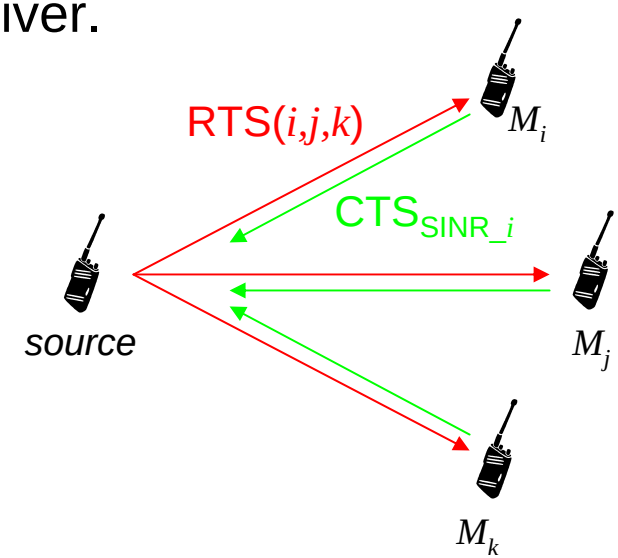
$$P_{s,l} = \Pr[\text{Success} \mid \overbrace{\text{SNR}_l}^{\text{signal-to-noise ratio}}]$$

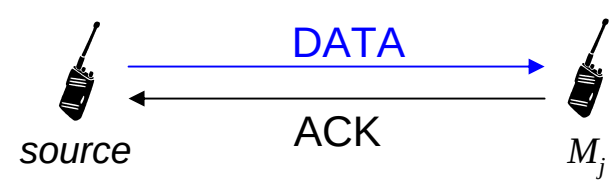
$$\hat{l} = \arg\max_{l} \underbrace{\left\{ \left(\overline{SD} - \overline{M_l D} \right) \cdot P_{s,l} \right\}}_{\text{expected progress}}$$

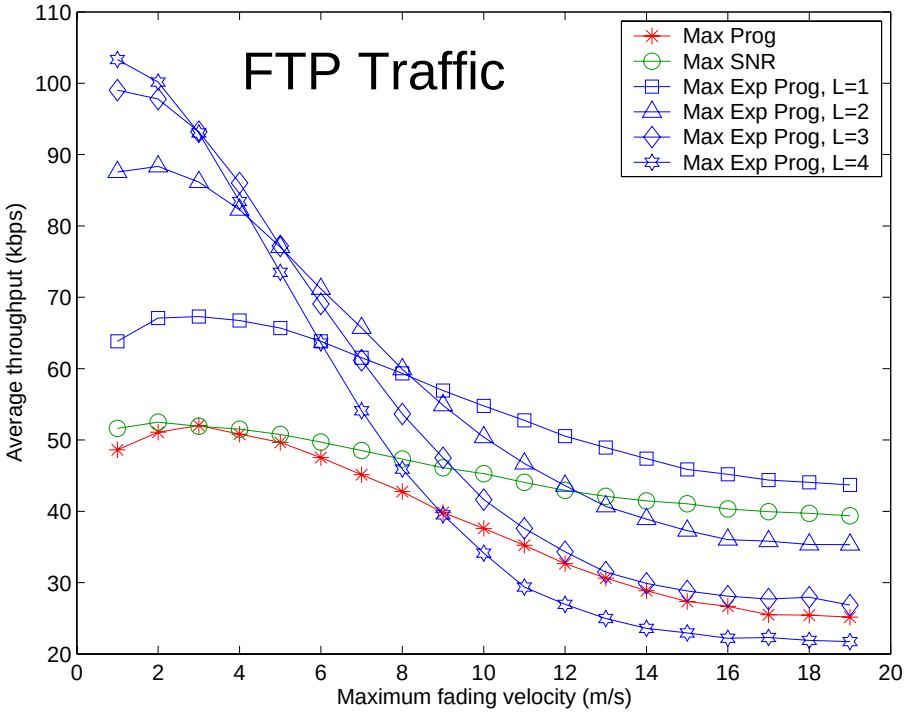


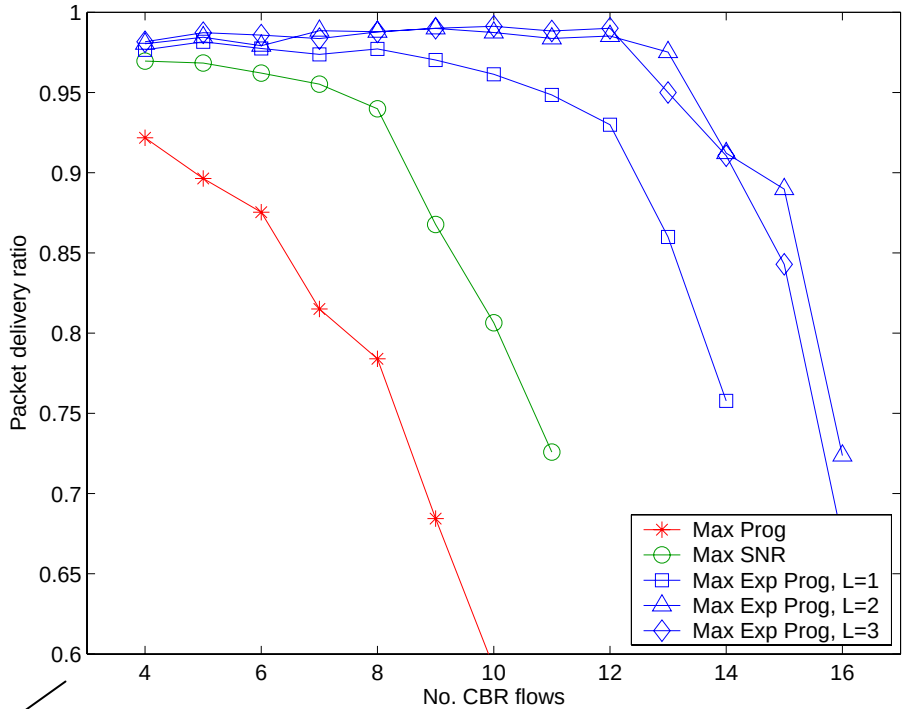
Short-Term Relay Selection

Poll multiple candidate relays with *Multicast* RTS. Transmit to "best" receiver.

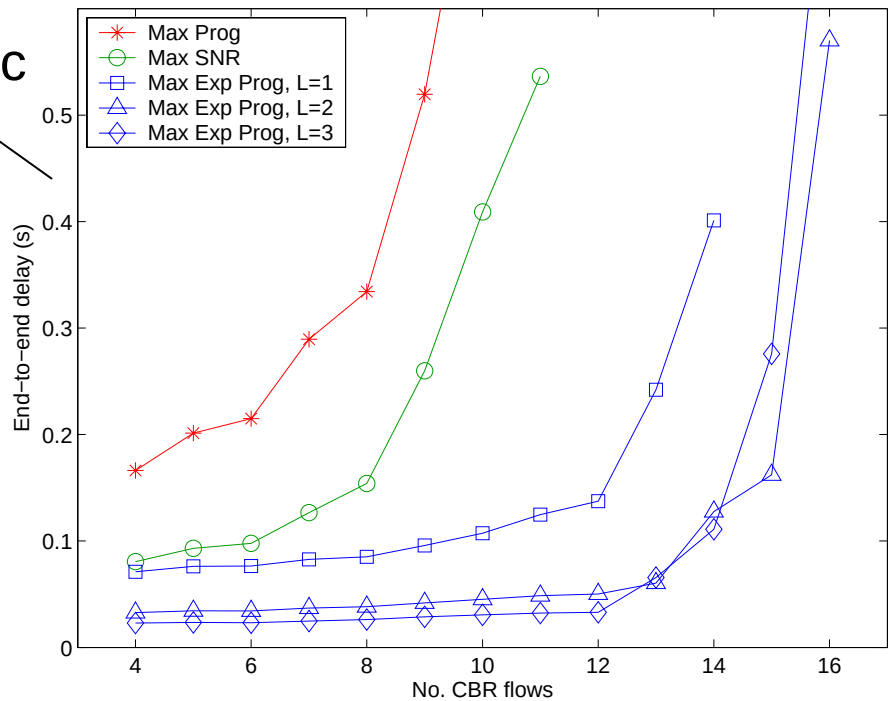








CBR Traffic



Simulation Results

- Obtained via QualNet
- Routing: GPSR
- MAC: IEEE 802.11b