

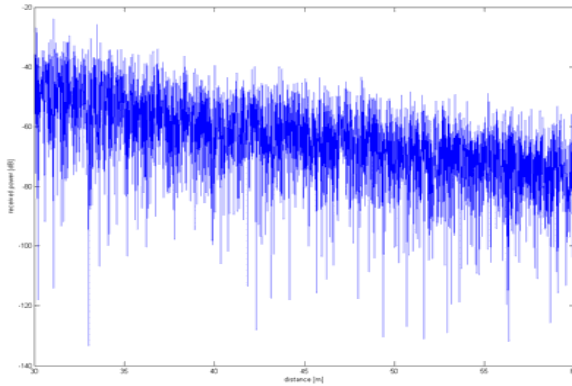


Relay Selection in Cooperative Relaying

ITG 5.2.4 Workshop "Wireless Mesh and Relay Networks"

Helmut Adam
Researcher, Mobile Systems Group

Introduction: Motivation

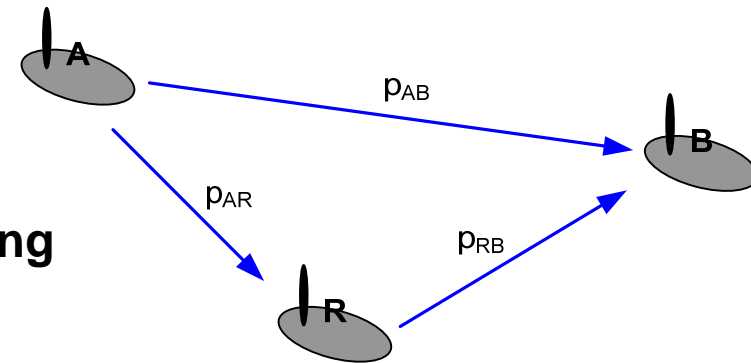


Small Scale Fading

Can be mitigated by:

- Equalization
- Channel coding
- Diversity

Cooperative Relaying



wireless channel = broadcast channel
uncorrelated paths between nodes
no additional hardware needed

Agenda

Basics of Cooperative Relaying

Relay Selection Issues

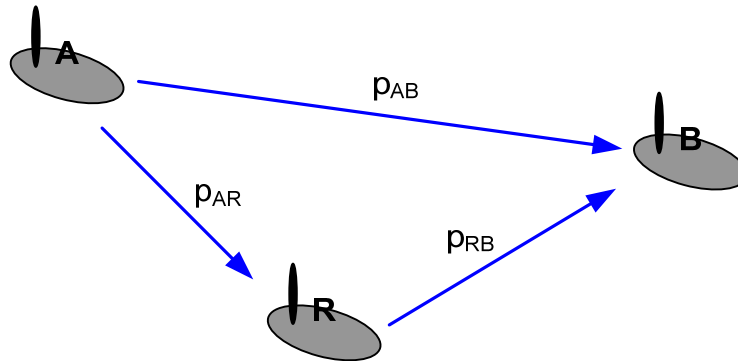
MAC and Cooperative Relaying

Multihop-Aware Relay Selection

Cooperative Relaying @ NES and Lakeside Labs



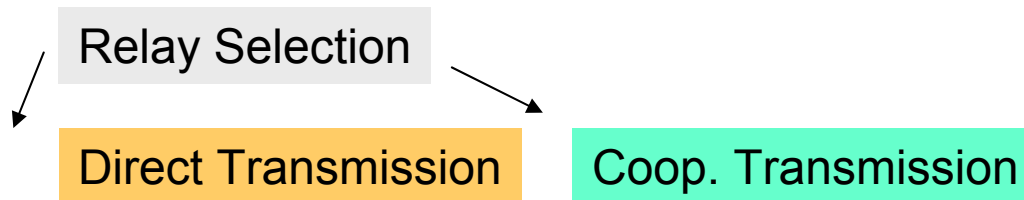
Basics of Cooperative Relaying [1]



Behavior of the relay:

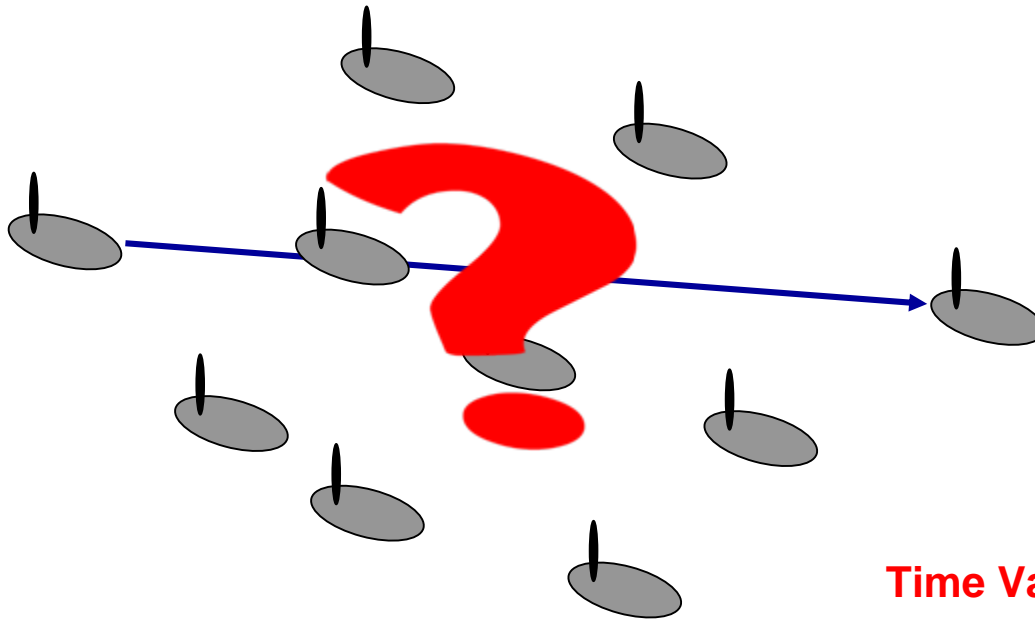
- Amplify & Forward
- Decode & Forward
 - Repetition Coding
 - Different Coding at relay

Cooperative Relaying consists of 3 phases:



Relay Selection Issues

Which node should relay a packet?



Possible Criteria:

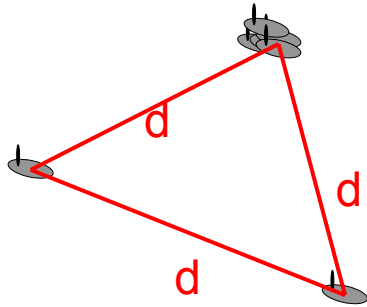
- Distance
- CSI
- Available energy
- Successfully received packet
- max. network throughput
- ...

Time Variant Channel

→ communication overhead

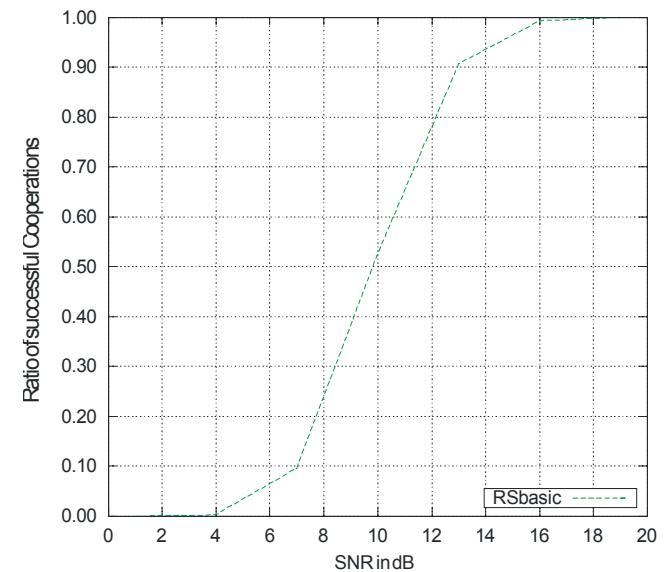
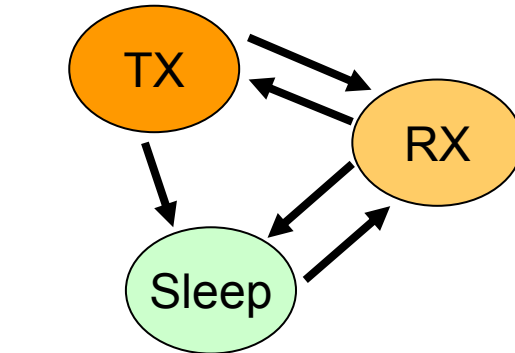
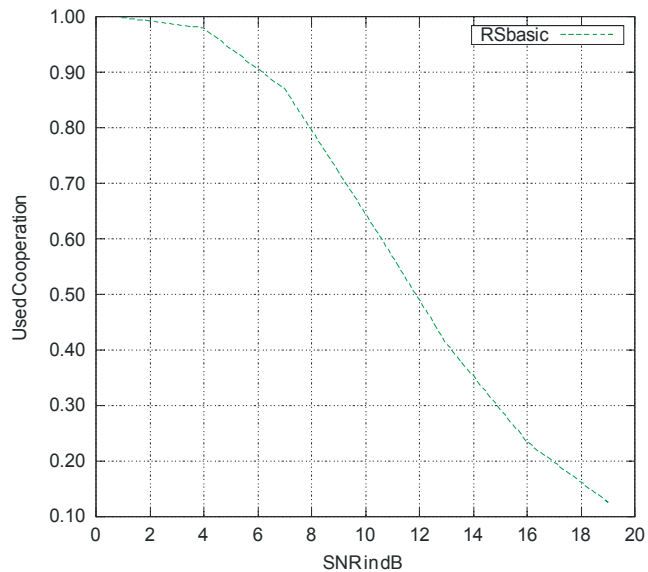
→ coherence time

Energy Consideration

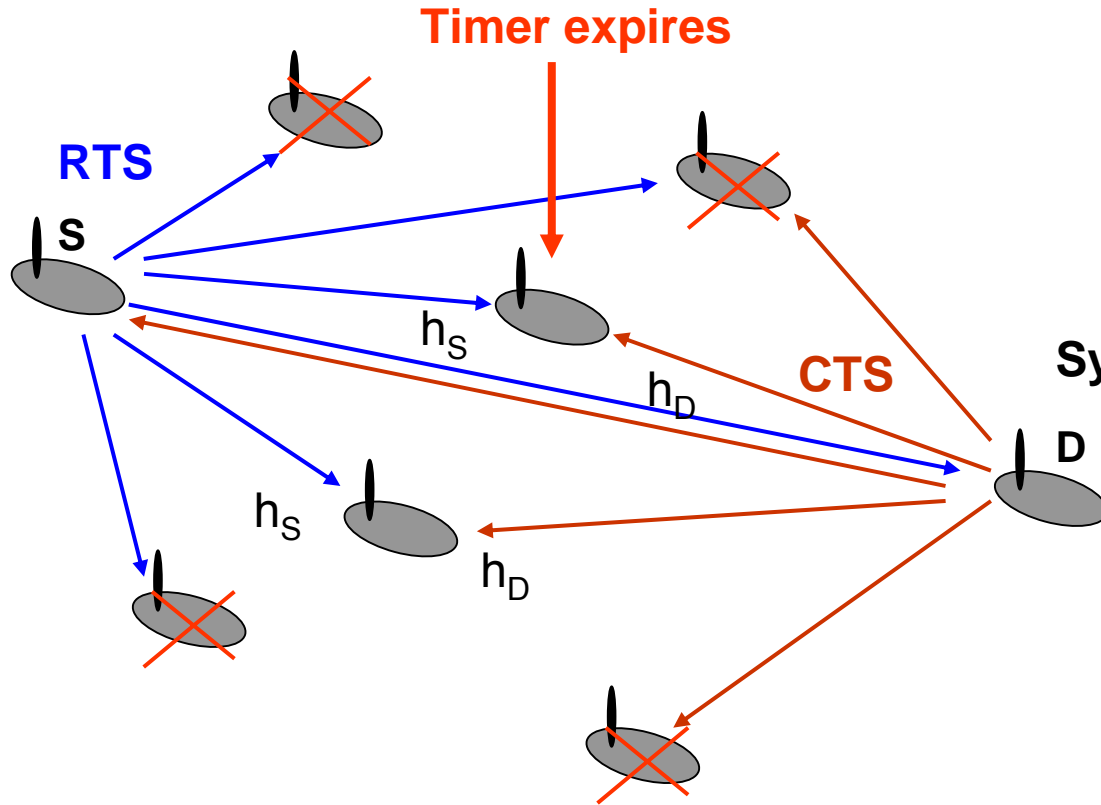


	TX	RX	idle	Sleep
I [mA]	284	190	156	10

Do not neglect the energy for receiving !



Relay Selection on Demand with Early Retreat - RSoDer [3]



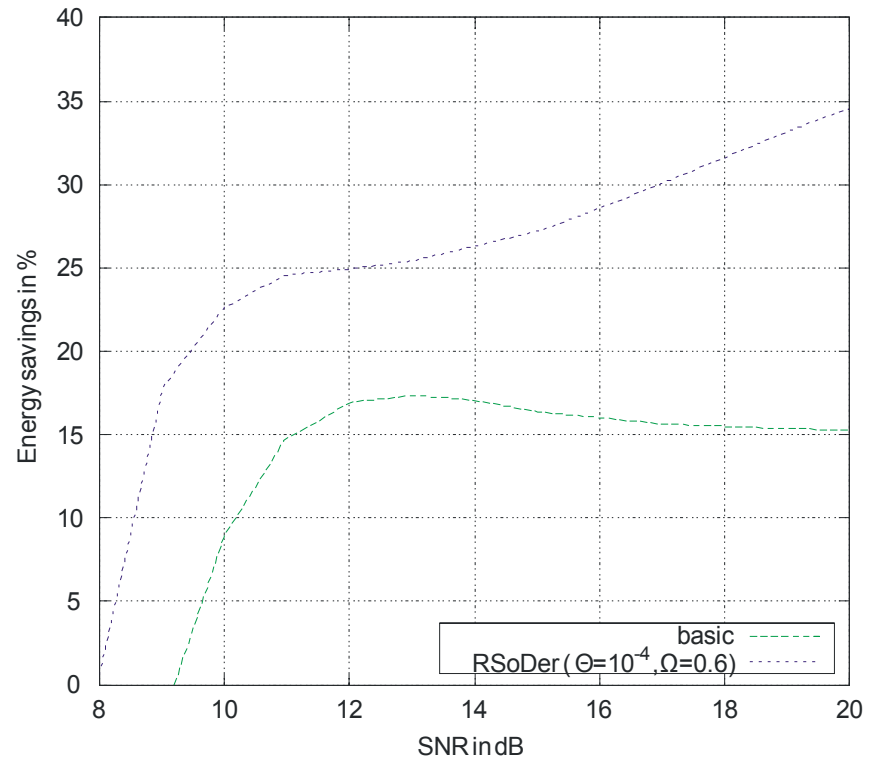
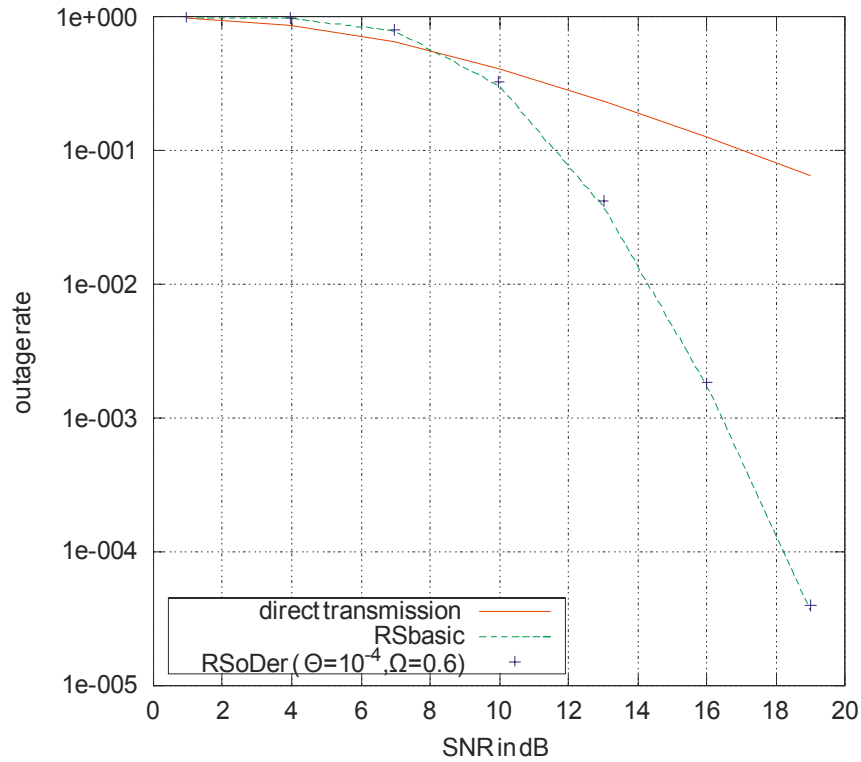
Timer:

$$t_i = \frac{\Lambda}{f(h_s, h_d)}$$

System Packet Error Rate



Outage and energy savings of RsoDer compared to [4]



Layering aspects of Cooperative Relaying

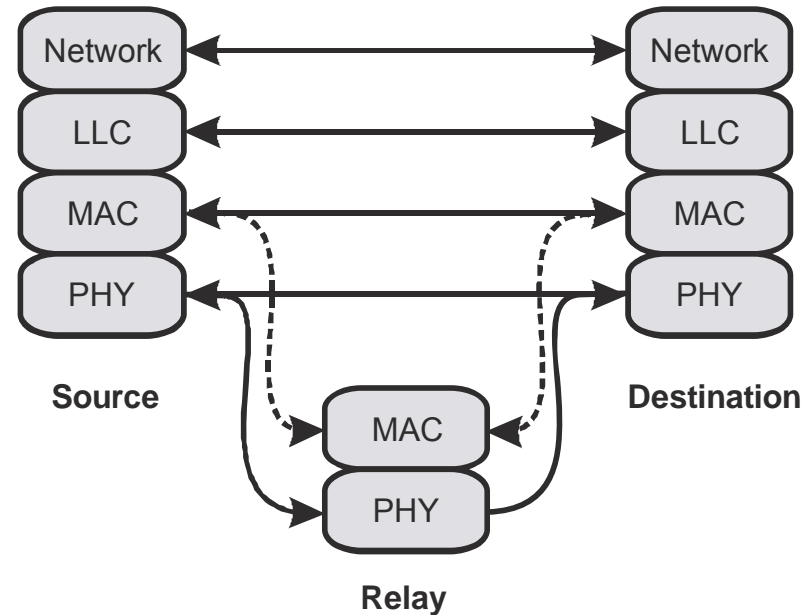
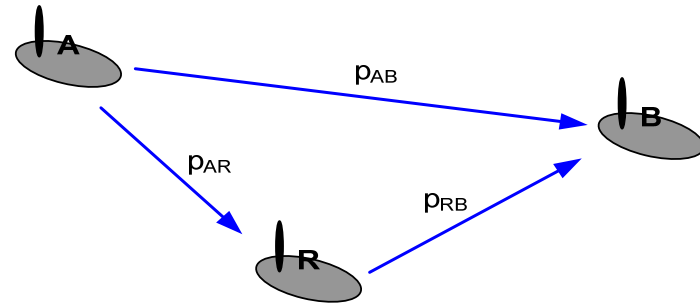
Direct / Coop. Transmission

Relay Selection

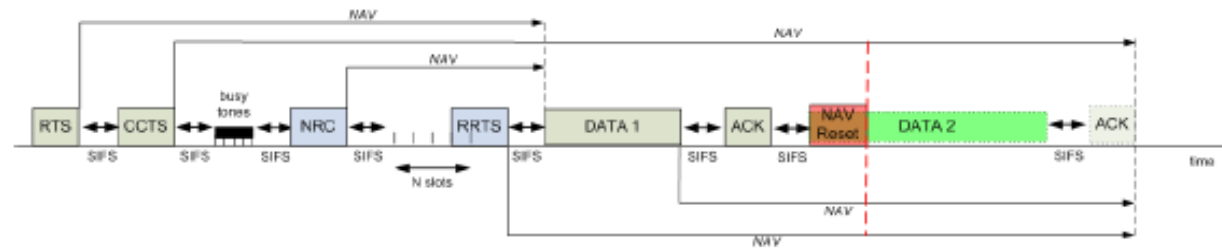
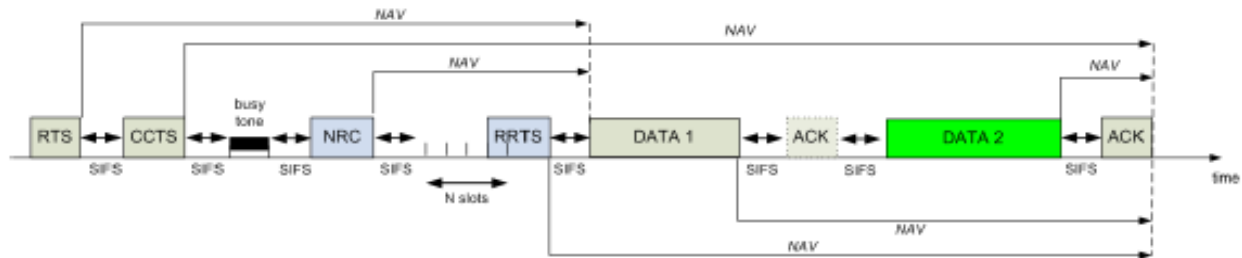
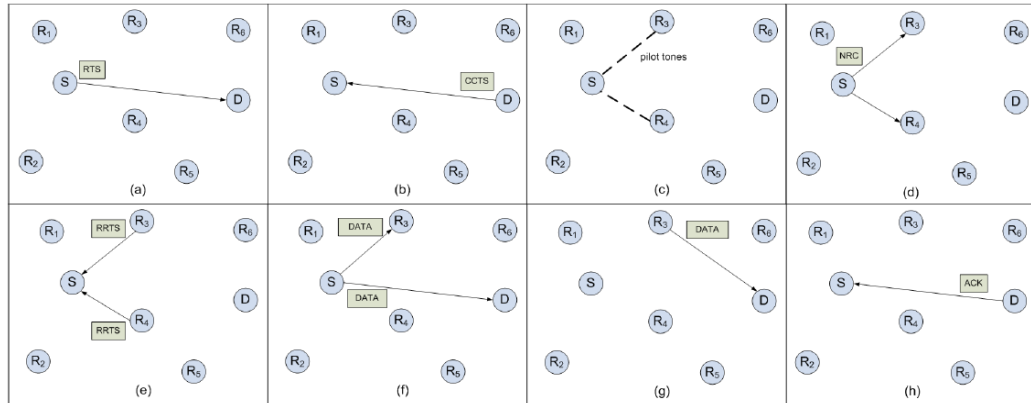
Resource Allocation

Over reservation

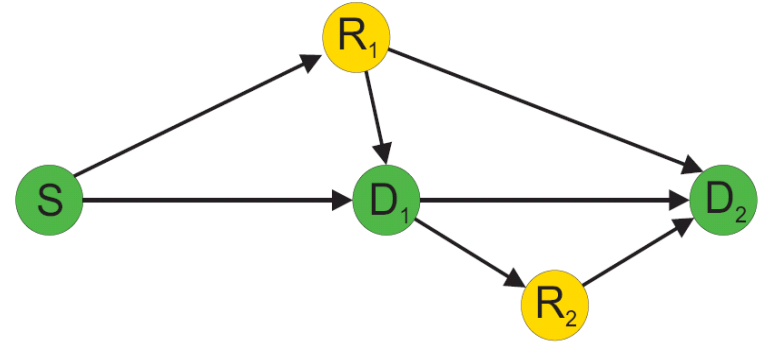
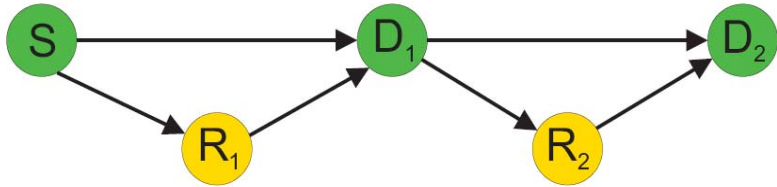
Spatial reusability



Cooperative MAC

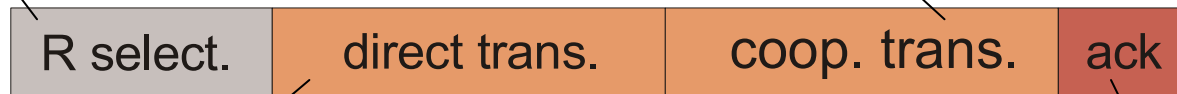


Multihop-Aware Relay Selection [5]



Relays needs to be aware of next hop node

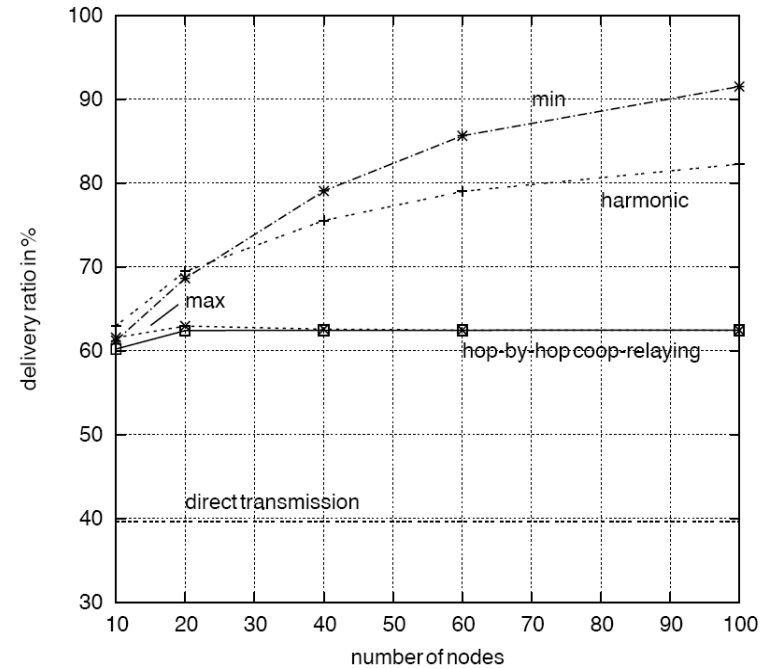
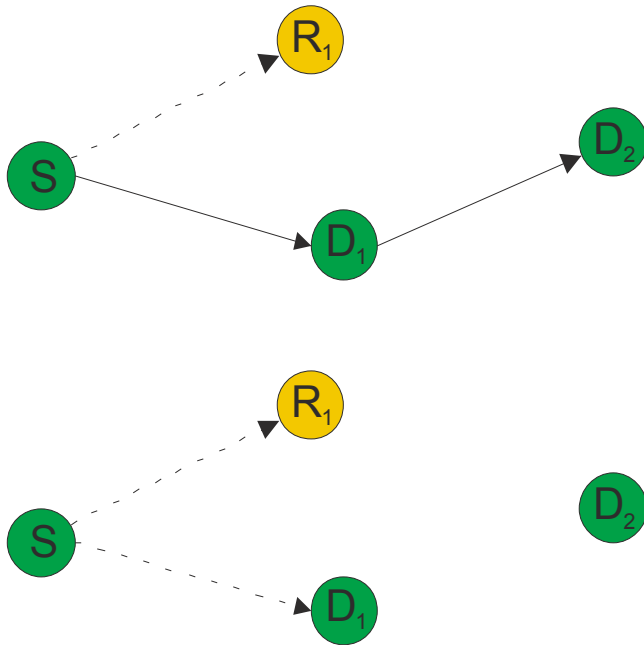
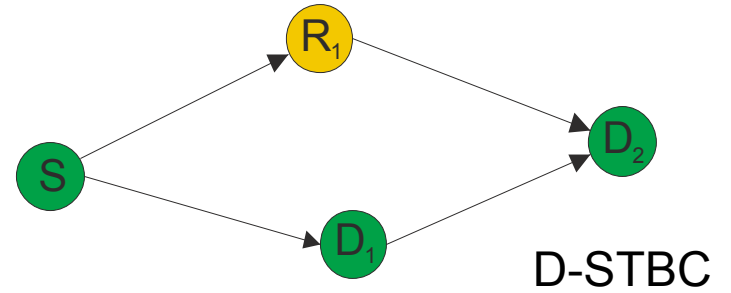
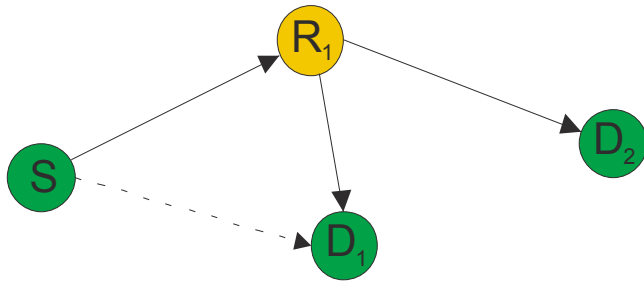
Next hop destination:
tries to decode message
If not successful:
store it as incremental redundancy



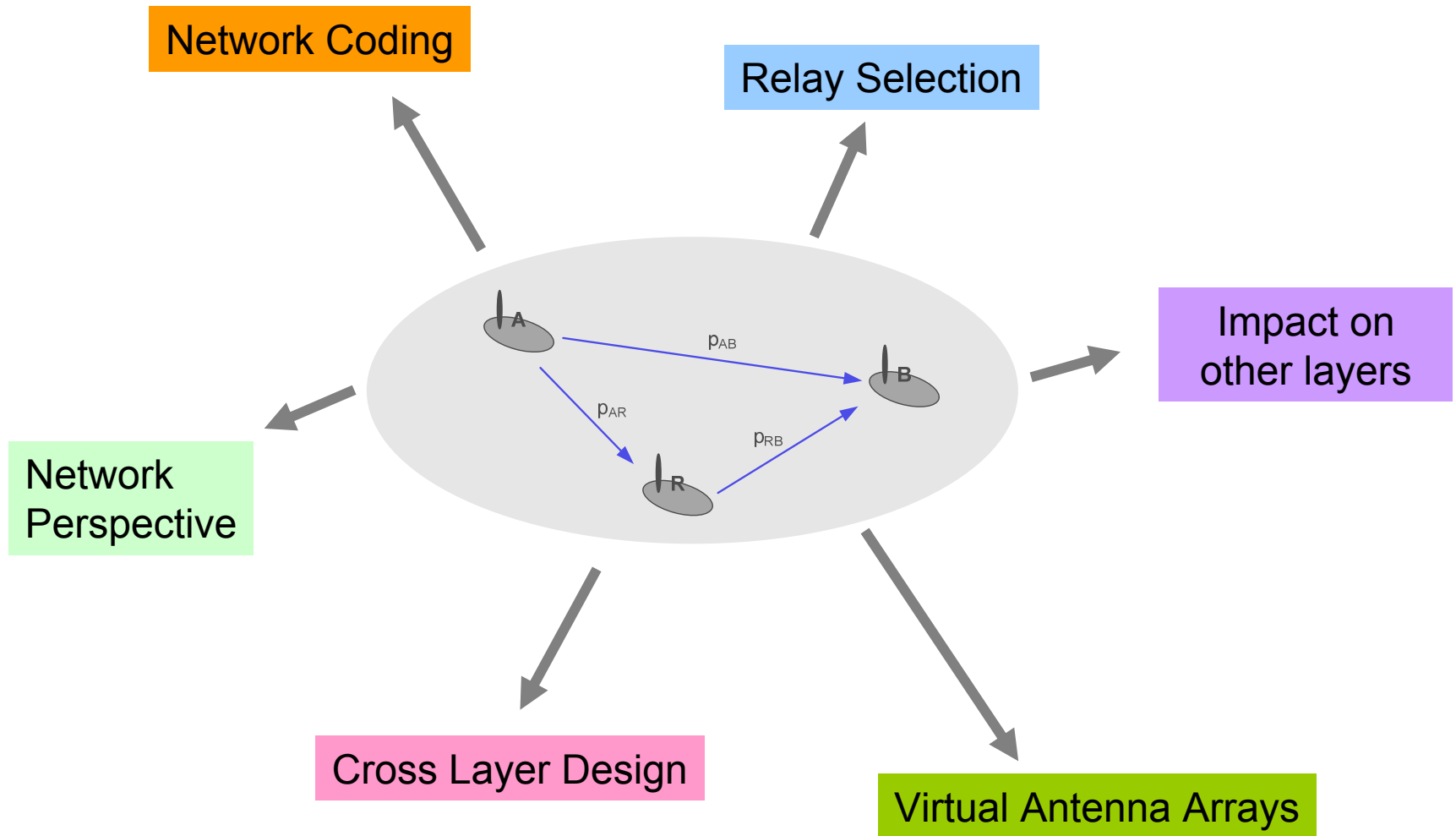
Nothing changes

Source needs to know of the success of the transmission.

Multihop-Aware Relay Selection [5]



Cooperative Relaying @ NES and Lakeside Labs



Conclusion

Cooperative Relaying (mitigates fading effects):

Relay Selection (Energy Considerations)

Layering Aspects

Multi-Hop Aware Cooperative Relaying

Further steps:

MAC protocol for MHA Coop. Relaying

Implementations of Protocols to Hardware



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- [1] W. Elmenreich, N. Marchenko, H. Adam, C. Hofbauer, G. Brandner, C. Bettstetter, M. Huemer, “Building Blocks of Cooperative Relaying in Wireless Systems”, E&I Magazine, Oct. 2008
- [2] L. Feeney and M. Nilsson, “Investigating the energy consumption of a wireless network interface in an ad hoc networking environment”, in Proc. IEEE INFOCOM, Anchorage, AK, April 2001
- [3] H. Adam, C. Bettstetter, S. Senouci, “Adaptive Relay Selection in Cooperative Wireless Networks”, in Proc. IEEE PIMRC, Cannes, France, Sep. 2008
- [4] A. Bletsas, A. Khisti, D. P. Reed, A. Lippman, “A simple Cooperative Diversity Method Based on Network Path Selection”, IEEE Journal on selected areas in Communications, vo. 24, no. 3, Jan. 2006
- [5] H. Adam, C. Bettstetter, S. Senouci, “Multi-Hop-Aware Cooperative Relaying”, submitted to VTC-Fall 2009

