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Channel-Adaptive Frequency-Domain Relay Processing in Multicarrier Multihop Transmission Systems

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Authors

Zhang, Wenyi
Mitra, Urbashi

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Channel-Adaptive Frequency-Domain Relay Processing in Multicarrier Multihop Transmission Systems

Wenyi Zhang and Urbashi Mitra
USC

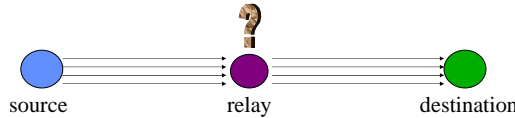
Introduction:

Multihop + Multicarrier

- **Multihop:** Dramatic power-saving by exploiting shorter propagation distances
- **Multicarrier:** Efficient bandwidth utilization
- Potential applications in both sensor networks and **WiMAX**-type of wireless networks

Intelligent signal processing at relay

- **Relay adopts symbol-by-symbol processing w/o coding**
 - Potential advantage in terms of *latency*
 - Adaptively optimized to exploit *diversity* in channel frequency responses



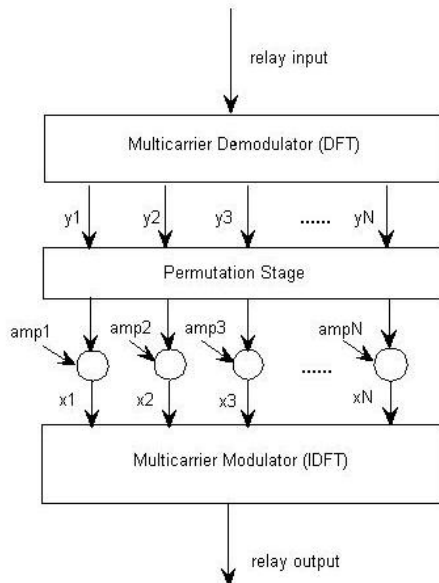
Problem Description:

How to design the relay given a multihop topology?

- Need to design power allocation scheme at both source and relay
 - Need to design permutation pattern of sub-carriers at relay
 - A non-convex + combinatorial optimization problem
 - Exact optimal solution difficult to obtain

Proposed Solution:

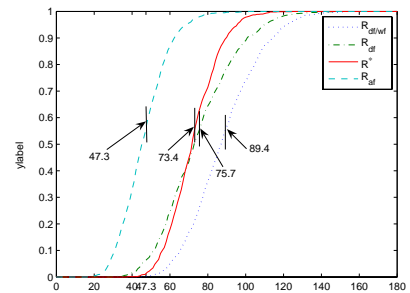
Heuristic Solution: Greedy Scheme



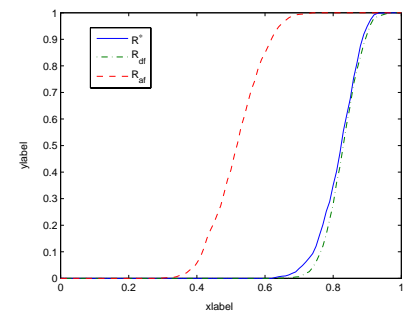
Numerical Results

- Substantially **outperforms** “dumb” amplify-and-forward
- **Comparable** with decode-and-forward without adaptive power allocation
- **Acceptable gap** to decode-and-forward with adaptive power allocation (optimal scheme achieving capacity)

Empirical CDF of rates:



Empirical CDF of percentage relative to decode-and-forward (capacity):



- Water-filling for source-relay and relay-destination links, separately
- Rank end-to-end sub-carriers at relay according to channel gains
- Permutation pattern follows sub-carrier rankings

Simulation parameters: Number of sub-carriers = 128,

Source average power = 256 (w.r.t. noise var)

Relay average power = 128 (w.r.t. noise var)