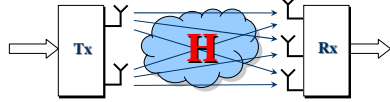


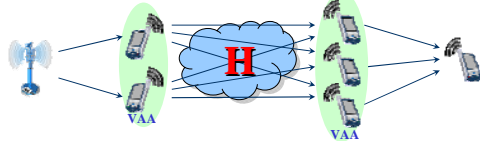
Relaying and Cooperative Communications

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Motivation



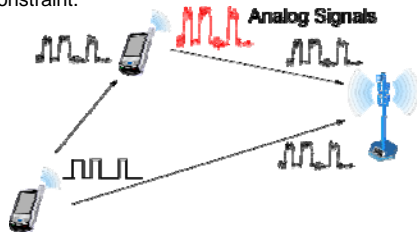
- Multiple-Input Multiple Output (**MIMO**) system
 - Advantages: high data rate, high diversity degrees → reliable communications.
 - Disadvantages: difficult to implement for a small mobile equipment.



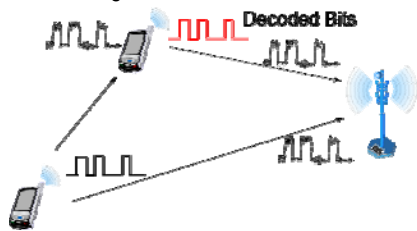
- Option: Virtual Antenna Array (**VAA**) → Distributed MIMO
 - Some spatially separated relaying nodes (e.g., mobile phone) are formed into virtual antenna arrays (VAAs).
 - Two VAAs can be further composed to a distributed MIMO system.
 - Some capacity enhancement techniques like Space-Time Codes can be applied to improve the performance of the end-to-end communication.

Relaying Protocols

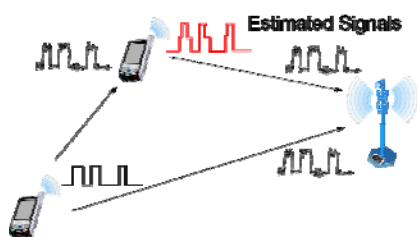
- Amplify-and-Forward (**A&F**)
 - Relays simply amplify the received signal subject to their power constraint.



- Decode-and-Forward (**D&F**)
 - Relays decode their received signals, re-encode the information and transmit the signals to the destination or other relays.

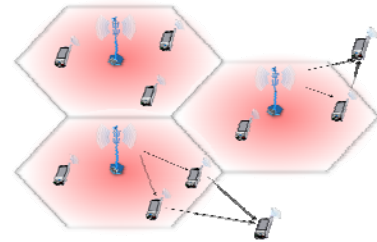


- Estimate-and-Forward (**E&F**)
 - Relays quantize (estimate) their received signals, and send them to the destination or other relays.



Applications

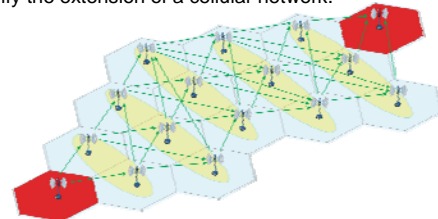
- 3G/4G Cellular Coverage & Capacity Extension
 - Extend the coverage area of a cellular network
 - Improve the performance of handovers
 - Reduces the number of new cells



- In-Home Broadband Access
 - Provide high-speed connections and link stability to residential areas via roof-top relaying systems.



- Wireless Backhaul Networks (Distributed MIMO multi-hop)
 - Allow high data rate connections between the base-stations without additional hardware, e.g., microwave equipment or optical fiber.
 - Simplify the extension of a cellular network.



Performance

- Cooperative transmission scheme (distributed MIMO multi-hop) outperforms the traditional SISO multi-hop system significantly, i.e., ca. 80% power reduction.

