Let there be light

University of Victoria

Network Coding Schemes for Wireless Communications

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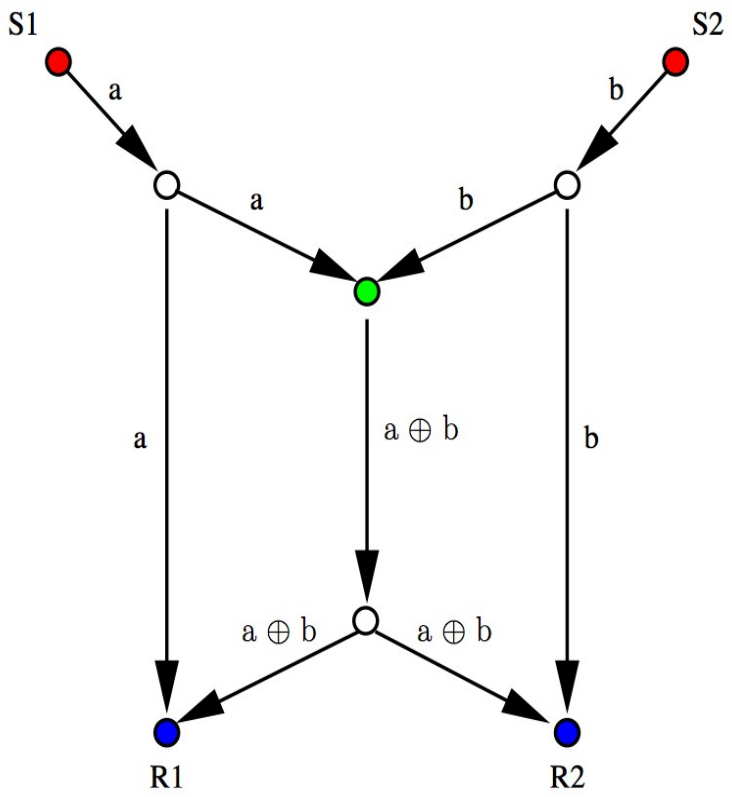
What is Network Coding and why do we do that?

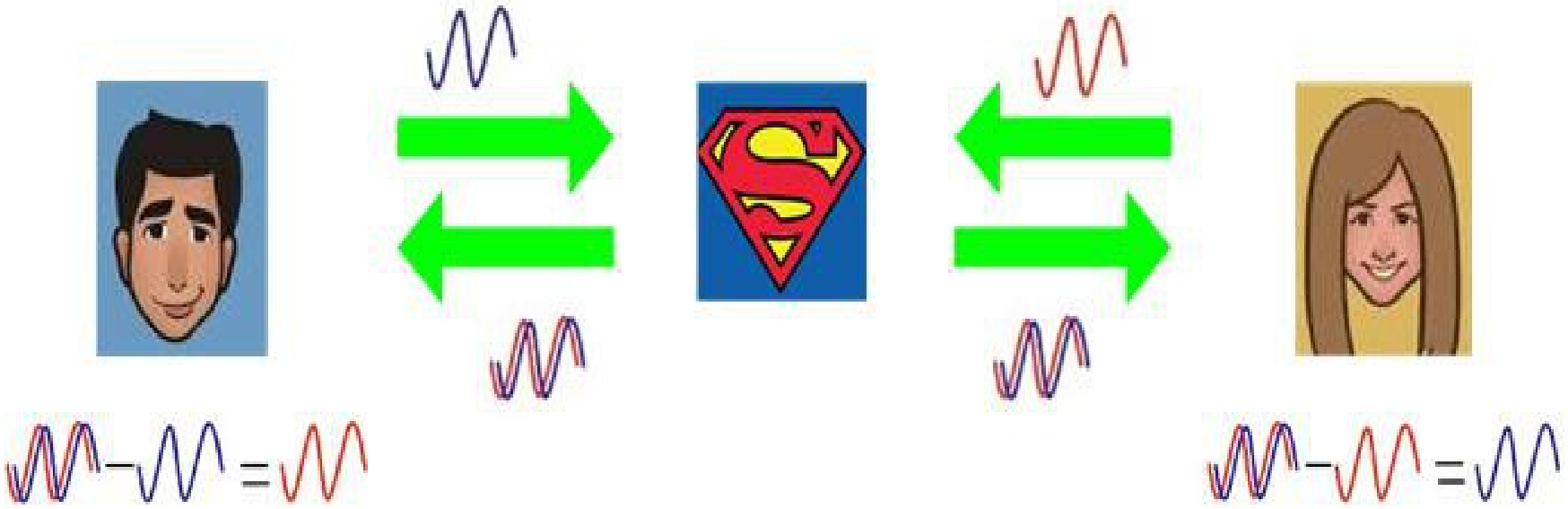
- The network coding approach allows the intermediate nodes to generate new packets by combining the packets



Benefits

- Increasing in **throughput**
- Improvement in **reliability and robustness** of the network
- Reducing the **energy** consumption.
- In wireless communication system especially relay-aided network, network coding can improve the **BER performance** as well

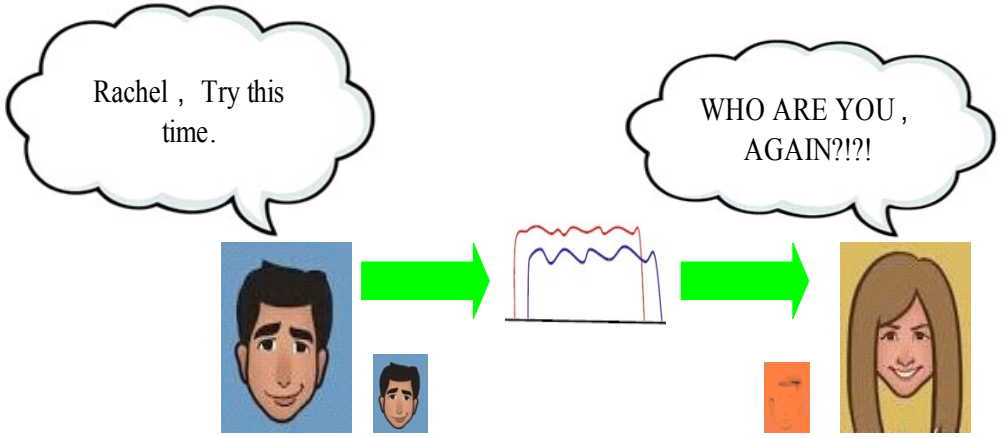
ANC : much more than going from four to two

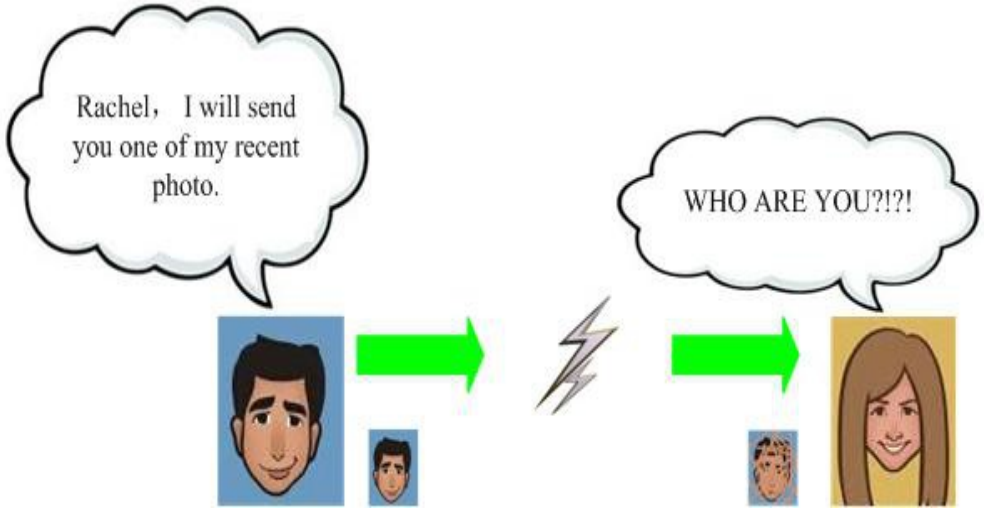


- Reducing the communication time from 4 slots to 2 slots
- Strategically exploit interference instead of avoiding it

Practical Challenge: Things never go as expected

- The relay nodes just amplified everything it received including the signals, the noise and effects of the channel





- Signals never synchronized to each other
- Instead of

$$S_S(t) + S_D(t)$$

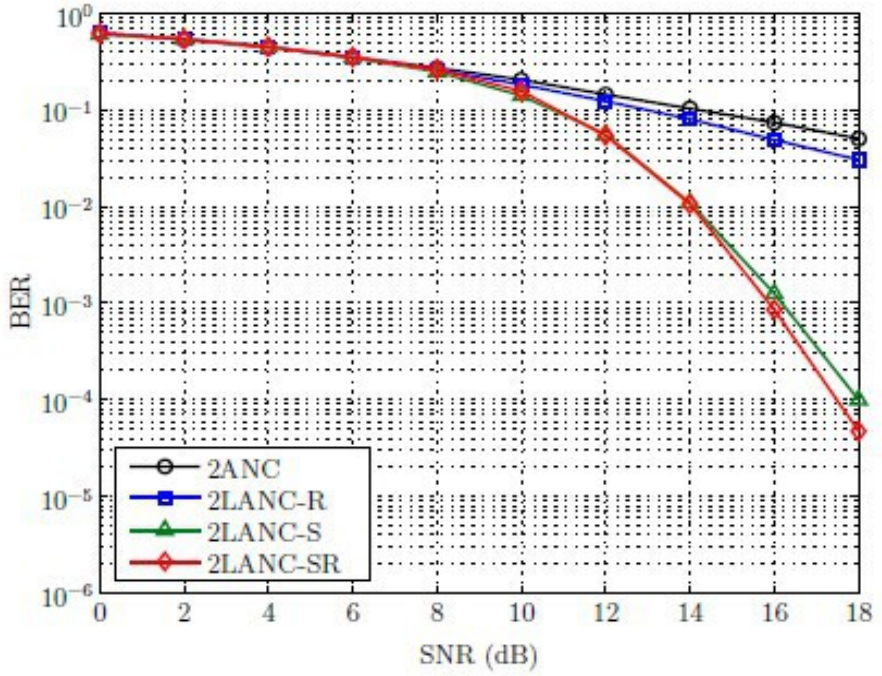
- It is more like:

$$F[S_S(t-\tau_1)] + G[S_D(t-\tau_2)]$$

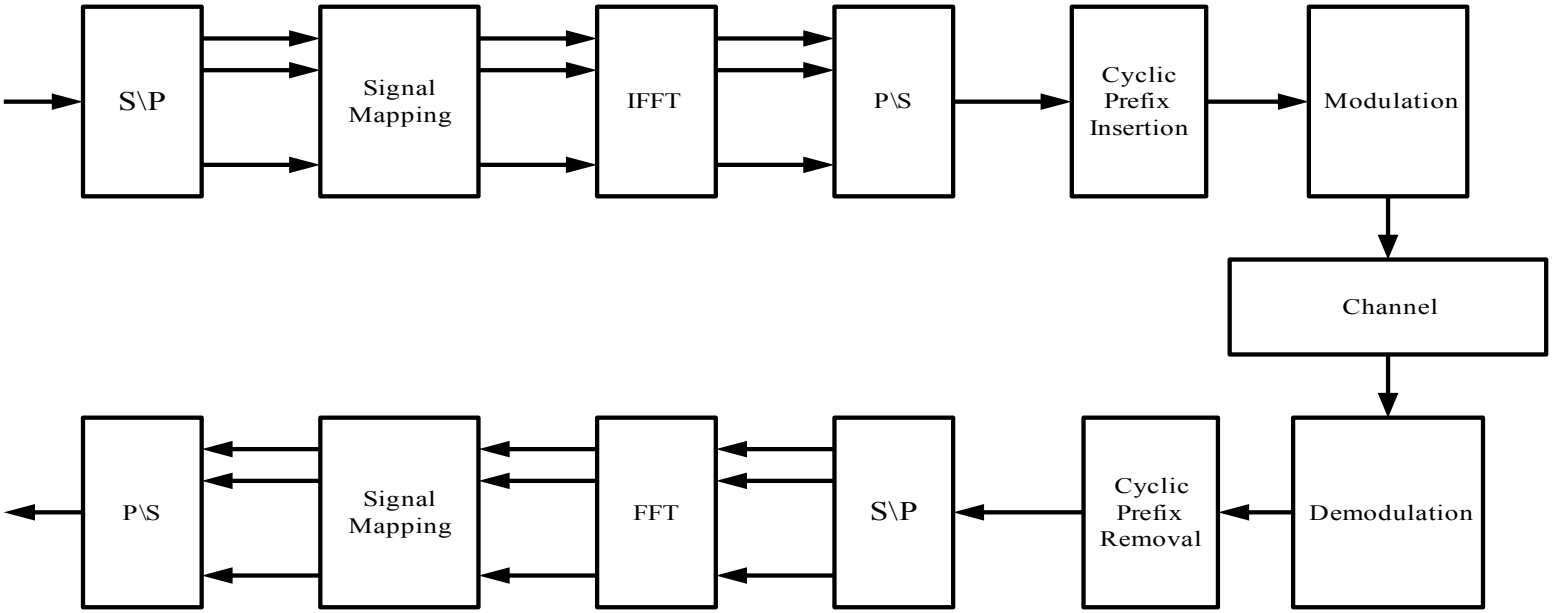
Motivation: Can we do something?

- It is very interesting to combine the forces of **ANC (Analog Network Coding)** and **OFDM.** In fact, the reason why OFDM was chosen as a signaling method is because the coding ideas in the new schemes exploit the **frequency diversity** offered by OFDM

- Introducing **linear-pre-coding** at the transmitter, the relay station, both transmitter and relay-station, which is so called **LANC-S**, **LANC-R**, **LANC-SR**, could help the system improve the BER performance



OFDM: More than coffee-mate

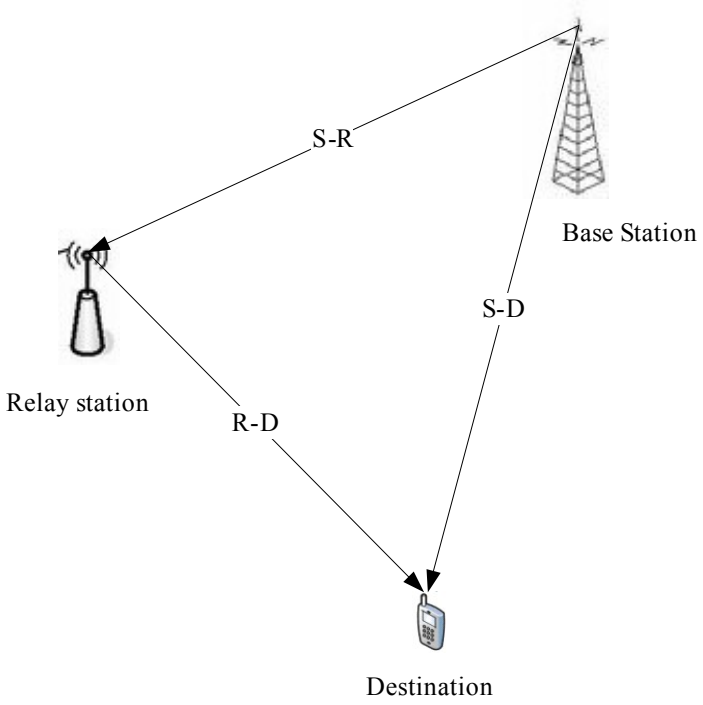


- Resisting multi-path fading
- More efficient frequency utilization
- High data throughput

OFDM: Are you the right guy for ANC?

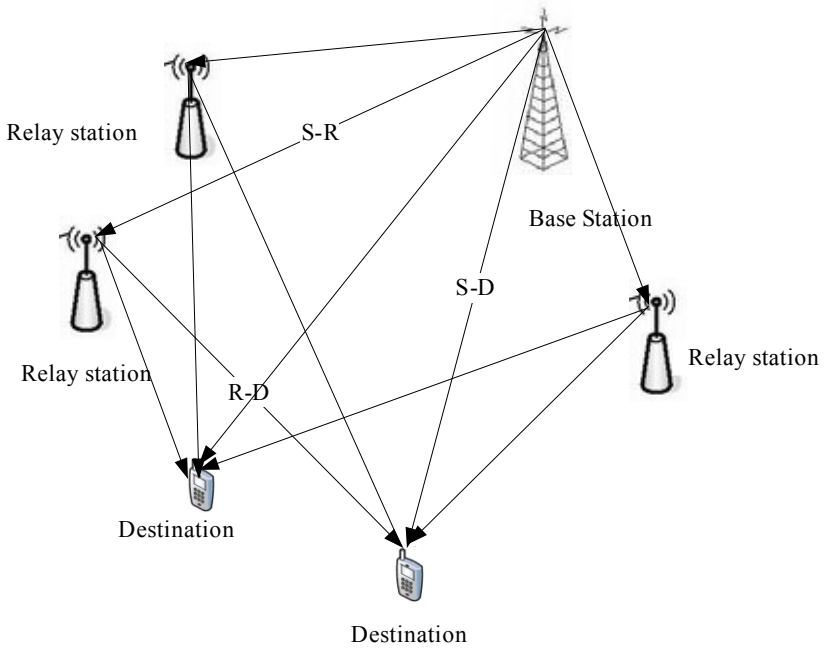
- Some works on pre-transformed OFDM, which is applicable to the new linearly coded ANC schemes being studied

- Dual-hop OFDM ANC shows its potential advantages in both BER performance, high data throughput and low-complexity implementation



MIMO: Dual-hop is not enough

- The advantage of MIMO-OFDM systems is that, on top of the frequency diversity offered by OFDM, the MIMO topology also provides **spatial diversity**, which can potentially further enhance the system's performance



Reference

- [1] Sachin Katti, Shyamnath Gollakota, and Dina Katabi. Embracing wireless interference: Analog network coding. In *Proceedings of the ACM Special Interest Group on Data Communications*, pages 397–408, Kyoto, Japan, August 2007.
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