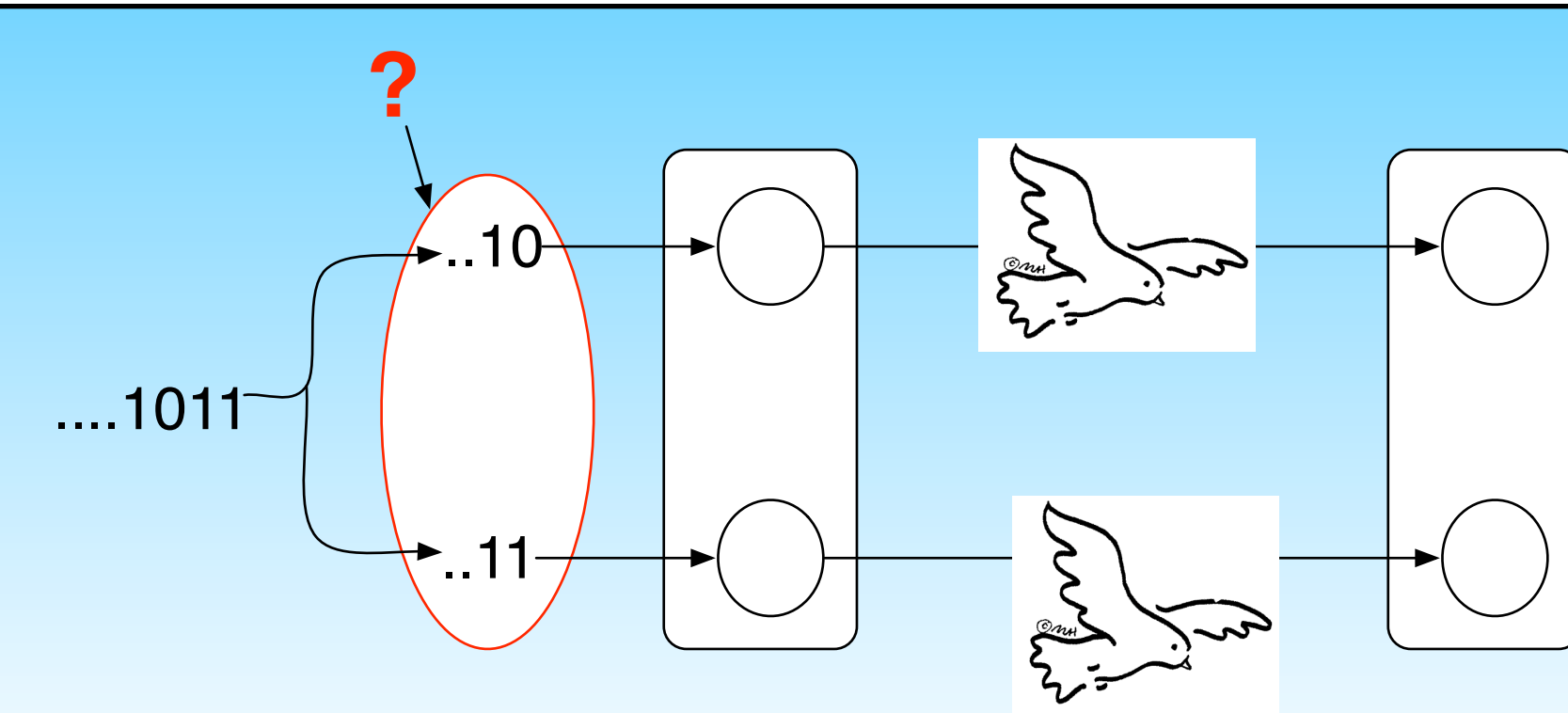




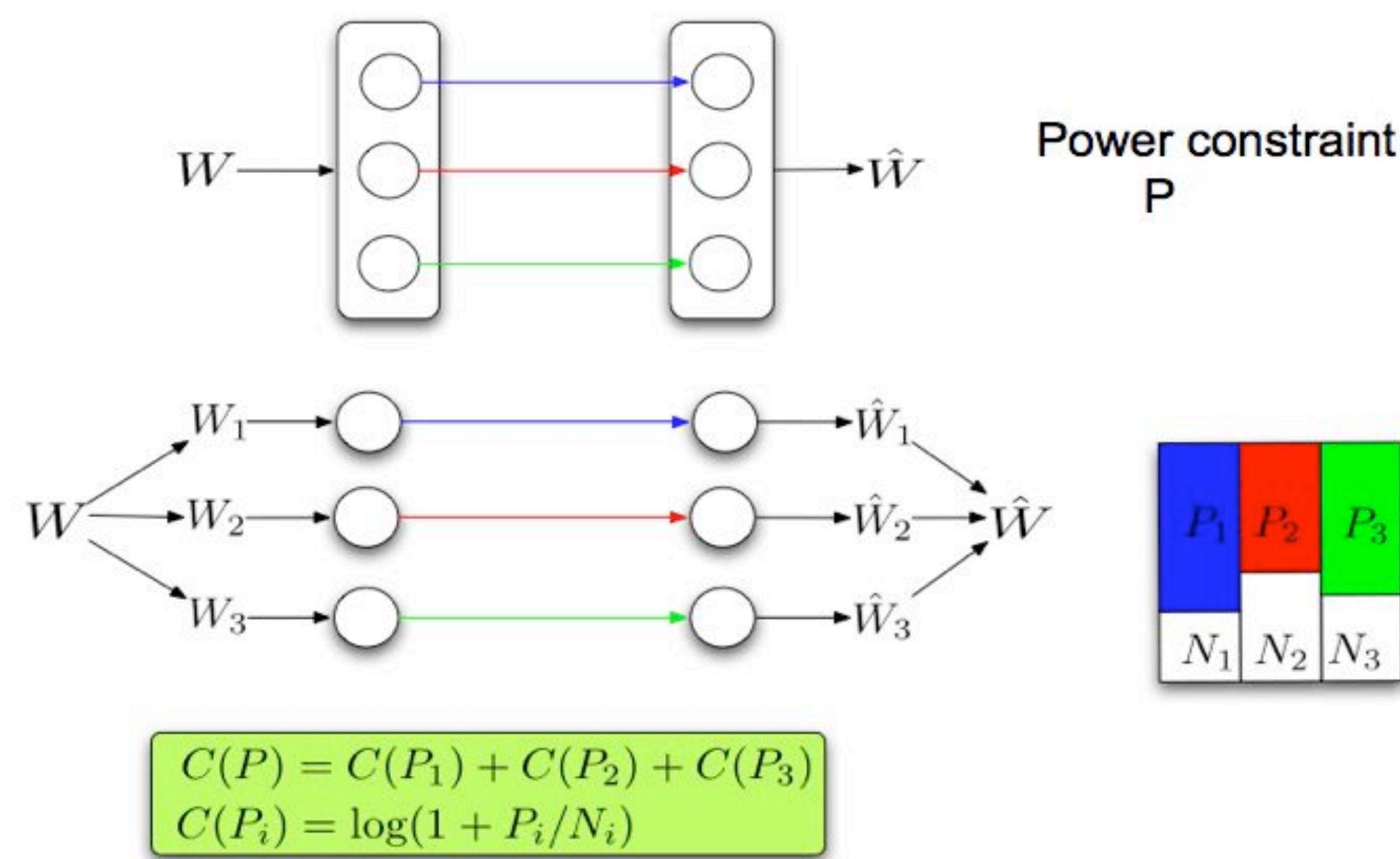
When is Separate Coding Optimal in Parallel Wireless Networks?

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The idea of Separate Coding

The parallel point-to-point channel is **separable**



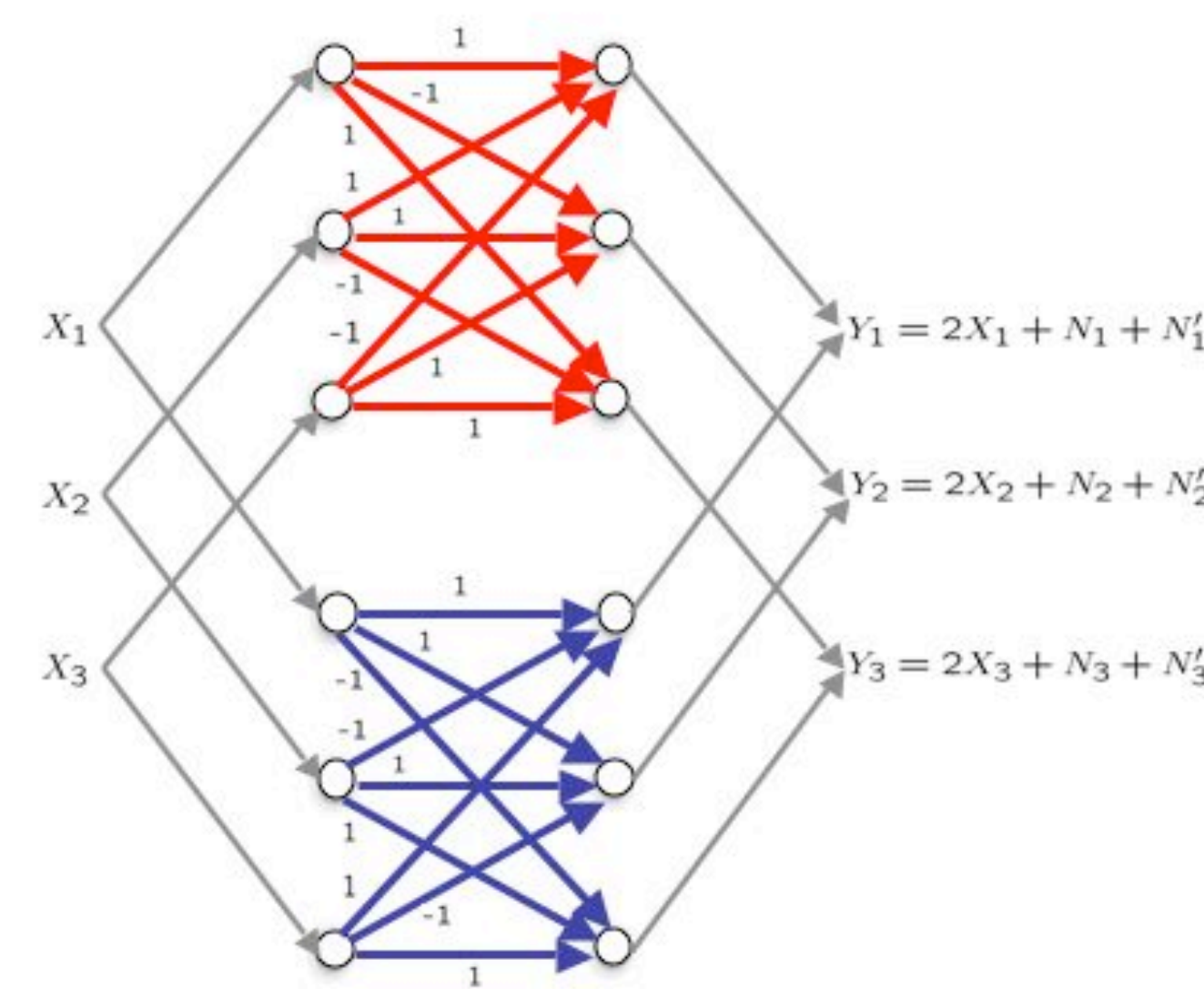
Parallel Multiple Access (MAC) and Broadcast (BC) channels are separable

- Any number of users.
- Any number of antennas at each user.

Interference Channels are NOT Separable!

Inseparability of 3 user interference channel

[Cadambe, Jafar 08]

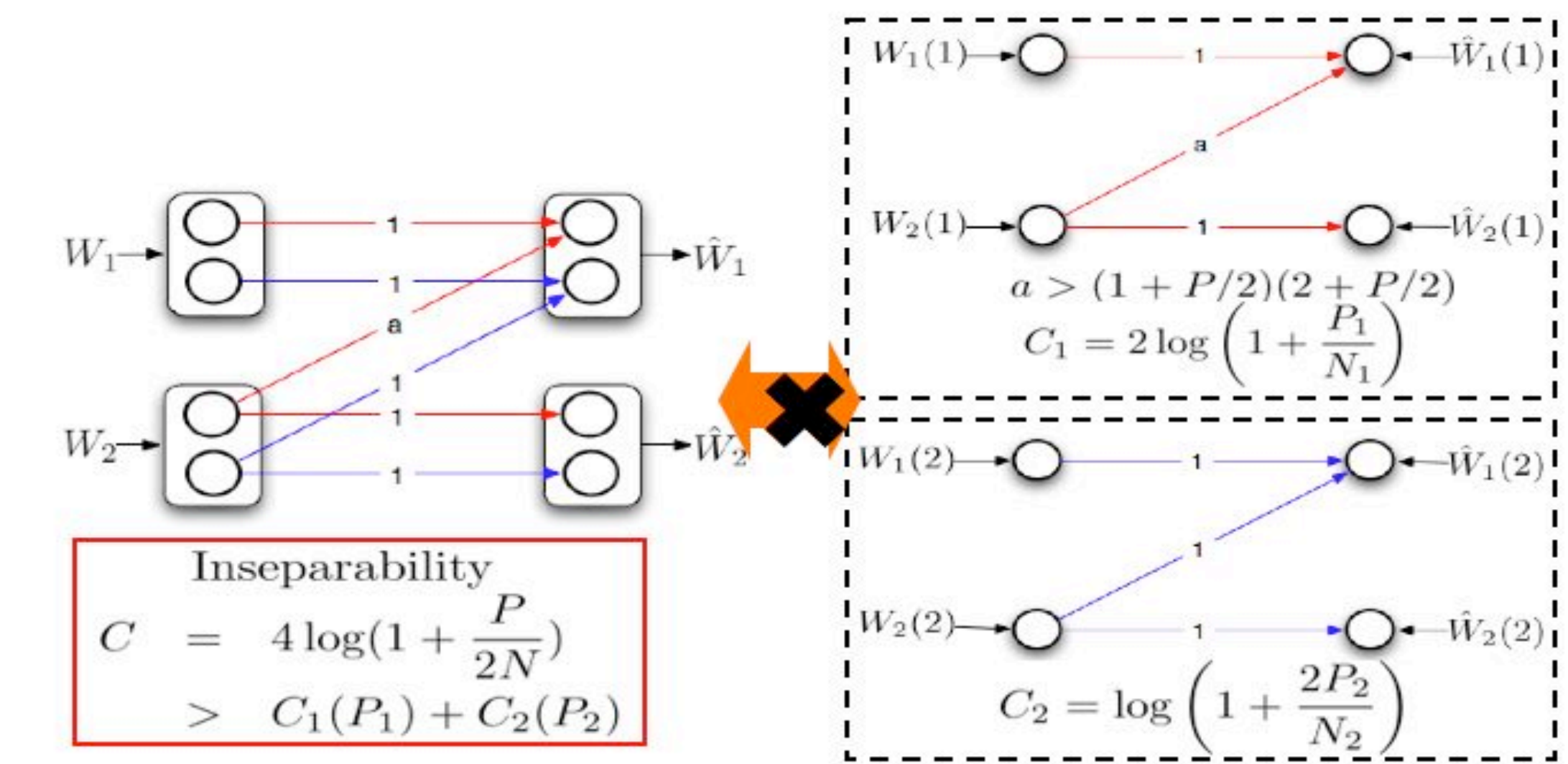


Cause of Inseparability

Joint coding (via beamforming) enables interference alignment, whereas separate coding does not.

Inseparability of 2 user interference channel

[Sankar, Shang, Erkip, Poor 08]

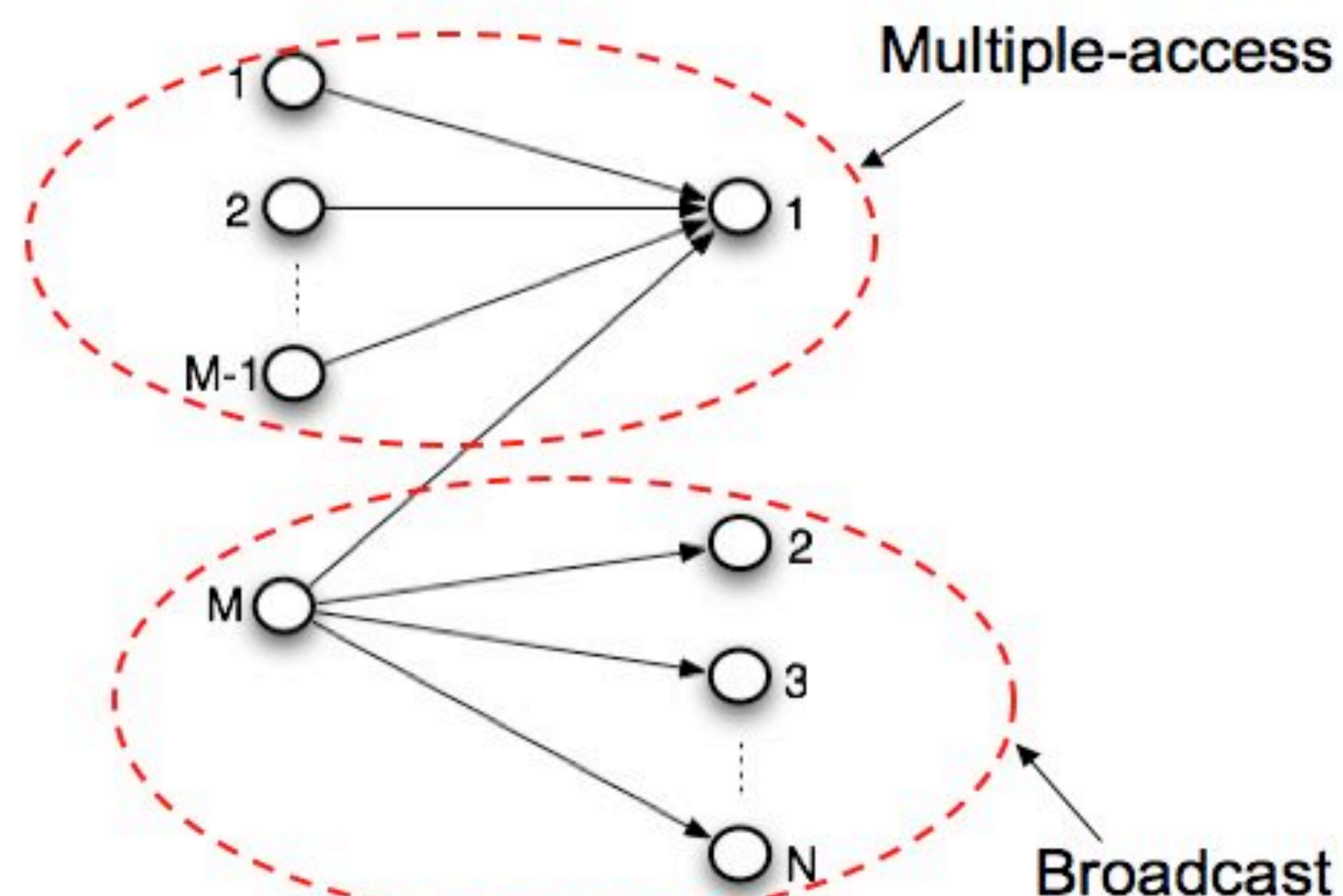


Cause of Inseparability

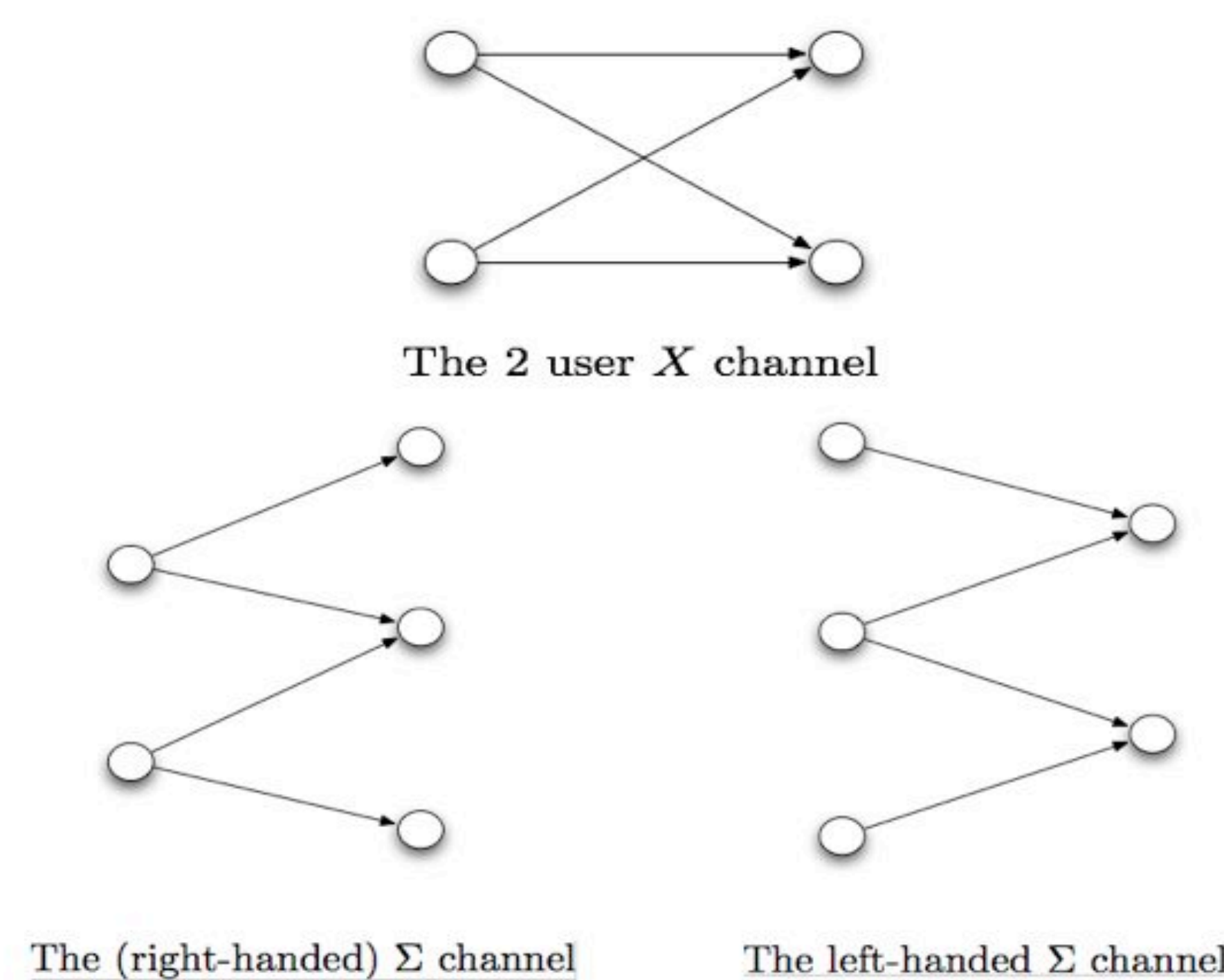
- Interfering link is weak in certain carriers,
- But very strong, if viewed jointly.
- Joint coding enables better interference cancellation

Main Result : Which single-hop wireless networks are separable, sum-capacity wise?

MAC-BC Z : The only separable wireless network

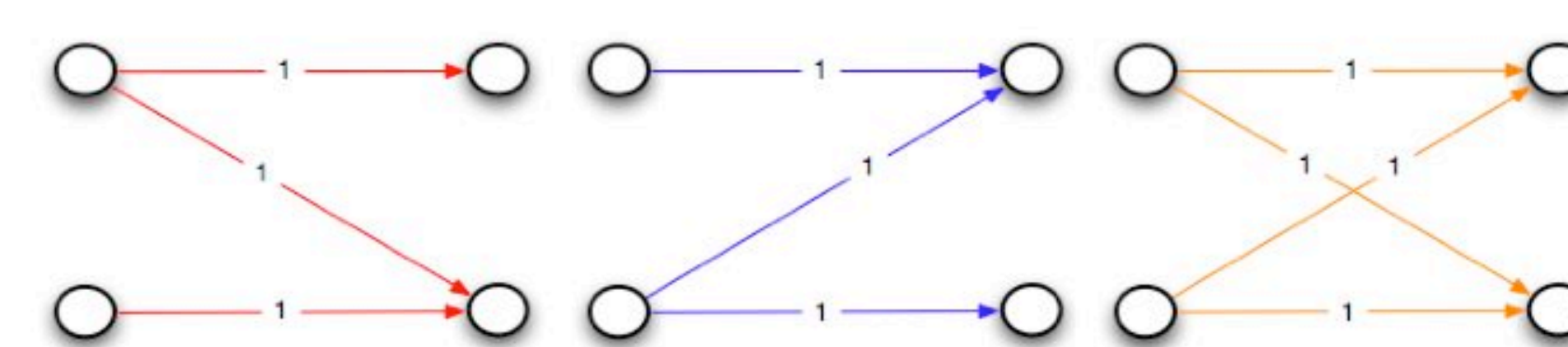


Inseparable Components of Inseparable Wireless Networks



Example : The X channel is inseparable

Separate coding achieves 3 degrees of freedom
Joint coding achieves 4 degrees of freedom using alignment



Cause of Inseparability

Joint coding (via beamforming) enables interference alignment, whereas separate coding does not.

Conclusions

The MAC-BC Z network is the only separable single-hop wireless network, from a sum-capacity perspective.

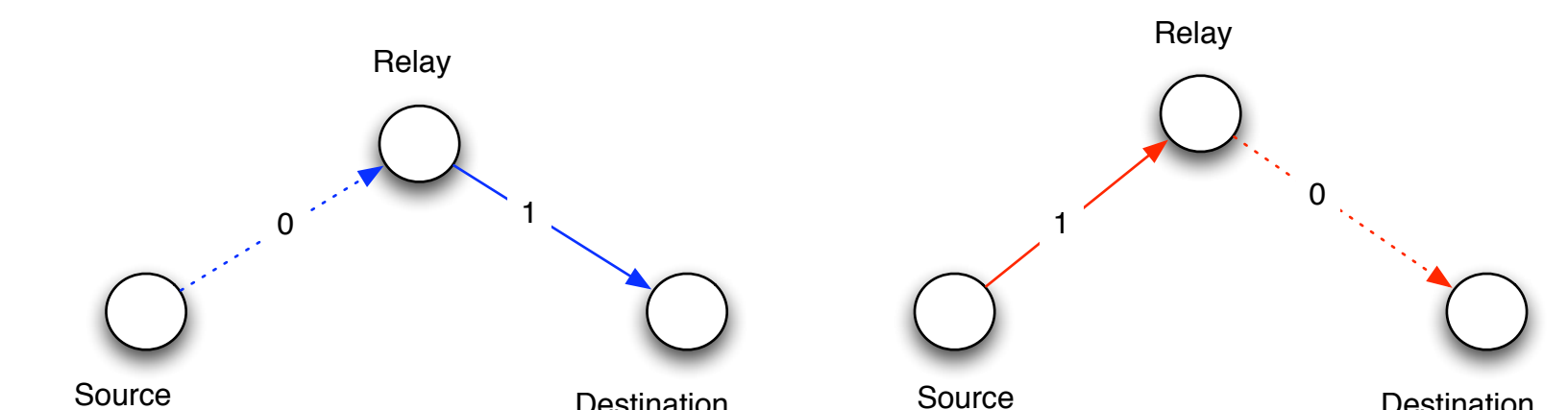
Wireless Networks are inseparable if :

- The network allows interference alignment.
- The reciprocal network allows interference alignment.

Inseparability Examples

- Alignment infeasible with separate coding, but enabled by joint coding.
- Joint coding enables interference dispersion and better interference cancellation.

Future Work : Multi-hop Networks



Inseparability of Relay Networks.

- Communication impossible with Separate Coding (zero rate).
- Communication possible with Joint Coding (non-zero rate).

What about other multi-hop networks?