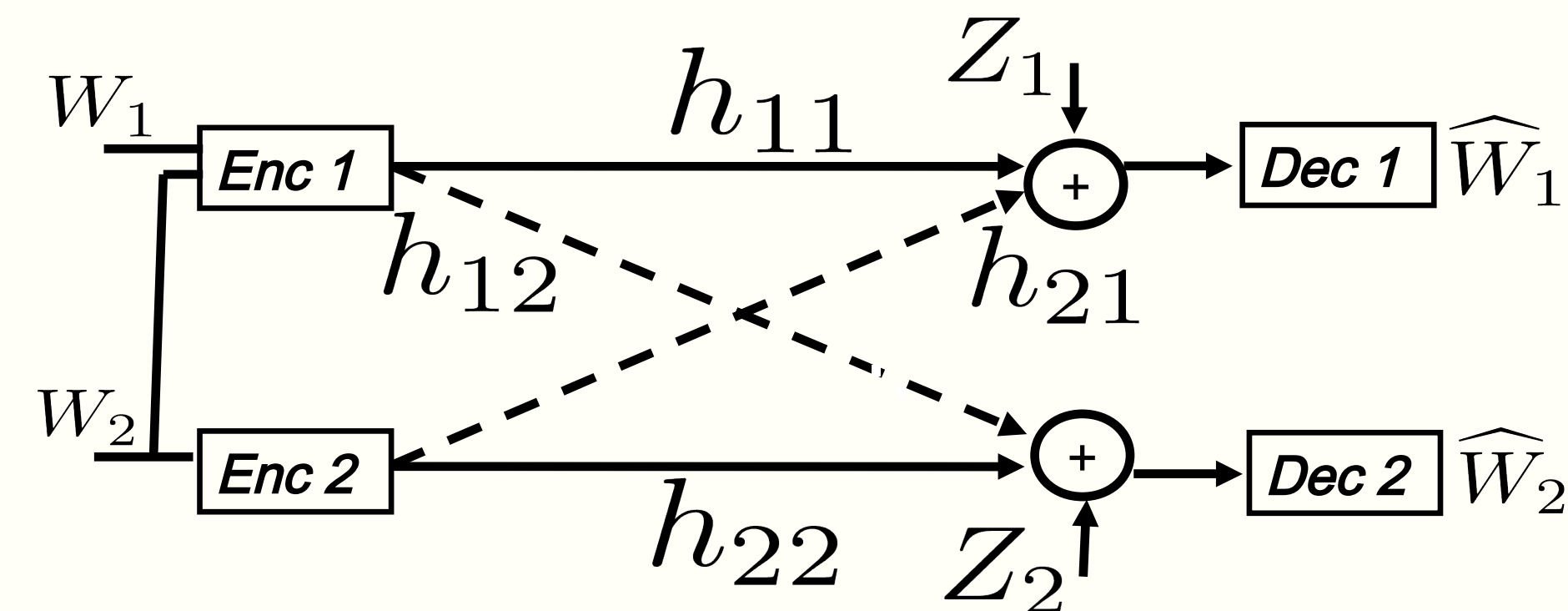


High SNR approximation of Gaussian Cognitive Interference Channels

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The Gaussian Cognitive Interference Channel (GCIFC):



Some usual assumption:

- independent messages
- White Gaussian noise

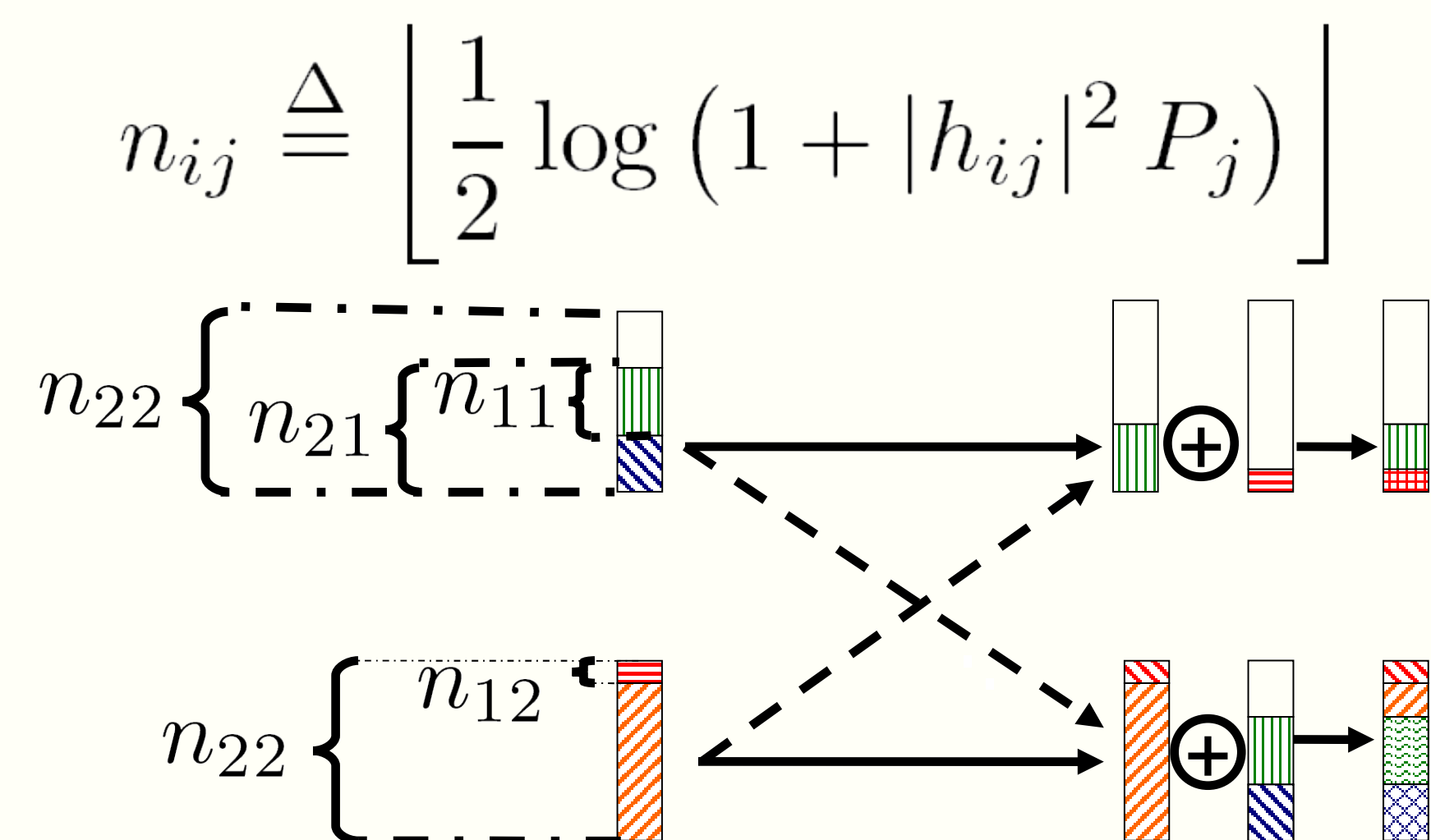
...plus cognition:

- Enc. 1 knows the message of the second transmitter

Cognition models a smart wireless device that is the secondary user of a given radio frequency:

High SNR Deterministic Approximation

We approximate this channel with a simple binary deterministic channel .



This approximation is valid for very high SNR, where the effect of the noise can be neglected.

Capacity Results

- Capacity is known for the weak interference case, that is when INR at receiver two is less than 1. This result was proved in:

W. Wu, S. Vishwanath, and A. Aripostathis.
On the capacity of interference channel with degraded message sets

- Capacity is also known for the very strong interference case, a subset of the case where INR at receiver two is greater than 1.

I. Maric, R.D. Yates, and G. Kramer.
The capacity region of the strong interference channel with common information.

High SNR Approximation: Outer Bounds

- Since the channel is deterministic, it is easy to determine which side information to add at the receiver.
- We obtain an outer bound that is piecewise linear in for every parameter
- There are four partitions of the parameter space that yield four different shapes of the outer bound

High SNR Approximation: Inner Bounds

- Designing achievable schemes in the deterministic approximation is relatively simple and straightforward
- We obtain derive four different achievable schemes for the four partitions of the parameter space

GIFC: Outer Bounds

- We derive outer bounds for the GCIFC in a similar fashion of the ones of the deterministic approximation
- We consider four outer bounds for the four partitions of the parameter space suggested by the deterministic approximation

GIFC: Inner Bounds

- We derive four different achievable schemes in the four different cases and show a constant gap in each instance
- Capacity was known for two of these sub-cases: we also prove achievability of a constant gap with a simpler scheme in one of these instances

References

The GCIFC is firstly introduced here:

N. Devroye, P. Mitran, and V. Tarokh. Achievable rates in cognitive radio channels.

the high SNR deterministic approximation here:

A.S. Avestimehr, S. Diggavi, and D. Tse. A deterministic approach to wireless relay networks.

A.S. Avestimehr, S. Diggavi, and D. Tse. Wireless network information flow.

Results

- We show a constant gap of at most 1.81 bits between inner and outer bound for the GCIFC channel.
- This result is proved using loose outer bounds and simple achievable schemes: given the simplicity of this solution, we consider it to be an excellent guideline for the design of real life communication systems.