Full Duplex OFDM implementation with USRP boards

GRCon17 Conference
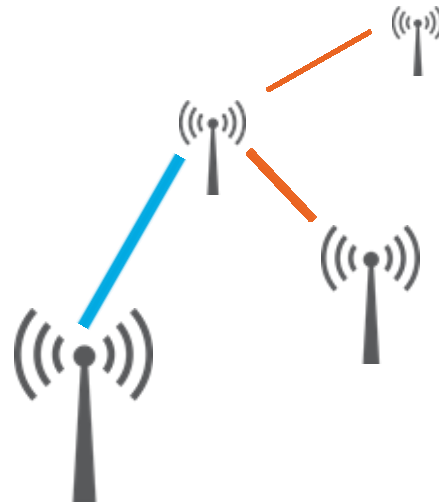
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CICESE, Research center

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Content

Introduction

5 G

Wireless revolution

Ever-increasing demands

Higher bandwidth

Higher spectral efficiency

Full-Duplex

What is Full Duplex?

Full-Duplex (FD) or
In Band Full Duplex (IBFD)

The current communication systems operates in **half duplex** mode or **full duplex out-of-band** mode
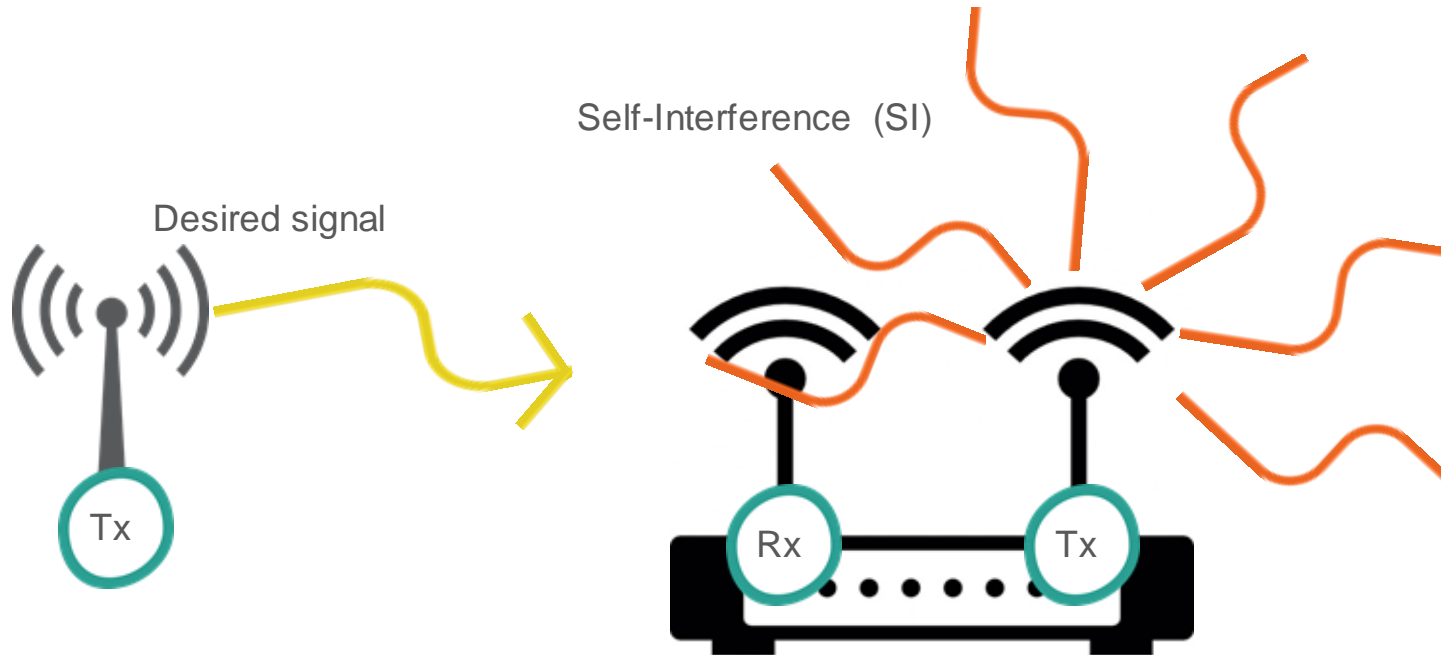
Frequency-Division Multiplexing

Time-Division Multiplexing

Transmit and **receive simultaneously** over the **same frequency band** has the potential to **double** the **spectral efficiency**.
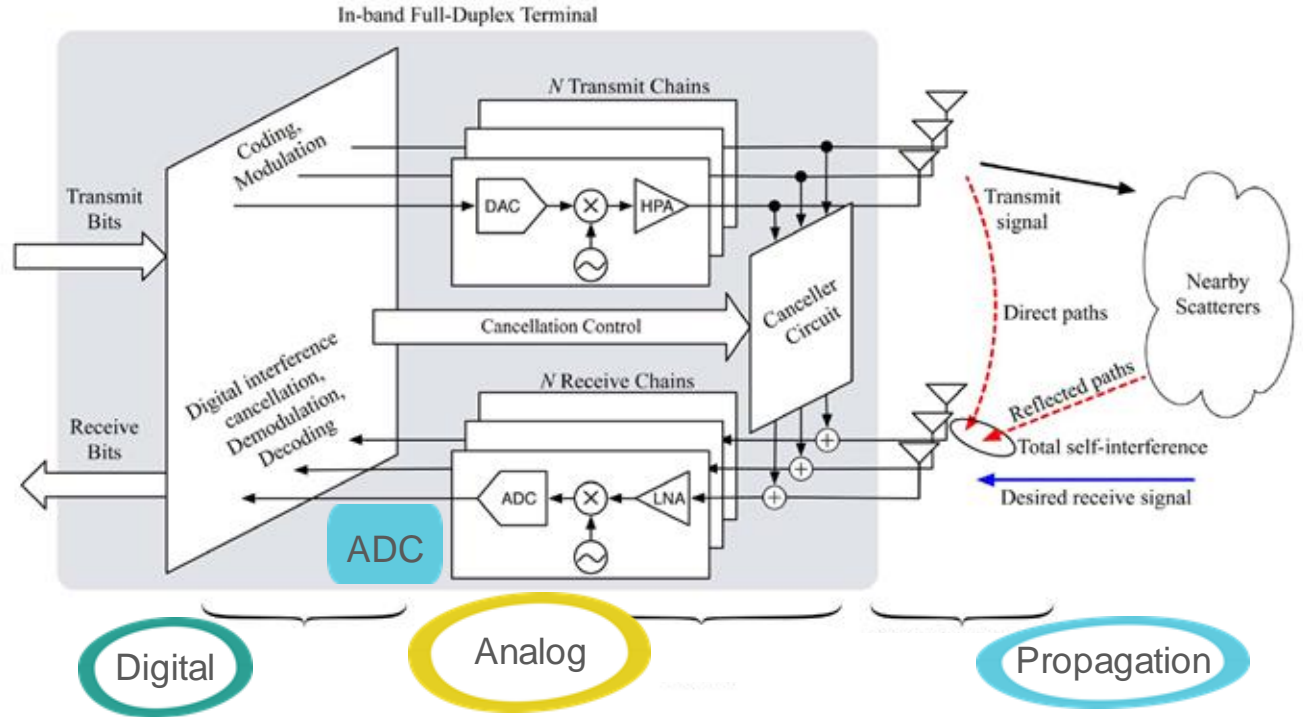
4

The Self-Interference (SI) problem

Self-Interference (SI)

Desired signal

Tx

Rx

Tx

Self-Interference Reduction

Techniques for SI cancellation

3 possible domains:

Digital   Analog   Propagation

Techniques for SI reduction

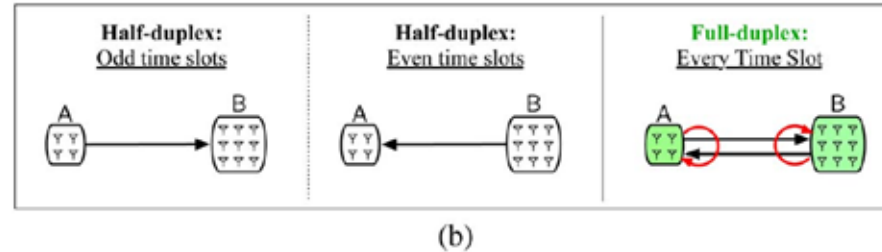**Propagation domain**

Cross-polarization
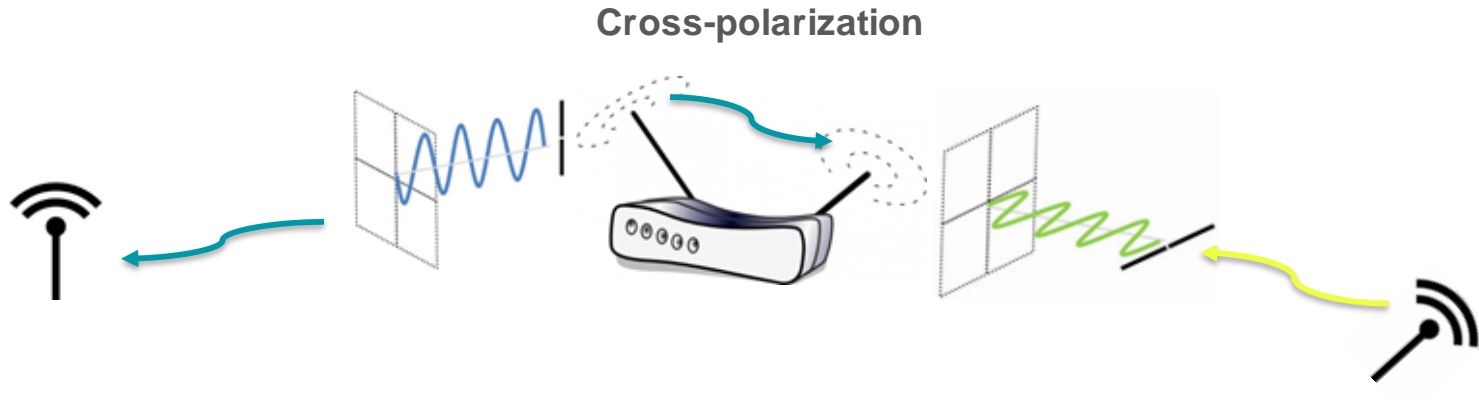
Three basic topologies

Relay
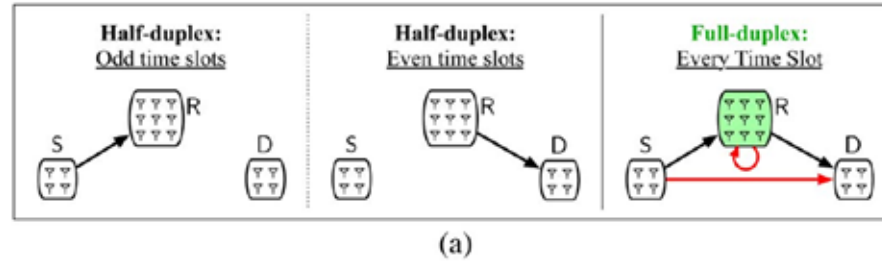
Bidirectional

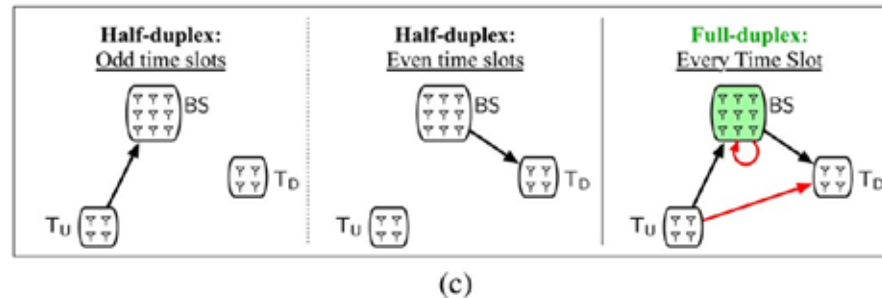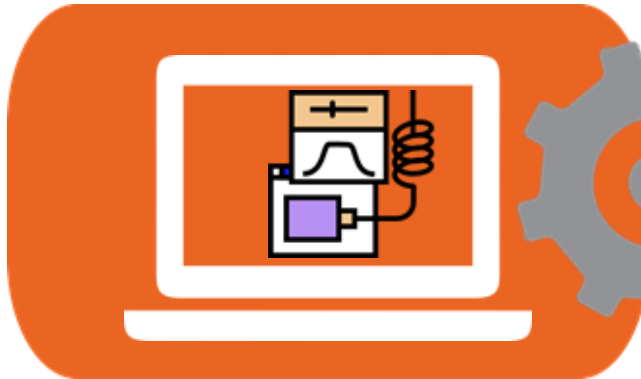Base station

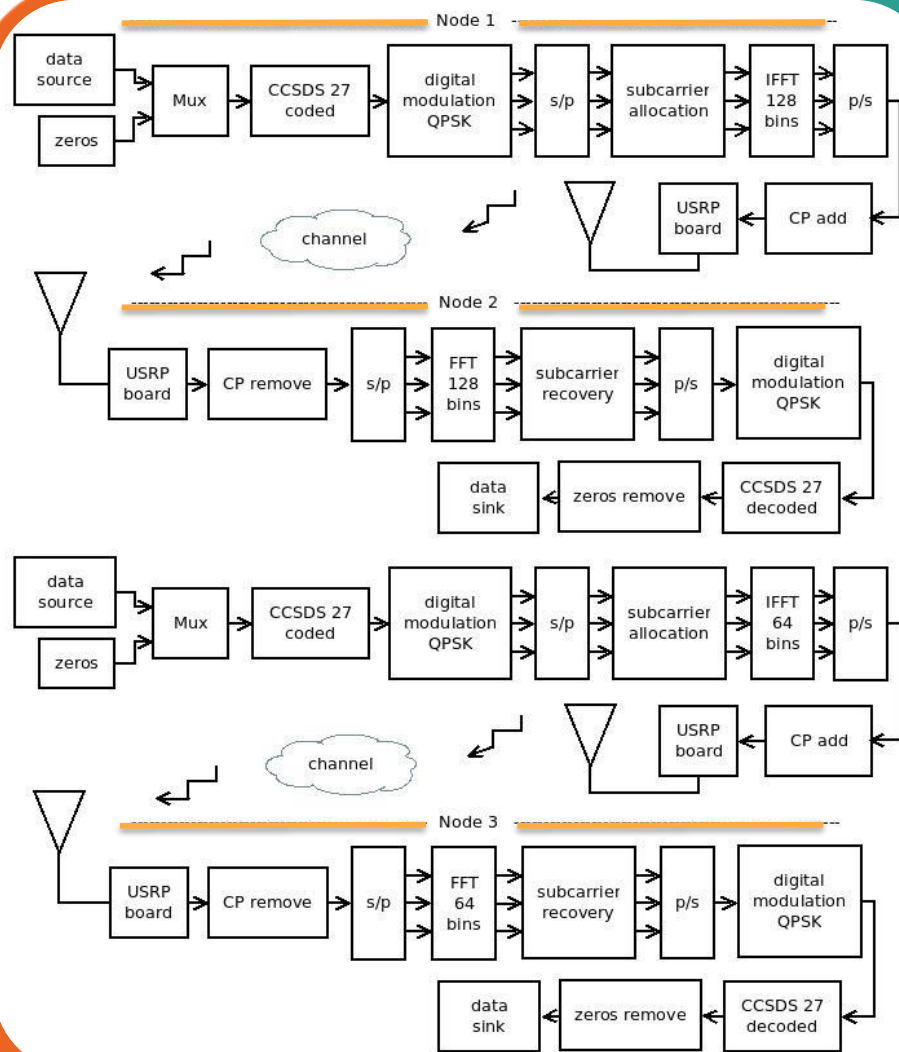# Software and hardware for implementation

GNU Radio Companion and USRP

70 MHz - 6 GHz
89.5 dB
USB 3.0

9

Block diagram

10

Experiment setup

HD Tx

FD Rx/Tx
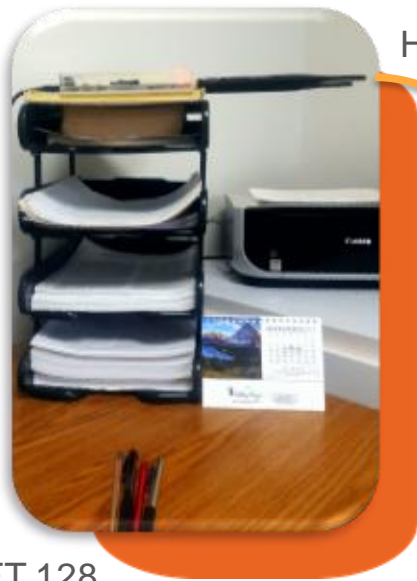
HD Rx

IFFT 128

FFT 128 /
IFFT 64

FFT 64

11
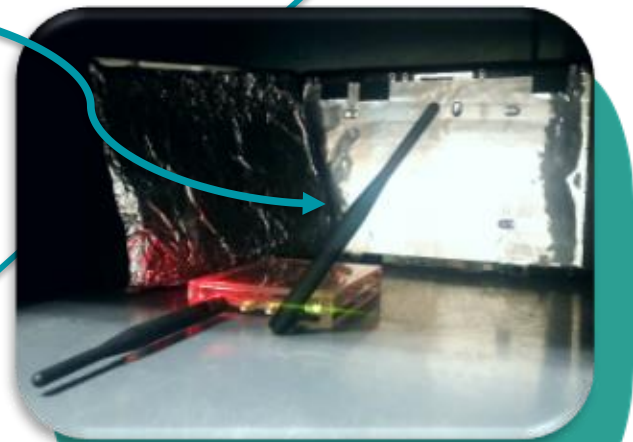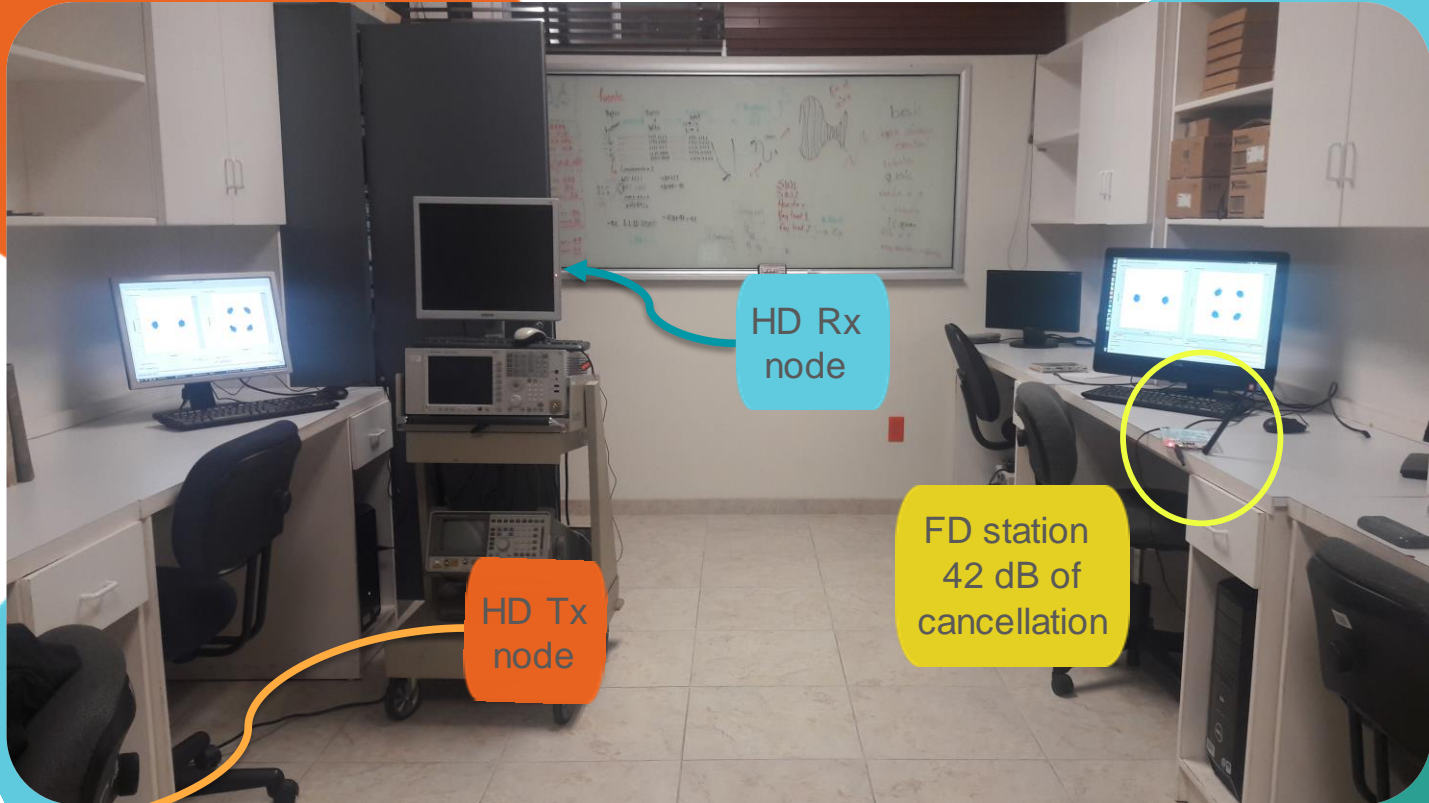
Experiment setup

HD Rx node

FD station 42 dB of cancellation

HD Tx node

Experiment setup [video]

HD Rx node

LINK

HD Tx node

FD node 42 dB of cancellation
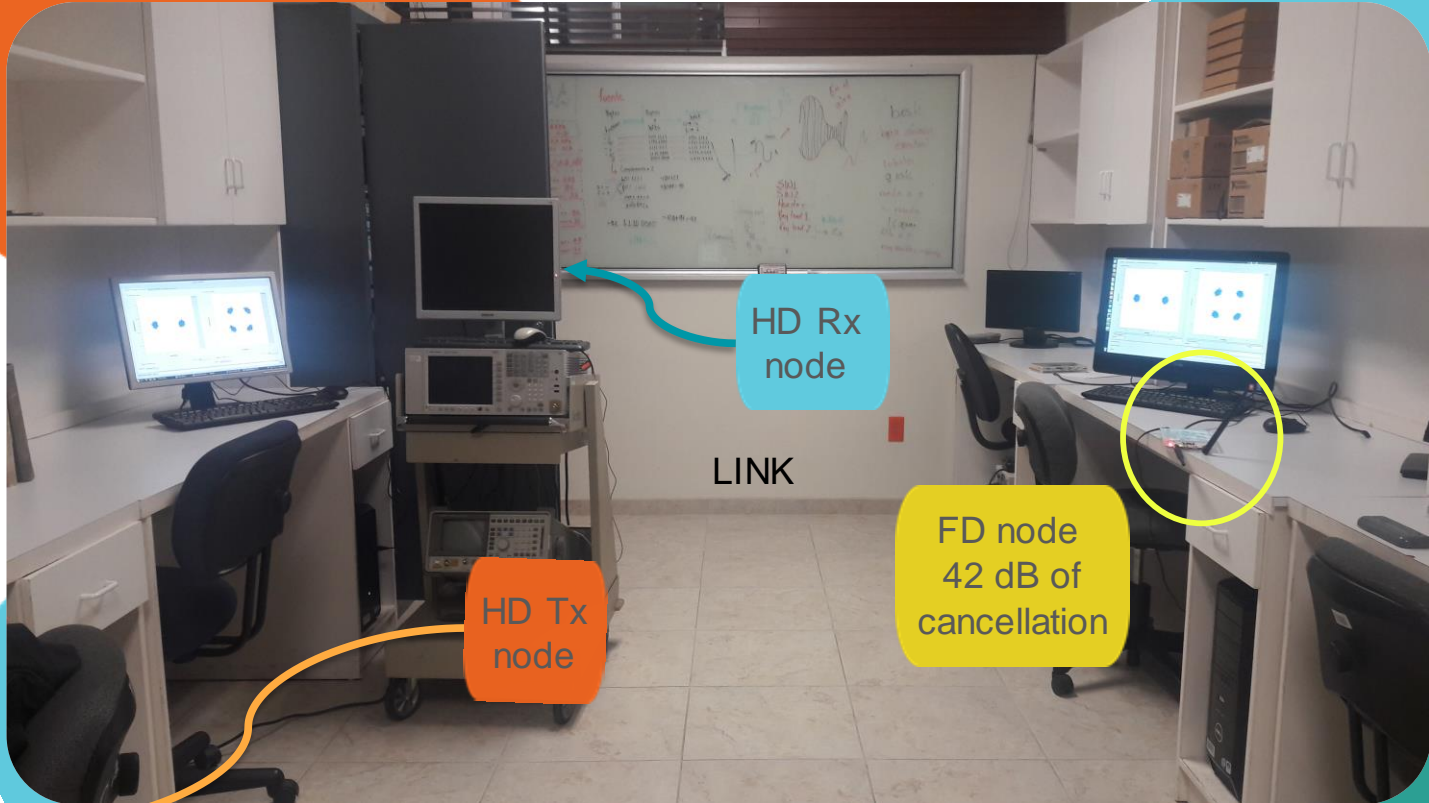
Conclusions

- It is possible to achieve a very good level of cancellation (42dBs) by making an orthogonal arrangement between the transmitting and receiving antennas of the same Full Duplex node.

- It is possible to avoid synchronization, between the transmitting antenna and the receiver, of the same Full Duplex node, using Fourier transform of different sizes.

  The bandwidth is the same for both Fourier transform and use the same frequency channel.

- Applying suppression in analog and digital domains, the total level of cancellation should be much better.

References (1/2)

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❑ M. Duarte. **Full-duplex wireless: Design, implementation and characterization**. [Online].
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❏ Epic Trailer Music - The Secession Studios   https://www.youtube.com/watch?v=BeEDQMLtyGY