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New Jersey Institute of Technology

CENTER FOR WIRELESS COMMUNICATIONS AND SIGNAL PROCESSING RESEARCH

Software Defined Radio - Communication Lab

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Software Defined Radio Team

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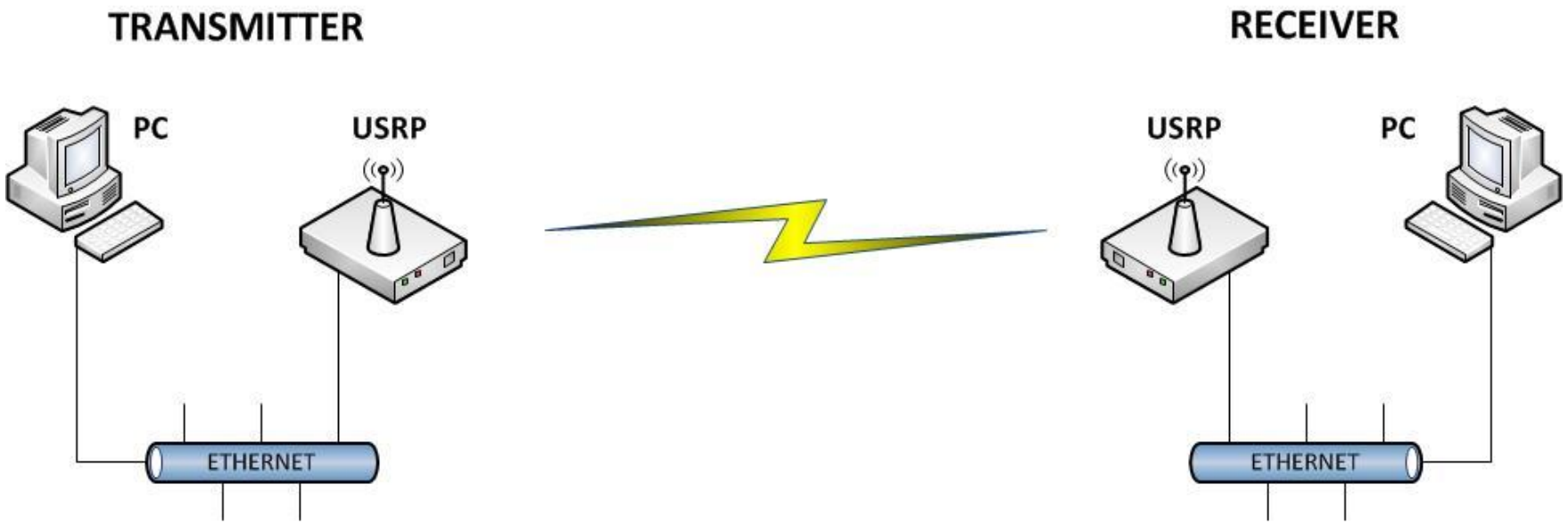
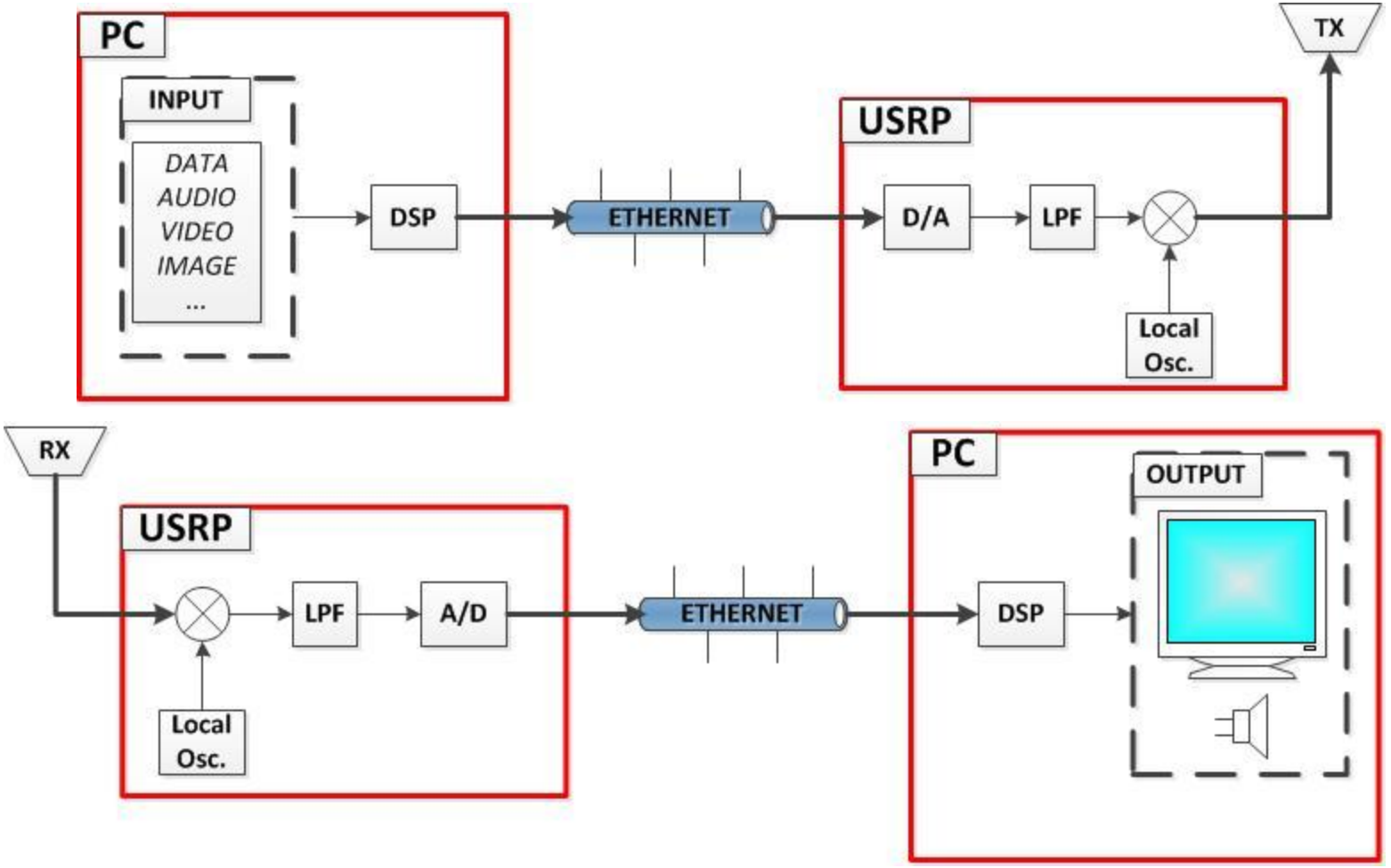
Overview

- Software Defined Radio (SDR)
- Universal Software Radio Peripheral (USRP)
- Features
- Prerequisite Knowledge
- Skills to be Acquired
- Demonstrations
- Conclusions

Software Defined Radio (SDR)



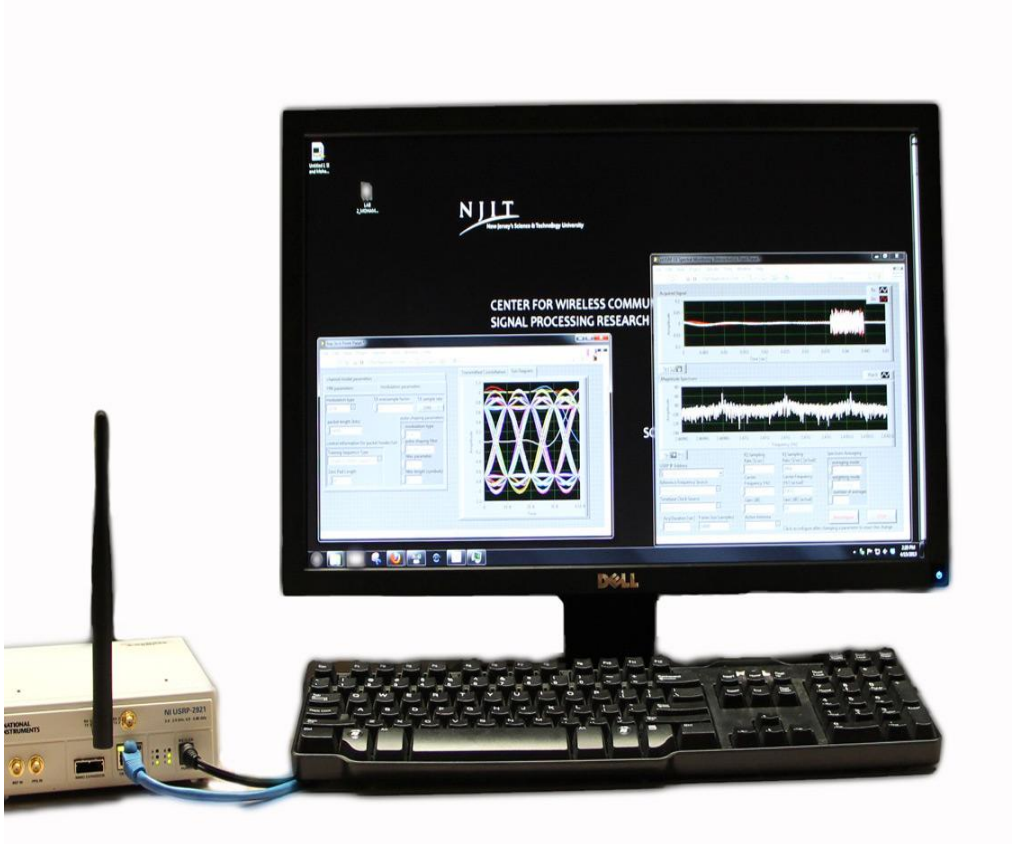
Software Defined Radio



Software Defined Radio
Applications

- Education (ECE – Communications)
- Research (Implementing new concepts)
- Amateur radio (WebSDR, GNURadio, etc)
- Military (SpeakEasy, JTRS)

Universal Software Radio Peripheral (USRP)



Universal Software Radio Peripheral

- Computer controlled software radios
- High speed connection (i.e., Gigabit Ethernet or USB)
- Control software:
  - LabVIEW (by National Instruments)
  - MATLAB (by MathWorks)
  - Third party software (mostly open-source)
- Inexpensive compared to traditional communication hardware with similar abilities

Features

- Hands-on, state of the art approach to undergraduate/ graduate communication systems laboratory
- Currently practiced at only a handful of institutions: Stanford, U of T (Austin), Rutgers, WPI, and ÉPFL
- Interactively experiment with different digital communication schemes
- Experiment with different algorithms
- Acquire the essential knowledge on Software Defined Radio systems

Prerequisite Knowledge

- Basic knowledge of wireless and digital communications
- Basic knowledge of using block diagrams to represent systems
- Familiarity with flowcharts and block diagrams

Skills to be Acquired

- Learn how to use a software which is widely used in industry (LabVIEW)
- Learn how to form algorithms using block diagrams
- Gain hands on experience with USRP units
- Gain hands on experience with a real wireless communication system

List of Topics
Under Development

Lab 1 – Introduction to LabVIEW

Lab 2 – Introduction to NI RF Hardware (USRP)

Lab 3 – Modulation and Detection

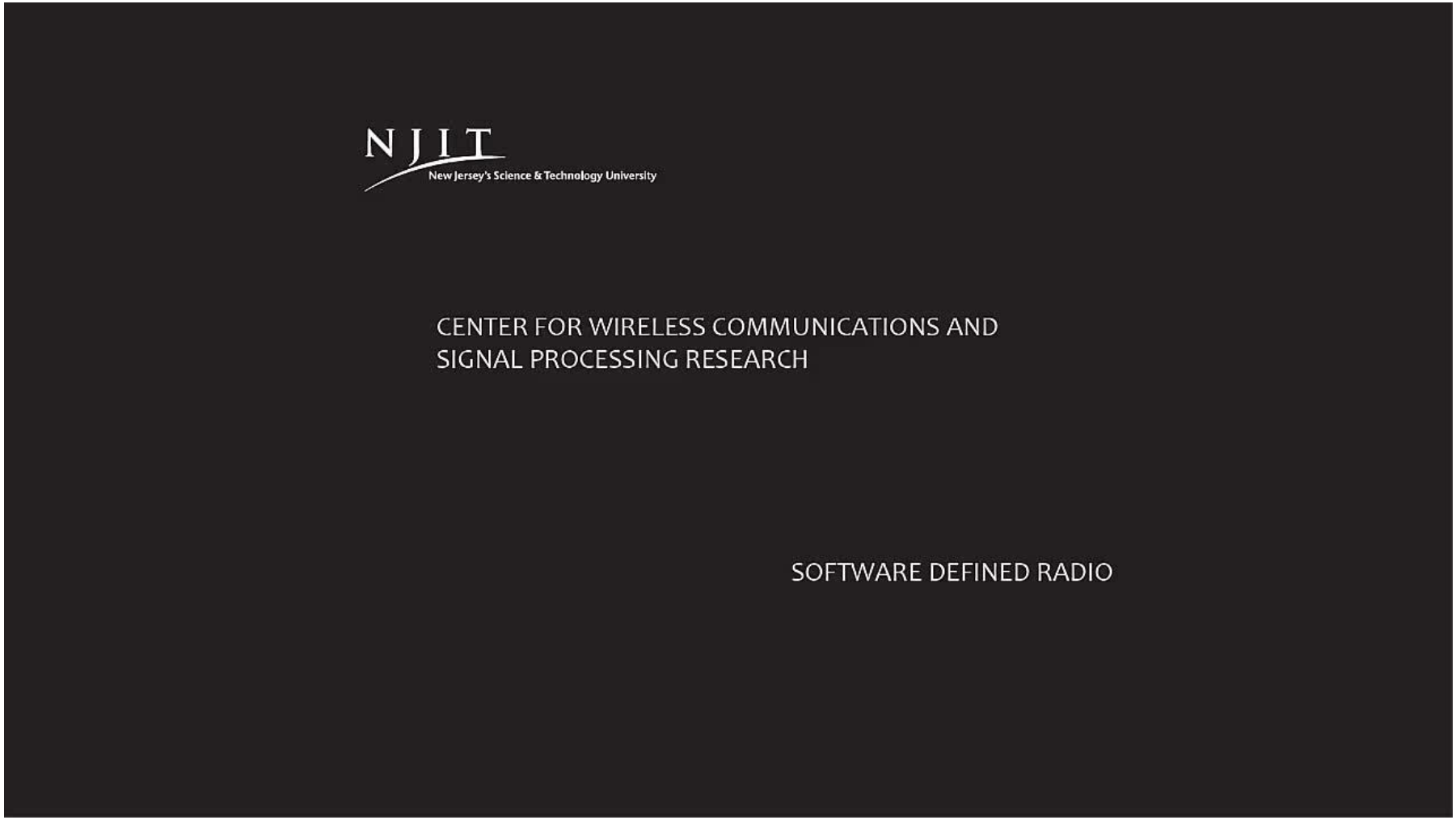
Lab 4 – Pulse Shaping and Matched Filtering

Lab 5 – Synchronization: Maximum Energy Alignment Method

Lab 6 – Synchronization: Early-Late Gate Method

Demonstration: Lab Preparation

Demonstration: Image Transmission



Conclusion

Proposed SDR Lab	Traditional Labs
Reconfigurable, limited by software	Fixed, limited by hardware
Easy to control (graphical development environment)	Requires knowledge specific to the equipment
Simulation before experiment	No simulation
Students have more control	Students have less control
Inexpensive to expand abilities	Expensive to expand abilities

Conclusion

- SDR allows to explore different digital communication schemes while using the same hardware.
- SDR is reconfigurable which allows students to experiment with their own algorithms.
- User-friendly LabVIEW, a flexible graphical development environment, is used with SDR.

THANK YOU

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THE EDGE IN KNOWLEDGE

QUESTIONS?