

# DARPA Spectrum Challenge

## Adaptive Software Defined Radio in the Presence of Noise

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### Introduction

The DARPA Spectrum Challenge is a competition to demonstrate a radio protocol that can make the best use of a given communication channel in the presence of other dynamic users and interfering signals. The Challenge is not focused on developing new radio hardware, but instead is targeted at finding strategies for guaranteeing successful communication in the presence of other radios that may have conflicting co-existence objectives.

We aimed to develop a radio protocol, which would adapt its method of transmission based on whether there was noise present. Our main focus is a condition where the allocated bandwidth is split into an upper and lower spectrum and noise is only present in one of the halves at a time.

### Motivation

Radios are used for a wide range of tasks, from the most mundane to the most critical of communications, from garage door openers to military operations. As the use of wireless technology proliferates, radios can often compete with, interfere with, and disrupt the operations of other radios. DARPA seeks innovative approaches that ensure robust communications in such congested and contested environments. Other factors that motivate the need for intelligent use of spectrum include:

- High priority radios in the military and civilian sectors must be able to operate

regardless of the ambient electromagnetic environment, to avoid disruption of communications and potential loss of life.

### Design

The radio hardware used is hosted by the Rutgers WINLAB ORBIT radio grid testbed. We use computer hosted software radios called USRP (Universal Software Radio Peripheral) coupled with the GNU Radio software, which is a toolkit that has a Python framework.

The design we came up with uses one of these halves for communication at a time. When noise is present in the half the radio is using, the protocol will switch the radio pair (transmitter and receiver) to communicate using the other half that is clear of interference.

The protocol may also delay the transmission of packets till the noise switches to the other half and the spectrum is clear of interference.

In order to implement our adaptive radio design, a half-duplex foundation for the radio pair was used. They needed to be able to talk to each other, bi-directionally.

### Conclusion

This new design focuses on using GNU Radio to create a software defined radio that will help to ensure successful communications even in the most congested environments by implementing half-duplex transmission with a check-sum type of protocol.