Radio Spectrum Characterization

Ashton Sopher, Ryan Davis, Andrew Xu

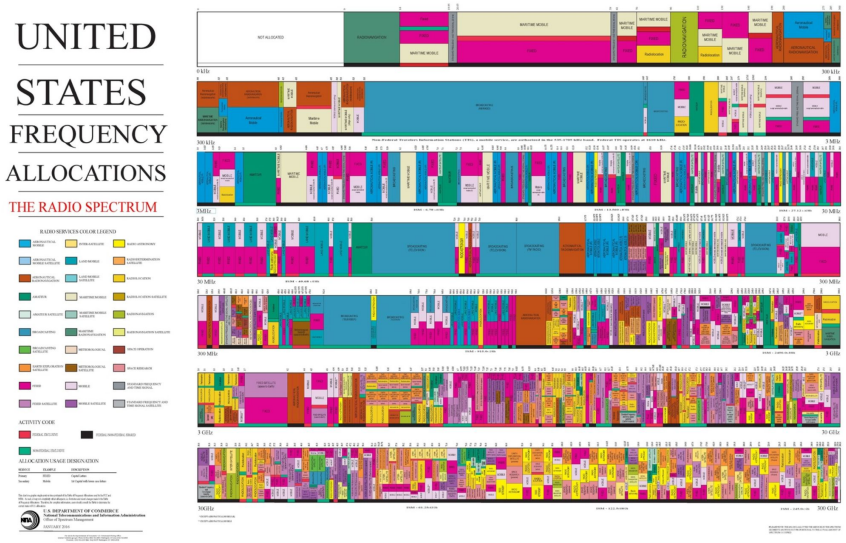
Who We Are

Ashton Sopher University of Rochester Computer Science/ Mathematics Class of 2021	Ryan Davis Rutgers University Computer Engineering / Computer Science Class of 2021	Andrew Xu Montville High School Interested in Mathematics and Computer Science Class of 2021
		

Motivation

- An efficient spectrum
  - Radio spectrum regulations
  - Wasted space
  - East coast study shows: “average total spectrum use of less than 10%” (Pickard)

- Characterizing transmitters
  - Security
  - Energy management



Our Project

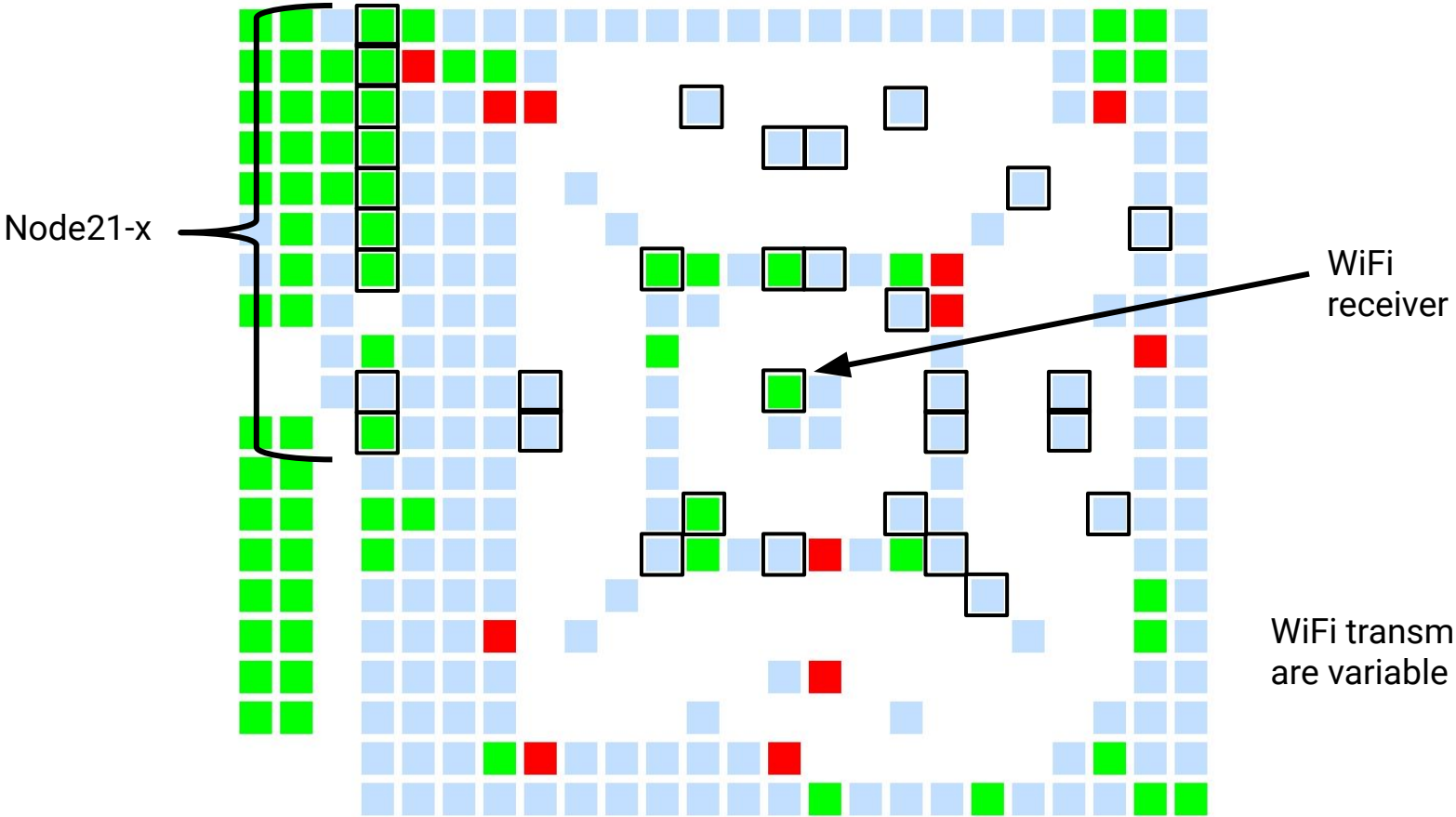
- Goals
  - Create experiments to represent usage of the radio spectrum
  - Record experiment data and archive for later use
  - Predict the next state of the spectrum

- Applications
  - Efficient spectrum management
  - Classification of transmitters
  - Many more

Terminology

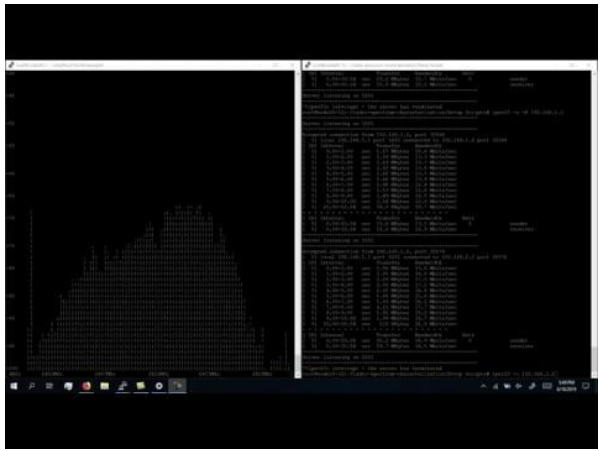
- Software Defined Radio (SDR)
- Universal Software Radio Peripheral (USRP)
- Orbit Nodes / Grid
- Node21-x
- WiFi Receiver / Transmitter
- LSTM (Long Short Term Memory) Neural Network

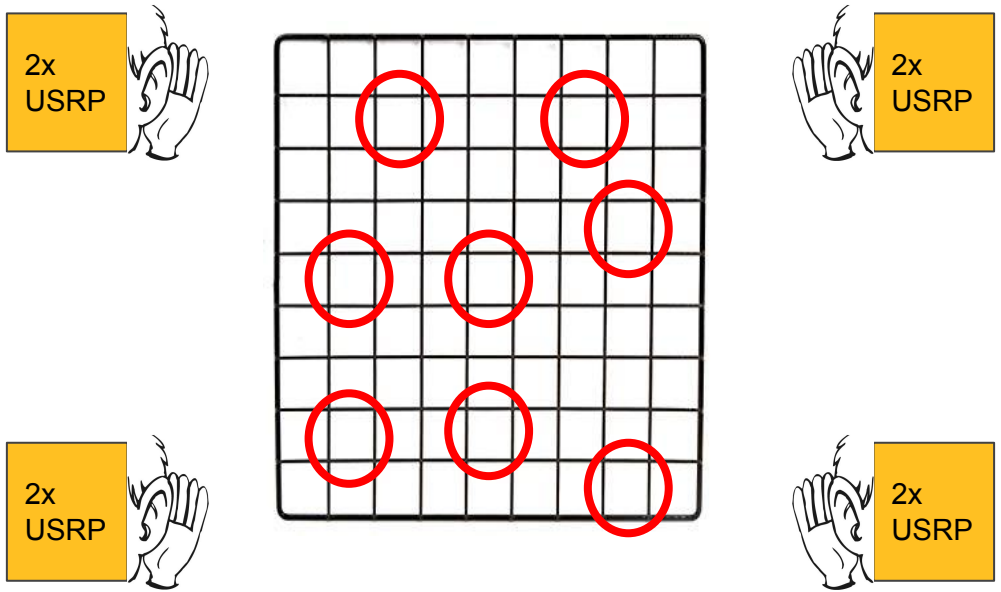
Topography



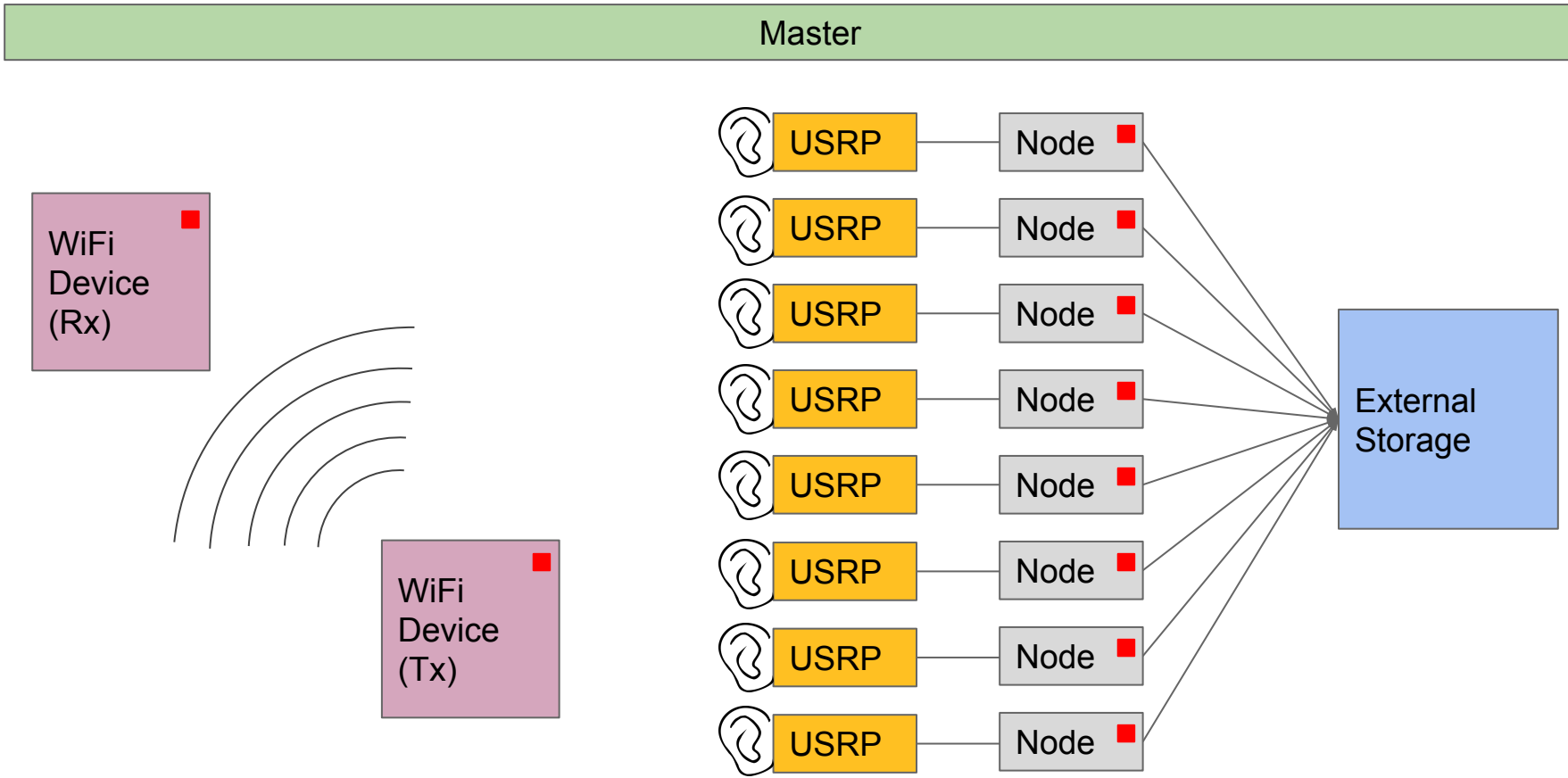
Experiments

- Recording basic activity
- Varying WiFi transmitter node position
  - 25 positions
- Varying file and bit rate
  - 3 bit rates (10, 30, 50 mbps)
  - 4 binary files
    (all 0s, all 1s, alternating 01s, random)



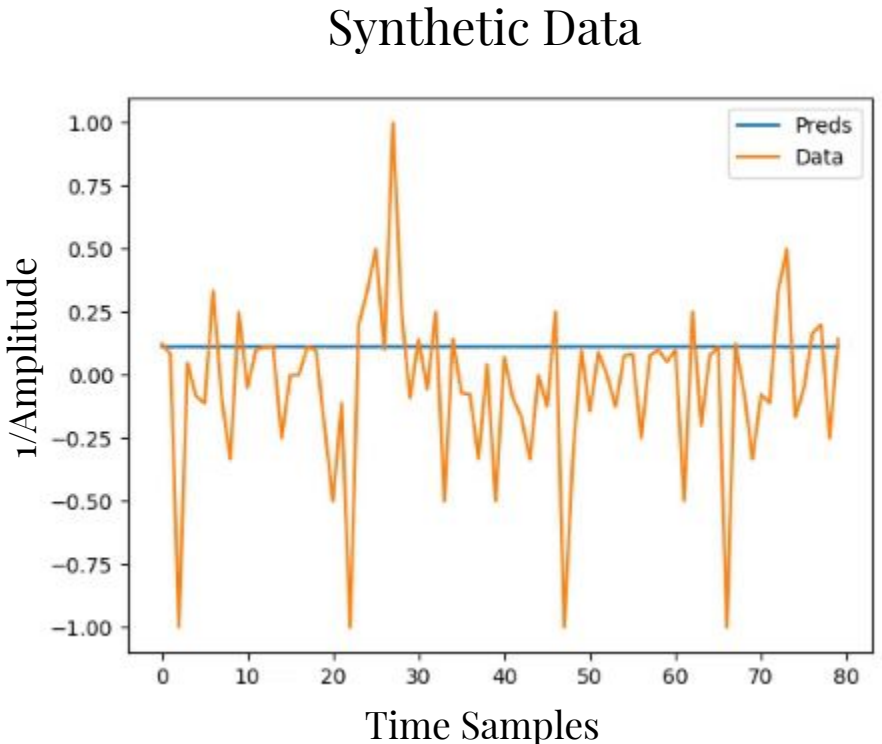


Automation


Master
WiFi Device (Rx)
WiFi Device (Tx)
USRP
Node
USRP
Node
USRP
Node
USRP
Node
USRP
Node
USRP
Node
USRP
Node
USRP
Node
External Storage

LSTM

- Predicting the spectrum
- Synthetic data
- Future plans



Issues

- Operating the USRPs
- Getting every node to cooperate
- Time synchronization
- LSTM neural network

References

Yung, Jessica. “LSTMs for Time Series in PyTorch.” *Jessica Yung*, 11 Sept. 2018, www.jessicayung.com/lstms-for-time-series-in-pytorch/.

Pickard, Victor W., and Sascha D. Meinrath. “Revitalizing the Public Airwaves: Opportunistic Unlicensed Reuse of Government Spectrum.” *International Journal of Communication*, ijoc.org/index.php/ijoc/article/view/467.

Q+A