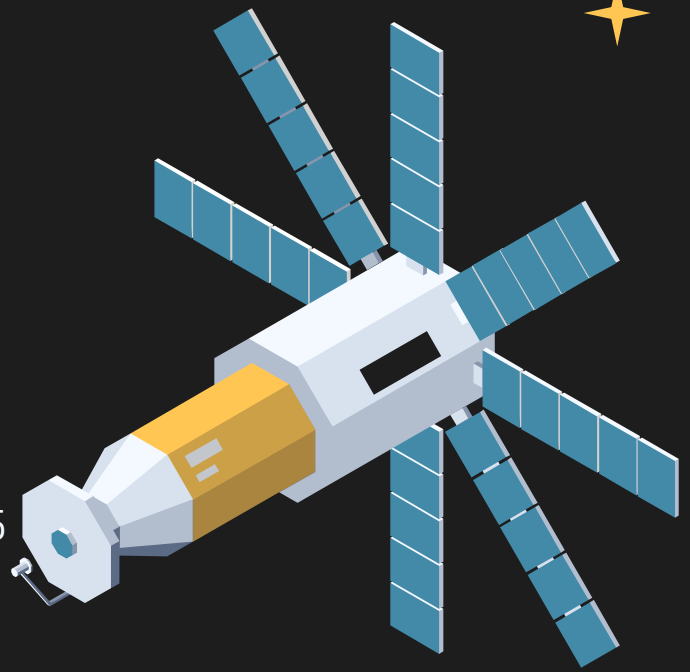
WebSDR Ground Station Project

"International Research and Innovation Project" - P005



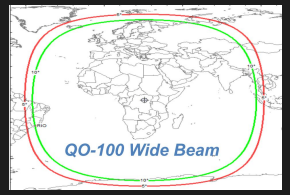
Team Members: Alexandre Achart, Alberto Bottari, Lorenzo Croce, Clement Fusero, Fatemeh Mahvari, Mihir Kumar Patel, Vedant Vedant

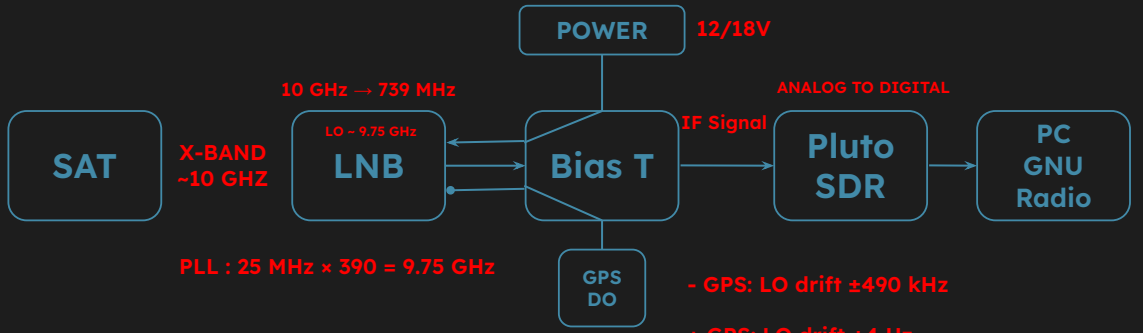
Project Leader: Stefan Valentin

No Internet? No Connection? No Problem!

When the ground networks fail, satellites don't.

Es Hail QO-100

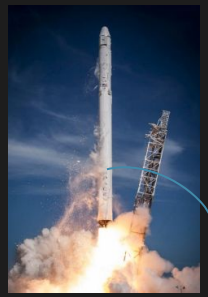




Launched: Nov 15, 2018

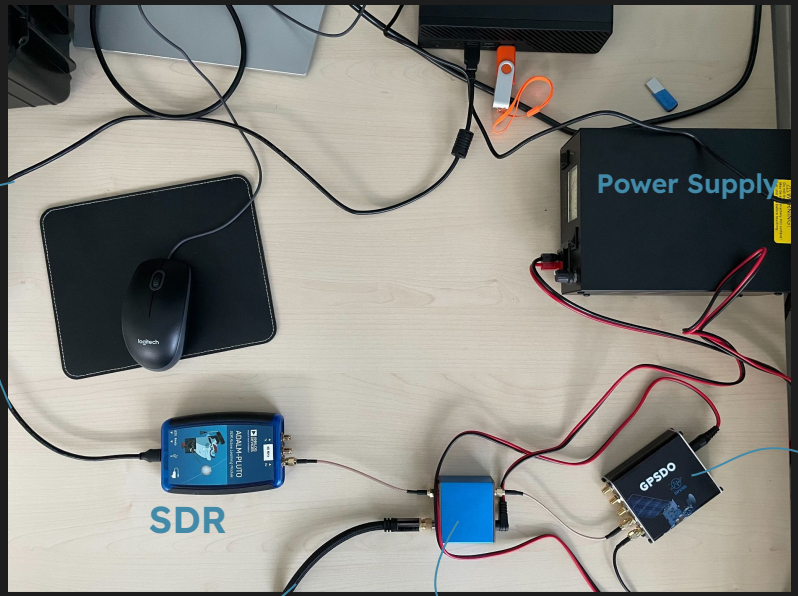
Owner: Es'hailSat (Qatar)

Mission: Commercial telecom + Amateur radio (AMSAT)



Falcon 9

Coaxial Cable

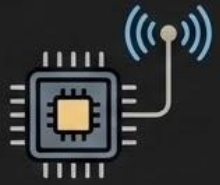


GPS Disciplined Oscillator

Bias-T

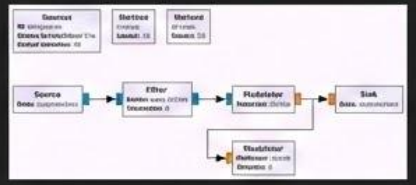
GNU Radio
THE FREE & OPEN SOFTWARE RADIO ECOSYSTEM

What is GNU Radio?



1. Software-Defined Radio (SDR) Toolkit

A free & open-source software development toolkit that provides signal processing blocks to implement software radios. It moves signal processing from dedicated hardware to flexible software on a general-purpose computer.

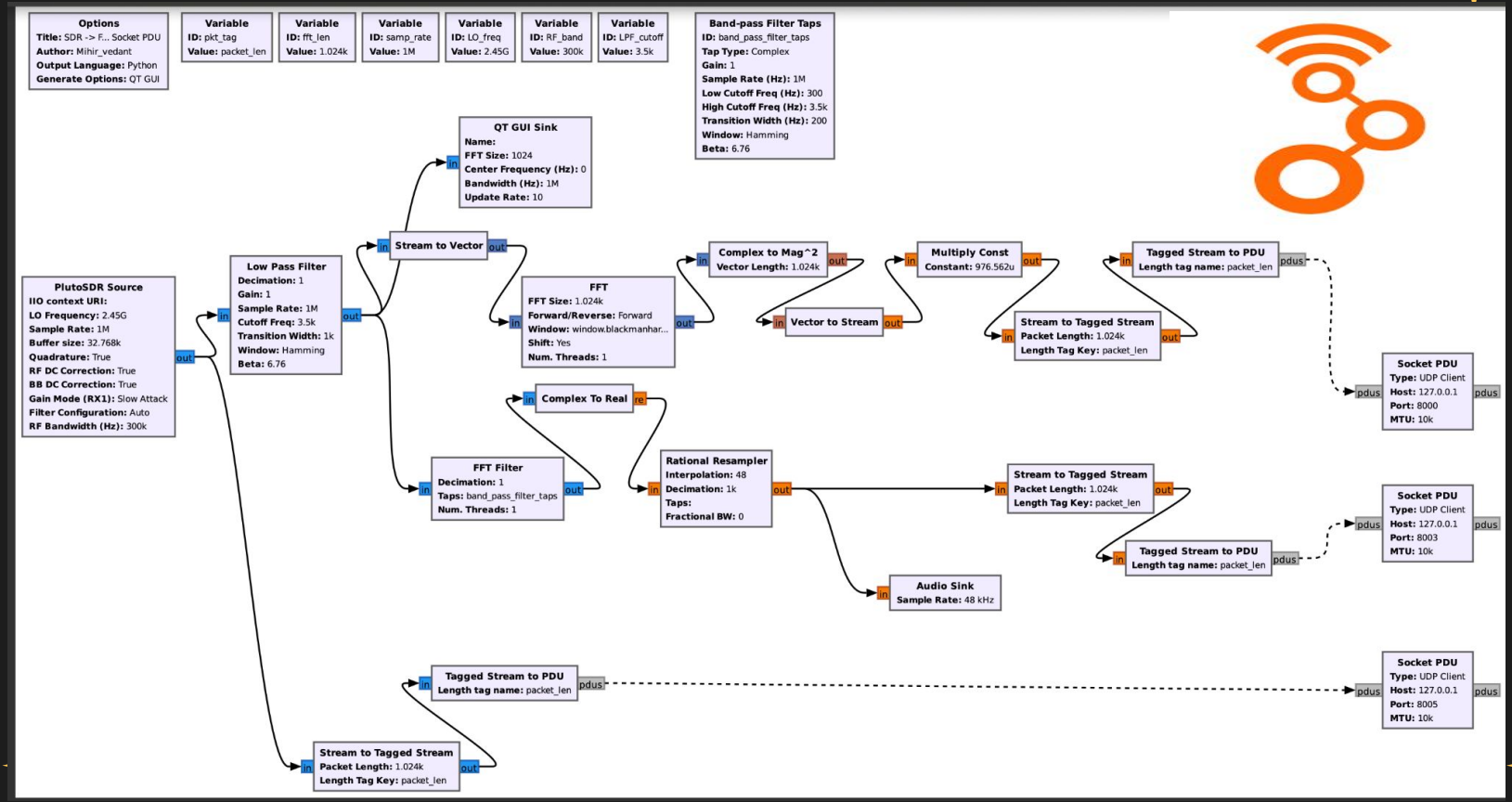


2. Modular Flowgraph Design

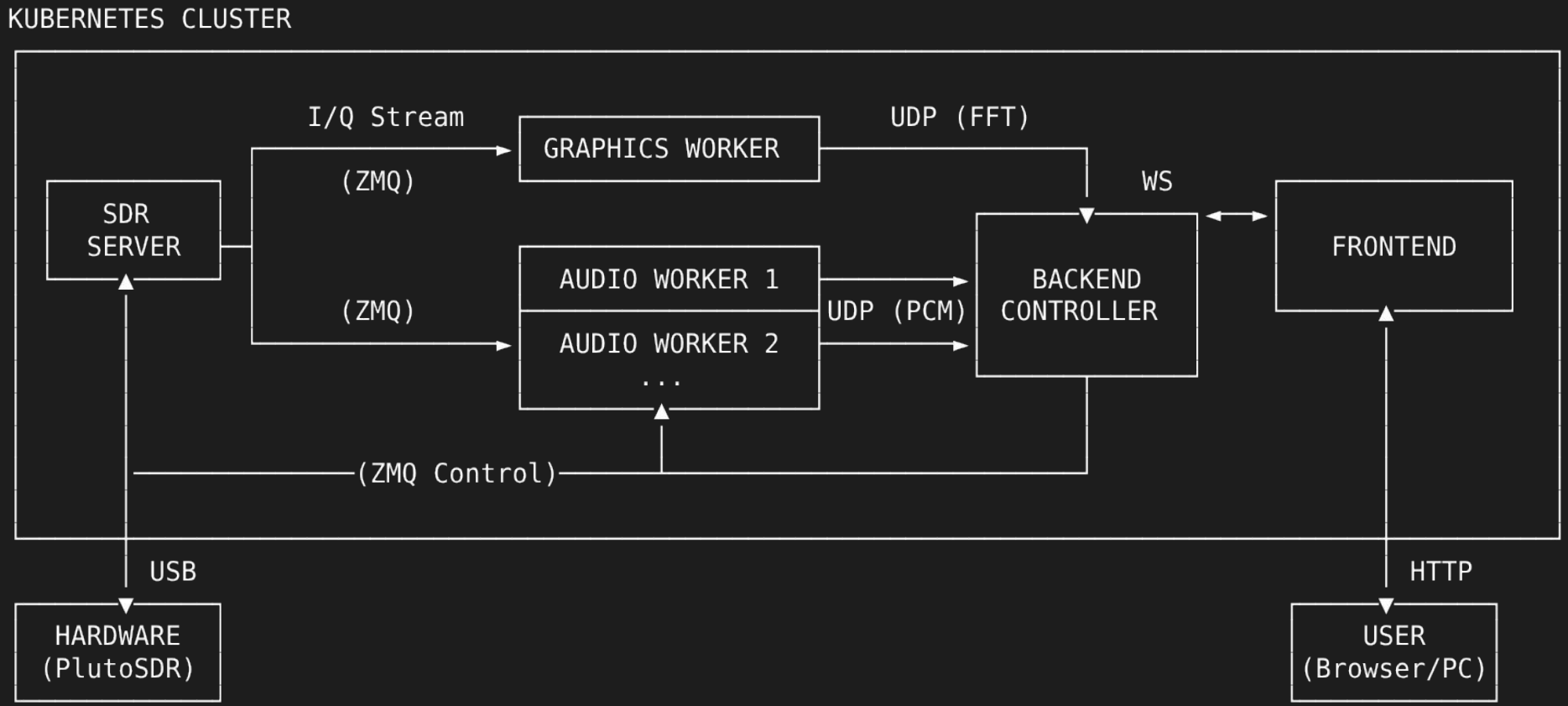
Users build radio systems by connecting modular, re-usable signal processing blocks in a graphical flowgraph (GNU Radio Companion) or directly in Python/C++.

3. Simulation & Real-World Interface

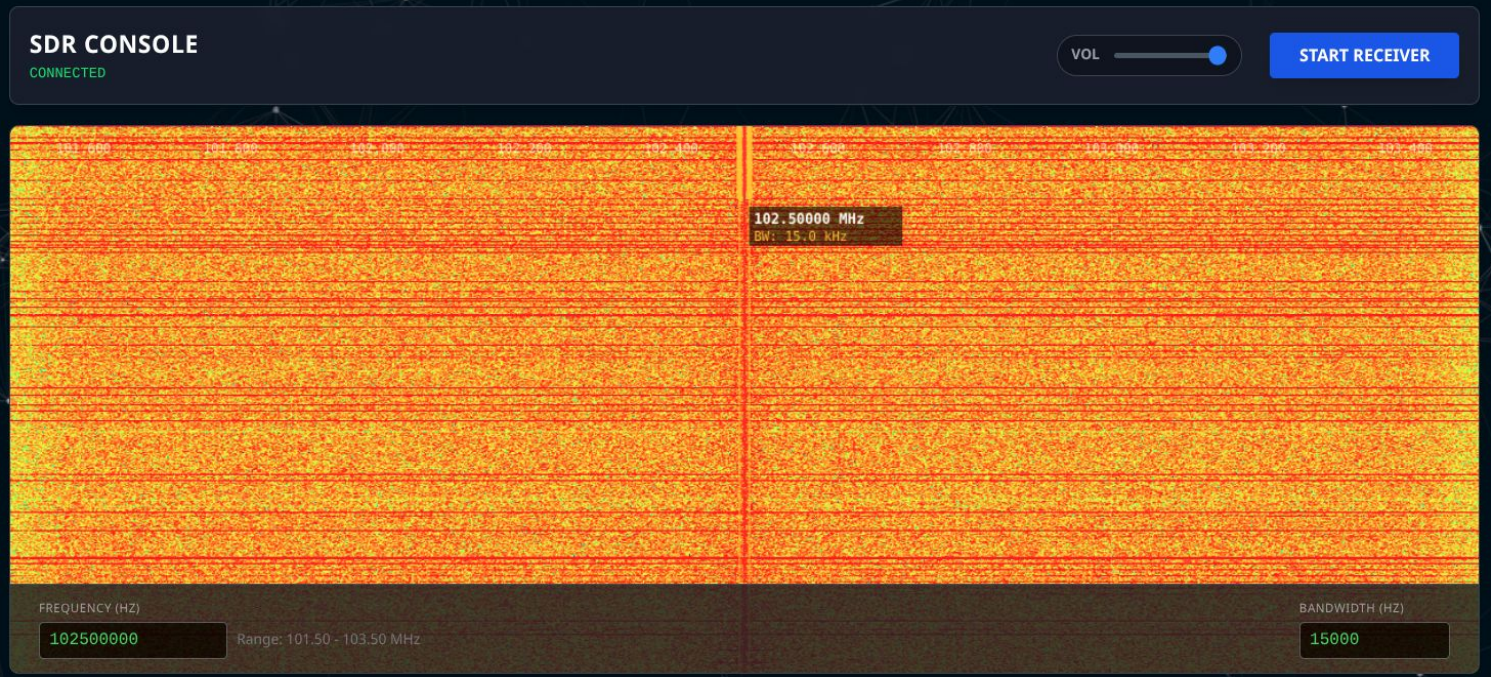
Can be used for pure simulation of complex systems or interface with real-world SDR hardware (e.g., RTL-SDR, USRP, HackRF) to transmit and receive real signals.


Options
Title: SDR -> F... Socket PDU
Author: Mihir_vedant
Output Language: Python
Generate Options: QT GUI
Variable
ID: pkt_tag
Value: packet_len
Variable
ID: fft_len
Value: 1.024k
Variable
ID: samp_rate
Value: 1M
Variable
ID: LO_freq
Value: 2.45G
Variable
ID: RF_band
Value: 300k
Variable
ID: LPF_cutoff
Value: 3.5k
Band-pass Filter Taps
ID: band_pass_filter_taps
Tap Type: Complex
Gain: 1
Sample Rate (Hz): 1M
Low Cutoff Freq (Hz): 300
High Cutoff Freq (Hz): 3.5k
Transition Width (Hz): 200
Window: Hamming
Beta: 6.76
QT GUI Sink
Name:
FFT Size: 1024
Center Frequency (Hz): 0
Bandwidth (Hz): 1M
Update Rate: 10
PlutoSDR Source
IIO context URI:
LO Frequency: 2.45G
Sample Rate: 1M
Buffer size: 32.768k
Quadrature: True
RF DC Correction: True
BB DC Correction: True
Gain Mode (RX1): Slow Attack
Filter Configuration: Auto
RF Bandwidth (Hz): 300k
Low Pass Filter
Decimation: 1
Gain: 1
Sample Rate: 1M
Cutoff Freq: 3.5k
Transition Width: 1k
Window: Hamming
Beta: 6.76
Stream to Vector
FFT
FFT Size: 1.024k
Forward/Reverse: Forward
Window: window.blackmanhar...
Shift: Yes
Num. Threads: 1
Complex to Mag^2
Vector Length: 1.024k
Vector to Stream
Multiply Const
Constant: 976.562u
Stream to Tagged Stream
Packet Length: 1.024k
Length Tag Key: packet_len
Tagged Stream to PDU
Length tag name: packet_len
Socket PDU
Type: UDP Client
Host: 127.0.0.1
Port: 8000
MTU: 10k
Complex To Real
FFT Filter
Decimation: 1
Taps: band_pass_filter_taps
Num. Threads: 1
Rational Resampler
Interpolation: 48
Decimation: 1k
Taps:
Fractional BW: 0
Stream to Tagged Stream
Packet Length: 1.024k
Length Tag Key: packet_len
Tagged Stream to PDU
Length tag name: packet_len
Socket PDU
Type: UDP Client
Host: 127.0.0.1
Port: 8003
MTU: 10k
Audio Sink
Sample Rate: 48 kHz
Tagged Stream to PDU
Length tag name: packet_len
Socket PDU
Type: UDP Client
Host: 127.0.0.1
Port: 8005
MTU: 10k
Stream to Tagged Stream
Packet Length: 1.024k
Length Tag Key: packet_len

Project Architecture:



Frontend - SDR Page:



Project management

Roles and collaboration

Backend + signal visualization tools

Develop **SSB receiver** on GNU Radio

Design **web interface**

Our tools

Development	   
Communication	 
Version control	
Orchestration	

Cost of the project

- 50 € Dish
- 55 € Antenna mount
- 15 € Coax satellite cable (10 m)
- 420 € Mini-PC
- 230 € ADALM-PLUTO SDR-Frontend
- 150 € Power amplifier (for transmitting)
- 58.50 € Coax N/N Ultraflex-10
- 198 € DXPatrol GPSDO
- 65 € LNB QO-100 10 GHz
- 119 € DXPatrol Helix Feed V2

Feedback and Reflection

Key Strengths & Achievements

Balanced In-Person Schedule

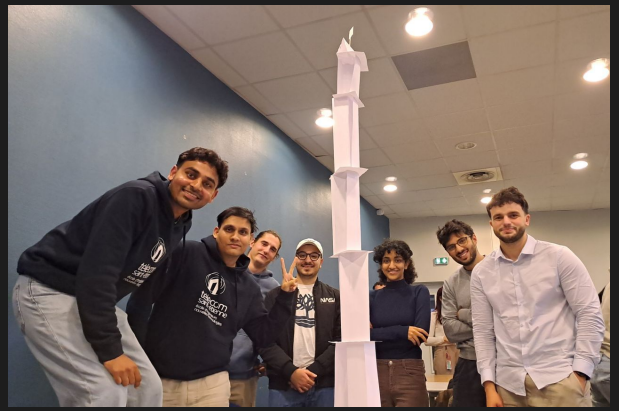
Immersive Onboarding Environment

Challenges & Limitations

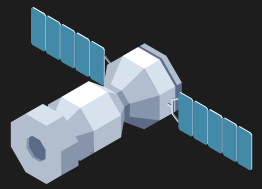
Integration Complexity

Remote Debugging Friction

Documentation as a Continuous Process



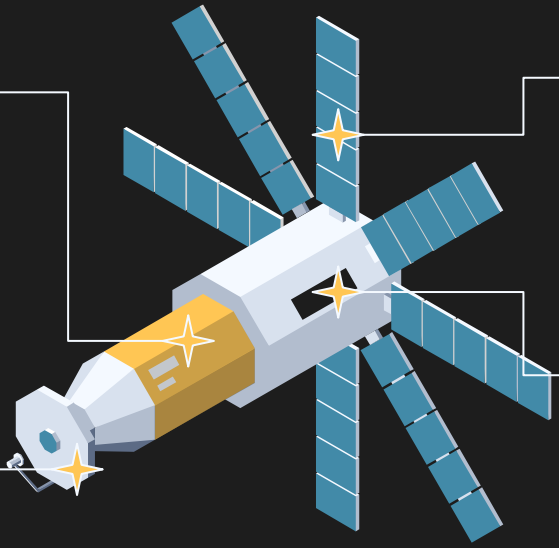
The tallest paper tower was also our teamwork achievement!



Summary

Developed an SSB receiver on GNU Radio.

Having a good looking frontend compared to the OpenWebRX



Successful implementation for multiple users was achieved.

Backend tools were developed for signal visualization.

Future work

Additional tools

Additional signal processing tools

Authentication

Assuring that the users have the permit

Open source project

Allow users to fork and upgrade the project

Transceiver

Allow users to send voice and data through the website

Auto detection

Automatic bandwidth detection

Improve Denoising

Reduce or suppress noises

Thank You for Your Attention!