

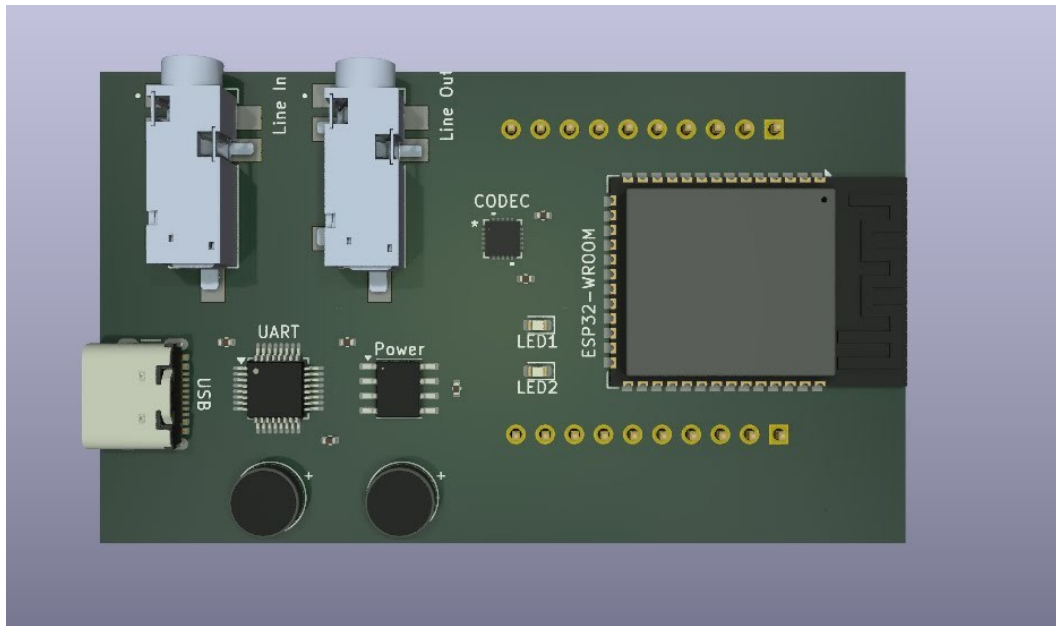


Enabling Signal Processing Education

by SigPro Labs

RadioSonic Platform Overview

A patent-pending software-defined radio (SDR) teaching platform that emulates real-time wavelength consistent wireless signals at a fraction of the cost of traditional RF lab gear.



The RadioSonic platform scales the **speed of light** to the **speed of sound**, enabling wavelength consistent simulation of RF propagation.

Digital RF processing techniques are brought into the **acoustic domain** for hands-on learning.

Applicable to learning **signal processing for SDR**, including multipath effects, time/frequency tracking, and beamforming.

Also useful for **introductory DSP topics** such as digital filters and basic DSP concepts with meaningful waveforms and hands-on hardware.

Existing Soundcard Based Solutions

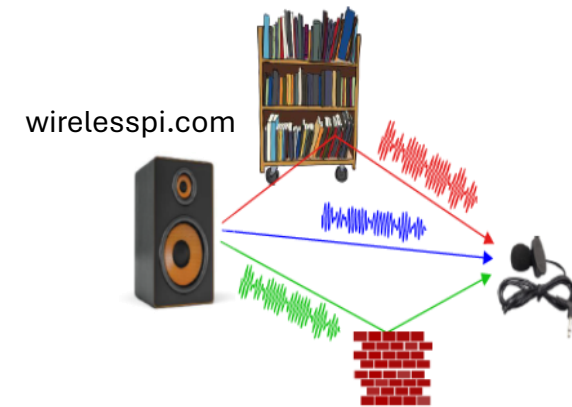
- Qasim Chaudhari:

<https://wirelesspi.com/sdr-course/>

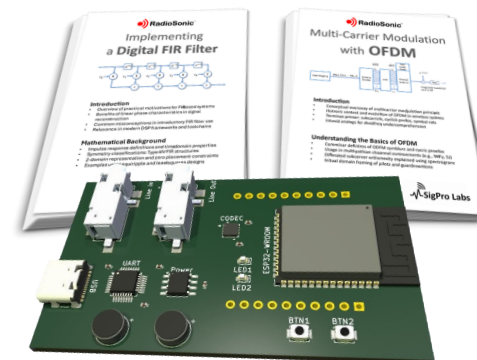
- Maximilian Matthé:

<https://dspillustrations.com/pages/pages/practical-ofdm-tutorial-using-your-soundcard.html>

RadioSonic is a **low-cost** real-time **stand-alone** platform purpose-built for **teaching** hands-on **Signal Processing** and **SDR**.

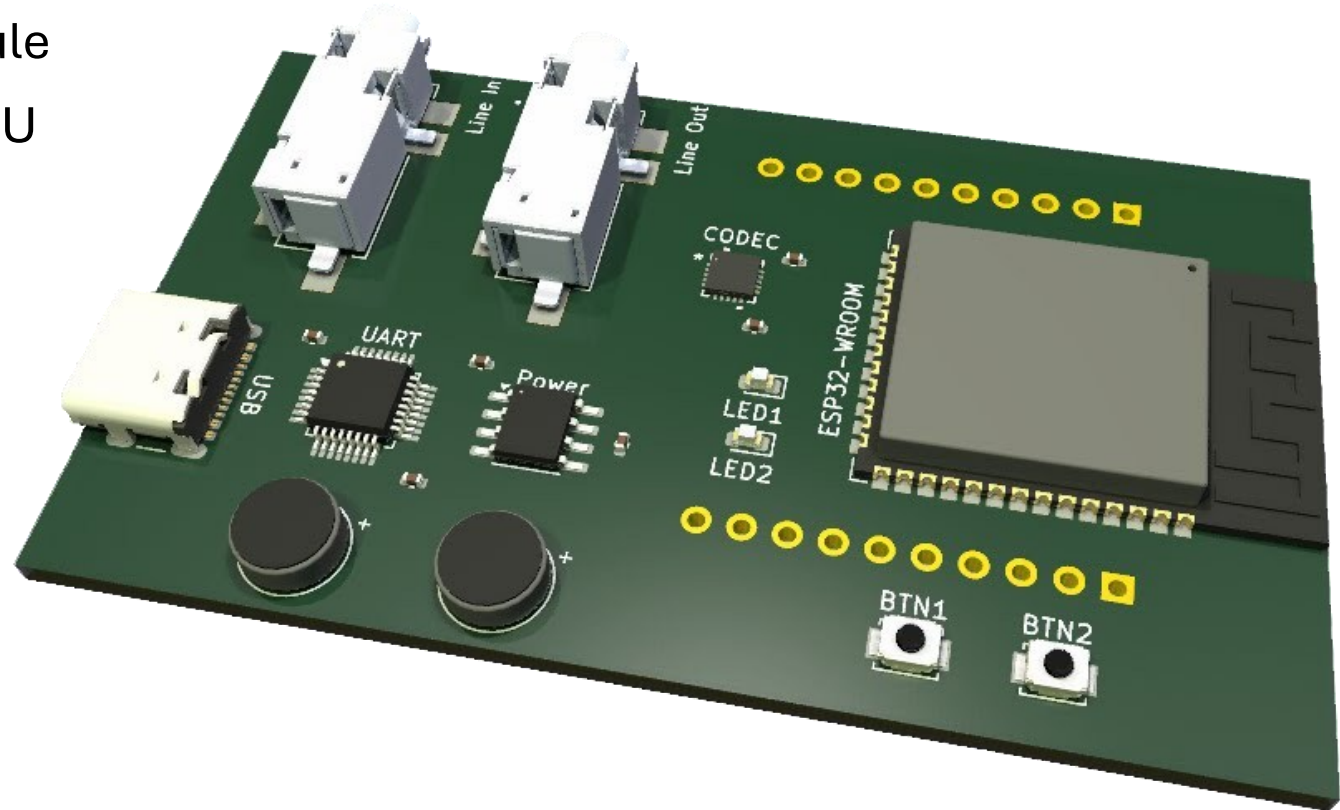


Send and receive **wireless signals** over the air without expensive SDR hardware through a speaker (Tx) and a microphone (Rx)



Hardware Features

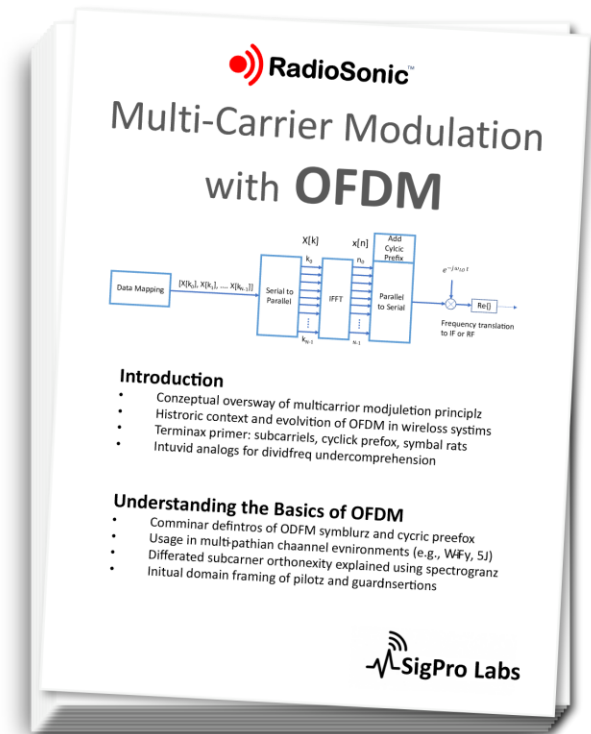
- ESP32-S3-WROOM-1 SoC Module
- Xtensa® 32-bit dual-core LX7 CPU
- 4 MB flash, 2 MB PSRAM
- 3.5mm Left / Right audio input
- 3.5mm Left / Right audio output
- Dual channel microphones
- 2.4 GHz Wi-Fi + antenna
- Bluetooth®, BLE + antenna
- USB
- Expansion header



Lesson Plans and Starter Projects

Jump-start your lab or course with ready-made projects.

Extensible software provided with common interfaces, minimizing the need for custom coding.

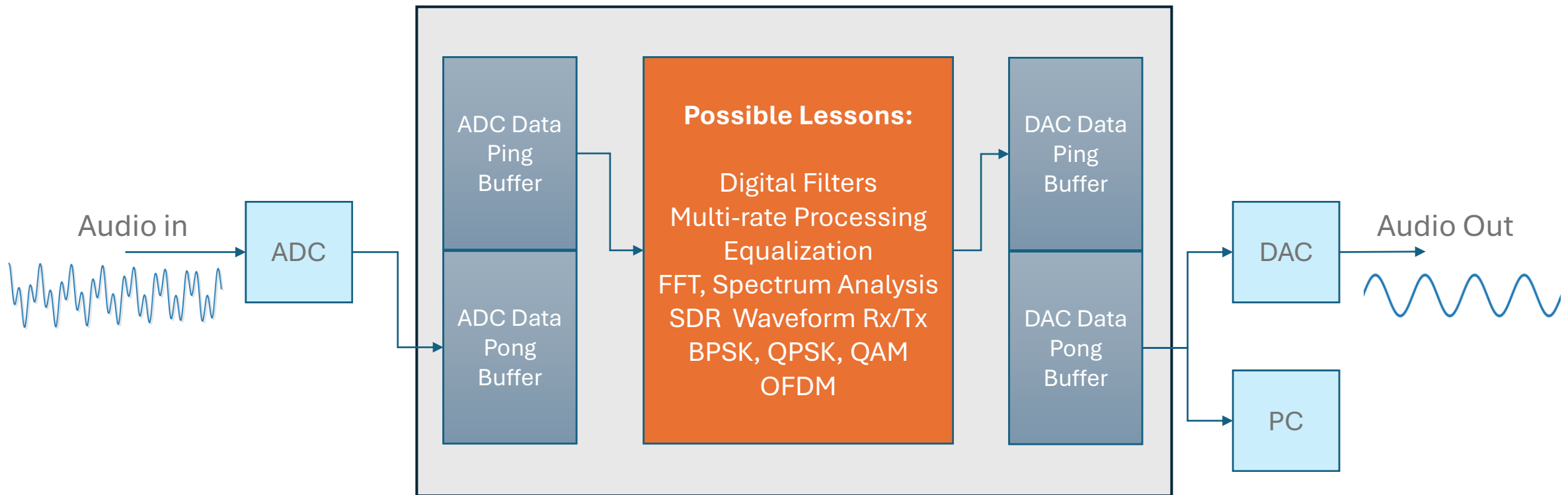


Features for University Courses and Labs

- Hands-on DSP and wireless with very low hardware cost.
- Curriculum fit: Intro Signal Processing, Software Defined Radio, Communications, Wireless Systems.
- All coding framework will be provided; students can engage without advanced programming knowledge.
- Lab Manuals, demo scripts and starter projects provided.

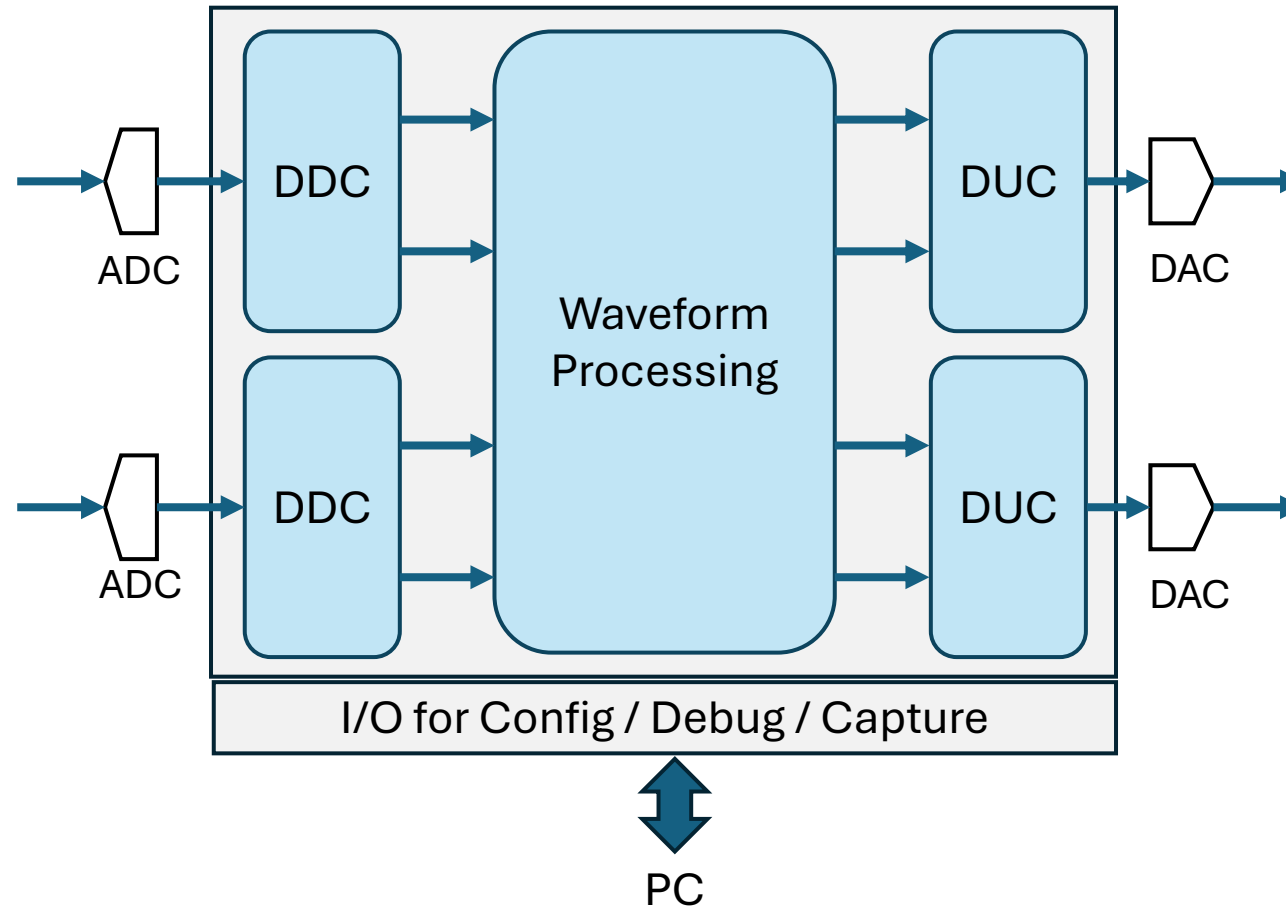
Core Platform Framework

Real Time DMA Streaming



Functional software for sample-by-sample DMA transfer from audio input to audio output, allowing for “drop-in” lessons customized to target learning experience.

Core Platform Framework

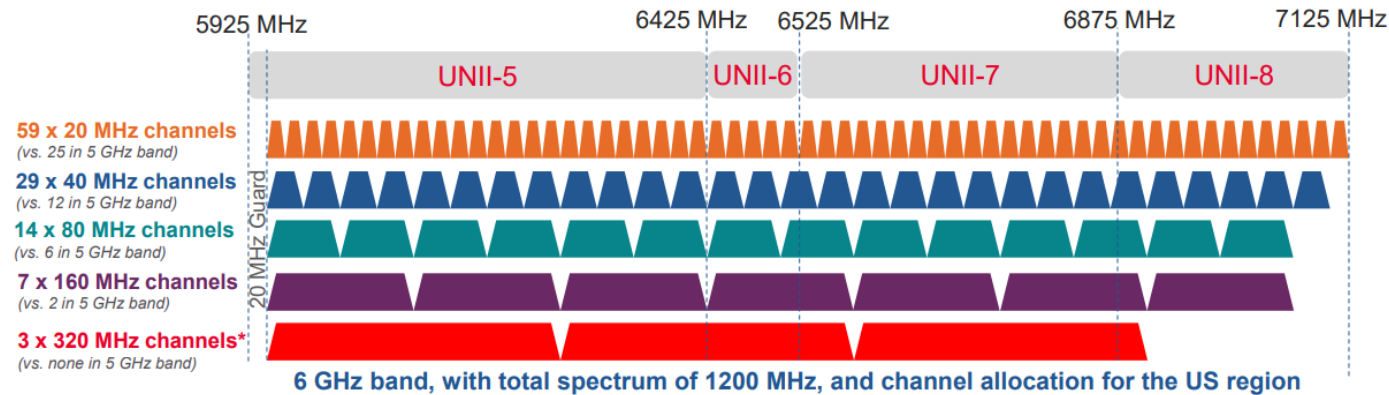


Digital Down-converters (DDC) and Digital Up-converters (DUC) can be part of core framework for baseband IQ processing or a learning activity in itself.

Dual channel audio inputs either from Line In connector or dual microphones.

Microphones spacing enables spatial signal processing (diversity, MIMO, beam-forming).

Signal Processing for Modern Waveforms

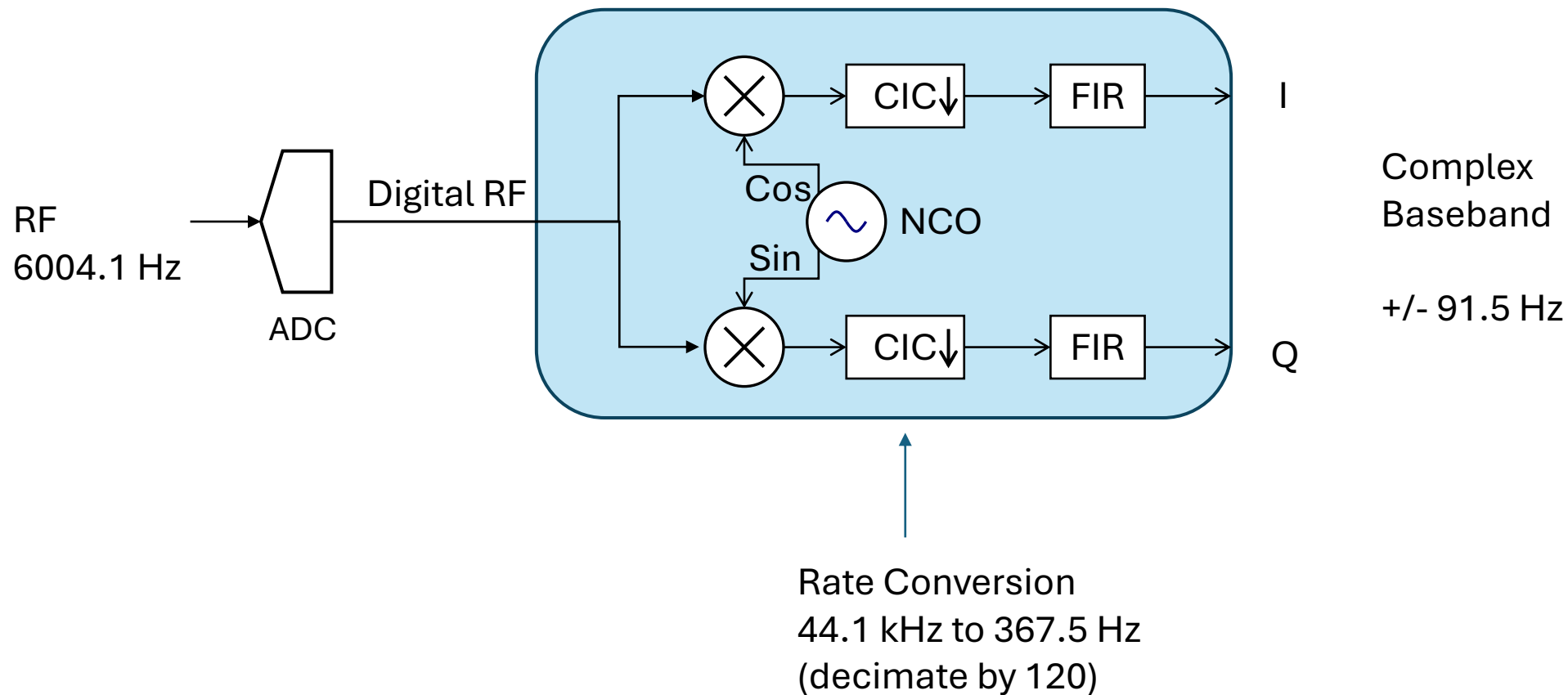


Frequency allocation for WiFi 7 (source: Keysight)

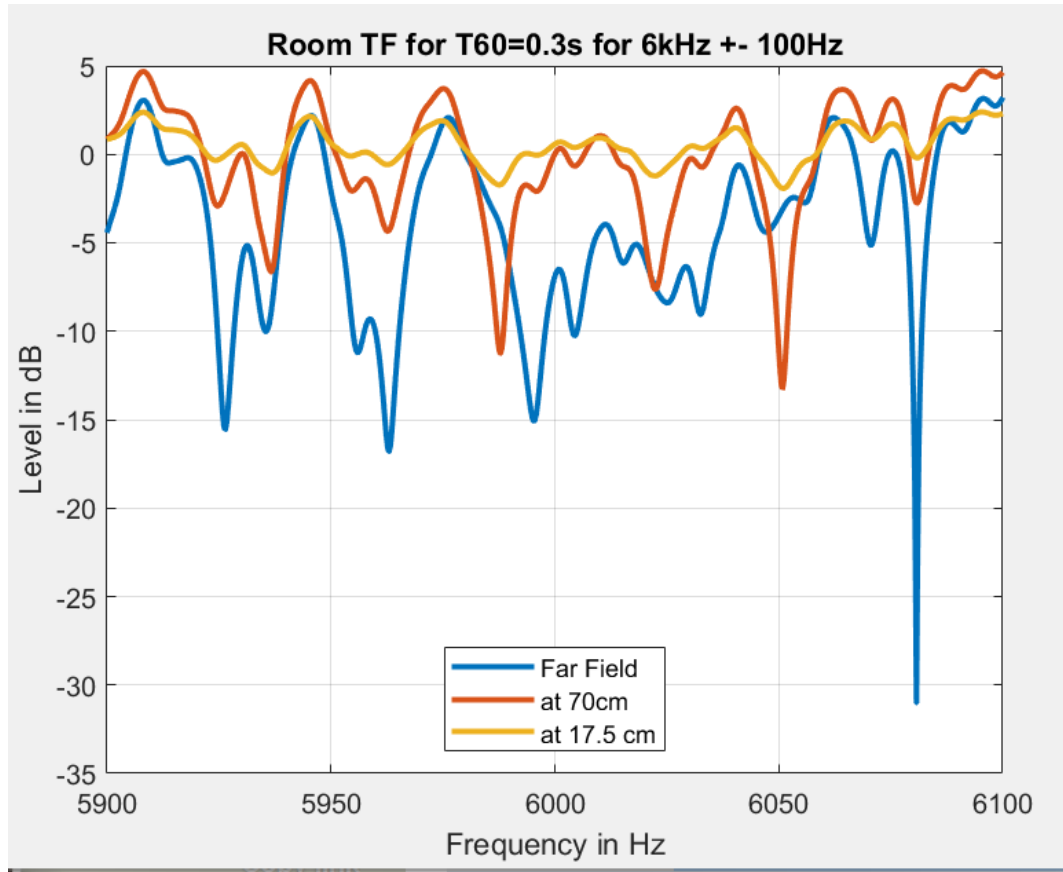
Example: Emulate a 160 MHz WiFi7 OFDM waveform

- Wavelength preserved scaling: similar delay spread for in the room communications
- In the 5 GHz band: Channel 50 (5.25 GHz) scales to 6004.1 Hz audio
- 160 MHz scales to 183 Hz total occupied bandwidth
- 2048 Bin FFT: Easily implemented on low-cost hardware given the 183 Hz symbol rate.

Digital Down Converter (Direct RF Assumed)



Acoustic Delay Spread at 6 kHz



Large surfaces result in similar multipath distortion ideal for demonstrating realistic equalization / compensation techniques.

Differences from RF: Surface reflectivity and object scale.

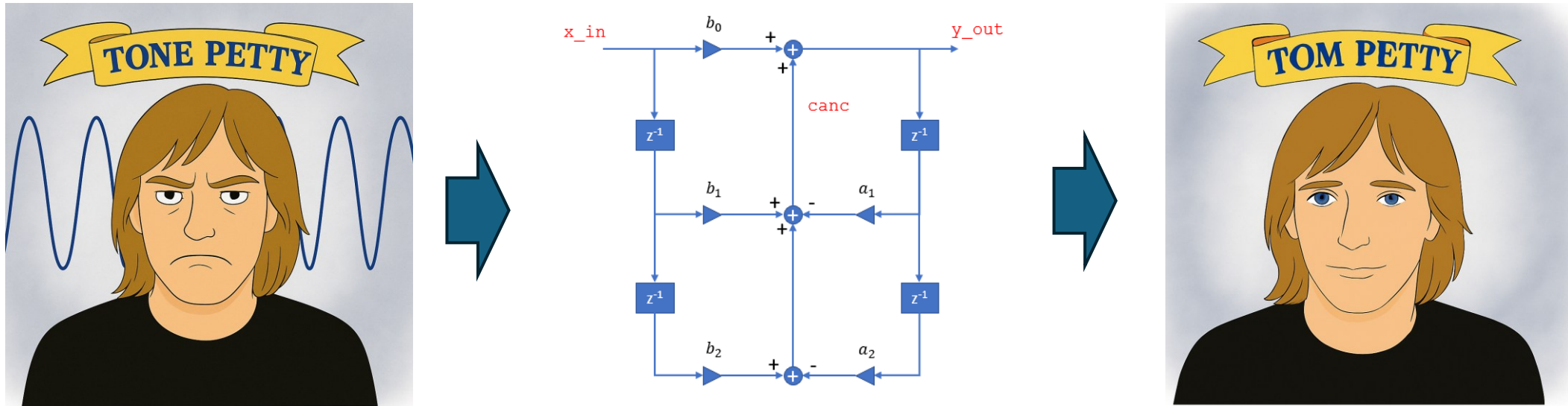
Scaled OFDM emulating 160 MHz BW:

183 Hz BW with 2048 sub-carriers:

*As at RF: challenging **frequency selective fading** becomes easy **flat fading**.*

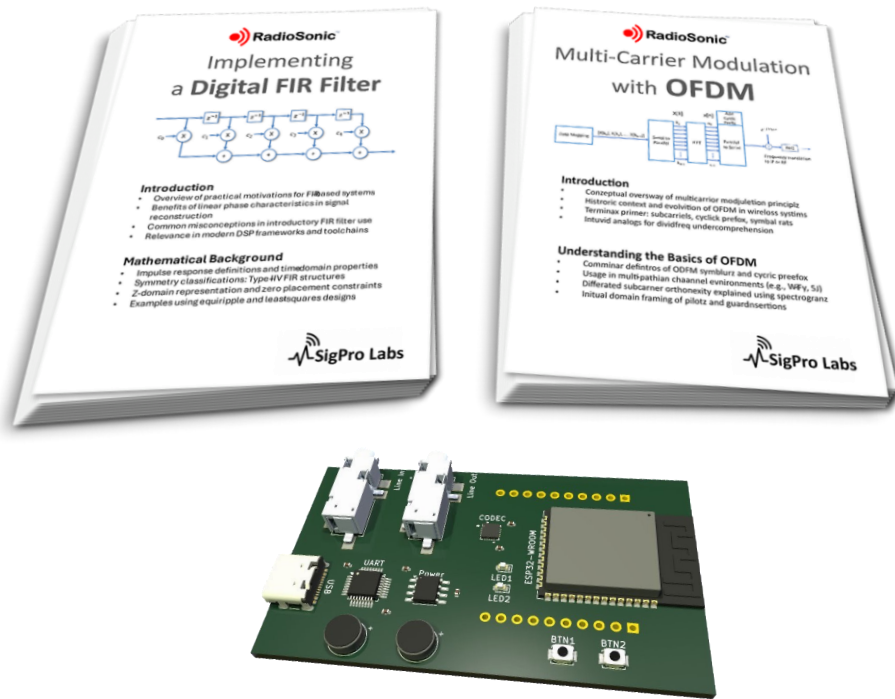
Learning Platform for Signal Processing

1 kHz Notch Filter



In addition to SDR, audio streaming enables relatable and fun signal processing demonstrations and lessons for introductory time and frequency processing (Fourier Transform, Z-Transform, Digital Filters).

Thank you!

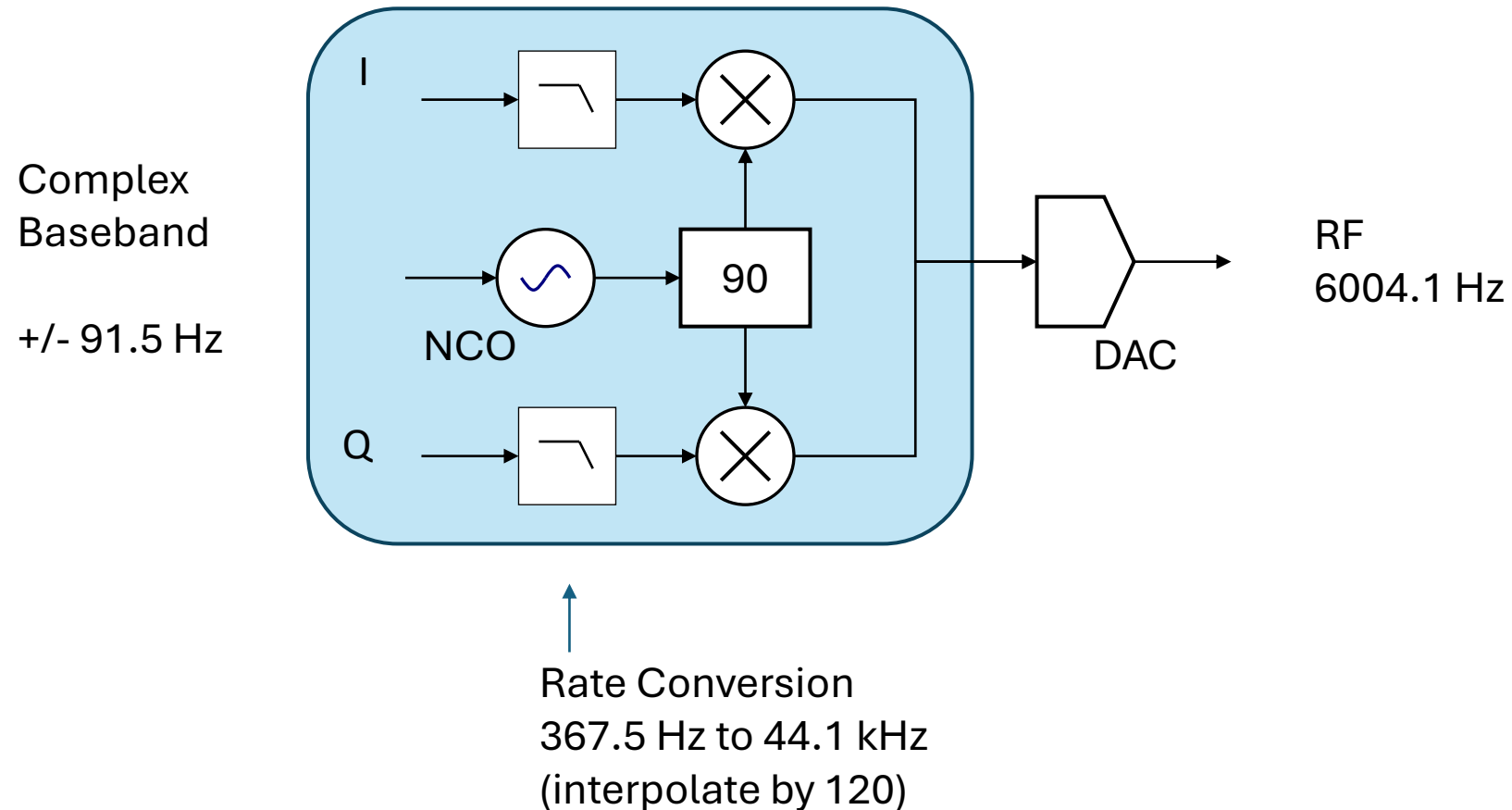


The RadioSonic Platform –
Combining fun with practical know-how
for signal processing education.

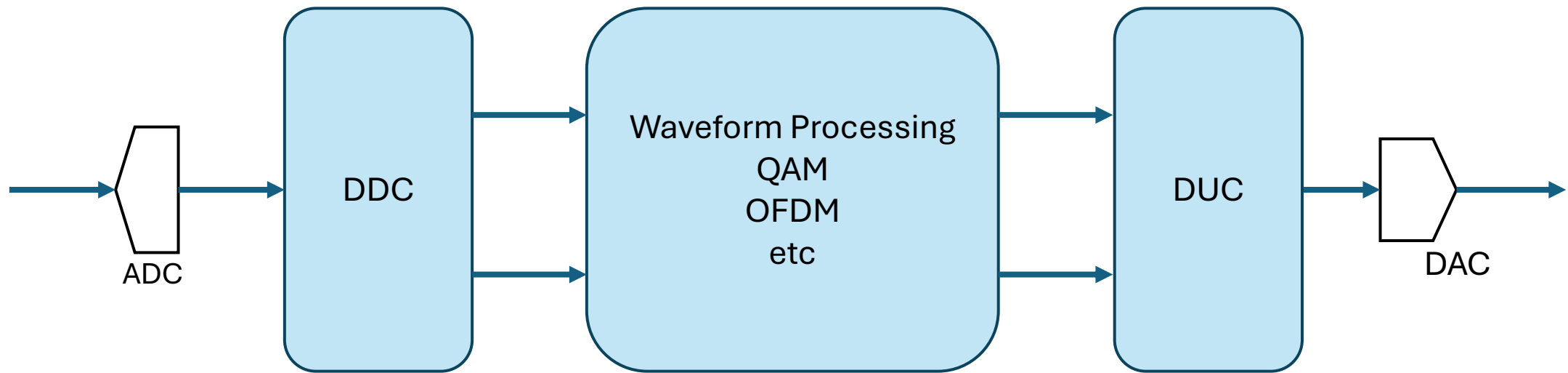
Contact us at info@SigProLabs.com
to get on our mailing list for product
announcements and waitlist signup.

Backup Slides

Digital Up Converter (Direct RF Assumed)



Rx and Tx Processing



Plug-and-play compatibility with Python and GNU Radio.