

Radio Frequency Noise Monitor

for the Dominion Radio AstroPhysical Observatory

Our Sponsors

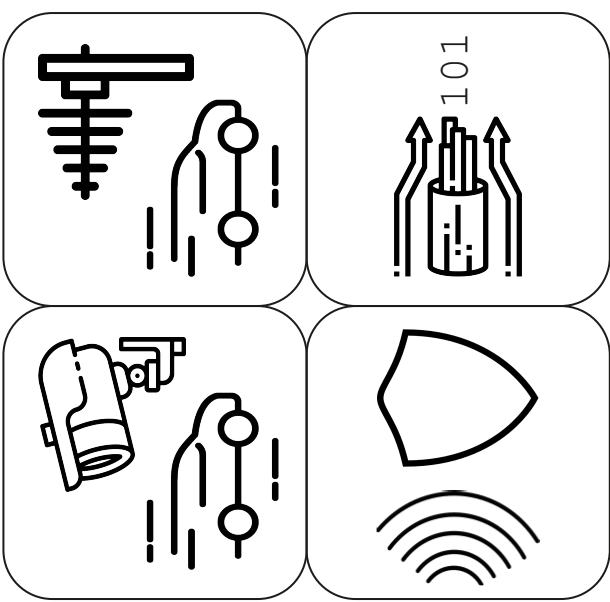
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Our Team

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Project # 2510



Motivation

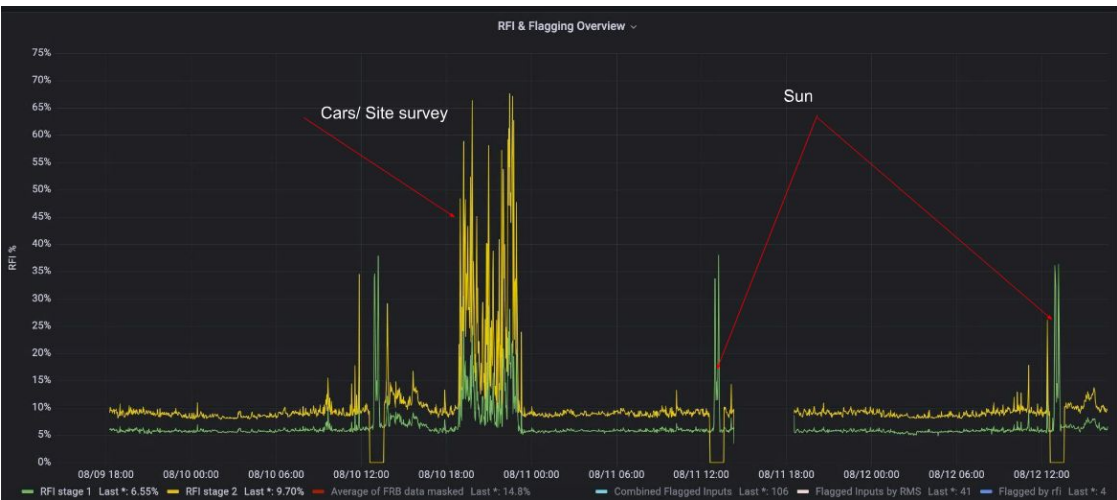
Background

The Dominion Radio Astrophysical Observatory, DRAO, is home to Canada’s largest radio telescope, CHIME, which collects emissions from the universe between 400-800 MHz with extreme sensitivity.



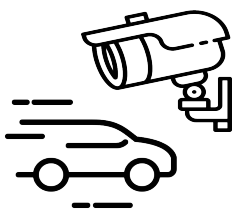
The Problem

Radio Frequency Interference (RFI) generated by vehicles on site disturb the telescope’s measurements.

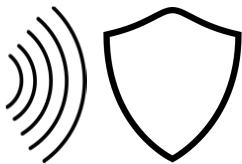


The Solution

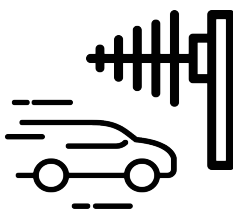
We designed a system that:



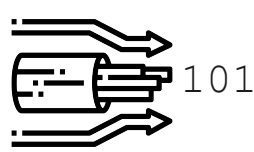
Detects the cars entering & passing by the telescope



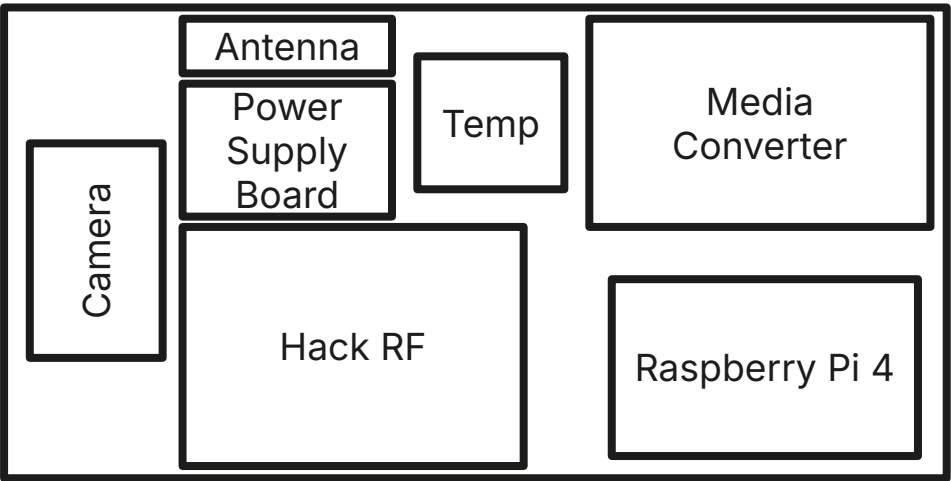
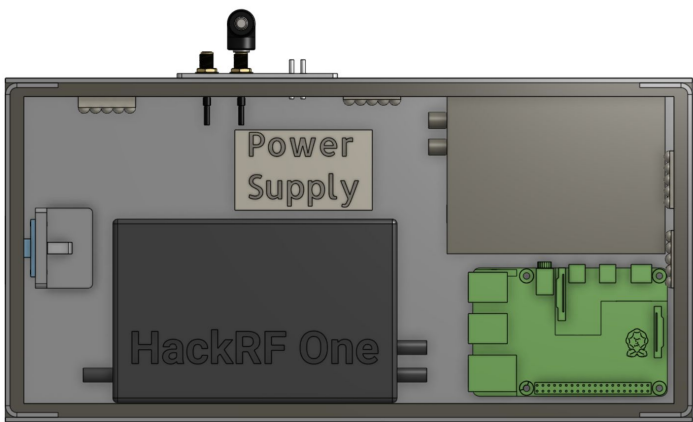
Emits no RFI itself and is protected in the environment



Captures cars’ RFI footprint in 400-800 MHz range



Reliably operates and exports data 24/7

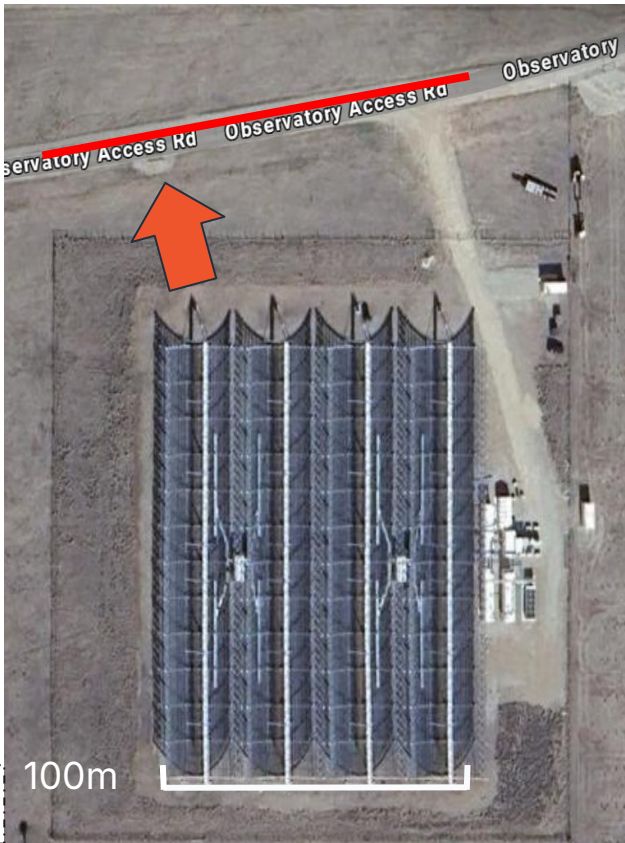
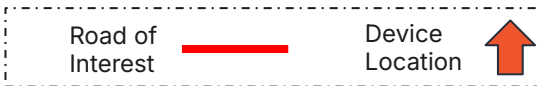
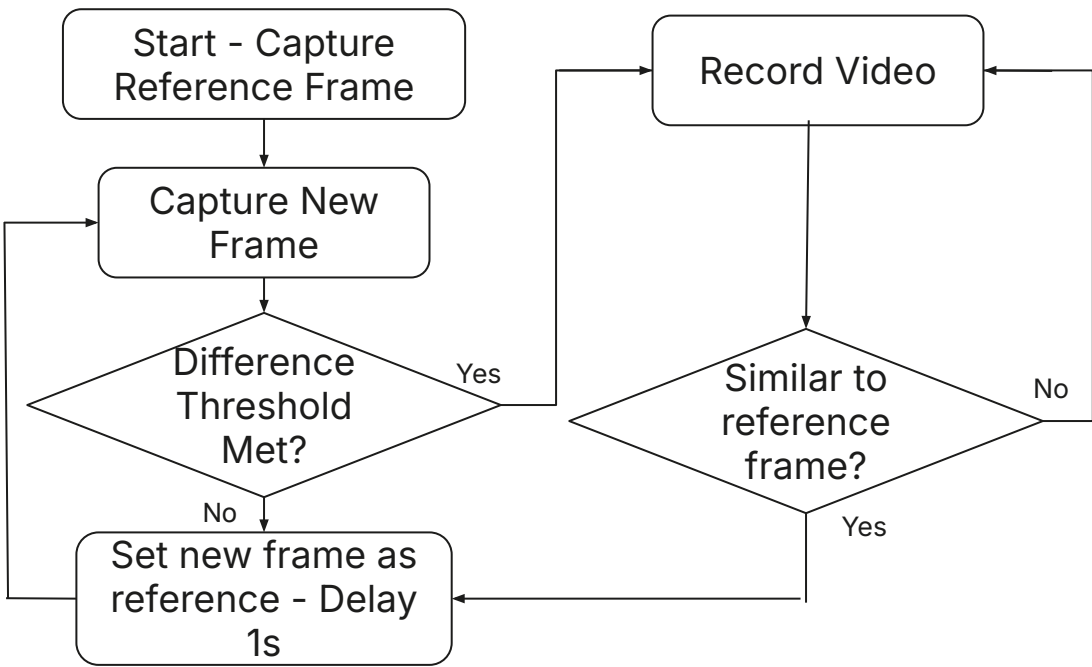


Our system, packaged in an RF-shielded box and protected against the elements and weather, will be installed on site at the DRAO observatory and connect to remote devices for monitoring and software maintenance.

Vehicle Detection



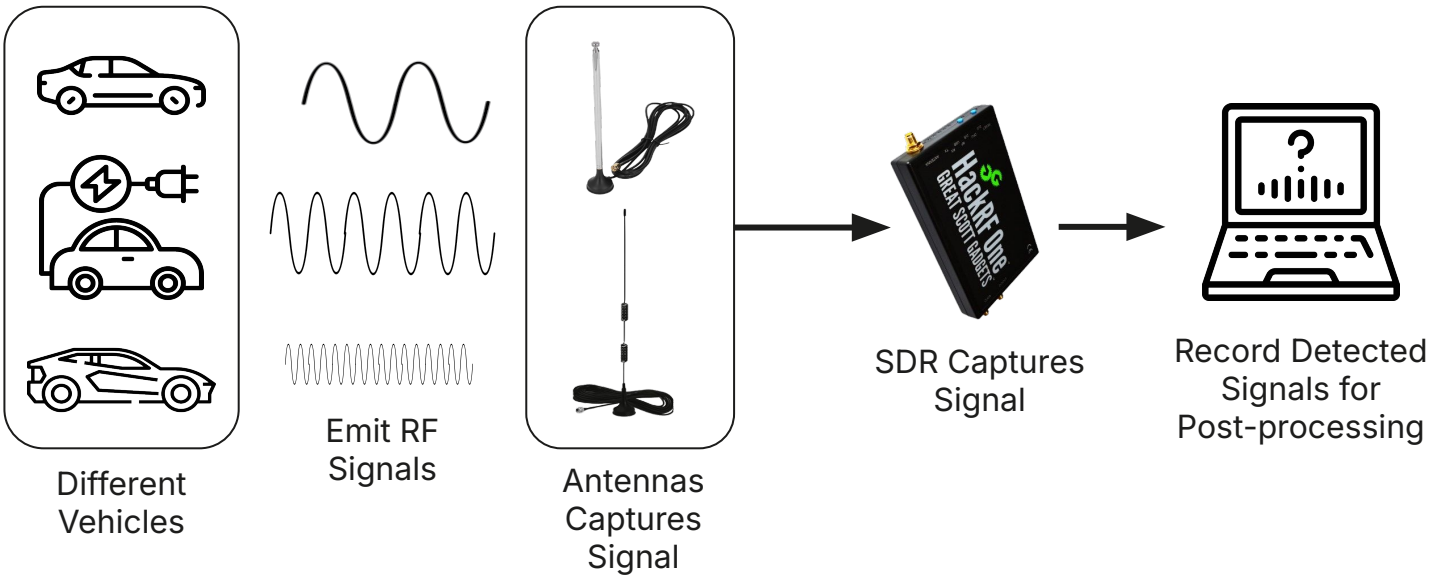
To detect vehicles on site and trigger, we implemented a motion detection system using a digital camera and a modified background subtraction algorithm.



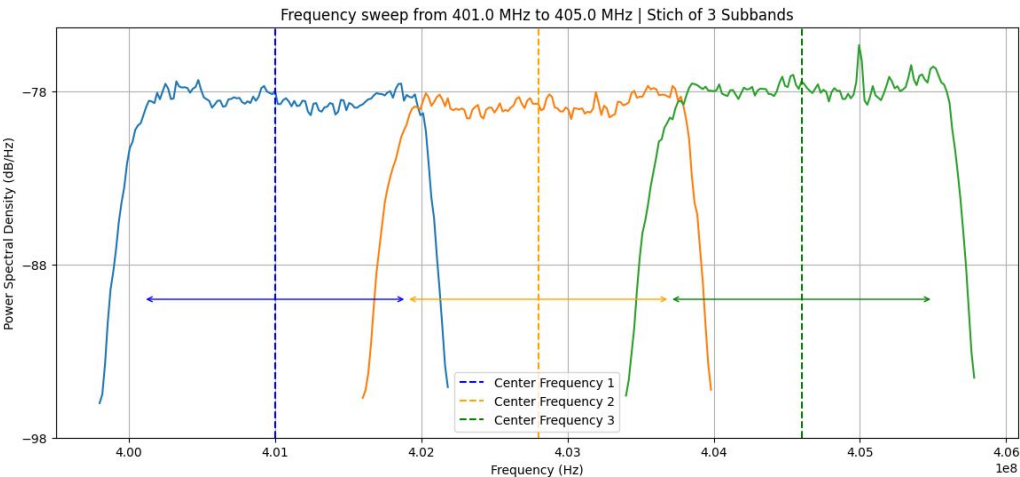
Vehicle RFI Footprint



To capture the RFI footprint of vehicles, we used a Software Defined Radio (SDR) to measure the RF signals and used signal processing algorithms to retrieve relevant information.



Sweep and Stitch



The SDR has a limited bandwidth of 20 MHz while the telescope has 400 MHz, so we used sweep algorithm to collect samples at smaller bandwidth and stitch the results in post-processing.

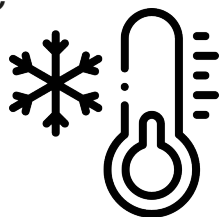
RFI Shielding & System Package



Since CHIME is very sensitive to any RFI emission, our system must be shielded without any RFI leakage. It must also be protected against environmental conditions.

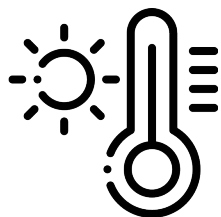
Mitigating Cold:

- Spec parts for -25°C



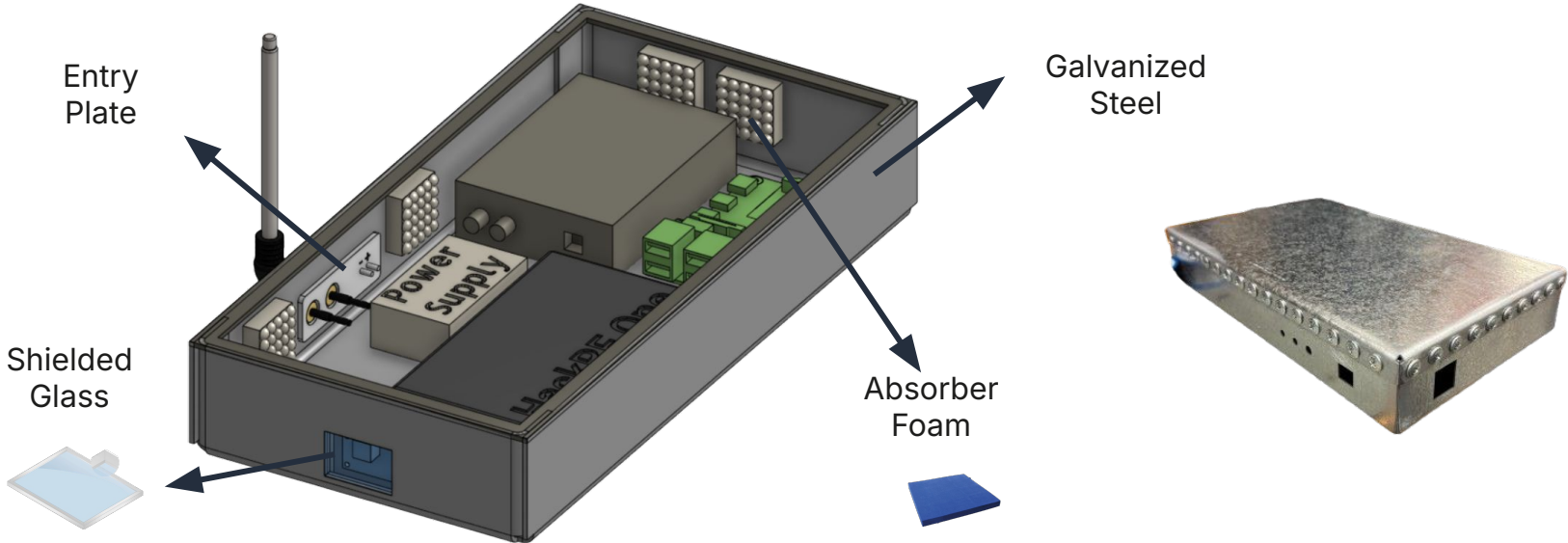
Mitigating Heat:

- Spec parts for 50°C

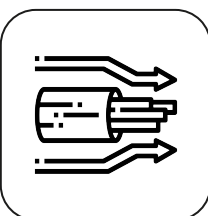


Rain and Snow:

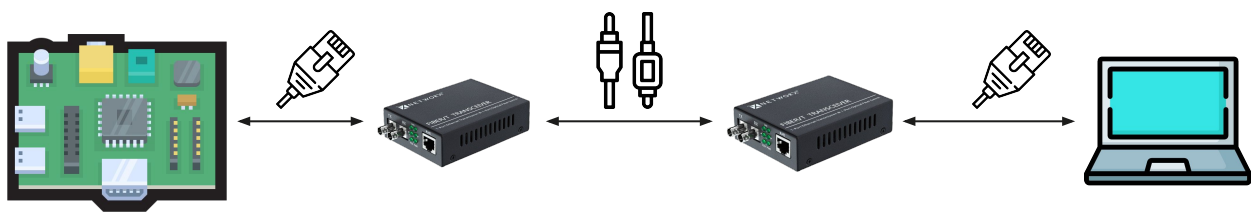
- Cover



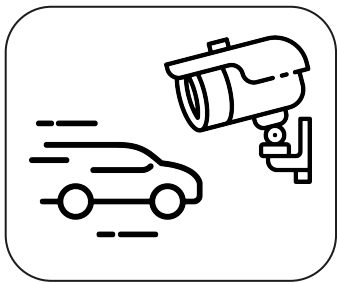
Data Communication



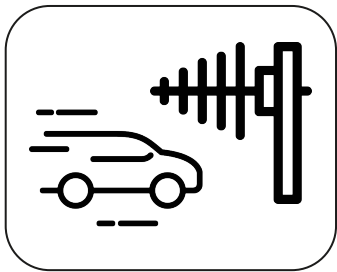
The Transmission Control Protocol (TCP) allows for remote communication with the box



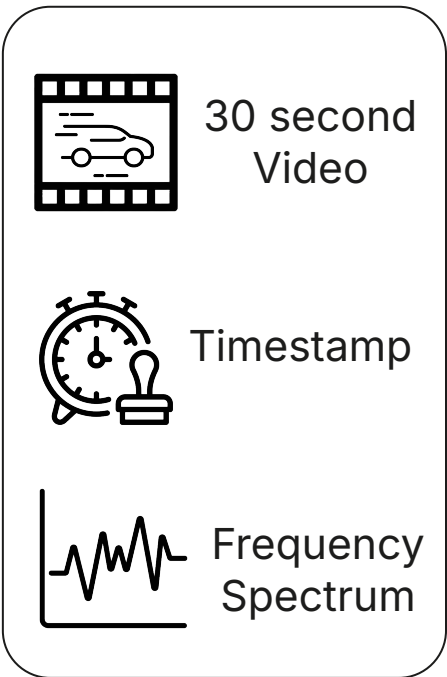
Collection, Storage, and Access



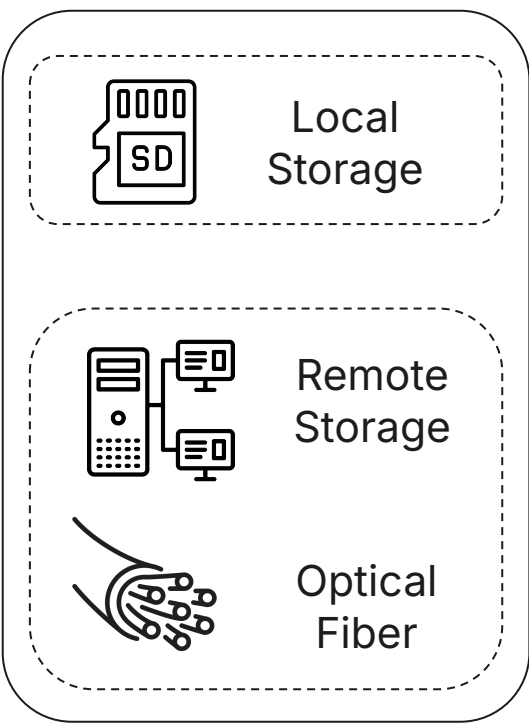
Car Detection



Frequency Detection

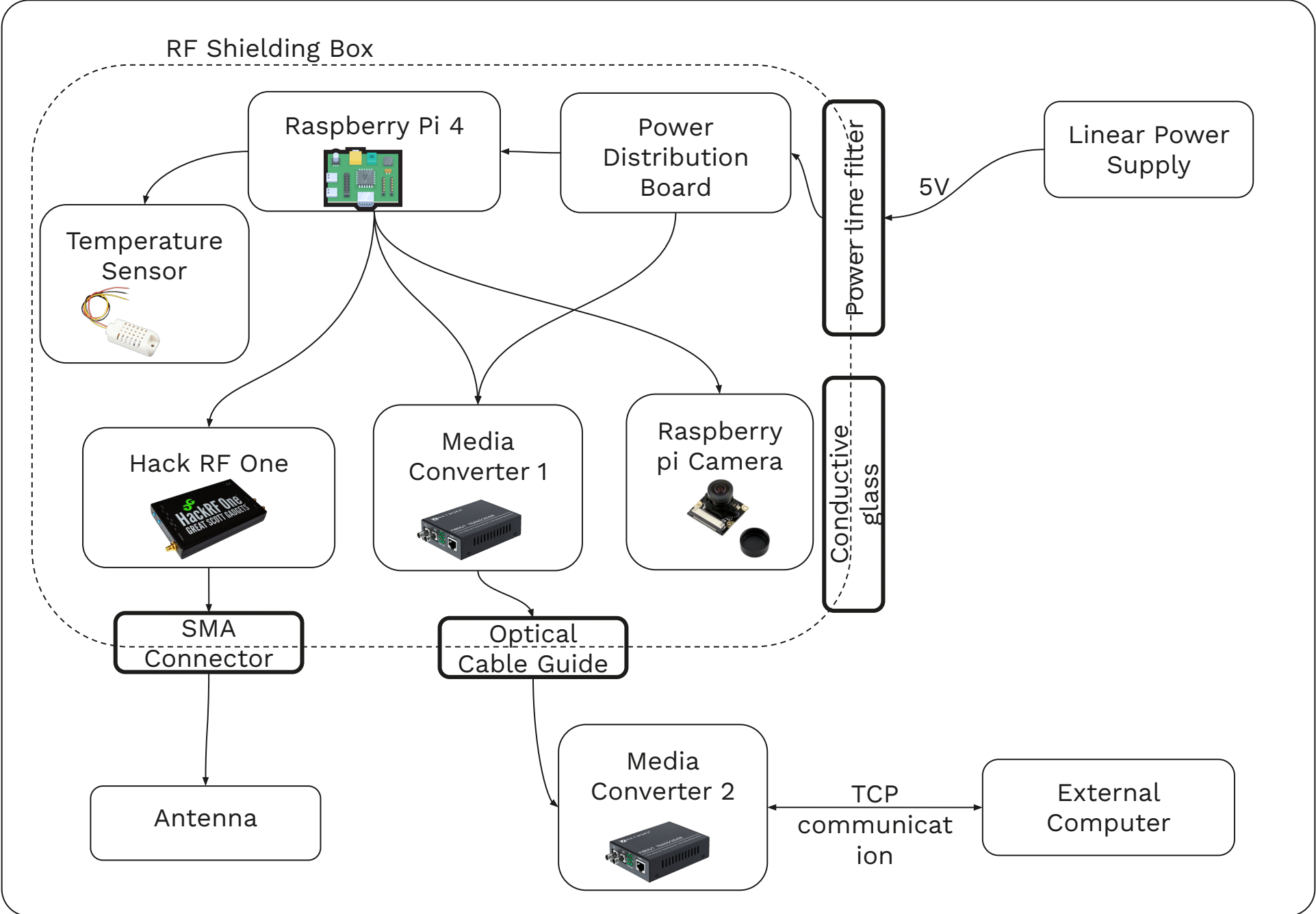


Collected Data



Storage and Access

System Level Diagram



Experiment Results

The graphs illustrate the signal detected from a car while idling. We observe a signal strength variation of approximately 10 dB, spanning a wide frequency range. These signals lie in the same frequency range as CHIME.

