The central component to our project is the USRP-2920 software defined radio (SDR). A traditional radio makes use of a number of filter and amplifier designs using discrete components and integrated circuits (ICs) to tune the resonance of the circuit to a desired frequency. An SDR takes advantage of modern transistor density to perform much of the signal processing needed in software instead of in hardware. SDRs are usually build around field-programmable gate arrays (FPGAs) that combine the speed and parallelism of monolithic circuits with the flexibility and ease of programming of code, usually a hardware description language. Instead of an integrated or discrete surface-mount circuit to perform filtering or other tasks huge numbers of individual logic gates are interconnected within the FPGA to complete the function. This allows a single SDR unit to possess a frequency range much larger than standard radios. Our system takes advantage of these properties to create a phased array of antennas performing angle of arrival estimation with a very limited RF front end; The only physical equipment needed other than the individual SDR units are antennas and the cables for them to interface with each other and the main computer. Phase alignment, clock synchronization, modulation and demodulation, and the direction finding algorithm itself is performed entirely in software. Duties are split between initial radio frequency processing using the onboard FPGA and more intensive signal processing on the primary computer.

A consequence of the increasing transistor densities that allow effective FPGAs is increasing heat density on microchips. This has led to the modern trend of decreasing power consumption for reasons of reliability. As nearly any integrated circuit consumes less power than its logical equivalent in discrete components with centralized processors even more so compared to individual ICs, SDRs are much more efficient than standard radios. This is of particular consequence to our project due to the expected deployment time off-grid. The intent is for receiver stations to be installed at a location to operate autonomously for multiple weeks of time before recovery. Reduction in power consumption results in reduced need for power production and capacity from onboard batteries and generators such as photovoltaic cells or wind turbines. The benefits of lessened power consumption cascade down the supporting systems and ultimately result in lower costs and higher reliability among other advantages.

As this project is largely inspired and encouraged by members of the Naval Sea Systems Command it reflects a cost-saving measure seen in many projects both government-funded and commercial: Commercial Off the Shelf (COTS) design. COTS emphasizes development of new products using hardware and software that is currently available on the market rather than custom one-off or application specific designs. Development costs for components are extremely high both financially and in work-hours spent. Purchasing a component that performs nearly or just as well as a custom design substantially reduces cost throughout the entire design cycle: from initial development and prototyping to quality testing for performance and reliability. Our project requires no specialized hardware past the SDRs themselves. While we have designed our own implementation of the Multiple Signal Classification (MUSIC) algorithm, there are a multitude of existing applications of the algorithm available for use if time to deployment of the system was a priority.