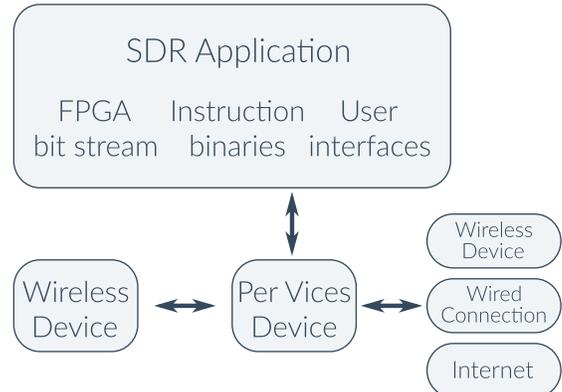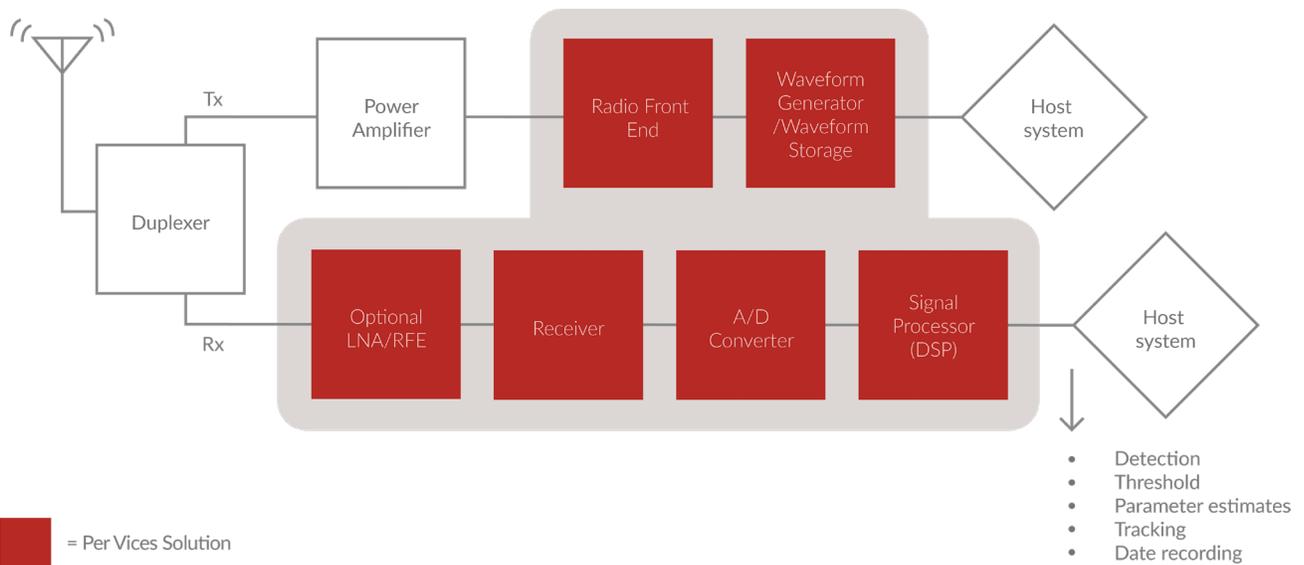Per Vices Corporation

## INTRODUCTION

Over the last several decades, there has been a lot of buzz around software defined radio (SDR). SDR are radio platforms that replace traditionally analog components for programmable digital components. With the recent advancements in SDR technology such as ease of integration, higher speeds and reliability, they have become an important consideration for radar systems. The ease of maintenance and set up of SDR's allow for seamless integration into any system.

## SDR USE IN RADAR SYSTEMS



SDR Application

FPGA bit stream    Instruction binaries    User interfaces

Wireless Device ↔ Per Vices Device ↔ Wireless Device / Wired Connection / Internet

## RADAR BLOCK DIAGRAM



- Detection
- Threshold
- Parameter estimates
- Tracking
- Date recording

█ = Per Vices Solution

## SYSTEM ARCHITECTURE

The figure displayed (above) shows a typical set up for a radar system where SDRs are incorporated. By integrating SDRs into your system, you have a fully integrated product that contains both the transmit and receive functionality required with the phase coherency and stability needed. The setup involves either a single or multiple host systems with the ability to send arbitrary waveforms or trigger pre-stored waveforms, on the SDR, with the output to either a single or multiple 50Ω SMA connections. This can be directly connected to your required power amplifier and transmitted. With the same SDR, you can also receive the reflected data, over multiple receive SMA ports, with optional increased low noise amplification, and convert the RF data into the digital domain. The FPGA on the SDR can further perform additional DSP or pass the data through to a host system for further analysis with your radar software.

## TRADITIONAL VS. SDR

| Traditional Platforms | SDR Based Platforms |
| --- | --- |
| Single application, would need to create a new platform for each applications | The same hardware can be implemented into many systems, developing code is inexpensive, and simpler than creating a new platform |
| Performance cannot be improved | SDRs can be tweaked, and different algorithms can be implemented to support newer standards |
| Limited frequency range | SDRs can be operated at multiple frequency bands simultaneously |

## TECHNOLOGY FEATURES
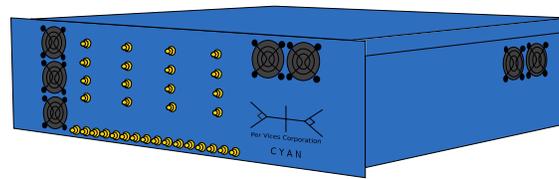


PER VICES STOCK PRODUCT

+

**FIRMWARE**
- Uses 8b10b encoding for in-band communication through control words
- On board data storage and transmission of arbitrary waveforms
- Signal processing can be handled using FPGA

**SOFTWARE**
- Support for latest Linux kernal drivers, mitigates large operating system induced latencies on most operating systems
- Can be managed remotely with numerous options for debugging and troubleshooting
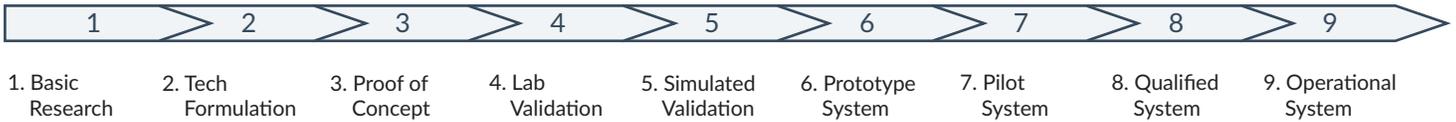
**HARDWARE**
- Supports beam forming with control of multiple transmission ports
- Preliminary filtering through RF ADC's allows direct downsampling increasing reliability and reducing cost
- Can operate at different frequency bands simultaneously, such as L band (1-2 GHz) S band (2-4 GHz), and C band (4-8 GHz)

=
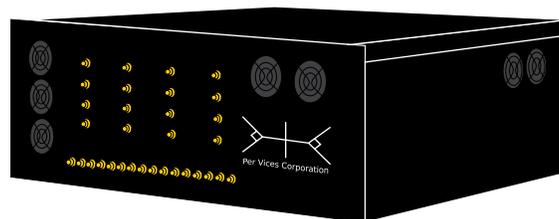


PLATFORM FOR CUSTOMER
SPECIFIC APPLICATION

# TECHNOLOGY READINESS LEVELS

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| 1. Basic Research | 2. Tech Formulation | 3. Proof of Concept | 4. Lab Validation | 5. Simulated Validation | 6. Prototype System | 7. Pilot System | 8. Qualified System | 9. Operational System |

Technology Readiness Levels (TRLs) were established by NASA, and are used by government institutions and companies globally to enable uniform discussions of technical development and maturity across different technologies. Per Vices makes the only customer-validated SDR platform that supports manufacturers from ideation through full production.

| Competitor Product | 1 | 2 | 3 |
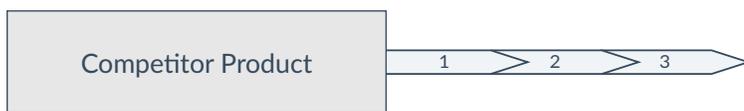
The closest alternative to Per Vices products lacks flexibility, reliability and performance that customers require to develop wireless systems past the initial testing and Proof of Concept phase.

## Customers Switch To Per Vices For:
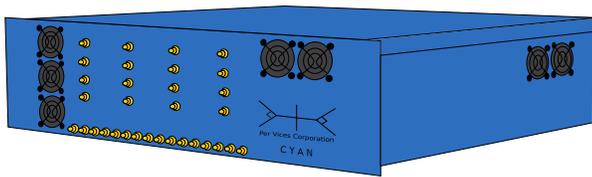


- Maximum flexibility - the ability to continuously update requirements and specifications as the design is refined.
- Easy integration - built-in connectors and tools that securely link harwdare, data feeds, etc. into broader system design.
- Extensible performance - powerful, modular, software-driven features ramp up platform capabilities as needed. Per Vices products take you right from basic research all the way to the operational system phase on the TRL scale.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

## COMPETITIVE MATRIX

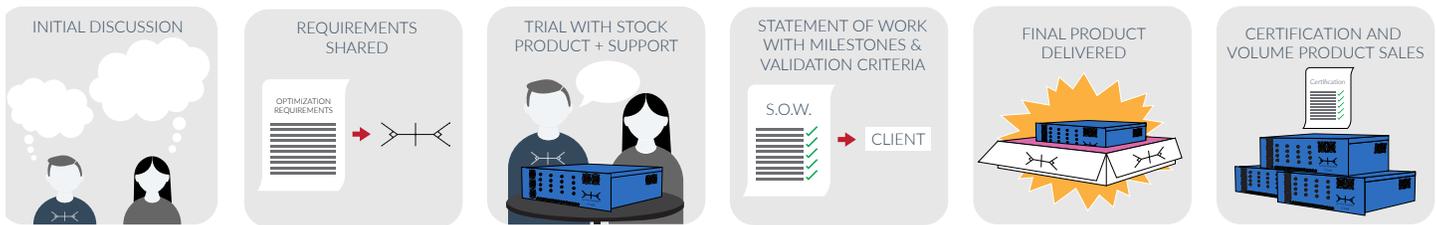|  | Per Vices SDR | Component Providers | Application Specific SDR Providers | Test & Measurement Equipment Providers | Hobbysit SDR Providers |
|---|---|---|---|---|---|
| Integrated Platform | Yes |  | Yes | Yes | Maybe |
| Full Customizable | Yes | Yes |  |  |  |
| Production Performance | Yes |  | Yes | Yes |  |
| Software IP Support | Yes | Yes |  |  | Yes |
| Maintenance Support | Yes |  | Yes |  |  |

## MAJOR DIFFERENCES

Traditional hardware-defined radios, with specialized analog signal processors, are single purpose and difficult to modify. In contrast, Software Defined Radios (SDRs) have more flexible signal processing components that are designed to run on high-speed embedded systems. Each SDR Application is an arrangement of the field-programmable gate arrays (FPGAs) on the radio working in place of the hardware components. Changing the SDR application changes the FPGA layout allowing the SDR to change it's internal behaviour as if it had a whole different set of circuitry!

## TECHNICAL SPECS

Our Crimson and Cyan products can be a valuable component of any radar system. The products possess a very high receive sensitivity of -87 dBm, and the units impart very little noise to the system with a noise figure of 3.1 dB. The products also showcase their sensitivity through their dynamic range with an SFDR of 47 dB. This performance is not limited to a small operating range either, our products can have an operating frequency of anywhere from near DC to 6GHz and can be extendedbeyond up to 18GHz. This allows for flexibility across any radar band without sacrificing performance. These specifications allow for the optimal performance that can be expected from our products.

## PER VICES COLLABORATIVE PROCESS



| INITIAL DISCUSSION | REQUIREMENTS SHARED | TRIAL WITH STOCK PRODUCT + SUPPORT | STATEMENT OF WORK WITH MILESTONES & VALIDATION CRITERIA | FINAL PRODUCT DELIVERED | CERTIFICATION AND VOLUME PRODUCT SALES |

## KEY POINTS

Per Vices is focused on delivering high-quality radios that are more commercially applicable - even for use in mission critical infrastructure. The application of our SDRs can have a tremendous impact on your radar system, increasing sensitivity and data throughput. With Cyan and Crimson, you can design a reliable, long lasting radar system that is easy to configure and update to suit your evolving needs.

## WORKING TOGETHER

Please contact us at solutions@pervices.com to learn more about how we can help you. Following our initial discussion, our team will support you throughout the whole process, from a trial with a stock product, to developing out specific requirements for a statement of work, all the way to the volume integration and certification stage. Our engineers work with you each step of the way to ensure it's a smooth and easy integration of our product into your systems.