WHITE PAPER

Per Vices Corporation
High Performance SDR for Low Latency Systems

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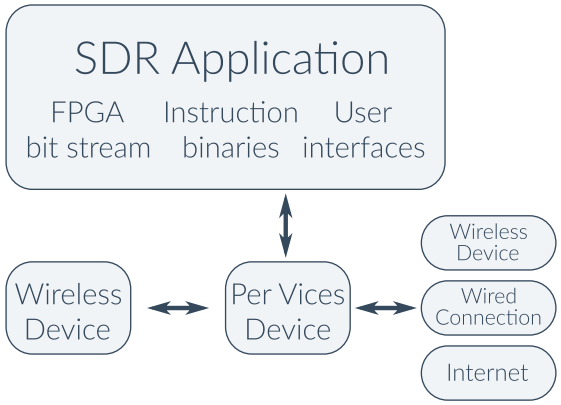
INTRODUCTION

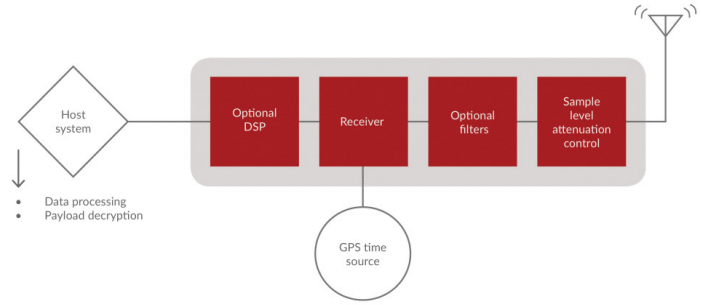
Over the last several decades, there has been a lot of buzz around software defined radio. The market demand for low-latency systems has been gradually growing. Most systems today are not designed with latency considerations in mind. Recent improvements in SDR technology (such as better integration, high speed digital back-haul) make them an important consideration for a broad range of low-latency systems. The versatility of SDRs make them easily adaptable and programmable to provide latency optimizations for existing projects.

USE IN APPLICATION

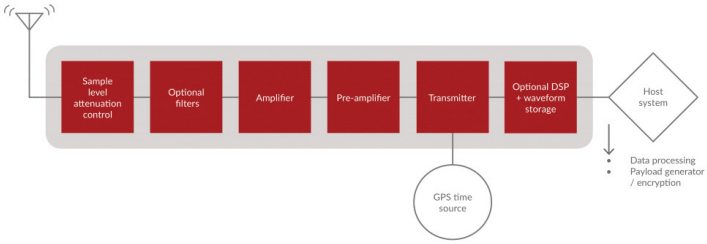


Traditional Platforms	SDR Based Platforms
Single purpose	Software modules, maybe applicable to multiple parts of your system
Limit range of frequencies	Multiple frequencies, simultaneously
Performance is tied solely to the analog circuitry	SDR applications can be tweaked for better algorithms and to support newer standards/data forms

BLOCK DIAGRAM RX



BLOCK DIAGRAM TX



= Per Vices solution

SYSTEM ARCHITECTURE

The block diagrams (left, below) show a typical network with different locations for the transmit and receive equipment. Network packets, containing a payload are transmitted from one endpoint and received at the other. By integrating SDRs into your system, you can reduce the latencies experienced on both ends of the systems.

During transmission, the SDR can offer additional DSP storage as alongside the Tx radio front end, pre-amplifier, amplifier, filters, and attenuation control. A custom digital backhaul (offered through the SDR itself!) may be used to increase the network throughput.

When receiving a signal, using a high sampling frequency allows you to capture more data-points so you can avoid having to do more processing later on. Aside from the Rx radio front-end, we again offer other similar improvements; attenuation control filters, a specialized receive radio chain and optional DSP.

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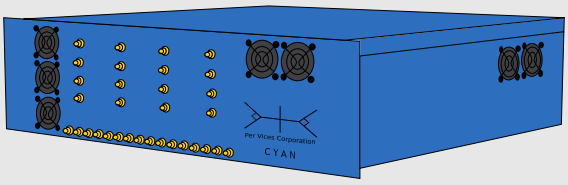
TECHNOLOGY FEATURES



PER VICES STOCK PRODUCT

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FIRMWARE

- Uses 8b10b encoding for in-band communication through control words
- On board data storage
- Additional customization to on-board DSP can offload complexity to FPGA

SOFTWARE

- Signal sampling with higher degree of precision = less complex processing system. Cyan's RF Chain can sample 1 GSPS with 16 bit resolution
- QPSK Modem designed specifically for low-latency point-to-point applications
- Efficient tuning: Tunes to different frequency within 2ms (fast tuning support for 40us)

HARDWARE

- Support for latest Linux kernal drivers, mitigates latencies introduced by large operating systems in most systems
- Can be managed remotely with numberous options for debugging and troubleshooting

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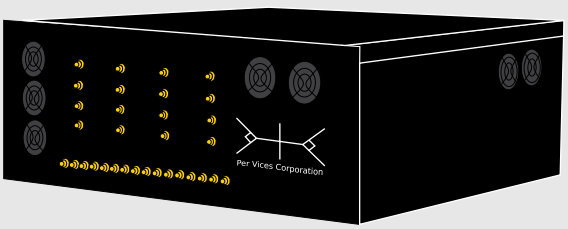

PLATFORM FOR CUSTOMER
SPECIFIC APPLICATION

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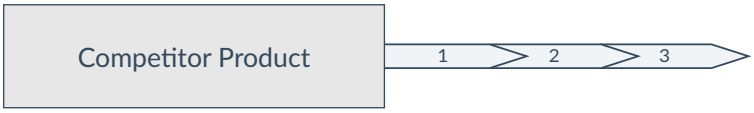
TECHNOLOGY READINESS LEVELS

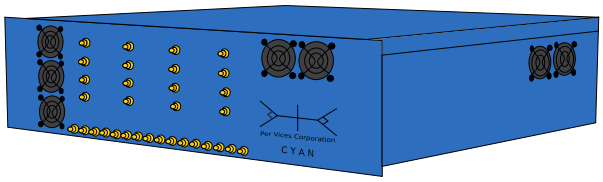
1. Basic Research
2. Tech Formulation
3. Proof of Concept
4. Lab Validation
5. Simulated Validation
6. Prototype System
7. Pilot System
8. Qualified System
9. Operational System

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.



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.

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		

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TECHNICAL SPECS

As a baseline, our stock Crimson TNG product can transfer a user payload across a 10Gb Ethernet link. After accounting for FEC correction checksums and encoding, this provides an effective user payload throughput of 227bps at a bandwidth of 10kHz. And this is just the beginning! Customizing the modem, link management and sensitivity improvements alone have been shown to improve these figures by up to 60%.

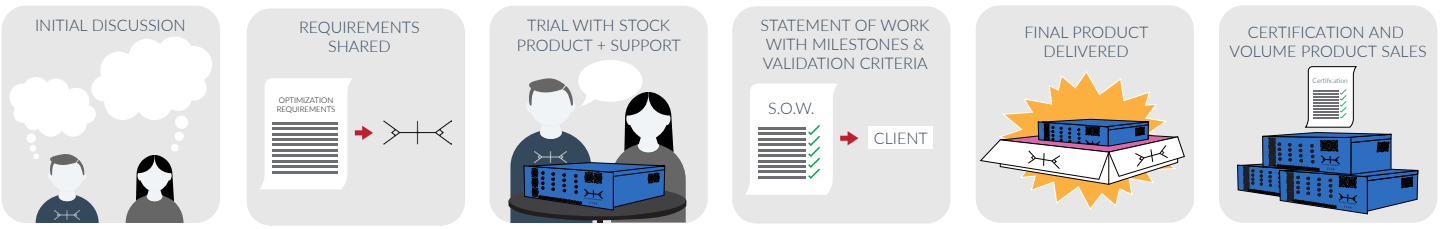
Our new Cyan platform is designed to work on a 40Gb Ethernet link. At 10MHz bandwidth, the device has a latency of only 4/5* (the speed of light). With it's improved processor and an increase in the number of configurable parameters, even more is possible!

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! This allows for trade-offs between reliability/latency and for algorithms to be updated frequently.

PER VICES COLLABORATIVE PROCESS



KEY POINTS

Per Vices is focused on delivering high-quality radios that are more commercially applicable - even for use in mission critical infrastructure. The low latency capabilities of our SDRs have aided in the construction of point-to-point networks. These networks have a tremendous benefits for distributed data transfers, civil & defence communications, and high-frequency trading alike. In the past, low-latency development was difficult, costly, and required lots of in-house development, but it doesn't have to be this way. Both Cyan and Crimson were designed from the bottom up with latency consideration at every stage of development.

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 link establishment for sending and receiving data at very low latencies. 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.