WHITE PAPER

Per Vices Corporation

Per Vices Corporation
High Performance SDR for Global Navigation Satellite Systems

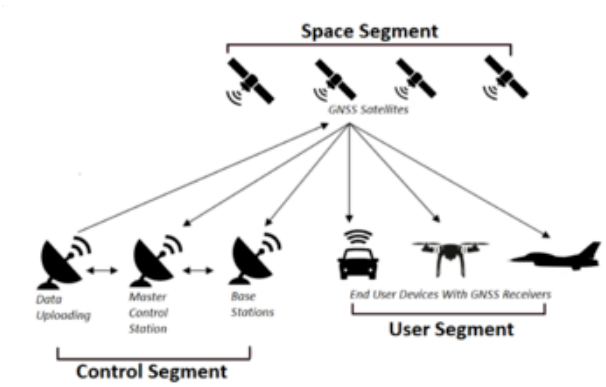
INTRODUCTION

Software Defined Radio (SDR) is an RF solution that can include transmit capability, receive capability, or both. For transmit, waveforms are generated in software, then passed through a DAC to a flexible radio front end (RFE) before transmission. Conversely, for receive, the signal passes from the RFE, through an ADC, to the software to be decoded.

The use of a DAC or ADC allows waveforms of any frequency (up to the limit of the converter) to be generated or interpreted. This is in contrast to a traditional radio, where a comparatively narrow band is able to be tuned. This is just one of the many benefits of SDR.

Overall, the two way communication enabled by SDRs allows for both digital and analog signals to be generated, sent, received, and stored, all with one platform. Per Vices SDRs can be integrated into larger systems, as a simple turnkey solution for many RF applications.

SDR USE IN GNSS



SDR can enable the functionality of both the control, and the user segments, as seen above in global navigation satellite systems. Per Vices SDRs are compatible with all the major GNSS currently used, including GPS (USA), Galileo (EU), GLONASS (Russia) and BeiDou (China).

TRADITIONAL VS. SDR BASED PLATFORMS

Traditional Platforms	SDR Based Platforms
Bulky, requiring several dedicated hardware devices	Modular, compact, single unit
Hardware defined, upgrades complicated and expensive	Software defined, enabling flexibility, versatility, configurability and ease of integration
Limited flexibility for improved accuracy	Increased accuracy using RTK
No onboard FPGA resources	Onboard FPGA resources

SDR replaces the need for extensive dedicated hardware in GNSS, allowing for system upgrades through software. Traditional platforms also do not have the FPGA resources available with an SDR solution. GNSS SDR transceivers' FPGA resources play a vital role in maximizing the capabilities of the system. In addition to providing very high processing power, an FPGA can independently process multiple signals simultaneously, and provides the ability to modify the firmware to work with different constellations and in different applications. The FPGA provides a reliable connection directly from the chip to any data source or data end. This creates links with very low latency and allows for very high bandwidth.

SDR USE IN GNSS BLOCK DIAGRAM

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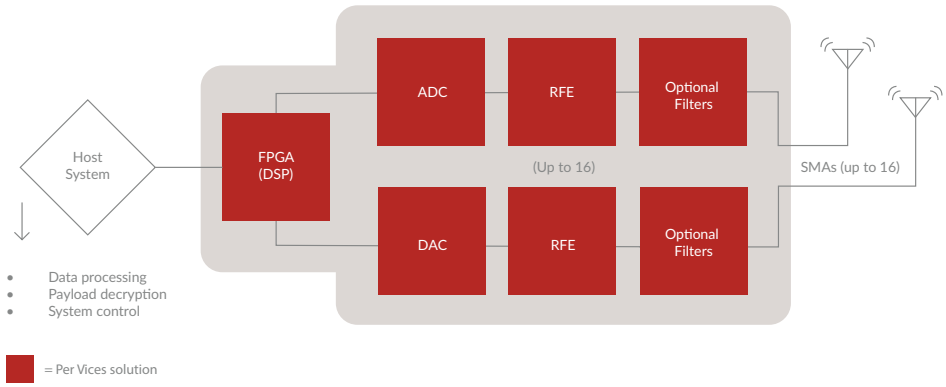
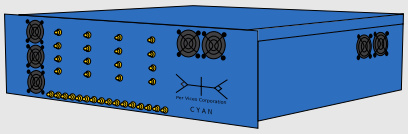


In the SDR's receive chain (left), the incoming signal is fed through a low-noise amplifier, followed by a series of filters and mixers before being digitized for further processing. Higher quality radios have higher quality RF front-ends and are better at locking signals, even when they are weak. Having a nice clean signal digitized quickly means that more of your processing can be done in software.

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
- Different IP cores enable different types of (de)modulation to be performed on the FPGA or host system
- Efficient tuning enabling switching to different frequencies within 40us

HARDWARE

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

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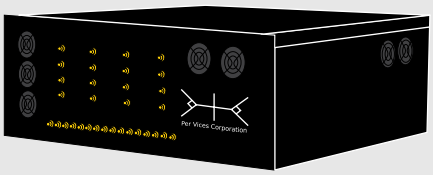

PLATFORM FOR CUSTOMER SPECIFIC APPLICATION

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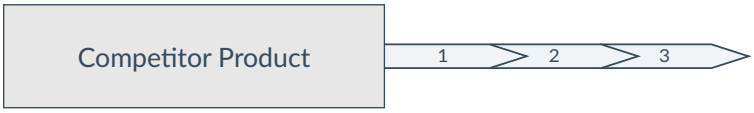
TECHNOLOGY READINESS LEVELS

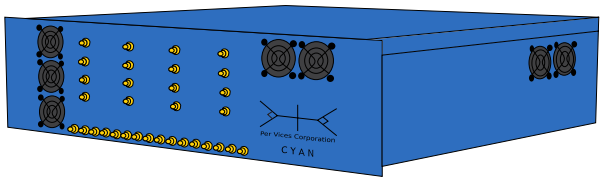
1. Basic Research
2. Tech Formulation
3. Proof of Concept
4. Lab Validation
5. Simulated Validation
6. Prototype System
7. Pilot System
8. Qualified System
9. Operational System

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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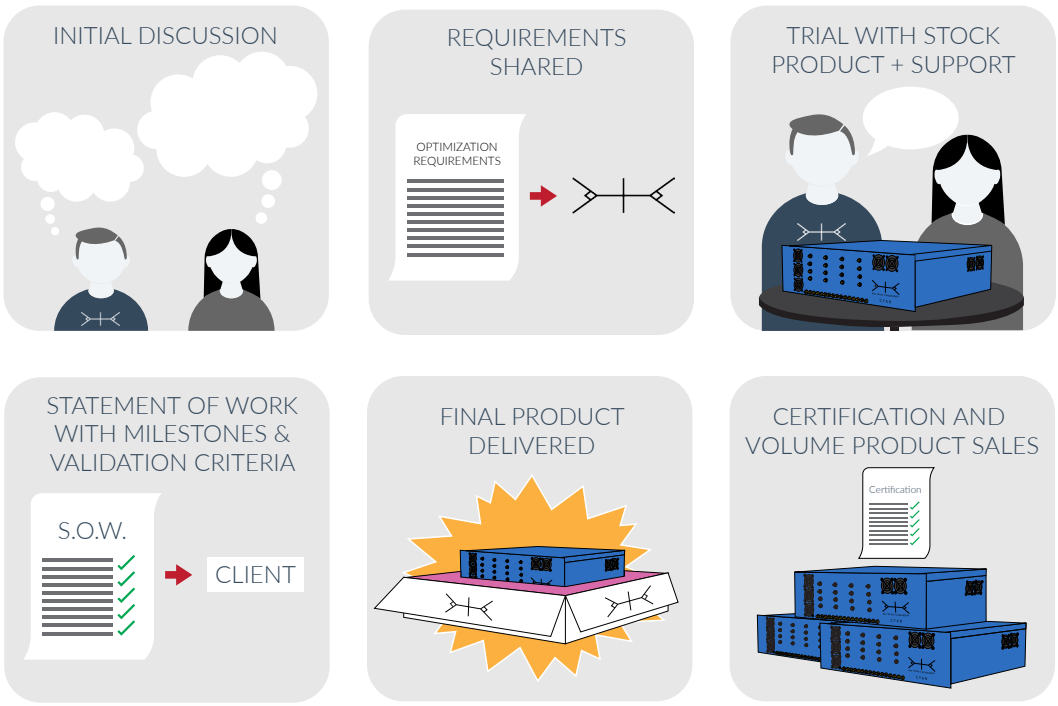
PER VICES COLLABORATIVE PROCESS



KEY POINTS

Per Vices focuses on delivering high-quality radios that are more commercially applicable - even for use in mission critical infrastructure. With a rise in the importance of GNSS, RF equipment is expected to operate on a greater number of bands (GALILEO, GPS, GLONASS, etc). Operating environments or the bands themselves might be contested. Signals might be weak or there might be interference. SDRs with low-latency, high-bandwidth enable dynamic simulations and reduce positioning delays. Per Vices radios are designed for congested or contested environments over a wide range of signal bands – with special considerations for the ones used for GNSS. Our interface rejection and RF interference protection techniques allow for easy filtering and channel rejection even when the channels are adjacent.

TECHNICAL SPECS

Software defined radio integration into GNSS enables precision, flexibility, time accuracy, ease of integration, fast convergence times, high sensitivity, signal accuracy, various frequency ranges, low latency, interference rejection, FPGA resources, and the ability to upgrade the system through software.

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.

More information is available at www.pervices.com.
If you have any questions, please contact us at solutions@pervices.com.