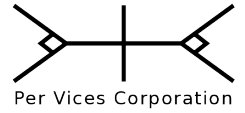


WHITE PAPER

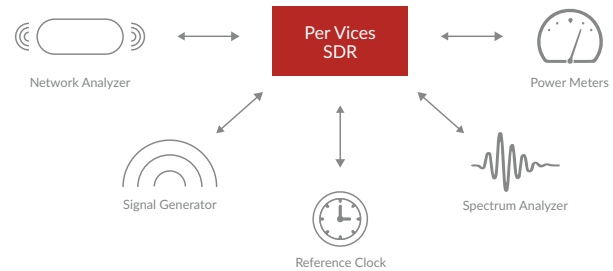
Per Vices Corporation
High Performance SDR for Test and Measurement



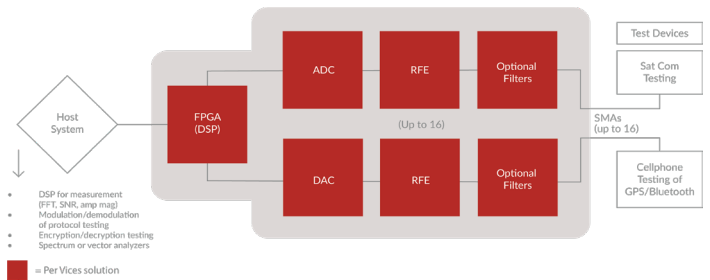
INTRODUCTION

Wireless devices have been omnipresent – with new devices and applications being developed daily, the world is stepping into new and innovative ways on wireless integration. This development process requires a large range of test & measurement instruments in order to design, calibrate, test, measure and simulate all electronic device functionality. In order to reduce the amount of different testing equipment required, software defined radios (SDRs) can be configured with a host computer for measuring components in RF systems: filter characteristics, antenna VSWR, reference signal phase deviations, oscilloscope measurements, etc. With Multiple Input Multiple Output (MIMO) for conducting various different tests on different channels over a very wide bandwidth (near DC – 18 GHz), there are no limitations in range. By having one device capable of acting as a network analyzer, signal generator, power meter, reference clock and spectrum analyzer, it allows for the streamlining of operations and training and facilitates a reduction in costs of having multiple dedicated devices.

SDR IN TEST & MEASUREMENT SYSTEMS



BLOCK DIAGRAM



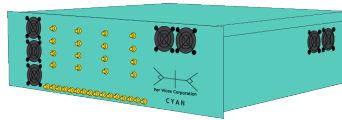
TRADITIONAL VS. SDR BASED PLATFORMS

TRADITIONAL PLATFORMS	SDR BASED PLATFORMS
Unable to record long term behaviour of electronic component measurements	Allows for long-term acquisition and storage of measurements over long time duration; important for assessing clock stability/jitter measurements, etc.
Only able to do one measurement at a time and visualize the result	Ability to build your own applications for visualization of multiple measurements simultaneously; such as spectrum analysis, time domain analysis, arbitrary waveforms
Only capable of using one communications protocol with one piece of radio equipment	Direct access to FPGA for custom use of various communications protocols (5G, GPS, Bluetooth, WiFi, etc) or a combination of several protocols simultaneously
Only able to be configured in one form factor/size due to it being a stand-alone commercial stock product	Can be modified due to modular design and assembled in custom form factor/chassis for applications such as 5G antenna towers or satellite payloads that require size, weight and power (SWaP) to be taken into account
Not a good return on investment (ROI) since it is single function/stand-alone equipment and cannot be upgraded to new radio protocols, etc.	Can be used for multiple T&M capabilities and be upgraded to new radio protocols, etc.

SYSTEM ARCHITECTURE

The Host system is connected to the FPGA via an Ethernet connection and is able to perform various measurements and testing. The radio front-end (RFE) consists of ADCs/DAC, filters, mixers, and amplifiers which are all configurable/controllable for various testing and measurement needs. This can be paired with our CI build system, which allows multiple developers to contribute to product repositories with automated compilation, packaging, testing, reporting, and deployment of tested packages. We use high quality components to ensure a clean digitized signal for software T&M applications so that development goes smoothly.

TECHNOLOGY FEATURES



PER VICES STOCK PRODUCT

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HARDWARE

- Can be used in various T&M applications simultaneously due to its many receive/transmit channels
- Has very high frequency ranges (up to 18 GHz) with the potential to extend for developing new 5G networks operating in the mmWave domain
- Is able to be managed remotely, which is important when SDRs are deployed in space or in large networks, since updates can be accomplished remotely

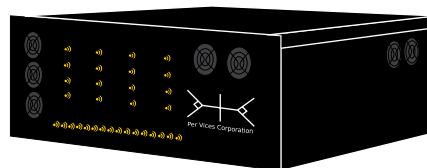
FIRMWARE

- FPGAs can be configured to test devices which operate on various frequencies and associated radio protocols
- Can offload DSP, encryption schemes, and error correction on the FPGA to test new mobile networks or GNSS constellations
- Highly parallel computations can be employed here; important for beamforming/beamsteering phased array testing

SOFTWARE

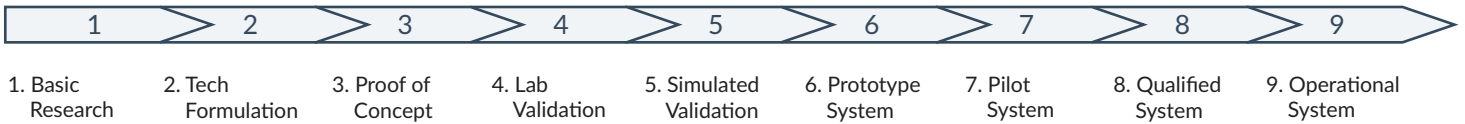
- Per Vices SDRs work with GNU Radio out of the box; an open source DSP and radio toolkit that can do various T&M tasks
- Is able to have programs written in various languages such as C++/C etc. where T&M custom algorithms can be designed
- Many software based measurement visualizations can be run simultaneously on one device being tested and therefore reduce development time

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PLATFORM FOR CUSTOMER SPECIFIC APPLICATION

TECHNOLOGY READINESS LEVELS



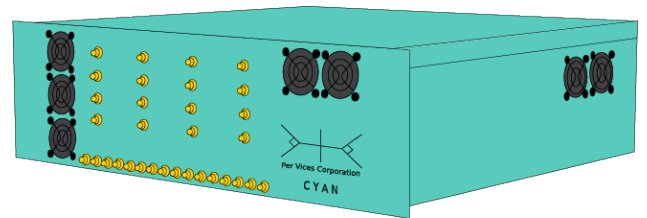
Technology Readiness Levels (TRLs) were established by NASA, and are used by government institutions and companies globally to enable uniform discussions of technical development and maturity across different technologies. Per Vices makes the only customer-validated SDR platform that supports manufacturers 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 hardware, 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	No	Yes	Yes	Maybe
Fully Customizable	Yes	Yes	No	No	No
Production Performance	Yes	No	Yes	Yes	No
Software IP Support	Yes	Yes	No	No	Yes
Maintenance Support	Yes	No	Yes	No	No

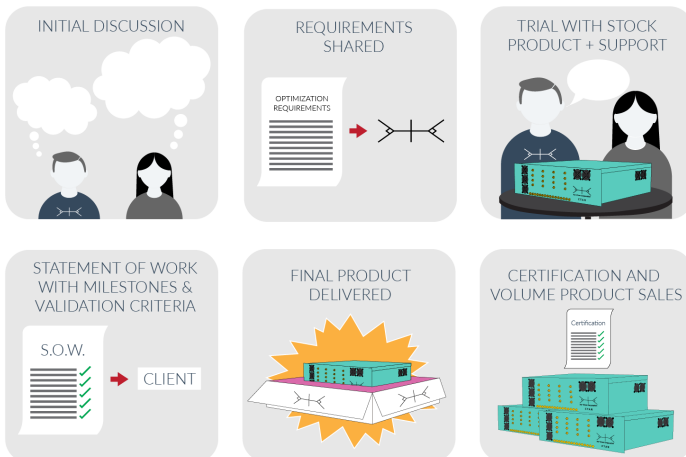
MAJOR DIFFERENCES

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 its 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.

TECHNICAL SPECS

- Processing from near DC to 18 GHz
- MIMO
- Open architecture, DSP & FPGA
- Flexibility to meet any system requirement

PER VICES COLLABORATIVE PROCESS



KEY POINTS

Per Vices delivers high-quality radios for test and measurement applications that can perform many functions, using a single device solution that can scale & go across multiple frequencies while providing consistent data rates and performance. SDRs are a reliable, long lasting system that are easy to configure and update to accommodate evolving needs in T&M applications.

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.

CONTACT US

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