OVERVIEW

The Universal Software Radio Peripheral (USRP) enables engineers to rapidly design and implement powerful, flexible software radio systems.

The USRP product family consists of the motherboards (the original USRP and the USRP2), which contain an FPGA for high-speed signal processing, and interchangeable daughterboards that cover different frequency ranges. Together, they bridge between bits in a host computer and one or more antennas. Among the various daughterboards, the USRP family has an overall range of DC to 5.9 GHz, which covers everything from AM radio through Wi-Fi and beyond.

The true value of the USRP family is in what it enables engineers and designers to create on a low budget and with a minimum of effort. The powerful combination of flexible hardware, open-source software and a community of experienced users makes it the ideal platform for your software radio development.

HARDWARE

The original USRP is a very low cost software radio device. It connects to a host computer by USB 2.0 (480 Mb/s), and can send up to 16 MHz of RF bandwidth in either direction. It contains an FPGA which can be reprogrammed, 4 high-speed Analog to Digital Converters (ADCs), 4 high-speed Digital to Analog Converters (DACs), and a lot of auxiliary analog and digital IO to make integration into a larger system easy. It can accommodate up to 2 transceiver daughterboards, making it 2x2 MIMO capable out of the box.

The USRP2 builds on the success of the original USRP, offering higher performance and increased flexibility. The USRP2 connects to the host computer via Gigabit Ethernet, allowing it to send up to 50 MHz of RF bandwidth in and out simultaneously. It contains a much larger FPGA which can even be used to operate the device in a standalone fashion, without a host computer. It has higher-speed and higher precision ADCs and DACs. The USRP2 holds a single transceiver daughterboard, and multiple USRP2s can be connected together to form very wide MIMO systems (up to 8x8).

APPLICATIONS

The USRP product family is in use all over the world in a wide variety of applications. While the USRP is often used for rapid prototyping and research applications, it has been deployed in many real-world commercial and defense systems.

Commercial Applications

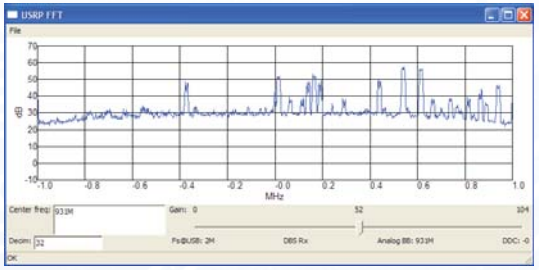
There are many applications for the USRP in commercial systems. System development and prototyping is ideally done on a software radio. And when an application does not have the volume to justify a custom hardware design, the flexibility of the USRP enables a cost effective, deployable system.

As an example, Path Intelligence Ltd., uses the USRP product family to track pedestrian foot traffic in shopping malls. The phased-array capabilities of the USRP allow Path Intelligence to determine the locations of shoppers by receiving the control-channel transmissions of cell phones.

Defense and Homeland Security

The USRP product family is being used by all branches of the U.S. military and intelligence services, many large defense contractors and other NATO nations. The USRP motherboard and daughterboards enable rapid prototyping and deployment of sophisticated wireless systems on a low budget. Some applications include:

- SIGINT/COMINT
- Battlefield networks, survivable networks
- JTRS research
- Public safety communications bridges
- Emergency low-power beacons
- Mine safety and underground communications
- Synthetic Aperture RADAR
- Passive RADAR



Spectrum of the 930-932 MHz pager band.
GNU Radio and USRP running on Windows XP.

Wireless Research

Numerous researchers in wireless networks are using the USRP product family to study such diverse topics as:

- MIMO systems
- Ad-hoc and mesh networking
- MAC-layer protocols
- PHY-layer design
- Spectrum occupancy, spectrum sensing
- Cognitive radio

The open and easy to use USRP product family enables rapid prototyping of innovative new communication systems. The low cost allows deployment of significant numbers of nodes in a test-bed for studying large-scale network effects.

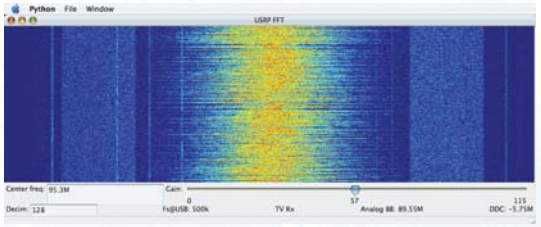
Teaching

Many universities within the U.S. and around the world have equipped student labs with USRP systems. The low cost, extreme flexibility, and open-source nature of the USRP product family and GNU Radio make them ideal for use in teaching:

- Software radio
- Signals and systems
- Digital signal processing
- Communication systems
- FPGA design

Other Uses

For over three years our customers have been coming up with new and innovative uses for their USRP systems. Some of the more interesting examples include radio astronomy, wildlife tracking, RFIDs, medical imaging, sonar, and customizable test equipment.



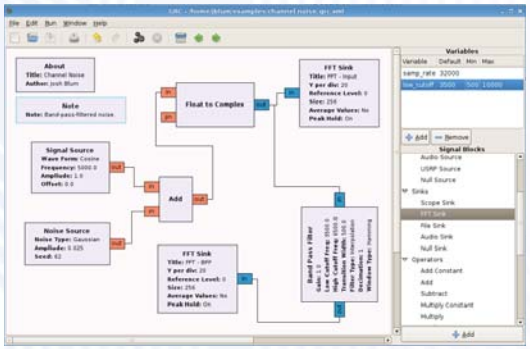
Spectrogram of an FM transmitter with iBOC sidebands.
GNU Radio and USRP running on Mac OS X.

SOFTWARE

GNU Radio

GNU Radio is an open-source software defined radio (SDR) platform. It is has a large worldwide community of developers and users that have contributed to a substantial code base and provided many practical applications for the hardware and software. It provides a complete development environment to create your own radios, handling all of the hardware interfacing, multithreading, and portability issues for you.

GNU Radio has libraries for all common software radio needs, including various modulations (GMSK, PSK, QAM, OFDM, etc.), error-correcting codes (Reed-Solomon, Viterbi, Turbo Codes), signal processing constructs (optimized filters, FFTs, equalizers, timing recovery), and scheduling. It is a very flexible system, and it allows applications to be developed in C++ or Python.



GNU Radio Companion (GRC), a GUI Radio Design system, similar to SimuLink™

Other Options

While most often used with GNU Radio software, the USRP is flexible enough to accommodate other options. Some users have created their own SDR environments for the USRP, while others have integrated the USRP into the LabVIEW™ and MATLAB®/ Simulink® environments.

OSSIE, an open-source implementation of the Software Communications Architecture (SCA) developed by a third-party, is also available for the USRP.

Open Source Community

The entire USRP design is open source, including schematics, firmware, drivers, and even the FPGA and daughterboard designs. When combined with the open source GNU Radio software, you get a completely open software radio system enabling host-based signal processing on commodity platforms. No software or licenses need to be purchased.

PRODUCT PORTFOLIO

- USRP System
- USRP2 System
- DC to 30 MHz receiver
- DC to 30 MHz transmitter
- 1 MHz to 250 MHz receiver
- 1 MHz to 250 MHz transmitter
- 50 to 860 MHz receiver
- 800 MHz to 2.4 GHz receiver
- 50 MHz to 1 GHz transceiver
- 800 MHz to 2.2 GHz transceiver
- 2.4 GHz and 5 GHz Dualband transceiver
- 750-1050 MHz transceiver (including cell and ISM bands)
- 1150-1450 MHz transceiver
- 1.5-2.1 GHz transceiver (including PCS bands)
- 2.3-2.9 GHz transceiver (including ISM band)

SUPPORTED PLATFORMS

- Linux, FreeBSD, NetBSD
- Windows XP, Windows 2000
- Mac OS X (Intel and PowerPC)

Applications written using GNU Radio will run on all supported platforms

ABOUT Ettus Research LLC

The USRP family of products is designed and built by Ettus Research. The company specializes in ASIC-, FPGA-, and software-based DSP systems. In addition, Ettus Research provides wireless, DSP, and software radio design consulting services.

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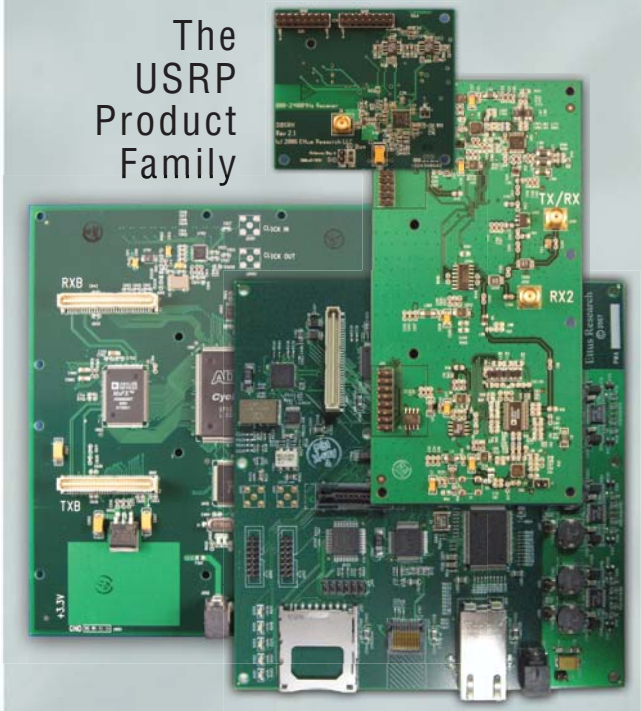
Ettus Research

Building Software Radio Systems

The USRP Product Family



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