LALP-10-044

Licensable Technologies

NextRF
Advanced RF detection, analysis and location receiver

Applications:

- Identifying and locating short time signals
- Blue force communication
- Spatial diversity
- Radio astronomy
- Search for Extraterrestrial Intelligence (SETI)

Benefits:

- Low power (battery)
- Light weight and portable
- Low cost
- Completely reprogrammable, fully digital channel architecture

Intellectual Property:

- U.S. Patent 6,529, 927
- U.S. Patent 5,589,881
- Disclosure in Progress

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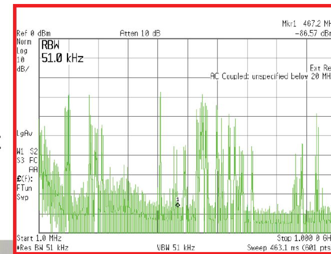
Summary:
The radio frequency (RF) communication spectrum is cluttered with an incredible volume of signals and background noise. For national defense, law enforcement, security, and wireless communications applications it is often necessary to be able to detect short time signals, or transients, and locate where these signals originate. The challenge is most RF detection and location systems today still use large antennas and analog methods to analyze the signals in real time. But wide area coverage and high sensitivity do not compute in a single antenna, so ensembles of small antennas provide higher performance.



NextRF system

Los Alamos National Laboratory (LANL) has developed the NextRF receiver, a cost-effective portable system for collecting, detecting, analyzing, and locating signals in real time. The technology uses LANL's direct conversion design principles, supporting multiple small low power active/passive antennas, offers 140MHz bandwidth, 14-bit digital receivers for processing the signals in real time, and can all be controlled from a portable PC operating MatLab, LabView, or C code modules.

NextRF optimizes tradeoffs between antenna cost, siting costs, and electronics costs. It covers 2MHz to 6GHz, a 140MHz survey bandwidth, and an analysis channel bandwidth of 20KHz. Each receiver channel supports one or more antennas depending on the desired tune range. A minimum of three channels are required to locate signals, but NextRF is scalable to as many antennas as are desired, and systems of 200+ channels are being considered to support high sensitivity, wide diversity applications.

NextRF leverages the uTCA Joint Architecture Standard (JAS), developed by LANL and Sandia National Laboratories, to streamline development of serial plug-and-play systems. JAS employs a modular, distributed computing architecture, using commercial standard serial networks, protocols (Serial Rapid I/O, Serial FPDP, Gb Ethernet, etc), backplanes (Micro TCA, VPX etc.), SRAM FPGAs, IP, and point-to-point Gb/s serial links. JAS allows for field reconfigurability, improved reliability, much lower size, weight, and power (SW&P), and much faster system integration using commercial, off-the-shelf (COTS) tools. In the development system hardware costs are approximately $10K per channel, and should be less than $2K in mass production.

Development Stage:
The NextRF receiver is being field tested using Virtex-5 FPGAs now, with migration to Virtex-6 and SIRF products in the near future. Use of SIRF devices enables migration to space compatible systems, where LANL has led the use of commercial products to reduce cost and integration time. Planned R&D work also includes development, testing, and integration of new DSP applications for NextRF.

Partnering Opportunities:
LANL is seeking government sponsors and commercial partners to further develop NextRF and collaborate on new applications. LANL's preferred method for collaboration will be through licensing the NextRF intellectual property or receiving funding to support collaborative research and development agreements (CRADAs).

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NextRF Device Specifications

NextRF Key Parameter	Comments	Performance
RF Coverage	Direct coverage in three bands from 2 MHz to 450 MHz. Microwave to 6 GHz via add-on tuner	• 2- 450 MHz Direct • 2 MHz – 6 GHz with tuner
Instantaneous Bandwidth	Direct Conversion receiver provides wide bandwidth at low distortion	• 135 MHz Direct • 50 MHz with tuner
Resolution/ Dynamic Range	Set primarily by TI5474 SiGe ADC	14 bits resolution, SFDR > 70 dB direct, > 60 dB tuned
Antennas Supported	Standard 50 ohm input, +10 dBm nominal = ADC FS – 6 dB	Wideband active < 450 MHz and passive spiral > 400 MHz
Channel Processing	Input processing supported on each channel, in uTCA form factor	1 ea Xilinx V5SX95T-3, ~ 24 Mbytes QDR SRAM
Combiner Processing	Custom LANL uTCA design, or a variety of COTS modules	1 ea Xilinx V5LX100T-3, 128 Mbytes DRAM
Number of channels	Extensible in uTCA crates and across multiple crates	1 minimum, >300 maximum
Control and Data Interface	Standard 1000bT port for control and data Additional 3.5 Gbit/s serial ports available	MatLab, LabView, or C interfaces supported
Power Requirement	Varies with processing load	2-7 Watts/channel
Size and Weight	Specified for conduction cooled form factor	6 x 1.4 inch and 2 lb/ch including chassis allocation