CRFS

RFeye Node

Wideband intelligent spectrum system for remote distributed RF monitoring

RFeye®

Key features

- ✓ 6 GHz standard and 18 GHz frequency extender
- ✓ 20 MHz instantaneous bandwidth
- ✓ Fast, sensitive, excellent noise figure
- ✓ Ethernet and wireless connectivity
- ✓ Embedded Linux system for standalone operation
- ✓ Local bulk data storage and integrated SSD option
- ✓ On-board GPS for accurate positional and time stamping
- ✓ DF and geolocation capable
- ✓ Multiple RF ports for multi-antenna operation
- ✓ Rugged IP67 housing, optional mounting kits
- ✓ Open API, fully programmable with supplied SDK
- ✓ Range of powerful RFeye system software applications

Introduction

Cost-effective networkable node for wide area or in-building remote real-time spectrum and signals monitoring.

Real time 24/7 monitoring
CRFS pioneered the concept of remote real-time networks of spectrum sensors to meet the challenges of modern day spectrum usage and efficiency requirements and of managing complex interference issues. The RFeye Node is the benchmark for cost-effective, real-time 24/7 monitoring of the radio spectrum. It has been specifically designed and packaged for flexible and scalable deployments in remote distributed networks both indoors and outdoors, including hostile environmental conditions.

Very high probability of signal intercept
Capable of sweeping from 10 MHz to 6 GHz (or optionally to 18 GHz) at 40 GHz/s, the RFeye Node captures signals of all types, including transient transmissions such as pulsing or short-burst signals. High sensitivity and exceptionally low spurious components mean that it is able to reliably distinguish even very low power signals from the noise floor.

Flexible multi-user multi-mission capability
The RFeye's unique architecture is capable of supporting multiple concurrent tasks and missions, as well as multiple queries from simultaneous users. Remote programming allows tasks to be assigned relative priorities and the Node is able seamlessly to execute the required tasks in the most efficient manner. These include performing sweeps and IQ captures, making spectrum occupancy measurements, alerting mask breakages and triggering alarms, logging data to memory, recording sequences for playback, measuring an Angle of Arrival (AOA) bearing or geolocating signal sources using Time Difference of Arrival (TDOA) and Power on Arrival (POA) techniques. In addition, there is no limit to the number of users who can simultaneously query the Node via IP and make varying requests to display information of interest.

Easy to deploy as fixed or portable/mobile units
The Node is housed in a rugged, compact lightweight enclosure and has an environmental cover that provides IP67 protection. The low power unit can be powered from multiple sources. It can be discreetly deployed in-building, easily mast mounted outdoors or deployed in various man-portable or mobile configurations. Data can be accessed securely in real-time via IP, stored locally to USB drive or optional internal SSD, transmitted via the built-in modem or via Ethernet to a centralized database.

Block Down Converter

Seamless 18GHz frequency extender for the RFeye Node with plug and play operation.

The RFeye Block Down Converter (BDC) seamlessly extends the frequency range of the RFeye Node from 6 GHz up to 18 GHz. Frequencies above 6 GHz are down-converted to allow analysis using the Node. It enables all of the extensive real-time analysis capability of the RFeye Node to be accessed at these higher frequencies with minimal impact on overall system speed and RF performance.

The BDC is connected to the RFeye Node via an IF link and is fully controlled by the node allowing for simple plug and play operation. It can be run from the same power supply, simplifying installation and reducing additional cable run requirements. The BDC accepts RF inputs for the full extended RFeye frequency range from 10 MHz to 18 GHz.

The BDC extends all of the multi-user, multi-mission functionality of the RFeye Node to microwave frequencies allowing monitoring of bands such as radar transmitters, satellite communications, radio relay links, short range terrestrial data links and high frequency bugging devices.

The BDC uses the same form factor and mounting options as the RFeye Node, permitting standardization of mounting options. It is also built to the same strict environmental specifications and is designed for use in outdoor or indoor, fixed or mobile operation, including in hostile environments.

Outdoor Mounting Kit

Pre-assembled rugged outdoor kit with interface panel and antennas for fast and simple installation.

The RFeye Node is available with a fully integrated Outdoor Mounting Kit (OMK) ready for quick and easy attachment to wall, pole or mast with maintenance free use. The OMK is supplied as a pre-assembled unit in a rugged lockable plastic case with wheels and foam insert for convenience and security of transportation.

The OMK includes a stainless steel outdoor mounting system with brackets and fittings, antenna pole mounts, hoist ring and sunshield, GPS and cellular antennas, Power on Ethernet injector with mains cable, all required cabling and an external interface panel with outdoor rated connectors. It also includes 2 omnidirectional antennas covering frequencies from 10 MHz – 1 GHz and 0.8 GHz to 6 GHz.

Optionally, the OMK can be provided with additional cabling, power supply and an 18 GHz omnidirectional antenna to accommodate the RFeye Block Down Converter for monitoring of SHF channels.

The OMK also has the option of an intelligent uninterruptable power supply (UPS) that can power the Node in the event of a power outage or allow the monitoring, data collection and Node management to continue during power brownouts.

The operating temperature range of the unit is from -30°C to +55°C (-22°F to +131°F), making it suitable for most environments.

Power and Network Connections

The RFeye Node takes DC power from 10 V to 48 V and typically uses only 6 – 18 W. Systems can be powered direct from mains power, via Power on Ethernet or even from local sources such as solar cells, batteries and/or vehicle 12 VDC auxiliary power points (cigarette lighter adaptors).

Network connections can be wired (Ethernet or optical fibre) or wireless (3G or 4G modem or Wi-Fi). The cellular modem allows units to be deployed over very large distances anywhere where there is cellular coverage. The RFeye is truly "plug and play" – simply mount, connect power and network and start monitoring. Network Nodes are accurately synchronized using the onboard GPS thereby allowing for geolocation of signal sources using TDOA.

Ceiling Mounting Kit

Pre-assembled kit built into a standard ceiling tile for discreet and low-cost in-building deployment.

The RFeye Node can be discreetly mounted in the void above suspended ceiling tiles using the Ceiling Mounting Kit (CMK). The CMK comes as a pre-assembled kit ready for mounting on a standard 600x600mm ceiling tile frame allowing for easy and low-cost installation.

The standard CMK comes fully wired and cabled ready for networking. The CMK includes an aluminium plate with mounting points, brackets and fittings, Power and Data Distribution Module, SyncLinc™ modules and an Interface Panel with connectors for the various power, data and antenna inputs. An environmental protection cover protects the Node from dust and moisture ingress. A ceiling mountable omnidirectional antenna completes the package. Optionally, an 18 GHz CMK can be supplied for deployments with the Block Down Converter.

Installation

The Nodes are networked using wired Ethernet which can provide both power and data connection. All Nodes are frequency locked and synchronized to a common reference using CRFS's proprietary SyncLinc synchronization system. Installation is simple using dedicated cable runs in the ceiling voids. SyncLinc gives better than 25ns synchronization and avoids any of the performance degradation issues that result from using standard shared network switching hardware. This allows for accurate geolocation of suspicious signal sources using POA amplitude comparison.

Node architecture

Designed from first principles as a uniquely flexible, networkable and remote programmable system for 'fit and forget' deployment.

The RFeye Node has been designed using the latest microwave components to give the radio hardware exceptional RF performance in the following areas:

- Low system noise figure
- Excellent front end linearity under high signal conditions
- Multi-stage pre-selection filtering
- Class-leading phase noise
- Low local oscillator re-radiation from all antenna ports
- High dynamic range with extremely low internally generated spurious components
- Manual and intelligent automatic gain control (iAGC) on a capture by capture basis

Only after the radio hardware section has completed its processing in the Analogue RF domain is the signal digitized and sent to the radio FPGA. This is a key differentiation between the RFeye Node and lower cost software defined radios. Without such close attention to managing the RF signals, RF performance will always be inferior.

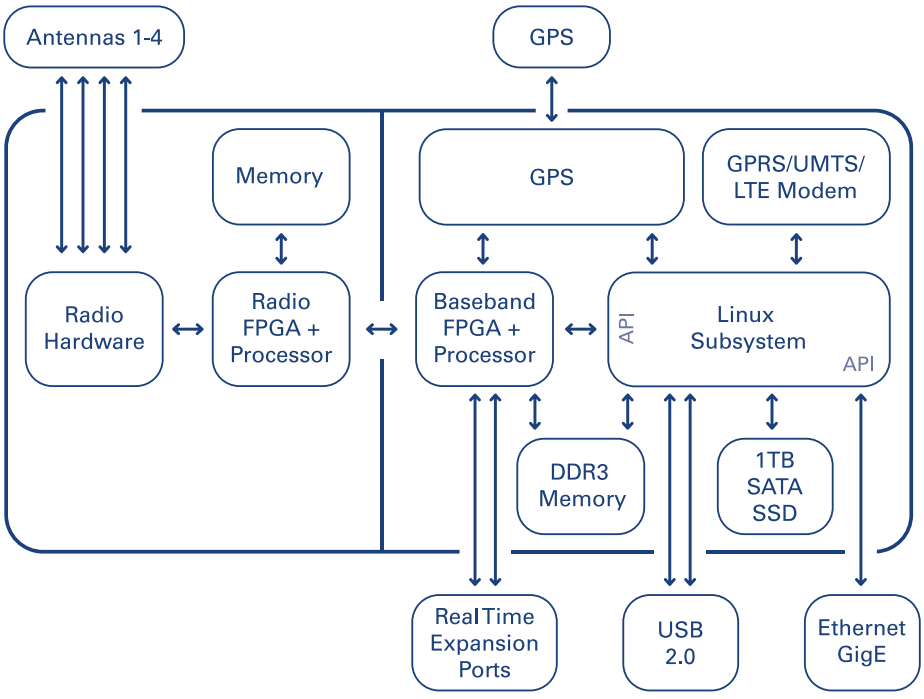
The digitized RF data is then transferred to the baseband FPGA where it is formatted for IQ streaming or FFT processing. The IQ data and/or FFT spectral data are then made available to the embedded Linux system for further processing or routing to the network ports and/or onboard data storage using USB mounted flash drives or internal SATA SSD flash drive.

Software applications can be written to run on the Node or control the Node via external interfaces using the published APIs and software development kits.

Real-time expansions ports are available to connect external references or output internal references and control external peripheral devices such as RFeye switches, Block Down Converter, UPS and/or SyncLinc in-building synchronization systems.

Network architecture

The flexible software architecture of the RFeye Node means that it can be deployed in a number of standalone or networked wired and/or wireless scenarios. These could involve collecting and processing real-time data for geolocation or interference analysis or collecting non-real-time data for RF surveys. The multi-user multi-mission nature of the network interfaces means that both of these tasks can be accomplished at the same time on any or all Nodes in the network.



RFeye Node technical specifications

Receiver Performance	
Frequency range	10 MHz to 6 GHz (18 GHz with Block Down Converter)
Receiver noise figure	8 dB typical (10 MHz – 4 GHz) 11 dB typical (4 GHz – 6 GHz)
Input connector	Four switchable signal inputs
Maximum input level	+15 dBm; 15 VDC
3rd order intercept point (IP3)	+20 dBm typical (AGC active)
1 dB input compression	+10 dBm typical (AGC active)
Level accuracy	± 2.5 dB typical
Antenna LO re-radiation	-90 dBm typical
Antenna port isolation	30 dB min. at 2 GHz
SSB phase noise	-90 dBc/Hz at 10 kHz oset -110 dBc/Hz at 200 kHz oset typical, at 2 GHz* (*low noise synthesiser)
Synthesiser switching time	50 µs typical (fast sweep mode)
Spurious free dynamic range	60 dB min.
AGC range	60 dB

Sweep and triggering	
Sweep speed	40 GHz/s (fast synthesizer) 10 GHz/s (high quality synthesizer)
Sweep mode	Fully programmable: Free run continuous, single, timed, delay timed user trigger, adaptive (if-then-else)
Trigger on event	Fully programmable: userdefinable masks, user-definable action when mask exceeded

Signal analysis	
Real-time analysis bandwidth	20 MHz maximum
Equivalent resolution bandwidth	20 kHz min. (max. analysis b/w) 18 Hz min. (reduced analysis b/w)

Operating system and software development options	
Linux version	2.6
Development environments	Full SDK C and Python development environment available

Frequency reference	
Selection	Internal, GPS or External
External ref. input	Via expansion port, 10 MHz ± 1 kHz
Reference output	Via expansion port, 10 MHz

Internal frequency reference	
Initial accuracy	Better than ±2 ppm at 20°C
Stability	Better than ±1 ppm (10°C to 30°C)
Ageing	Better than ±2 ppm per year

Timing reference	
GPS	30 ns RMS accuracy typical
RFeye SyncLinc	< 10 ns RMS accuracy typical

Mechanical	
Dimensions (w h d)	170 mm x 60 mm x 125 mm (6.7 in x 2.4 in x 4.9 in)
Weight	1.4 kg (3.1 lb) [Node only] 2.0 kg (4.4 lb) [with environmental protection cover]

Environmental	
Operating temp.	-30 to +55°C (-22 to 131 °F)
Storage temp.	-40 to +70°C (-40 to 158 °F)
Envrn. protection	IP67 (with environmental cover fitted)

Interfaces	
RF input	SMA (X 4)
DC power	10 - 56 VDC
DC power input	Direct to node or via Ethernet (POnE)
Power consumption	15 - 25 W, radio operational 6 W typical, radio idle
GPS antenna	SMA, passive and active (3.3 V nominal DC) antennas supported
Cellular modem	Internal quad-band 850/900/1800/1900 MHz (GSM/GPRS/UMTS/HSDPA), external SIM port
Cellular modem antenna	SMA
Ethernet	1 x 1 GigE
USB	2 x USB A (2.0)
Expansion ports	2, configurable to provide: (a) trigger input (b) frequency reference input (c) external (peripheral) control (d) frequency reference output

Data storage	
USB	USB flash drive via 2 x USB ports
SSD	Optional internal integrated SSD 512 GB *(add -SD1 to product code)*

For more information

To find out more or discuss your specific application, please e-mail us at enquiries@crfs.com or call +44 (0) 1223 815 615. You can also find useful resources on our website at www.crfs.com.

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