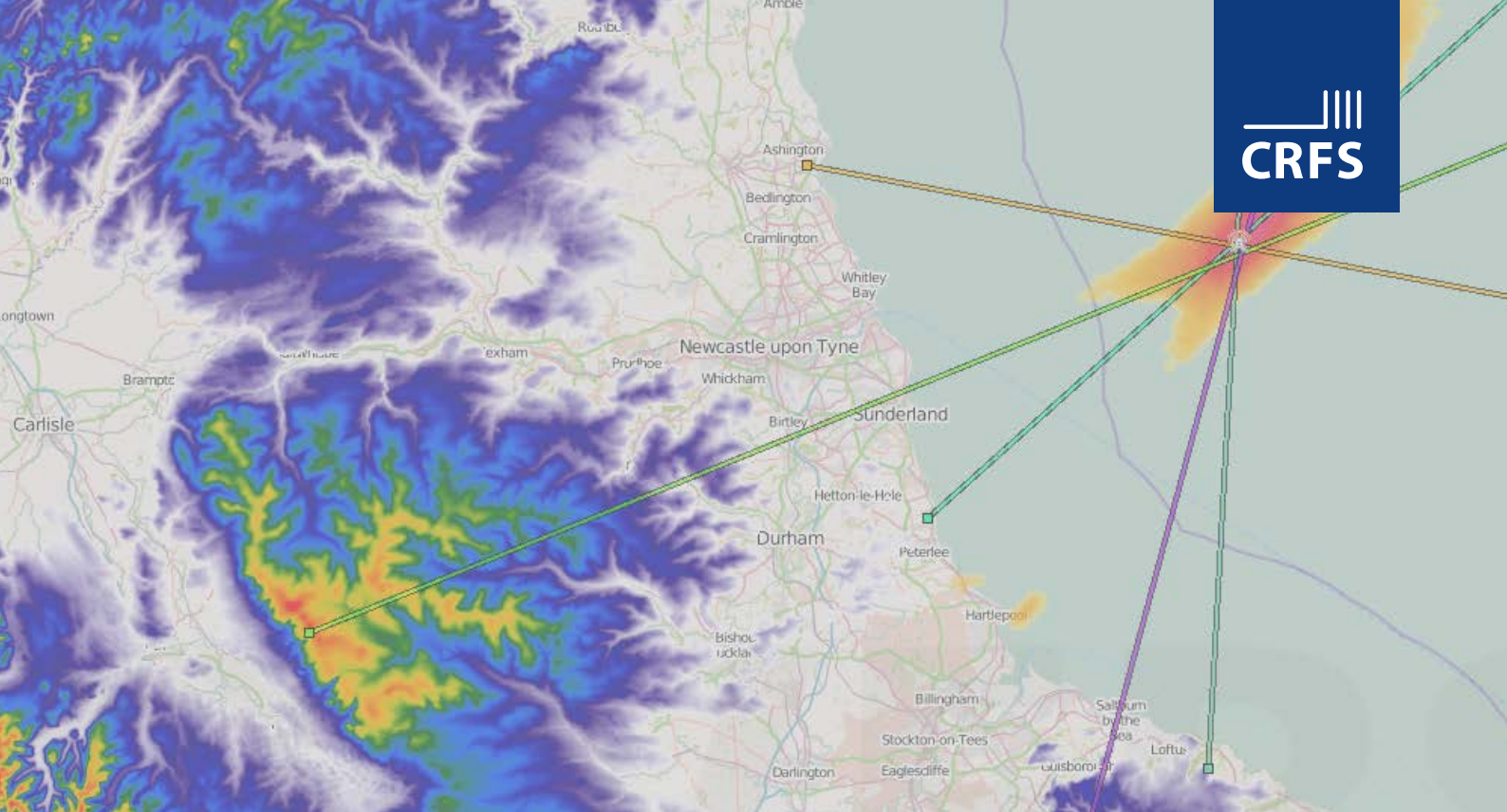




RFeye System Software

Powerful real-time and database analytics and visualization tools

Introduction

RFeye system software unlocks the power of remote distributed RF intelligence systems for real-time and database applications.

CRFS's suite of software tools significantly differentiates the RFeye from any other systems on the market. The unique architecture of the RFeye allows for different kinds of software application to be used simultaneously with the RFeye nodes either via real-time connections to an individual node or network of nodes or via application-specific programs running on the embedded Linux system of the node. The real-time software packages have been designed and optimized to run as fast as possible to keep up with the very high rates of data capture from RFeye receivers. Rapid visual refresh rates enable users to derive maximum intelligence from the data.

RFeye Map

Enterprise-level spectrum database application for the management, analysis and visualization of the very large data sets using advanced graphing and mapping tools. The software uses a proprietary database architecture to enable highly efficient storage and retrieval of data. It can be operated from a standalone PC, as a client-server, or via a web-interface to enable remote users to access the data analyzer.

RFeye Site

Real-time Windows application allowing multiple users to make multiple connections to individual nodes or networks of nodes over IP or peer-to-peer PCIe links. Functions range from requests for basic spectrum, masks and alarms, to complex geolocation measurements and signal classification. Using a

.Net framework, the software is modular and users can write their own plug-ins using the API.

RFeye Monitor

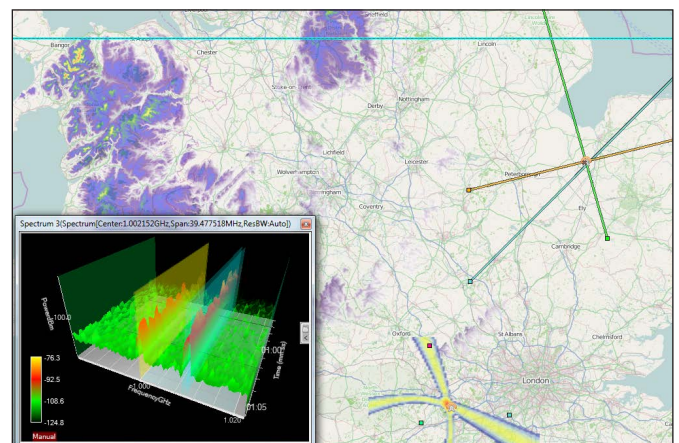
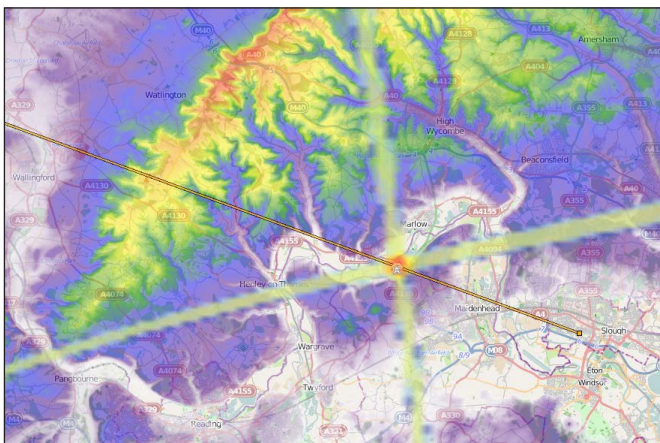
Web-based server combining a spectrum database with data handling processes to present an integrated, convenient and responsive portal to logged data from networks of RFeye nodes. Includes a series of tools for data logging, data transfer, database storage and filtering, and web display of requested results. Users can set up their own spectrum campaigns and access up-to-the-minute data via a web browser.

RFeye Manager

Windows application allowing a large network of nodes to be efficiently monitored and controlled. Functions include status monitoring for position, health and logger alarms for each node and whether it is connected. The software also enables configuration information and upgrades to be uploaded to selected network nodes easily and conveniently.

RFeye Apps

Lightweight application-specific programs running on the nodes that perform tasks independently and simultaneously with any other external application/user requirements. A small number of Apps is currently available from CRFS covering key spectrum background tasks. CRFS will continue to build its own library of Apps and, in addition, users can write their own Apps to run on the node using the SDK tools and libraries.



RFeye Map

Database application for managing and analyzing wide area spectrum data, designed for multi-terabyte data sets.

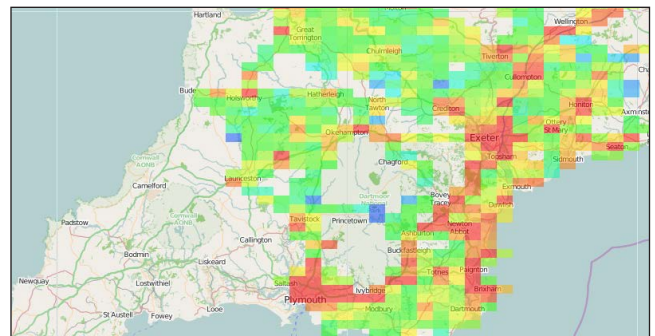
RFeye Map is an enterprise-level spectrum mapping and analysis database application for the management, analysis and visualization of the very large data sets collected by modern spectrum monitoring organizations. Using a proprietary database architecture and powerful data processing tools, the software provides fast, fully interactive analysis and visualization of spectrum usage and occupancy.

The software is able to display and analyze spectral data in a number of different ways, including synchronized map-based displays, spectrum plots and spectrograms, occupancy plots, and time evolutions. Data can be selected by any combination of RFeye node/network, location, time window or frequency range, and resolution can be displayed from national level to individual street location. Data can be displayed and analyzed from both mobile and fixed monitoring operations. Many different reports can be produced and tailored to specific requirements.

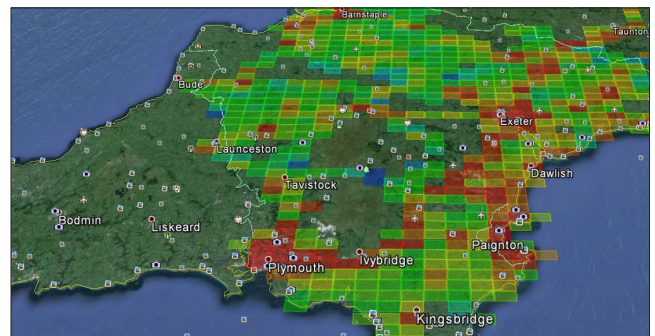
RFeye Map can be operated from a standalone PC, as a client-server, or via a web-interface to enable remote users to access the data analyzer.

The data handling and processing efficiency of RFeye Map allows the operator to quickly interrogate the entire database to understand and resolve potentially complex real-world spectrum issues. A series of graphical reporting tools are linked and updated simultaneously with the geospatial representation of measured spectrum on the map overlay. Examples of the processing tools available from RFeye Map for visual representation on the map overlays include mean signal, peak signal and band utilization.

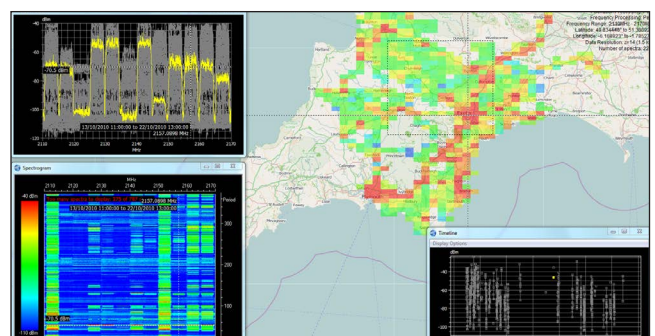
Reporting options include spectrogram charts for temporal analysis, spectrum charts for summarizing signal power by frequency, and spectrum use reports to step through the selected dataset at user-defined resolutions to understand total spectrum utilization across an area.



Mean signal display showing average signal strength in a given geographic area for a given frequency band



Overlay of spectral data onto Google Earth map



Combined view of selected data points with map, spectrum, spectrogram and timeline plots

RFeye Site

State-of-the-art real-time software for managing complex spectrum operations in building or over large areas.

RFeye Site allows networks of RFeye nodes to be managed and controlled and multiple different tasks and missions to be performed with simple button and mouse control. The software is highly configurable and has a powerful visual interface with full object-orientated command and control, real-time spectral displays in multiple formats and advanced mapping capabilities, including 3D displays.

Each individual RFeye node or all nodes in the network can be assigned tasks from a menu, ranging from requests for basic spectrum sweeps and occupancy measurements, to the detection and alerting of spectrum events, advanced signal classification and real-time geolocation of sources of interest. Multiple users can simultaneously make multiple requests of all or any of the nodes over wired or cellular networks.

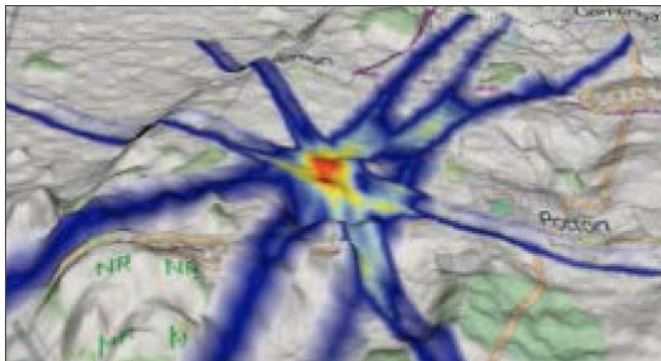
Optional plug-in modules are available for Time Difference of Arrival (TDOA), Angle of Arrival (AOA) and Power on Arrival

(POA) geolocation. These support multiple simultaneous geolocations on multiple target frequencies. Results are overlaid on 2D or 3D site maps and are displayed as heat map probabilities. Multiple results can be overlaid onto the map for ease of visualization and analysis. The mapping tools include full zoom facility and ability to display many simultaneous maps, with Shuttle Radar Topography Mission data overlay available to aid geolocation analysis.

RFeye Site can also be used in a powerful simulation mode for modelling capability to detect and geolocate different signal types taking account of the sensitivity, density and positioning of receiver nodes in a free-space path loss environment. An optional propagation analysis plug-in tool is available for modelling optimal receiver positioning in a given location taking account of actual terrain and Fresnel diffraction.

Key capabilities

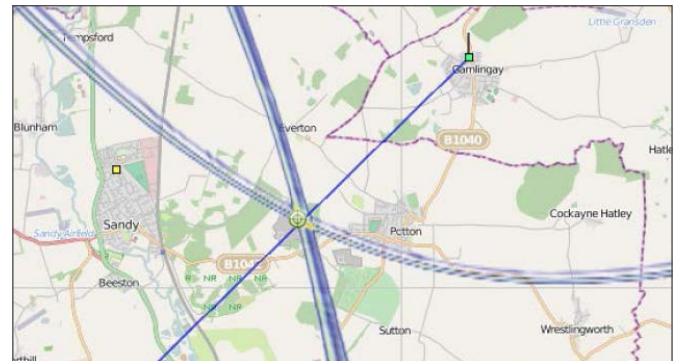
Advanced mapping



The location of all RFeye nodes in the network together with their unit information is displayed in RFeye Site via a range of mapping interfaces including 2D maps, various satellite imaging sources and 3D topographical data.

RFeye Site supports multiple map formats (open StreetMaps, Mapquest or custom tiles), satellite imagery (ESRI, Map Quest Aerial, GeoStage or custom tiles) and SRTM elevation data. These data sets can be Alpha blended and overlaid on top of one another to give the best possible view of the terrain and structures. Additional graphical data can be overlaid on the map windows in Shape and GeoTiff file formats.

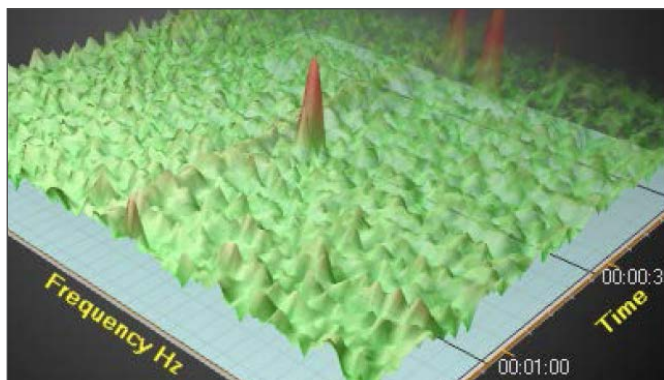
Geolocation of transmitters



There are many different signal types that are potential sources of interference, indicators of illegal activity or unauthorized spectrum use. Direction finding and individual geolocation techniques are each effective for only a limited range of target signal types, which varies according to many factors including signal bandwidth, modulation, power, background noise, pulse duration and receiver speed. The most reliable and cost-effective method to ensure detection and successful localization of the maximum range of target signal types is to combine each technique in a single real-time overlay.

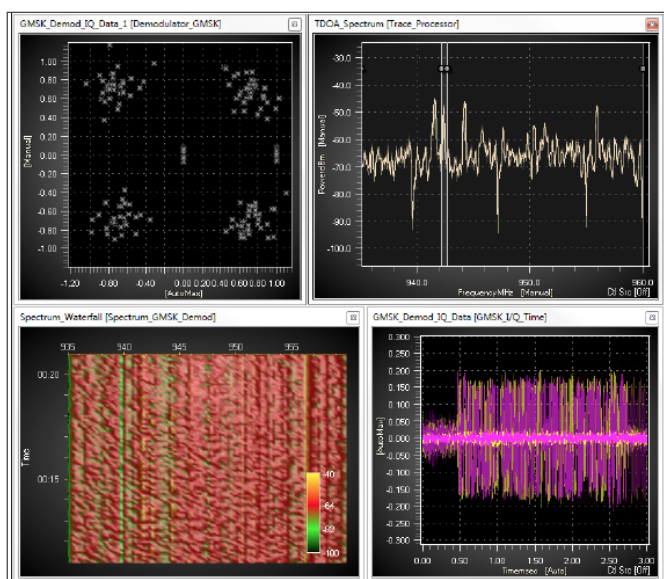
RFeye Site outputs geolocation results as POA and TDOA probability heat maps and overlay real-time AOA vectors onto map interfaces. When combined with the 3D topographical displays and the additional user-defined data layers that can be input via import wizards, this visualization of the geolocation results provides an unrivalled means of tracking signal source in real-time.

Sweeps and time captures



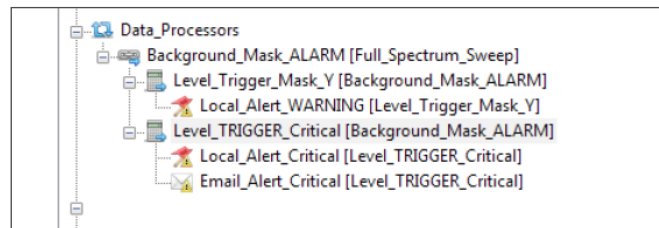
RFeye Site provides a familiar and simple spectrum analyzer interface for each connected RFeye node, with real-time frequency and time domain spectra and constellation diagrams, 2D or 3D waterfall displays. Each node can be output to individual displays, or displays can be combined and overlaid for more powerful analysis options with selectable data processing modules. Individual elements of a more complex mission can be controlled and configured per node. For example, after obtaining a TDOA geolocation result using a GPS synchronised RFeye network, an individual node can be selected based on proximity to the signal for targeted time captures and further detailed analysis.

Signals recognition



RFeye Site supports an optional plug-in module which is able to identify a comprehensive range of modulation types, both analog and digital, covering military and civilian standards. This extends the core SIGINT functionality of RFeye systems, as well as offering depth and context to data in general spectrum monitoring applications.

Mask triggers and alarms



RFeye Site can be configured to issue alarms via the local system, to log files, SMS and email from user-defined triggers and spectrum masks. Simple mask break scenarios can be useful for triggering alarms when any signal exceeds an expected background spectrum of known signals, or more advanced modules allow notifications on events such as detection of certain modulation types and channel identification.

Record and playback

RFeye Site allows data to be recorded and played back via a simple interface. Recording can be manual using the "Record" button and all data processes that are running in RFeye Site at the time will be recorded. Alternatively, recording can be set to trigger on a mask breakage in which case all data relating to the mask breakage will be recorded using predetermined parameters.

File formats

RFeye Site supports a number of data formats for data storage and license database formats. It can store the spectral/time/ intercept data output from entire networks of nodes efficiently in a number of data formats. Primarily these data are stored in Google Protocol Buffers which are highly efficient for storing dynamically changing packet type data. The raw low level Node Control Protocol packets can also be stored allowing the user to replicate all data transfers across the RFeye network. These data can then be exported in a variety of other formats including Spectrum PNG, CSV UTF8, CRFS XML, CRFS JSON, ITUR SM1809, KML and MLog.

RFeye Site supports import of license databases in a number of formats such as PUB7, CSV, UnicodeText and JSON. These data can be overlaid on graphs, maps and cross referenced to signal intercepts.

RFeye Monitor

Integrated, configurable application for collecting and managing spectrum data from a network of widely distributed RFeye nodes.

RFeye Monitor is a series of tools for data logging, data transfer, database storage and filtering, and web display of requested results. These tools have been designed to provide a seamless user experience through a secure and streamlined web-based application interface.

Once logged, data are transferred from the node into the RFeye Monitor database. This can be done in a number of ways to suit requirements and will normally involve either UDP or TCP data transports. The database is capable of storing several different types of data, including text, spectra, occupancy, time, cell survey, temperature and voltage, as well as information about the network and individual campaigns. It uses a single comprehensive library of scripts able to deal with data provided by any of the possible data transfer mechanisms.

The data from the database are accessed via a configurable web portal. The portal allows users to query the data and graph the results, as well as to create individual campaigns to run on the distributed nodes. It provides secure logins and varying levels of access based on user privilege.

Campaigns

Users can define and run multiple simultaneous spectrum monitoring campaigns within RFeye Monitor. Campaigns can be assigned to the entire RFeye network, sub-groups and

regional networks, or individual sites as required. In addition to background spectrum monitoring, campaigns are defined for specific missions such as to monitor ISM band usage, TETRA interference, GSM and UMTS coverage, suspected GPS and other jammers. Campaigns can be configured in response to events such as mask breakages and conditional expressions, allowing targeting of spectral events of interest.

Occupancy data aggregation

Users can run queries by individual node or aggregated groups for occupancy by time or frequency during any selectable period of time. The nodes take measurements at the requested rate based on power measured above a threshold, in accordance with ITU recommendation SM 1880 for occupancy.

Sweep and time capture data

The interface allows the user to zoom from broad-range frequency occupancy data (aggregated from the entire RFeye network) to tracking of occupancy by time for specified frequencies of interest at particular node locations. This enables quick drill down from spectrum events spotted in top level overview reports to a detailed localized timeline of spectrum activity surrounding the signal of interest. This information can be combined with other features such as spectrum licensee status to provide further layers of context for decision-making.



Web interface

RFeye Manager

Windows application for efficient monitoring and control of large networks of nodes.

RFeye Manager makes the management of networks of RFeye nodes simple and convenient. The GUI provides a dashboard indicating the health/alarm status of each node in the network. A map view indicates the locations and health/alarm/connectedness of each node and a list view provides further details. Various alarm functions can be set with notifications to specified recipients when an alarm occurs. RFeye Manager

can be used in a network operations centre to provide real-time updates on the status of the network for fixed and/or mobile deployment of nodes. Multiple networks can be supported with independent tasks such as configuration changes and upgrades performed across independent groups of selected nodes. RFeye Manager supports all types of RFeye networkable nodes and systems and can be configured in multiple languages.

RFeye Apps

Embedded lightweight application-specific programs running on the RFeye node.

Logger

Logger is a data processing app that records spectrum data and makes them available for database interrogation. Logger reads a configuration file to determine which scans to perform, what level of processing is carried out on the resultant data and how those data are presented. As well as performing captures, calculations and analysis, Logger also creates notifications and SMS messages to flag events and warnings.

Recorder

Recorder is a data gathering app that allows the user to request any number of node tasks to be requested on a round robin basis and saves the returned data to local files. Recorder does not process the data but allows them to be saved to various files based on size and duration. The app runs as a background process and allows a user to investigate the cause of reported spectrum issues after the event.

Threshold

Threshold is a data processing app that allows the user to configure any number of frequency bands of interest, each with its own threshold level. It then performs data capture and threshold analysis on the data saving the results to file. The raw data, the resultant values and the threshold breakages are all made available. This allows operators to post-process the data to find the cause of threshold breakages. For a network of RFeye nodes, geolocation of a given signal source can be determined from the raw data.

Stations

Stations performs a number of analysis steps on any number of bands of data. Stations allows the bandwidth, centre frequency, modulation, occupancy and power of a single frequency band to be tested against bounds and any anomaly reported to logs or via SMS message or to a listening SNMP server. Calculated values can be saved for further analysis.

Survey

Survey performs statistical analysis of power measurements on any number of bands of data. It provides the instantaneous power, peak power, mean power, median power and standard deviation of the power values at set intervals. It can output the raw data and calculated values along with GPS position to a simple CSV format or as KML for integration into Google Earth.

Software Development Kit

A full SDK is available containing tools and libraries to help software engineers develop their own applications to run on the RFeye's embedded Linux system. The SDK also gives configuration examples to make it easy for users to control how the node collects and processes data. This is done with simple scripts making it usable without any programming knowledge.

Product range

Software	Base / options	Description	Order code
RFeye Map	Client / Server	Database application for managing and analyzing wide area spectrum data, designed for multi-terabyte data sets. Client PC application interfaces with database on server.	APP-MAP0001
	Additional clients		APP-MAP0002
	Web interface	Web interface version of the application, allowing simple remote access via web browser. Multi-user access via unique user logins.	APP-MAP0003
RFeye Site	RFeye Site	State-of-the-art real-time software for managing complex spectrum operations in-building or over large areas, including geolocation missions.	APP-SIT0001
	Signal Recognition	Signal Recognition plug-in extension to RFeye Site, for recognition and classification of signals by analogue and digital modulation type.	EXT-REC0001
	Propagation Analysis	Propagation Analysis plug-in extension to RFeye Site, for geospatial modelling of RF propagation and RFeye network planning.	EXT-PGA0001
RFeye Monitor	RFeye Monitor	Integrated, configurable application for collecting and managing spectrum data from a network of widely distributed RFeye nodes. Server application with web interface.	APP-MON0001
	Additional client users		APP-MON0002
RFeye Manager	RFeye Manager	Windows application for efficient monitoring and control of large networks of nodes, including remote software management and batch configuration.	APP-MAN0001
RFeye Apps	Logger	Embedded application for continuous background spectrum data collection and processing.	EMB-APP0001
	Recorder	Embedded application for continuous background collection of raw, unprocessed spectrum data.	EMB-APP0002
	Threshold	Embedded application providing dedicated power threshold monitoring by frequency band.	EMB-APP0003
	Stations	Embedded application for analysis and processing of signal characteristics by frequency band.	EMB-APP0004
	Survey	Embedded application for detailed analysis and processing of power-based measurements.	EMB-APP0005

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.

