RFnest™
The real world in a box

Product Specifications

Intelligent Automation, Inc.'s *RF*nest™ provides a cost-effective, repeatable RF test environment that provides realistic and high fidelity channel emulation across a broad RF spectrum. *RF*nest™ accelerates the development, maturation, and fielding of new radios, protocols, and complex wireless network solutions.

Intelligent Automation, Inc.'s ***RF***nest™ is a network channel emulator that allows a full mesh of wireless nodes to experience realistic and high fidelity emulation across a broad RF spectrum. ***RF***nest™ is the only channel emulator that supports integration of real radio nodes and virtual (simulated) radio/network nodes with simulated and real nodes communicating seamlessly. Using real/virtual network emulation technology, real and simulated radio nodes exchange information and experience realistic signal interference as if they are a part of the same network of wireless nodes in a field environment.

RFnest™ provides a repeatable and controllable RF test environment for a network of wireless nodes in a laboratory setting. It supports the test and evaluation of a network of RF devices in a multipath fading environment with attenuation, Doppler delay, interference, directional antenna support, and other realistic channel effects.

RFnest's family of products is designed to address the specific needs of each customer. This family includes the ***RF***nest™ Analog and the ***RF***nest™ Digital series, both powered by ***RF***view™ software. The ***RF***nest™ Analog series is an affordable network channel emulation tool with the capability to emulate full mesh frequencies with flat fading channels. The ***RF***nest™ Digital series offers a complete solution for the emulation of frequency selective channels in a highly dynamic environment. The ***RF***nest™ Digital series is designed as a modular and extendable solution that allows the user to optimize testing from a handful of Single Input Single Output (SISO) to up to 96 Multi Input Multi Output (MIMO) nodes in a full mesh setting.

RFnest™ enables integrated control and monitoring of all levels of network performance. Hardware parameters such as channel impulse response and frequency bands can be varied by the user. Recorded RF signals can be replayed for evaluation and refinement. ***RF***view™ interfaces with third party channel modeling tools for specific channels of interest as well as network emulation software including EMANE* and CORE.**

RFnest™ Digital D512

RFnest™ Analog A208

*EMANE: Extendable Mobile Ad-hoc Network Emulator
**CORE: The Common Open Research Emulator

Features

- Cost-effective, high fidelity, realistic, repeatable, and mission customizable Test and Evaluation (T&E) environment for mobile networks in a laboratory environment, enabling accelerated development, maturation, and fielding of new radios, protocols, and network solutions.
- Modular design where 8 node network emulator modules can be used independently or expanded to build up to a 96-node emulator with full-mesh connectivity.
- Radios with MIMO capabilities are supported by ***RF***nest™ hardware and channel modeling tools.
- ***RF***nest™ supports integration of virtual nodes (with real/emulated operating systems and protocols and software-modeled radios) with real RF devices, with correct wireless interactions, thus allowing for T&E of large scale networks.
- Field-recorded channel properties can be used to replay a field test, enabling evaluation of new techniques (e.g., protocol improvements) or scenario variations (e.g., different adversarial RF behaviors) in a laboratory environment.

Applications

Research and Development

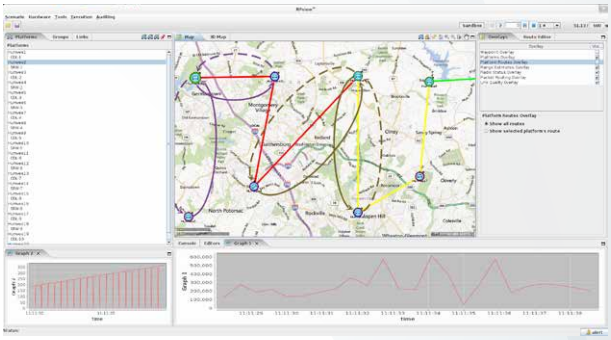
RFnest™ is an essential tool for the development of new wireless network technologies that are at the test and evaluation phase. ***RF***nest™ provides a realistic propagation environment without the need for a lengthy frequency allocation process. ***RF***nest™ is the ideal tool for the testing of emerging technologies such as cognitive/software-defined radios which are otherwise difficult to test due to regulatory issues.

Network Design and Realistic Protocol Evaluation

Protocols can be tested on real devices with real software and radios; environmental effects (including antenna directionality) experienced by transmitted RF signals are emulated, allowing high fidelity T&E in a lab environment, thereby reducing development cost and time.

Wireless Network Design

RFnest™ is a tool designed to simplify wireless network testing. ***RF***nest™ provides a repeatable and controllable environment where up to 96 radio nodes (with arbitrary mobility) are connected. To measure the performance of a network design, radios are connected to ***RF***nest™. Channel models are configured according to the desired environment. The mobility of the nodes are set up using the GUI. The scenario and performance are recorded by the ***RF***view™ software. For example, network designers can use this tool to determine the required number and locations of access points based on the number of nodes and the throughput goals.



RFnest™ Testing of three wireless networks at the same time; two nodes transmitting bulk data at 900 MHz frequency band, video communication between two nodes in 2.4 GHz band, two real nodes and 7 virtual nodes forming a multi- hop wireless network transmitting bulk data at 2.4 GHz frequency band.

Cellular Networks

RFnest™ allows network providers to use real base stations and physical user handsets to communicate over an emulated wireless environment for design and verification purposes. With this tool, the location of base stations, location, speed, and number of users can be modeled using the GUI environment. Full mesh channel models between the nodes are supported. ***RF***nest™ accurately emulates all of the channel impulse responses, the propagation delays, and interference among the handsets/nodes as well as provides all performance metrics.

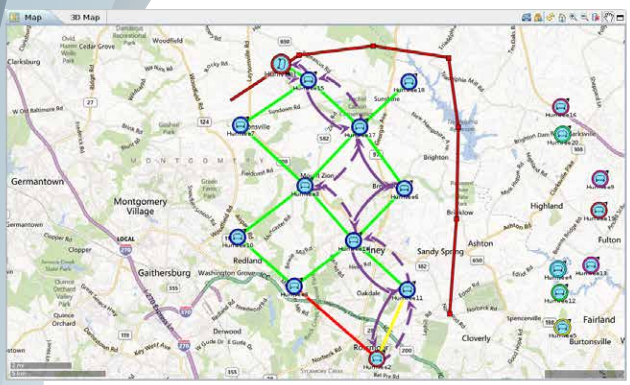
Electric Warfare (EW) Applications

The jamming and anti-jamming performance of radios can be tested by connecting a jamming signal source and radios under test to ***RF***nest.™ ***RF***nest™ emulates the channels between different radios and jammers. ***RF***nest™ can clone jamming signals so that multiple jamming sources (cooperative or non-cooperative) are supported using a single jamming source. ***RF***view™ software allows users to generate arbitrary jamming signals and play it in the RF environment. In all these cases, jamming occurs in a realistically controlled wireless environment without regulatory compliance issues.

Airborne Networks

RFnest™ facilitates the test and validation of mobile airborne networks that are traditionally difficult to model and very costly to develop. ***RF***nest™ supports the creation of environments containing the complex RF interactions present in the airborne environment for assessment before actual flight testing is conducted. Test scenarios can be recorded, reproduced for debugging, and refined in advance of flight tests in a realistic network environment. The ***RF***view™ data display and visualization tools provide the user with a reliable and repeatable assessment of the communications protocols and network performance.

Models and Software



Video transfer between two real nodes
Integration with EMANE* and CORE** emulation platform enables ***RF***view™ to provide users with a highly flexible and powerful GUI-based interface to incorporate software-only virtual nodes into testing scenarios.

Highly configurable ***RF***view™ software and user interfaces provide the capability to:

- Create, manage, and monitor T&E scenarios. Integrated display of network scenarios, performance graphs, link status/quality, and routing behaviors.
- Configure myriad fading profiles - Rayleigh, Rician, Pure Doppler, Frequency shift, Phase shift, and log-Normal Fading.
- Optional support of industry standards such as - LTE, WiMAX, W-CDMA, CDMA2000®, GSM, and SCM/SCME.
- Provide API's for other channel models.
- Configure node mobility models.
- Record and play back signal levels, scenarios, and performance of all nodes, for analysis, debugging, and optimization of behaviors from a link and network perspective.
- Simulate large, contested EW environments by replicating the transmission at multiple locations.

*EMANE: Extendable Mobile Ad-hoc Network Emulator
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RFnest™ Digital D548

Support and Pricing

All sales of RFnest™ products include on-site training and installation. Additional support for new features and capabilities is also provided by IAI's applications engineers.

For further information, please visit IAI at www.i-a-i.com/rfnest, or contact rfnestsales@i-a-i.com for detailed cost and ordering information.

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Specifications

	*RF*nest™ **Analog A208**	*RF*nest™ **Digital D500 series**
Hardware		
RF inputs/outputs	8	Avail. configurations 8, 12, 24, 48, 96 nodes
Number of channels	28	28, 66, 276, 552, 1104
RF configurations	SISO, SIMO, MISO, MIMO, MESH	SISO, SIMO, MISO, MIMO, MESH
Maximum nodes	8	96
MIMO configurations	2x2, 4x2, 4x4 uni or bi-directional	2x2, 4x2, 4x4, (8x2, 8x4, 8x8 upgradable)
Frequency band	0 - 1 GHz, 1.2-1.9 GHz, 1.8 - 2.8 GHz, 2.7 - 3 GHz, 3.4 - 4 GHz	20 MHz to 3 GHz 3 GHz to 6 GHz
Maximum bandwidth	Any	250 MHz (each 12x12 mesh) 31.25 MHz (each 24x24 mesh)
Calibrated Dynamic range for 2.4 GHz	Greater than 30dB (1 dB resolution)	60 dB (0.5 dB resolution)
Input power	< 10 dBm	-40 dBm to -20 dBm
RF output level	Typically -30 dB to -67dB for 0 dBm input signal	-20 dBm to -130 dBm
RF output accuracy	2 dB	2 dB
Maximum multipath taps per channel	N/A	Up to 20
Maximum propagation delay	N/A	Up to 2 s
Doppler shift (for each path)	None	200 KHz
Internal interference generators	None	Customizable via provided API's
Physical dimensions	Height: 3.5" Width: 16.63" Depth: 8.0"	6U (up to 20 nodes) 16U (24 to 48 nodes) 31U (96 nodes)
Models, Software, and Visualization		
Standards-Based Models (Options Available) - LTE, WiMAX, UMTS, CDMA2000®, WLAN, GSM, SCM/SCMET		✔
Frequency flat fading: Rayleigh Rician, log-normal		✔
Frequency Selective fading: Rayleigh, Rician, log-normal with Doppler shift and phase adjustment	✔	✔
Custom multipath profiles		✔
Virtual node support	✔	✔
Live RF interference	✔	✔
Digitally injected interference		✔
Integration with EMANE and CORE	✔	✔
Scripted node movement	✔	✔
Scenario record and playback	✔	✔
Built-in signal validation and FFT display		✔
Integrated logging of scenario and performance	✔	✔
Integrated display of network scenario, performance graphs, link status/quality, and routing behaviors	✔	✔
Display and analysis of Tx/Rx state of all nodes over time at usec-level granularity for Link/PHY layer debugging		✔
Display/dump of sampled signals		✔
Tunable frequency band		✔
Support for internal clock		✔

Specifications subject to change without notice