*RF*nest™

The real world in a box

Product Brochure

As the demand for broadband availability in the wireless industry increases, new and complex communications systems are being developed to provide the required services. This leaves developers with the question: How do we test wireless communication networks realistically and reliably in a laboratory environment? The answer: *RF*nest™.

Capturing the behavior of a wireless network is a complex problem that involves an understanding of the performance of protocols at different layers, as well as the behavior of the physical hardware. At one extreme, simulations generally lack the level of fidelity needed to guide practical design, while at the other extreme, all wireless field tests are expensive and time consuming. Furthermore, field testing is not easily scalable, controllable, or repeatable. As a result, it is very difficult to evaluate new protocols or solutions for wireless networks.

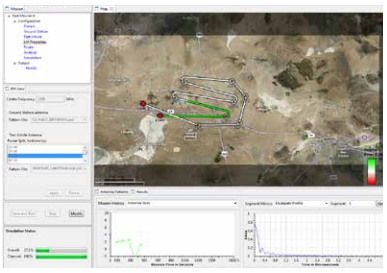
RFnest™ is a network channel emulator that allows a mesh of wireless nodes to experience realistic channels effects. Radios and systems tested via ***RF***nest™ experience an RF environment identical to a field test. ***RF***nest™ is the only channel emulator that supports the integration of real radio nodes and virtual (simulated) radio/network nodes where the simulated and real nodes communicate seamlessly.

Using network emulation technology, real and simulated radios exchange information and experience realistic signal interference as if they are a part of the same network of wireless nodes in a fielded environment.

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 an advanced solution for emulation of frequency selective channels in a highly dynamic environment. The ***RF***nest™ Digital series is a modular and extendable solution that allows the user to optimize testing from a handful of Single Input Single Outpout (SISO) to myriad Multi Input Multi Output (MIMO) nodes in a full mesh setting.

*RF*nest™ has a modular design with three main capabilities:

Emulation hardware with RF front ends that allows real radio nodes to send their RF signals over an emulated channel without any modification to the radios.



Modeling of time-varying channel impulse responses within the emulation hardware, with channel properties based on mobility models receiving input from an interactive Graphical User Interface (GUI).

Integration with network emulators and monitoring functionality that allows the user to configure, manage, and monitor real and virtual network nodes within the scenario.

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

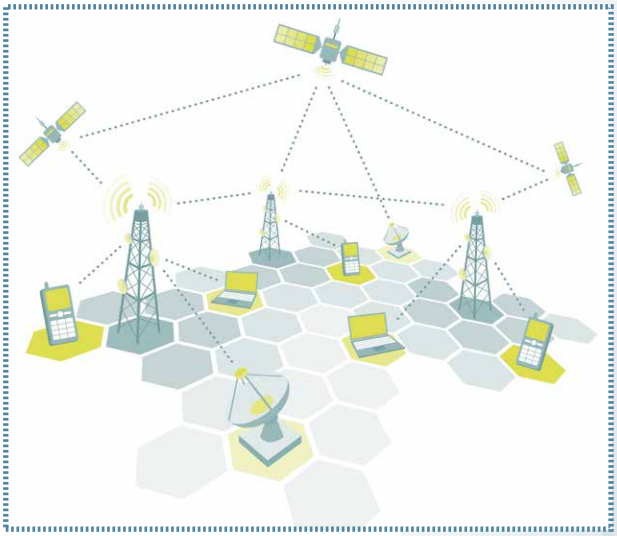
RFview™ software is a complete tool set with an interactive user interface that supports the following capabilities:

- Allows integrated control and monitoring of all levels of network performance.
- Interfaces with third party network emulation software including EMANE* and CORE**.
- Controls interactions between virtual and real nodes.
- Interacts with ***RF***nest™ hardware to set parameters such as channel impulse response and frequency band.
- Receives recorded RF signals, and replays arbitrary or recorded RF signals.
- Interfaces with third party channel modeling tools for specific channels of interest.
- Records scenarios, performance, and observed RF data for replay and post-test analysis.

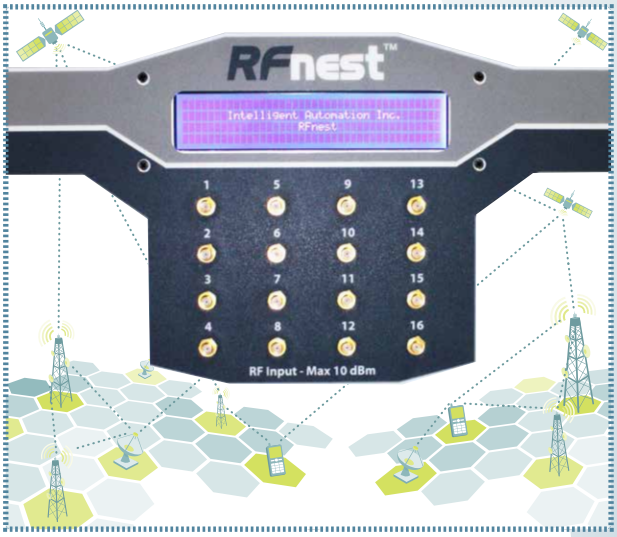
*Extendable Mobile Ad-hoc Network Emulator (EMANE)
**The Common Open Research Emulator (CORE)

"***RF***nest™ is a key technology that provides high fidelity emulation capabilities supporting our efforts to bridge the theory-practice gap in wireless networks. Enabled with repeatable, controllable and scalable experimentation functionalities, ***RF***nest™ finds a wide range of applications, including theory validation, fast algorithm design, system implementation and testing with real wireless radios"

Dr. Mung Chiang, *Arthur LeGrand Doty Professor of Electrical Engineering*, **Princeton University**

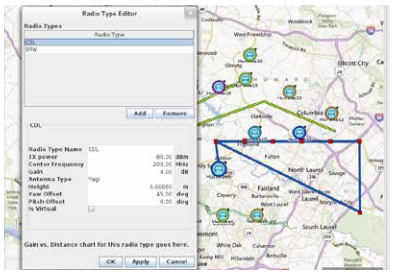


Real Environment

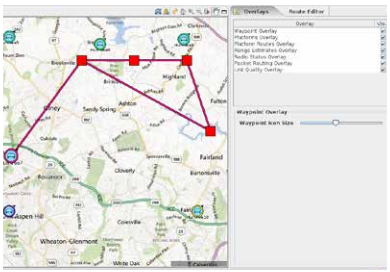


Emulated Environment in *RF*nest™

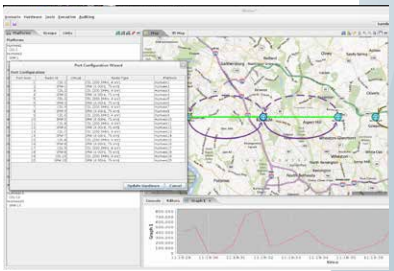
The ***RF***nest™ test procedure can be summarized in the following steps:



1. The ***RF***view™ tool supports the creation of dynamic multipath scenarios with real and virtual radios. An API allows the user to import specific channel modeling tools or recorded field test data.



2. Define the test setup and connect radios. The editor tool can be used to configure up to 96 nodes. Channel characteristics and other features can then be set independently for each channel.



3. Run the scenario in ***RF***nest.™ ***RF***nest™ provides accurate, repeatable results that can be recorded, replayed, and evaluated to quantify system performance.

*RF*nest™ Features and Benefits

RFnest™ features a modular and scalable design with unique capabilities for Test and Evaluation (T&E) of RF systems and network solutions in a laboratory environment. RFnest™ is:

- **Cost-Effective** – ***RF***nest™ replaces repeated field testing, allowing the developer to use captured field data as well as scenarios to evaluate the actual functional and performance characteristics of the radios, protocols, and network solutions.
- **Repeatable** – Unlike field testing, ***RF***nest™ allows the user to input and test the exact same scenario over and over again, enabling effective comparisons between radios, protocols, and test configurations.
- **Realistic** – ***RF***nest™ allows real radios to send and receive their RF signals over an emulated channel without any modifications to the radio. The ***RF***nest™ system operates at high fidelity assuring that you can trust the test results.

RFnest™ enables myriad functions for analyses including the following:

- **Provides network mesh support** – ***RF***nest™ provides a mesh of channels for a network of radios with each channel independently controlled.
- **Performance analysis** – ***RF***nest™ is a dynamic wireless network test environment that allows the user to test, record, and analyze network performance.
- **Scales up to 96 real nodes** – ***RF***nest™ supports more actual radios than any other channel emulator available, accomodating up to 96 radios simultaneously.
- **Supports virtual nodes** – In order to emulate even larger networks, ***RF***nest™ supports the addition of virtual nodes to the emulation environment. Virtual nodes are seamlessly integrated with real nodes, and are subject to full channel effects.
- **Accomodates a broad frequency range** – ***RF***nest™ supports radio frequencies from 0 Hz to 6 GHz. Special converters are available to support even higher frequencies.
- **Integrated Software** – ***RF***nest™ hardware complemented by ***RF***view™ software, allowing users to easily configure, analyze, and test radios and RF networks. The ***RF***view™ software is user friendly while providing a rich set of tools allowing the user to configure and display the most important data.

RFnest™ is the cornerstone for a cost-effective, realistic, repeatable, and mission customizable, high fidelity, Test and Evaluation (T&E) environment for mobile networks, in a laboratory environment, thus allowing for accelerated development, maturation, and fielding of new radios, protocols, and network solutions. All sales of ***RF***nest™ 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.

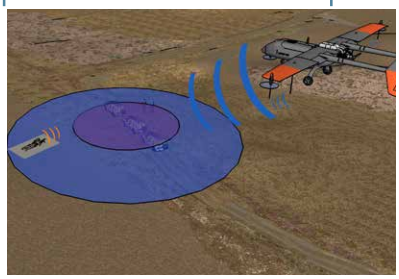
RFnest™ specifications at a glance (please see datasheets for each model for more details):

Number of Ports: ---------- 8 to 96
RF Configurations: --------- MIMO, SISO, SIMO, MISO, MESH
Frequency Band: ---------- 0 Hz to 6 GHz (model dependent)
Maximum Propagation Delay: ---------- 2 seconds
Doppler Shift: ---------- up to 200kHz
Frequency flat fading: --------- Rayleigh, Rician, log-normal
Frequency Selective fading: ---------- Rayleigh, Rician, log-normal with Doppler shift & phase adjustment
Interference Generator: --------- Independent per channel

*RF*nest™ can help product development and evaluation

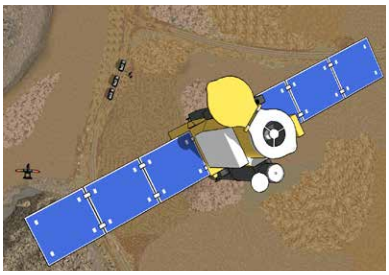
Mobile ad hoc Networks (MANET)

MANET is a self-configuring infrastructureless network of mobile devices connected by wireless communication links. Devices within the network are free to move and therefore can change links to other devices frequently. ***RF***nest™ provides a realistic test environment to assess MANET connectivity and quality of service.



Tactical Data Links

Military communications rely on Tactical Data Links (TDL) with standards such as Link-16. Military aircraft, ships, and ground forces exchange a wide range of data with secure and jam-resistant connectivity over long distances. ***RF***nest™ provides an emulation environment to analyze Tactical networks.



Satellite Communications

Satellites are in motion relative to the ground, so accurate accounts of path loss, delay, and other effects are important. ***RF***nest™ emulates long delays and Doppler shift phenomena typically experienced in ground to satellite communications.

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