

Virtual Modeling Tools Help Plan Military, Commercial Communications Networks

Flexible testing and emulation software helps network planning and spectrum management.

BY HENRY S. KENYON

Virtualization tools allow organizations to model complex, dynamic systems for flaws and performance issues long before hardware and field testing occur. The Defense Department has long realized the utility of simulation, and recently it has applied sophisticated modeling technology to study and plan communications networks. Such capabilities have both military and commercial applications.

As the Defense Department's wireless communications networks became more sophisticated and complex, the need grew for a modeling and testing system to search for potential bandwidth and scalability issues. This became especially necessary with the development and operational deployment of the military's Joint Tactical Radio System (JTRS) family. These software-driven radios use a sophisticated set of waveforms for moving a variety of data across the battlefield.

But modeling and planning how such radios would work and interact in networks presented a number of challenges because of the complexity of the waveforms and the dynamic way JTRS devices were supposed to interact in networks. This led to the development of the JTRS Network Emulator by Scalable Network Technologies.

Now known as the Joint Network Emulator (JNE), the software-based system is in use across the military for planning, testing and training purposes. The JNE software can simulate large-sized military communications networks under a variety of conditions, explains Sheetal Doshi, Scalable's JNE project lead. The

software also allows physical radios to connect and communicate with one or more radios simulated in JNE.

A big advantage of the JNE is its ability to realistically simulate large tactical radio networks and realize an at-scale operational tactical network laydown that consists of part live, part simulated radios by only using a few physical radio assets, Doshi says. The JNE also can be used to develop, emulate and run a variety of simulated radio waveform models for use in testing, planning and training. He notes that Scalable's real-time network emulation technology is the basis of the JNE, and the long-term vision is to provide: a framework for the DOD where users can create high-fidelity models of legacy and modern/prototype waveforms and run these models in real time for use in place of live radio assets, especially in situations where live radio assets are scarce and difficult or costly to obtain.

The ability to run both experimental and legacy waveforms is critical for software-based radio systems such as JTRS. One of the radio's key roles is to eliminate the need for multiple radios operating on different frequencies with a single radio capable of running existing waveforms and being loaded with new waveforms as they become available.

The JNE has been used at the Army's Network Integration Evaluation (NIE), an annual exercise to test the suitability of new military communications and networking equipment and software under harsh field conditions.

At the NIE, the primary use of JNE has been to simulate live JTRS networks under a variety of network

loading conditions that directly arise from operational maneuvers simulated in JNE, Doshi says. He adds that the Army's development and testing community uses the JNE to perform upfront network configuration testing and validation before full field testing at events such as the NIE.

This laboratory-based risk-reduction capability allows the Defense Department to conduct system tests and run a "sanity check" to ensure that they will perform properly before the equipment is deployed in an expensive exercise, Doshi says. "It really saves a lot of time for the DOD," he explained. The JNE also allows analysts to identify gaps and issues in radio network coverage, and it permits tests with real tactical applications such as full motion video and blue force situational awareness by running these applications on top of the virtual network in JNE to see how equipment and waveforms will work with these applications before field deployment.

However, Doshi notes that the Defense Department can use the JNE framework operationally as a network planning and optimization appliance to tune radios and other communications gear before it is used in the field. Another Scalable Network simulation-based product offering with commercial applications is QualNet, which can run simulations of complex networks orders of magnitudes faster than real time and scale up to large-sized models of radio networks and nodes. A modeling and simulation product such as QualNet is useful for the DOD because it meets the military's need for sophisticated communications modeling tools that can provide results in a rapid manner, he explains.

There are three domains for application of the real-time emulation technology that JNE provides, Doshi says. They are testing, planning and training. He notes that the technology can be used for testing and laboratory-based risk reduction to provide more efficient communications to warfighters and first responders. The next goal for the JNE is moving into the planning mode to help the Defense Department manage and configure ground-based radio networks.

JNE can also serve in an important role during soldiers' training on upcoming DOD networking technologies, Doshi says, noting that training on a simulated communications network is a good experience for military personnel before they are issued real equipment.

This modeling and scalability capability can also be applied to the commercial sector, and Scalable has a commercial network emulation product offering called EXata (which shares the same underlying network emulation technology as JNE) for use in the commercial and enterprise networking space. For example, as more devices feature embedded Wi-Fi and processors to collect and share data, bandwidth requirements will continue to grow. Commercial firms can use EXata as a scalable planning and simulation tool would be useful for spectrum and bandwidth assignments/testing, Doshi says.

Commercialized products arising out of the real-time network emulation technology can be used in parts of the world that lack connectivity to help model and plan out coverage for handheld devices, satellites and drones, Doshi says. As more technologies become ubiquitous in commercial use, he explains that the number of network-centric systems and applications that rely on network availability for their critical operations (such as Amazon's proposed commercial drone delivery system) will continue to grow. There will soon be a need to link all of these disparate technologies together as these systems will both share information with each other, but they will have to work in a larger environment of devices and software, Doshi says. Wireless modeling software will permit developers to plan out future spectrum and bandwidth allocations for a host of interconnected devices. Spectrum also remains an issue for civilian

mobile and wireless devices, Doshi says. He notes that even with the most current technology and access to a Wi-Fi node, users may not be guaranteed access in some regions. "You are going to have spectrum access issues," he says.

But if commercial users had access to wireless network emulation technology, it would provide them with a picture of available bandwidth and any local interference issues, Doshi says. For businesses such as wireless Internet service providers, he explains that such a capability allows them to model how their products work in a busy spectrum environment and how to develop resources to overcome any spectrum blockages.

Another advantage of the network emulation technology products from Scalable is that they allow networks to be tested to destruction in a safe virtual sandbox. Scalable's modeling technology allows users to simulate a variety of events, from working out network configuration issues to testing resilience to cyber attacks. Such systems let organizations know how these Web and spectrum phenomena affect an organization's mission, Doshi says.

This spectrum management and sandboxing capability also can be applied to wireless devices such as mobile phones. Even with strong commercial or government encryption, Doshi notes that there is always the possibility that a mobile device's signal can be captured and decoded by a rival business or foreign power. "The fact is that every communication is susceptible to cyber eavesdropping," he says.

Virtual, scalable simulations also help with systems and network planning, Doshi says. Because wireless communications and data networks operate in a very dynamic environment, properly testing them cannot be left to statistical estimates alone because of all the potential variables caused by built-in issues such as transport segments. He maintains that systems must be fully and dynamically simulated in real time under varying load and operational conditions to spot potential bottlenecks. One of the ultimate evolutionary goals for the technology behind the JNE and EXata is to create an expert system for network planning,

Doshi says. "You need to model these complex interactions," he maintains.

Besides modeling wireless network communications, there is also a strong use case for applying the system for cybersecurity vetting and testing, Doshi says. From a commander's perspective, they need to know if a cyber attack will harm their ability to carry out their mission, and if so, the extent of that damage. This can now be answered with cyber effects simulations, he adds.

This cyber attack modeling capability is also applicable to the commercial sector. Companies have a pressing need to test their networks' resistance to breaches and identify any potential weak spots, Doshi says. A key question such modeling should answer for both military commanders and chief information officers is "will the system go down completely? Will it be impaired?" he asks.

The modeling technology products that Scalable provides also allows organizations to sandbox and model an attack and how it would affect business/mission processes. Real-time testing also determines how resilient networks are to a range of attacks and model how best to deal with such situations, Doshi says.



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Our solutions integrate software virtual networks with physical hardware and applications, allowing users to rapidly test a wide range of highly realistic scenarios for better operational planning, more effective training and enhanced communications effectiveness without the expense of building out physical infrastructure. SCALABLE provides a repeatable, verifiable and highly cost effective solution.

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