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Change the Defense innovation game: Use a virtual network test bed from day one

by Jason Coe, Network Architect at Fuse Integration

Defense organizations routinely collaborate with multiple industry partners to develop tactical edge networking and communications innovations. Typically, hardware, software and systems advancements take priority when integrating new components and capabilities into a platform, and it's only at the end of the process that the network team gains exclusive access to test and verify configurations prior to flight. Too often, just when the team believes that each of the innovations are ready to test, the "last mile" of network integrations and critically important application flows don't work as intended, and they're challenging and time-consuming to resolve.

Recently, teams have transitioned to using a network virtual twin from day one of development, collaborating to shape integrated solutions throughout the development cycles. This game-changing approach not only speeds up defense innovations, it can also accelerate transitions from current technologies to the technologies of tomorrow, while reducing costs and risks.

The trouble with traditional tech exercises

Every branch of the U.S. military sponsors live exercises to test innovative communications and networking advancements. There's no substitute for the learning and insights that happen when industry and defense innovators come together to test tactical edge communications and networking solutions.

Traditionally, each team – hardware, software and network – design, develop, test and verify their prototypes and configurations in advance of an upcoming flight test. On site, all teams verify operational configurations and make any necessary last-minute changes.

Unfortunately, there are usually many adjustments from the specs that were laid out at the start of the design process. And rightly so! Each team may have improvements from what was initially envisioned. However, if the network is configured for old specs, or if the hardware is locked down so tightly that it doesn't communicate with the network, or if there are too many other variations, the integrated solution doesn't perform as expected. Precious time and energy are used to troubleshoot during the time meant for test flights and exercises. It's an expensive and exasperating experience.

Crawl, walk, run, sprint … then fly!

Now, instead of waiting until the flight test for integrations, cross-functional defense teams are starting to work together very early in the development process using a virtual network test bed (VNTB). Integrating suites of commercial off-the-shelf hardware and open-source technologies, users are empowered with a toolset to validate and experiment with the combined network configurations in a full virtual or mixed live-virtual environment.

Using a VNTB, defense teams and their industry partners can help to define network architecture and pre-plan for specific missions such as flight tests, information exchange requirements and network outages. By connecting, communicating and testing throughout the design process, the improvements each team makes along the way are

shared with others and incorporated into their designs, too.

One best practice is to use a phased approach when introducing VNTBs into the development process. Teams limit their introduction of variables as they test and iterate in each phase to reduce risk before transitioning to the next phase.

- **Crawl: Simulation of ideal conditions.** This phase is used to verify network configurations and operations, along with application flows, in the most ideal conditions. Hardware-in-the-loop is integrated for items that are either impossible or difficult to virtualize, like hardware-based encryption devices.

- **Walk: Introduction of limited network variables.** In this phase, controlled variations in network performance such as statically defined bandwidth constraints, latency and jitter are introduced to test and evaluate network performance in less-than-ideal conditions.

- **Run: Transition to over-the-air emulation with fixed-location assets.** Once the network consistently meets rigid defense requirements under the "walk" phase, emulated real-world radio frequency models are introduced. Tests in this phase exercise network performance in anticipated, yet controlled, real-world RF conditions.

- **Sprint: Pre-planned movement.** Tactical edge communications involve troops, ships and flights, and it's important to test network performance in motion. In this fourth "sprint" phase, RF links are dynamically moved to different locations and altitudes, using pre-planned routes, to reveal expected performance in flight. RF emulation environments that integrate digital terrain elevation data quickly expose mission challenges and flex network reacquisition configurations.

- **Fly: External stimuli.** To take it one step further, the inclusion of a fifth "fly" phase brings in emulation control and configuration from external systems, closing the testing loop. Using a flight simulator, for example, the team uses real platform configuration data to make observations and decisions regarding latitude, longitude and altitude in real time, rather than relying on a pre-defined track. A VNTB, driven by existing Unified Modeling Language platform configuration models, greatly reduces the amount of time the virtual infrastructure is put in place for testing.

All of these phases can be conducted virtually, with the full team watching and verifying what works (and what doesn't). Stepping through these phases and related adjustments before getting to live flights significantly reduces time, reduces risks and improves outcomes of the integrated solution.

Creating successful tactical edge networking solutions is just the beginning

Security and performance of innovative and integrated solutions will only be as good as the testing. If integrated testing is happening at every phase of development, the final prototypes and products will evolve from smarter and faster advancements to deliver superior outcomes.

Ultimately, we all want tactical edge networking and communications innovations delivered to warfighters for competitive advantage. Using a VNTB to create new products is the first step. Then, defense teams must transition from the tools and technologies that are currently deployed to support the programs and technologies for tomorrow. Once again, a VNTB can help to test, evaluate and validate integrations and configurations throughout that all-important transition to operational use to ensure security and performance, reducing risk.

We are just at the forefront of our capabilities of what we can emulate. There are immense possibilities. And there is more work to be done. Every step forward moves us closer to battlefield advantage for our nation's warfighters. ■