

Technology **Today**

HIGHLIGHTING RAYTHEON'S TECHNOLOGY

2007 Issue 3

**Raytheon's Command, Control,
Communications and Intelligence Core Market**
Delivering Operational Advantages for Our Customers



Raytheon

Customer Success Is Our Mission



Guy Germana
Senior Principal
Engineer; NCS
Airspace Management
and Homeland
Security

Years with Raytheon: 10

Q: Which programs are you working on?

A: I'm working on several programs related to perimeter security. The LaGuardia Airport

CCTV System will provide the airport police with a video surveillance capability. The Safe Haven program is a study contract to develop a security concept for rail yards. And I'm also writing a perimeter security section for the RTCA Airport Security guidelines.

Q: How did you become involved with perimeter security?

A: I worked on most major air traffic control systems — oceanic, en-route, and airport — for 20 years. I was ready for something new!

Q: What are some of the challenges you're facing?

A: Raytheon is still expanding our Mission Systems Integration positions, so there are challenges there. Moving from the defense world to the commercial/civil world is also a big challenge.

Q: Did anything in particular prepare you for your present role?

A: My engineering educational background has helped me tremendously — thank you University of Maryland! The opportunity to manage several engineering projects has also helped tremendously.

Q: What's the secret to individual success at Raytheon?

A: It's really the basics — understanding what the customer wants, ensuring the customer understands and agrees to what Raytheon is providing, and managing change.

Q: What about your job keeps you up at night?

A: Figuring out how to deliver value to the customer, given their budget constraints.

Q: What excites you about your job?

A: I'm excited to have the opportunity to participate in a new and growing business area, and I enjoy working with the people involved. I've met quite a few smart people throughout the company.

The Next Generation of Troposcatter Systems

In the 30 years since Raytheon developed the AN/TRC-170 family of tactical troposcatter systems — and produced over 800 systems for the U.S. Army, Air Force and Marine Corps — little attention was given to the next generation.

During the 1970s, troposcatter was the only means to convey megabit data at over-the-horizon distances up to several hundred kilometers since tactical SATCOM capacity was limited to critical C2. Over the last 25 years, the focus on over-the-horizon high-capacity military communications shifted to SATCOM with continuous upgrades planned for the foreseeable future. Despite this rapid growth in SATCOM capability, the growth in information need-lines has been even greater, resulting in the need to lease expensive commercial SATCOM resources. While many of these high-capacity SATCOM need-lines span ranges that are compatible with troposcatter operation, the AN/TRC-170 is often not used because it's considered too large, too slow to setup, limited in data rate, and it requires specially trained operators.

To exploit this opportunity, Raytheon undertook an IRAD project starting in 2005 to develop a prototype next generation troposcatter terminal. Ideally this new terminal would have many advantages over its predecessors: It would be no larger than a SATCOM terminal; it could be quickly set up; it required no special skills to operate; and it would provide data rates in excess of 20 Mbps.

That next-generation terminal is the DART-T, or Dual-mode, All-band, Relocatable, Tactical-Terminal (DART-T). It has been produced in HMMWV-mounted, trailer-mounted and transit case (Flyaway) versions. To combine small size and ease of use with high performance, DART-T has achieved a number of technological firsts, including single antenna quad-diversity, Ku-band propagation, software definable advanced



An HMMWV-mounted DART-T is tested at Camp Pendleton.

modulation, automatic antenna alignment and adaptive data rate.

The DART-T Design

To keep DART-T competitive in cost, it was decided to use proven components from rugged commercial-off-the-shelf (COTS) SATCOM terminals where possible. Hence, the terminal antenna is based on a single COTS 2.4m High-Wind Vertex/RSI antenna which has previously been adapted to HMMWV, trailer, and transit case transport.

While high-performance tropo links often use larger antennas, going to higher RF frequency also gives a smaller antenna higher gain. Thus, a Ku-band capability was incorporated and a new angle diversity feed was developed, which provides two independent beams in elevation spaced by a little over one beamwidth. The use of angle diversity and dual transmitters (frequency diversity) allows DART-T to achieve quad-diversity with only a single antenna, while TRC-170 needs dual antennas for this performance — a large reduction in terminal "footprint."

Ku-band was previously rejected for troposcatter operation due to potential rain attenuation, but USAF/MITRE-sponsored

Continued on page 10

Continued from page 9

testing in the 1990s showed that rain also enhanced the forward scatter, so the net effect was often neutralized. Since the COTS 2.4m antenna is motorized in elevation and azimuth pointing, algorithms were developed to allow the antenna to automatically search and acquire the signal from the distant terminal. This feature, combined with software that allows operators to estimate link performance before setup, nearly eliminates the special skill needed by an operator in the areas that are unique to troposcatter.

Another innovation is a new state-of-the-art modem developed at Radyne, which allows data rates up to 20 Mbps compared with the 4 Mbps maximum for TRC-170. This new modem also incorporates forward error correction coding and provides several dBs of system advantage even at TRC-170 data rates. This software-definable modem allows any data rate in 1 bps increments rather than the handful of fixed rates previously available.

Another major first for DART-T is the incorporation of Adaptive Data Rate, which allows the DART-T terminals to automatically adapt the data rate to the prevailing troposcatter path conditions. Previously, tropo data rates were set based on the maximum that could be supported 90 to 99 percent of the time, despite the fact that most of the time signal levels could be as much as 20 dB higher. With Adaptive Data Rate, the DART-T always provides maximum throughput — an ideal solution to an IP-based network (all military nets are migrating to IP).

DART-T Testing

During 2006, DART-T Ku-band prototypes were successfully tested on an 83-mile troposcatter path at Otis Air Force Base, a 45-mile diffraction/tropo path at Ft. Huachuca, and a 5-mile triple-diffraction path at Camp Pendleton. At Otis AFB, side-by-side testing was conducted against the TRC-170 V2 (largest family member) on the same path, and performance was comparable on both systems at the same data rates. This was a



Side-by-side DART-T and AN/TRC-170V2 testing at Otis AFB



A transit case DART-T at Ft. Huachuca

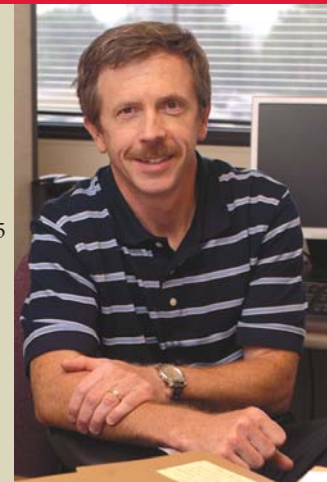


Trailer Mounted DART-T at Ft. Monmouth

clear indication that a viable tactical troposcatter system could be implemented at Ku-band, and that a much smaller terminal could exceed TRC-170 capabilities.

Testing at Ft. Huachuca and Camp Pendleton demonstrated data rates to 20 Mbps, which were error-free for long periods. Most of the time, performance was such that two parallel 20 Mbps streams, or 40 Mbps total, could be transferred. ●

Fred Unkauf
manfred_g_unkauf@raytheon.com



Douglas Johnson
Program Manager;
NCS Effects/Battle
Management
Systems Group
Years with Raytheon: 25

Q: What program are you working on these days?

A: I've been working with AFATDS (Advanced Field Artillery Tactical Data System) programs for 16 years. During that time, I've held various positions; it usually changes every three years. The program is always evolving, so the work has never gotten monotonous.

Q: How did you arrive at your current position?

A: I started my career as a digital circuit designer. Then when digital design became less needed due to microelectronic design advances, I transitioned into system engineering. From there I got into program team leadership, project management, project engineering and finally program management.

Q: What are some of the things that have allowed you to excel at Raytheon?

A: There are a few. One is working for very supportive leaders who help guide my career and give me greater responsibility going forward. It's also important to work with a very dedicated team. Another key is not being removed from my responsibilities when things don't go as well as planned. I think it's really important to have the opportunity to make decisions and then learn from your mistakes — that's how you grow.

Q: What part of your job concerns you the most?

A: I'd say worrying about making all of our commitments. Maintaining a healthy work/life balance for me and everyone on the team is also a challenge.

Q: What's the most rewarding aspect of your job?

A: Providing products that meet or exceed the users needs. And of course seeing soldiers get excited about the product — and really want to use it!

Copyright © 2007 Raytheon Company. All rights reserved.
Approved for public release. Printed in the USA.
Customer Success Is Our Mission is a trademark of Raytheon Company.
Raytheon Six Sigma, MathMovesU and NoDoubt are trademarks of Raytheon Company.
Capability Maturity Model, CMM and CMMI are registered in the U.S. Patent and
Trademark Office by Carnegie Mellon University.

Raytheon

Customer Success Is Our Mission