HIGHLIGHTING RAYTHEON’S TECHNOLOGY

RAYTHEON
The Leader in Radar Systems and Technology

The AN/APG-79
The Next-Generation Active Electronically Scanning Array Radar

ALSO IN THIS ISSUE

- Engineering Fellows Program
- Excellence in Technology
- CMMI and Raytheon

http://home.ray.com/rayeng
In our second issue of technology today, we are focusing on our radar capabilities across this great company. One of the strengths of Raytheon lays in our airborne and surface radar capabilities within Electronic Systems. This capability has leveraged itself into our commercial products as well as our Command, Control, Communications, and Information Systems (C3I) business.

One of the key foundations of technology is our ability to drive next generation RF components through our Raytheon RF Components (RRFC) and Advanced Product Center (APC) organizations. We lead the industry in developing next generation transmit/receive modules and high power components that enable our technology leadership in radar systems.

It is also interesting to take note that in this issue we are addressing the great advances we are making in Capability Maturity Model (CMM), Capability Maturity Model Integration (CMMI) and Raytheon Six Sigma. As we incorporate best practices from CMMI, Integrated Product Development System (IPDS) and Raytheon Six Sigma, we are seeing the benefits in our ability to invest more in R&D and product development. Our efficiencies and productivity improvements have given way to higher customer satisfaction.

I am certain all of you are aware of our pursuit to work as one company, pooling our resources and technical expertise, to provide the best solutions to our customers. We highlight a few examples of the strides we are making toward this goal. Included are the Capture/Proposal IPT’s efforts to increase our win rate, the sharing of knowledge and expertise at our engineering symposia and the EKV programs cross company teaming to improve the detector design.

I hope that this issue brings you some interesting insights into our capabilities in radars as well as the technical greatness of this company. We truly are re-inventing Raytheon for the better!

Sincerely,

Greg

On the Cover
The AN/APG-79. This radar is the next generation active electronically scanning array radar. Enhancements to this system will include:
- Very long target engagement
- Interleave mode capability
- Very high resolution SAR mapping capability
- Greatly improved reliability and supportability
- Latest generation transmit/receive modules

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EDITOR’S NOTE

The second issue of technology today is complete. I have had the recent opportunity to meet many of you at our engineering symposia, awards ceremonies and plant tours. I continue to be amazed by the breadth of technical knowledge and expertise within our company. We have made tremendous progress as a company, working together to promote excellence, teamwork and original thinking.

It is clear we have had many successes but we still have work to do. One of the areas Engineering and Technology is trying to improve on is communication. This magazine, technology today, the Engineering and Technology web site (http://home.ray.com/rayeng) and our internal symposia are a few of the vehicles that we are sponsoring to improve our internal communications. I encourage you to submit abstracts, share news, and suggest one company and story ideas that feature innovation, technology and your personal successes at Raytheon. You have the passion - you can make a difference.

Jean Scire, Editor
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Today Raytheon is the leading provider of radar systems to the United States and International Governments, addressing all application domains. We have design and manufacturing capability throughout the United States, in Canada, and in the United Kingdom (UK) at Raytheon Systems Limited (RSL). For air, ground, sea and space applications, we are a strong competitor because our technology edge has led to a high percentage of wins. No other company, past or present, can match our design and manufacturing expertise.

Our systems and technologies are varied. From arrays that are measured in kilometers to those you can hold in your hands, from fitting into the nose of a missile to matching the size of a ten story building, we are unmatched in the breadth of our products. This breadth comes from the integration of the former Raytheon, Hughes and Texas Instruments (TI), each significant in their own right. We have programs that have been in production for decades and new developments that exploit the latest technologies. We are making technology advances in system concepts, algorithms, software architectures, hardware devices and in active electronically scanned arrays (AESA), as well as both electrical and mechanical design.

Yet as we move toward being One Company, we are finding innovative ways to integrate our technologies, to consolidate our investment strategies, and to formulate integrated systems designs that offer the best technologies from across Raytheon. An excellent example is the SPY-3 radar (previously Multi-Function Radar (MFR)) a competi-
tive procurement for the Navy where Raytheon was not considered the front runner. Our technical approach, developed by the Naval and Maritime Integrated Systems (N&MIS) Program Management Office and Surface Radar Engineering, was based on an evolution of Air Missile Defense Systems (A/MDS) phased array radars such as Theater High Altitude Air Defense (THAAD), yet incorporated key functionality developed in Electronic Systems (ES) North Texas and ES El Segundo, to provide the absolute best value to the customer.

A comprehensive treatment of our development and production programs and the underlying technologies would take a volume much larger than an issue of technology today. Within these pages, selected highlights demonstrate the breadth of our programs and systems. Raytheon has unprecedented capability to support its customers with major design facilities at Electronic Systems in California, Massachusetts, and Texas; C3I in Massachusetts, Waterloo, Ontario; and RSL in the UK. All of these sites have manufacturing capability along with our plant in Forest, Mississippi.

From these locations, we have achieved leadership positions in most market segments and provide system solutions for airborne applications, including air combat and ground and ocean surveillance; ground applications including missile defense, air traffic control (civilian and defense), and space surveillance; and ship applications for self-defense and volume surveillance.


As the business unit name implies, A/MDS provides radars for air and missile defense. The long-standing product lines include PATRIOT and HAWK. These field proven systems have established A/MDS as the leader in radar systems for missile defense. A/MDS has also built nearly every radar system used for ballistic missile early warning and data gathering including PAVE PAWS, Ballistic Missile Early Warning System (BMEWS), COBRA DANE, and COBRA JUDY. These legacy systems are joined by a number of development programs including THAAD, Upgraded Early Warning Radar (UEWR), X-band Radar (XBR), Joint Land Attack Cruise Missile Defense Elevated Netted Sensor (JLENS), and Affordable Ground Based Radar (AGBR).

The PATRIOT radar is a C-band multifunction phased array with track-via-missile guidance. It provides long range high-altitude, all-weather coverage designed to defeat advanced threats, including aircraft, tactical ballistic missiles and cruise missiles. The design has continuously evolved and the sixth major software functionality increase since initial deployment is currently in development. Hardware improvements have been made to support enhanced target classification capabilities.

An integral part of the THAAD System, the THAAD radar is an X-band, phased array, solid-state radar. It supports the long-range functional requirements of the THAAD mission by delivering high power output and exceptional beam/waveform agility. After a successful demonstration/validation phase, the program is currently producing the EMD radars.

The X-Band Radar (XBR) is a large, phased-array that is the primary fire control sensor for the Ground-Based Mid-Course Defense (GMD) system providing surveillance, acquisition, tracking, discrimination, fire control support and kill assessment. The radar performs surveillance autonomously or as cued by other sensors such as UEWR, and will acquire, track, classify/identify and estimate trajectory parameters for targets. The radar has sophisticated discrimination capability able to identify re-entry vehicles from other objects including decoys. XBR has a thinned array with a limited electronic field of view that is augmented by a dynamic pedestal and mechanically slued to provide hemispheric coverage. XBR derives its configuration from Ground Based Radar Prototype (GBR-P) architecture and leverages a high percentage of software reuse from GBR-P, which in turn was leveraged from the THAAD system. XBR and THAAD also share many hardware components such as the transmit/receive (T/R) modules.

The UEWR program is upgrading the existing early warning radars to support the GMD mission. The apertures of these radars
will remain unchanged achieving performance improvements with new receiver hardware and software algorithms. These are intended to improve detection and target tracking, object classification and operation in a disturbed environment.

The JLENS is a tactical, theater-based, advanced sensor system that enhances wide-area protection against land attack cruise missiles, while supporting secondary missions such as combat identification, communication relays, and attack operations. The JLENS system consists of two radars on tethered aerostats: a fire control radar and a surveillance radar. The program is a collaborative effort with Raytheon Surveillance and Reconnaissance Systems (SRS) which will develop the surveillance radar.

More recently, A/MDS has won the Affordable Ground Based Radar (AGBR) program that is a concept development platform for the emergent Multi Role Radar System (MRRS), a highly mobile radar system designed to provide the United States Marine Corps (U.S.MC) early air surveillance capabilities ashore during operational maneuver from the sea. The U.S.MC objective for MRRS is to replace the AN/TPS-63, AN/TPS-73 and the AN/MPQ-62 for the missions of air traffic control, tactical air operations and short range air defense as well as providing three dimensional radar coverage in that are areas out of the view of the AN/TPS-59 (V) 3 radar. The AGBR Advanced Development Model ADM will be used to validate the feasibility of incorporating technology that meets MRRS requirements.

Radar Systems in Naval and Maritime Integrated Systems (N&MIS)
N&MIS has developed some of the most advanced radar systems used by the Navy’s surface combatants. The legacy of deployed radar systems includes MFCS Mk74 (TARTAR), AN/SPY-1 (AEGIS transmitter), MFCS Mk99 (AEGIS Illuminator system), and the SPS-49 Volume Surveillance Radar. Building on this legacy experience, new development programs are in process, including the AN/SPY-3 Multi-Function Radar, Volume Surveillance Radar (VSR), Dual-Band Radar (DBR) and High Power Discriminator (HPD). In addition, N&MIS Radar Systems is pursuing international opportunities for derivatives of SPY-3. This includes an agreement to work with Thales on SEAPAR, which is planned to provide NATO countries with a multi-faced active X-band phased array system for ship self-defense.

The missions supported by N&MIS radars in current development include:
- Ship Self-Defense (both Anti-Air Warfare (AAW) and Surface)
- Ship Based Area Defense
- Carrier Air Traffic Control (ATC) and Precision Landing Support
- Threat/Kill Assessment
- Ship Based Theater Missile Defense
- Surface Surveillance and Ship Navigation
- Periscope Detection and Discrimination
- Counter Battery and Naval Surface Fire Support

The enabling technologies of the N&MIS radars include:
- Active T/R modules
- Active Phased Arrays
- Low Noise Exciter, Receiver and Power Systems
- Versatile, Direct Digital Wideband Waveform Synthesis
- Synchronized Multi-Faced Waveform Generation
- Centralized Off-Array Beamsteering Command Generation
- High Throughput, Low Latency COTS Signal Data Processors
- Advanced Signal Processing Techniques for Clutter and Jammer Suppression
- Advanced Data Processing Algorithms for Multi-Function Scheduling and Multi-Hypothesis Tracking

Potential new surface combatants using N&MIS radar systems include:
- LPD(X)
- DD(X)
- CVN/CVX

SPY-3
The AN/SPY-3 system, also known as Multi-Function Radar (MFR), is a 3-face, active, X-band phased array radar. This system is intended to be deployed on new surface combatants, including DD(X), CV(X) and LPD(X). The primary mission of this system is to support ship self-defense. This requires the system to provide horizon search/track-while-scan (HS/TWS), precision track of engaged threat targets and own-ship missiles, missile uplink/downlink, and threat target illumination. In addition, the radar supports various ancillary search and track functions. These include volume/sector search, cued acquisition, periscope detection and discrimination, counter-battery, naval surface fire support and surface search/navigation. Tracking modes supported include Threat Assessment functions such as Non-Cooperative Target Recognition, Raid Count, Maneuver Estimation and Kill Assessment. These modes are performed against advanced threats in challenging natural and man-made interference environments associated with littoral operation. To meet performance requirements in these scenarios, the radar employs fast beam switching, low
noise, active phased arrays, state-of-the-art dynamic range receive systems, adaptive digital matched filtering and Doppler processing for the high sub-clutter visibility and interference suppression required in dense target environments.

**VSR**

The VSR system is a 3-face, active, L-band phased array radar, intended to be deployed on new surface combatants, including DD(X), CV(X) and LPD(X). The primary mission of this system is to provide hemispheric volume surveillance to compile the total air picture. In addition, coupled with SPY-3, VSR supports ship self-defense for targets in the volume. This requires the system to provide volume search/track-while-scan (VS/TWS) and precision track of threat targets. In addition, the VSR provides low elevation detection functionality in the stressing clutter and interference environments associated with littoral operation. The VSR provides long range surveillance to extend air dominance against advanced threats in wide area battle spaces. To meet performance requirements in these scenarios, the radar employs fast beam switching, low noise, active phased arrays, state-of-the-art dynamic range receive systems, adaptive digital matched filtering and Doppler processing for high sub-clutter visibility and interference suppression in a dense target environment.

**DBR**

The DBR concept combines the detection capability of the SPY-3 system on the horizon and the VSR in the volume to efficiently respond to surveillance, track, threat assessment, and engagement support commands from the ship’s combat system. Coordinated resource management, scheduling and tracking provide potent functionality to provide quick reaction cued acquisition to threat targets, dual band counter to electronic attack, backup L-band horizon search coverage during X-band missile illumination support, and balancing of precision tracking radar resources. Control of each radar at the waveform level promotes a more optimized usage of both frequencies to maximize utilization of the radar timeline and increase search and track revisit rates. Correlation of detection measurements in a centralized track database provides for improved precision threat track, minimized fades and reduced susceptibility to electronic attack. The DBR concept also provides an excellent ATC capability for CV(X) operations; whereby, the VSR handles air traffic marshalling and the MFR supports precision landing.

**HPD**

HPD is a single face, X-band active phased array radar system based on THAAD array technology and software reuse. This ship-based system will be mechanically trainable to allow for adjustable sector coverage for Navy Theater Missile Defense (TMD). The HPD radar provides the long range detection capability and high range resolution to support area defense against endo- and exo-atmospheric missile defense.

### Missions for Maritime and Overland Surveillance Radars

- Anti Submarine Warfare (ASW)
- Anti Surface Warfare (ASuW)
- Overland Surveillance/Mapping
- Navigation/Weather
- Precision Targeting
- Combat ID/BDA

### Radars for Tactical Systems

The Maritime and Overland Surveillance radar systems are based in McKinney, Texas. The AN/APS-137 is the current generation of a family of surveillance radars that has been supporting the U.S. Navy’s maritime missions since the 1960’s. These systems have been deployed on the P-3, the S-3 and the U.S.CG C-130 aircraft as well as some limited installations on Navy surface vessels for special operations. Early mission capability consisted of sea surface search, periscope and small target detection and navigation/weather avoidance.

New technologies were introduced in the 1980s that included multiple target track-while-scan, and Inverse Synthetic Aperture Radar (ISAR). The APS-137 was the world’s first radar to incorporate ISAR and provide the fleet with over-the-horizon ship imaging and classification capability. The U.S. Navy’s mission changed after the Cold War from deep “Blue Water”
RADAR TECHNOLOGY (continued)

scenarios to the shallow water littoral environment. The littoral land-sea transition region demands new capabilities for successful mission operation. As part of the Navy’s ASuW Improvement Program (AIP), the APS-137 was upgraded with high and ultra-high resolution ISAR for imaging and classification of small fast moving vessels that operate close to the coastline. A true Synthetic Aperture (SAR) mode was also added to allow imaging of stationary ships and boats close to shore and for multiple resolution (down to 1 foot) overland imaging. In recent conflicts, such as Operation Enduring Freedom, the U.S. Navy is often “first on scene” and can make a significant impact at the outset of a regional engagement depending on the action it takes. During these engagements, a standoff real-time precision targeting capability is needed for successful strike of time critical targets. To satisfy this requirement, the APS-137 has recently been upgraded with a precision targeting mode that produces target quality coordinates directly from the radar that can be handed off to a shooter. It is significant to note that, unlike other radars, the targeting data does not require mensuration (alignment) with overhead imagery in a separate process, and therefore is not subject to the inherent inaccuracies in cases where when mission operations are in desert regions or other areas where no dominant land formations are available for registration.

A derivative radar system from the APS-137 family is the SeaVue, which is a lower cost versatile system providing maritime and overland surveillance capability for small airborne platforms. It provides SAR and ISAR imaging, Doppler Beam Sharpening, Moving Target Indication, and Search and Rescue Transponder Indicator. More than 50 systems have been delivered to both foreign and domestic customers.

The next generation surveillance radar has already been developed and operationally tested in a joint program with Raytheon, NAVAIR, NAVSEA, and ONR. While maintaining all existing APS-137 modes, this radar, named the Automatic Radar Periscope Detection and Discrimination system (ARPDD), can automatically detect and track low radar cross section (RCS) periscopes with short exposure times and alert the operator of their presence using Automatic Target Recognition (ATR) algorithms. This new ASW capability is a high priority for the fleet as the proliferation of quiet diesel electric submarines is a significant threat to the security of the naval battle group and task force. The ARPDD system has been successfully deployed on both airborne and shipboard platforms and has demonstrated the capability to detect and simultaneously track up to 3000 targets and automatically identify short exposure periscopes in high sea states with extremely low false alarm rates.

The AN/APS-137 and ARPDD family of radars has been, and will continue to be a major product for Raytheon, serving the U.S. Navy’s surveillance needs for many years to come.

The Tactical Radar Branch provides a Family of Terrain Following/Terrain Avoidance (TF/TA) Radars which have been in production since 1965 and has produced and delivered over 5000 systems.

Enabling Technologies for Maritime and Overland Surveillance Radars
- Ocean Clutter Decorrelation
- Periscope ATR Algorithms
- Ship Classification (ISAR)
- High Resolution Ground Map (SAR)
- Precision Targeting
- Ground Moving Target Indicator (GMTI)

These systems have been deployed on the F-11, RF4-C, Tornado, F-16, F-15, CV-22, MH-47, MH-53, MH-60, MC-130 aircraft as well as limited installations on other aircraft for special operations. The primary missions of the radars are covert penetration by using Terrain Following/Terrain Avoidance radar sensing for terrain contour flights at altitudes as low as 100 feet in all weather conditions.

Raytheon has dominated the TF/TA radar market for over 30 years by providing a low cost, light weight, highly specialized sensor specifically designed for low altitude flight. The terrain contour flight technique depends on providing a continuous two-dimensional data picture combined with specialized flight command algorithms tailored for each aircraft installation type. The radar employs monopulse resolution improvement techniques with specialized waveforms and unique discrimination algorithms in a fail-safe design. This approach eliminates false alarms and refines terrain locations for anticipatory flight commands that allow flight over or around obstructions. This allows safe ingress/egress over mountainous terrain while flying from 40 to 700 knots depending on aircraft type. For Special Operations, covert penetration also means controlling RF emissions. The next generation of TF/TA sensors presently under development will be Low Probability of Intercept/ Low Probability of Detection radars that use GPS and DTED to augment the terrain database during flight. This next
Raytheon has dominated the TF/TA radar market for over 30 years by providing a low cost, light weight, highly specialized sensor specifically designed for low altitude flight.

generation is a “quiet” radar that utilizes lower emission power with uniquely coded waveforms and wide RF bandwidth for emission control. These radar sensors are now being conceptualized by Raytheon for SOCOM and are being planned for an engineering development phase starting in 2003.

With the advent of stealth aircraft, ground hugging TF/TA radars have been declining except for the Special Operation Forces. However, as technology improves, stealth aircraft can potentially become more at risk to next generation radar detection. This could provide more demand for a TF/TA radar mode in future tactical aircraft and a new market for these specialized radars.

Air Combat & Strike Systems (AC&SS) Radar Systems

Air Combat & Strike Systems (AC&SS) radars provide war fighters with the ability to fulfill their air superiority and precision long range and/or tactical strike missions. The radars provide high-powered long range target detection and tracking. This long-range capability provides the fighter with the advantage of detecting his adversary first and usually to deliver weapons first, thereby maximizing survivability and ensuring mission success.

The radar can track multiple targets while at the same time searching for additional targets providing the war fighter with enhanced situational awareness. The radar also is capable of supporting simultaneous multi-weapon delivery.

The AC&SS radars provide high-resolution radar map imagery. This capability is provided in all weather conditions, providing an advantage over optical or infrared sensor systems. This imagery supports delivery of precision guided weapons during surgical strike missions. It is also used in performing battle damage assessment or reconnaissance missions.

The APG-63 (v) 2 radar is an active array radar on the F-15 fighter. It incorporates an agile beam, high power and high sensitivity active antenna with a multi-function APG-63 radar. Like other AC&SS radars, it provides target detection, tracking and weapon delivery in a high clutter environment. It takes advantage of high technology T/R modules and MMICs,
high dynamic range receivers, advanced algorithms and high-density signal and data processing subsystems. F-15 fighters are flying patrols in the Iraqi “No-fly Zone”, and these fighters provided both fighter intercept, precision strikes and escorts for missions supporting the efforts in the Persian Gulf.

Deployed products include, APG-63, -63(v)1, -63(v)2, APG-70, APG-73, APG-71, and AN/APG-181. A current development program is APG-79 AESA.

The enabling technologies in AC&SS radar systems include T/R modules, active arrays, algorithms, digital receivers, MMIC, and high throughput processors.

**Radar Systems for Air Traffic Control**

Raytheon has been expanding its base in radars for domestic air traffic control (ATC) and related applications over the past few years leveraging radars developed for the international market. The ATC radar work is performed by C3I facilities in Marlboro and Sudbury, Mass., and Waterloo, Ontario with Monopulse Secondary Surveillance Radars (MSSRs) from RSL in the UK.

Most notable in this market segment is the DoD/FAA’s ASR-11 Digital Airport Surveillance Radar (DASR), which has entered Low-Rate Initial Production (LRIP). Our DASR design won competitive procurement and was almost entirely based on our ASR-10SS and ASR-23SS product line, previously developed for the international market. Over 15 countries with
more than 75 sites around the world have selected this all-solid-state Primary Surveillance Radar (PSR).

DASR is the next generation solid-state, S-band, terminal area air traffic control radar providing PSR coverage to 60 miles and MSSR coverage to 120 miles. The system also provides six-level weather reflectivity data.

The DoD and the FAA plan to use DASR to replace their aging GPN 12/20s and ASR-7/8s throughout the United States at up to 213 sites.

Another radar with ASR-10SS legacy is the Air Traffic Navigation, Integration and Co-ordination System (ATNAVICS), a highly mobile military landing system, enabling the rapid deployment of troops and equipment to remote locations where no operational airport control and landing system exists. The system uses an S-Band air surveillance radar, an L-Band secondary surveillance radar/identification friend or foe, and an X-Band precision approach radar.

ATNAVICS is contained in two four-wheel drive HMMWV vehicles and two towed power generator trailers. The vehicles, and hence the system, are air liftable and can be rapidly deployed to forward airstrips. It can be set up in less than 60 minutes.

Developed in conjunction with ATNAVICS, and using the same hardware and software, Raytheon’s Fixed-Base Precision Approach Radar (FBPAR) offers a transportable precision aircraft control. FBPAR uses a pedestal-mounted antenna, which rotates to cover six predetermined runway approaches, and a standard ISO container to house the PAR electronics. The AN/FPN-67 FBPAR is a modern, reliable ground-based precision approach radar in a fixed shelter (or integrated with the mobile ATNAVICS system).

Another development program is Raytheon’s next generation ASMR radar that monitors surface traffic at airport locations. It is a low-cost, solid-state, extremely reliable system that supports redundant transceivers, radar data processors and displays. It is being supplied to the FAA as part of the ASDE-X program.

ASMR operates in the X-band combined with frequency diversity and circular antenna polarization that improves performance in rain and snow. It provides the accuracy and resolution required to detect small surface vehicles as well as aircraft of all sizes. Sophisticated clutter rejection software in the radar data processor automatically adjusts to changing weather to maintain optimal radar performance in all weather conditions.

Raytheon has been expanding its base in radars for domestic air traffic control and related applications over the past few years leveraging radars developed for the international market.

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Raytheon is at the forefront of advanced technology and manufacturing for the devices that comprise our systems. Our device foundry in Andover, Massachusetts (Raytheon RF Components), along with our transmit/receive (T/R) module manufacturing center in Dallas, Texas (Advanced Product Center), combines technical expertise and manufacturing capability to keep components flowing into our systems at the impressive rate of more than 10,000 modules per month. By the year’s end, more than 4000 T/R modules a month will be required by missile defense programs alone. Similar components are being supplied in real time to the F-22, F-18, CEC, SPY-3, and MK-73 solid-state antennas. These monolithic microwave integrated circuits (MMICs) and modules are incorporated into various hardware architectures by Raytheon business units to meet their customer’s requirements.

Through Raytheon RF Components (RRFC), we endeavor to develop the best microwave technology in the world for our defense customers. We have developed state-of-the-art gallium arsenide (GaAs) MMIC pseudomorphic high electron mobility transistor (PHEMT) devices that went into production programs as early as 1995. The PHEMT technology has enabled a level of performance for our X-band applications that is significantly better in terms of RF power output and noise figure than similarly constructed metal semiconductor field effect transistor (MESFET) devices from other foundries. Today we are finishing the transition of our metamorphic high electron mobility transistor (MHEMT) process to the production wafer manufacturing operation. The MHEMT technology promises to bring the same level of performance improvement to the realm of millimeter wave applications, while maintaining the low cost of

**MMIC and MODULE TECHNOLOGY IS THE KEY to SOLID-STATE APPLICATIONS**

T/R Modules are being built at the APC in Dallas, TX using GaAs MMIC devices from RRFC in Andover, MA.

The Transmit/Receive Integrated Microwave Module (TRIMM) is a value-engineered conduction-cooled assembly consisting of MMIC T/R modules, radiators, power converters, and logic.

A higher level of MMIC integration using RRFC’s advanced semiconductor processes is a keystone for the future of Raytheon’s array antennas.

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the finished product. Future generations of military solid-state radars will use wide band-gap semiconductors, and RRFC is one of the industry leaders in developing these devices and materials. The resultant systems will be capable of enormous new potential when this technology matures.

Through the Advanced Products Center (APC), we have capitalized to ensure that our supply of MMICs and modules will not bottleneck the programs to which they are supplied. This highly integrated module manufacturing facility makes use of robotic equipment, automated handlers, and high-speed microwave test equipment to ensure high-volume production. Module hardware is assembled and tested using batch processes to achieve the highest throughput with the minimum labor cost.

Design engineers across our one company are learning to utilize the production manufacturing capabilities of both the Andover and the Dallas facilities as designs unfold for the next-generation antennas and tube replacements in phased arrays and other transmitting hardware.

Advanced semiconductors form the core of low-cost, high-performance modules for use in tomorrow’s systems. For example, today we are building PHEMT T/R modules with nearly double the performance when compared to prior MESFET modules, and all of this is being accomplished at nearly half the selling price to the customer. Within RRFC we have worked to provide higher levels of integration in MMIC chip design. This allows T/R modules to be built with fewer components and less direct assembly and test labor. The most successful chip of this type so far is the THAAD multi-function chip, which combines a 7-bit phase shifter; 6-bit attenuator; amplifier gain stages for transmit and receive; T/R switching; and digital serial-to-parallel interface circuitry.

The enabling technologies for advanced T/R modules will include both semiconductor and microelectronics manufacturing innovations. Advanced semiconductor technologies including MHEMT, E/D-PHEMT, and wide band-gap semiconductors will allow for higher device power output, higher system efficiency, better noise figure, and more functionality at the element level. All of these contribute to far more capable systems. These become enablers for multifunction, wideband, shared beam apertures that will dominate the future. The push for “module-less” array panels will necessitate building multiple elements-worth of electronics into a single integrated assembly. Some of these concepts are now in exploratory development phases and will pave the way toward more productized configurations.

– Mike Borkowski

Raytheon’s semiconductor technology is being used in solid-state upgrades on board Navy ships to replace aging tube-based systems.

Key to cost-effective solid-state products is mutual coexistence of defense and commercial development and manufacturing.

Demonstration of low-cost alternatives for today’s T/R module functionality will secure the future for Raytheon in solid-state array technology.
NEW DIRECTOR OF ENGINEERING AND TECHNOLOGY AT RSL

Alan McCormick was appointed director of engineering and technology at Raytheon Systems Limited (RSL) in February 2002.

Alan was formerly Engineering Director with AMS Radar Systems Division. He also spent nine years on the Isle of Wight with Siemens Plessey Systems where he started as an antenna designer progressing to being responsible for the design groups there.

In this position, Alan is also a member of the Engineering and Technology Council (E&TC), the council that includes the engineering and technology leaders working together to leverage our technology with cross-business opportunities and solutions to maintain our competitive advantage through synergistic product development and technical reuse.

Alan and his wife currently live near Colchester, England but are keen to move closer to Harlow in the not too distant future. He's also interested in tinkering with cars and owns an old MG, which he'd like to spend more time under than his new role currently allows!

His goal for the Engineering Professional Group is to become a world-class engineering organization by the end of next year. “Our reputation should be that we are the best and our excellence is recognized across Raytheon and the industry,” he said.

Alan holds a MEng and a Ph.D. in Electrical and Electronic Engineering from Heriot Watt University, in Edinburgh.

NEW CHAIR FOR AERONAUTICAL ENGINEERING COUNCIL (AEC)

Sam Bruner, the new chair of the Aeronautical Engineering Council, has over twenty years of experience in general aviation and corporate aircraft. A Raytheon employee for more than 13 years, Sam has performed many different roles in the design of aircraft. As a functional manager, he has been heavily involved with aerodynamics, flight mechanics, and aircraft preliminary design. Sam has also served in project assignments: project manager on one new aircraft program, and as chief engineer on Raytheon Aircraft’s new Hawker Horizon program. Sam’s current assignment at Raytheon Aircraft Company (RAC) in Wichita, Kansas, is as their Director of Air Vehicle Analysis.

Sam’s enthusiasm for aviation extends beyond the office. A private pilot for over 25 years, he is an active member of the Raytheon Aircraft Employees Flying Club. He is also an active participant in many industry, AIAA, and NASA advisory committees. He remembers the value of his internship experience at RAC’s predecessor Beech Aircraft, and attempts to share that experience through ongoing mentoring at Raytheon Aircraft. Sam also serves as the Raytheon Campus Manager at his alma mater, the University of Kansas.

Sam holds a BSAE from the University of Kansas, a MSAE from Wichita State University, and is currently pursuing his Ph.D. in Aeronautical Engineering from Wichita State University.

Career Development Brochure

The Raytheon Learning Institute (RLI) has a new brochure available. This eight-page brochure, entitled “Visualize Career Success” describes the steps to career success.

- Define your Ideal Job
- Self Assessment
- Characterize the Gap
- Develop a Preliminary Plan
- Discuss Your Performance and Career Plans with Your Boss
- Execute Your Plan...Adding Value In Everything You Do

The brochure was developed as a response to feedback from employee surveys in which employees expressed a need for more information to help them manage their careers effectively. This brochure complements local career development initiatives and does not replace them.

The brochure is available online on desktopHR under the Career Development tab, or directly at https://hrlibrary.raytheon.com/dscgi/ds.py/Get/File-2449/CareerBro.pdf

Your career is a journey.
It is up to you to take the first step...and keep it on track.
Quality Engineering Receives Northrop Grumman Award

Raytheon recently received the Key Plan Preferred Award from Northrop Grumman’s Integrated Systems operation in Los Angeles. The award was presented in recognition of superior and sustained excellence as a supplier to Northrop Grumman on the Joint Surveillance Target Attack Radar System (J-STARS) program for the U.S. Air Force.

Product Assurance Engineer Tom Hephner, who accepted the award at a luncheon in Los Angeles, said the criteria included consistently meeting cost, schedule, and performance and reliability requirements. He added that of the scores of contractors, who produce products for Northrop Grumman, only 26 qualified to receive the Key Plan Preferred award this year.

J-STARS is an airborne surveillance and target acquisition system that provides accurate real-time surveillance and targeting information. Raytheon C3I has produced the J-STARS Communication and Cosite Systems since the mid-1980s.

The 12 sets of Raytheon UHF radio systems in each J-STARS E-8C aircraft provide robust connectivity with air, land, naval and space forces, and Raytheon cosite systems enable the radios to operate simultaneously without cosite interference. Components are produced at the Fort Wayne, Ind., and Largo, Fla., operations.

“The relationship between Northrop Grumman and Raytheon has been mutually beneficial, and we appreciate the recognition from our customer,” said Joe Sweeney, J-STARS program manager. “Our J-STARS team in St. Pete, Largo and Fort Wayne performs consistently well on the program. We are now working under our tenth production contract, and we anticipate more J-STARS business over the next several years.”

John Rudy Presented with One Company Award

John Rudy received a One Company Award from Greg Shelton, Raytheon’s vice president of Engineering and Technology, for his twenty-four years of leadership of the Raytheon Software Symposia. “We present this One Company award with sincere appreciation and gratitude in acknowledgement of your commitment to one company, and to the furtherance of Raytheon Software technical excellence” stated Greg Shelton.

John, the co-chair of the first joint Systems/Software engineering symposium, was presented the award at the opening keynote address in Tucson, Arizona, in March 2002.

His one company promotion of knowledge sharing and design reuse began in 1978 when he was on the committee for the first Software Symposium, held at the Lexington corporate offices. This event consisted of one track with ten papers and lasted one day. In 2002, the symposium consisted of five parallel tracks with over 100 papers lasting three days.

John has chaired seven symposia and has been on all the committees since 1978. John’s energy, passion and enthusiasm are contagious. John credits much of his success to the excellent committees he has worked with especially the other chairs Lou DiPalma, Tom Lydon and the Ben and Sharon O’Neal team (husband and wife from Tucson who co-chaired the 2002 symposium with Rudy).

“John is a great team leader. He is very organized and kept everything on-track,” stated Jean Scire, Technology Networks project manager. “The first Systems/Software symposium was attended by more than 500 Raytheon personnel and it was well executed with high quality papers.”

There has been a lot of growth over the years and a big change in what was important. At the first symposium, the issue was VAX VMS vs. UNIX. Some years later the big issue was Ada, and that lasted for half a dozen years. The next big issue was OO, first as a concept, then for code, then for design. And then CORBA. A few years later the big issue was the web, and Java. Throughout it all there were always papers on re-use, and OO was supposed to solve that problem. So over the years, the symposium has been a forum for whatever was the latest in ideas. The original position of discussing completed work (or late in progress) as opposed to concepts has stayed consistent, and as a result the material presented has remained as material that the listeners could bring back to their shops.

Rudy shared a story from an earlier symposium of what it was like when Phil Cheney, former Raytheon vice president of engineering, joined the company. “Phil was a digital designer, one of the young kids. The norm was analog. Eventually digital became the way of life. He then watched the emergence of software and remarked that at the symposium in question the size of the Software lab had just surpassed the size of the Digital Lab, and the world had changed once again. We see what it is like now.”

“I’ve presented four or five papers at the symposia, chaired a few dozen tracks and panels, and found that this has been a mechanism for me to learn far more about the breadth of our industry than would ever have been possible without this participation,” stated Rudy. “Reading over 300 abstracts last spring provides quite a view into the breadth of what is happening in the company. And with our geographic growth, the need for these internal symposia is greater than ever. I only regret that we do such a poor job of quantifying what our attendees learn from the symposia and to what extent they are able to apply these new understandings in their work.”
The Engineering Fellows Program at Raytheon
AN OVERVIEW

At Raytheon, we value our technical contributors. The Engineering Fellows program was created to provide a career track for our expert individual contributors, supporting technical growth and recognition as an alternative to the career track for managers. The Engineering Fellows Program and the accompanying Skills Inventory help us to become “One Company.”

The Engineering Fellows program has two available positions, Engineering Fellow and Principal Engineering Fellow (E44 and E88, respectively). Figure 1 shows the technical ladder and the job grades associated with each level.

Both the E44 and E88 positions are unique in that to be appointed to the position or to receive honors, you must be nominated by the business vice president of engineering and approved by the office of the corporate vice president of engineering and technology. Some of the qualifications for Engineering Fellow include:

- Exhibiting an exceptional degree of ingenuity, creativity and resourcefulness.
- Being responsible for developing highly advanced technologies, scientific principles, theories and concepts.
- Being recognized as a leader within the company and as an expert within the field.

The qualifications for the position typically also include inventions (patents), and program technical expertise. The nominee would typically have a foundation of at least 12 years equivalent experience.

Each nominee is considered on an individual basis and it is the overall credentials of the nominee that lead to their acceptance as a Fellow. For example, software developers often do not have patents.

The E88 position is senior to the E44 position and requires all of the above plus technical leadership and national recognition in the individual’s field with a typical foundation of at least 20 years of equivalent experience.

Engineering Fellows are the key experts in the company and it is important for them to spread that knowledge as widely as possible. In keeping with that, an Engineering Fellow is expected to pursue the following activities:

1. Be available, subject to approval by their supervisor, as an on-call consultant for funded short-term tasks in any company business.
2. Provide a skill profile (as described in the next paragraph) and keep it up to date.
3. Provide technical mentoring to other individual contributors.
4. Participate in technical/gate reviews.
5. Continue to innovate and submit patents, publish at conferences and symposia, and/or participate in professional and industry associations.
6. Communicate with other Fellows across the company through Technology Networks or other means to share expertise.

**Figure 1 - Raytheon’s Technical Ladder**

**Figure 2 - Fellow’s Search Process**
Because of the value we place on our Engineering Fellows, we have created a database of skills that allows us to identify experts in specific areas. These experts can then be invited to act as consultants to any part of the company that requires their expertise. This database is available to all Engineering Fellows and Principal Engineering Fellows. Individuals complete their own profile using a web-based form. Engineering Fellows and Principal Engineering Fellows who have not yet completed their form and need assistance should contact corpeng@raytheon.com or call the Corporate Engineering HelpLine at 866-318-6463 or 781-860-2221 or tie line 422, extension 2221.

The database provides a vehicle for technical interchange with technology leaders across the company. The process for using this database is detailed in Figure 2.

The process begins with a project leader or program manager deciding that they have a problem in an area where their local organization does not have available expertise. The manager either contacts an Engineering Fellow at that location or the corporate or local help line so that a database search can be conducted.

The Fellows who are found to potentially meet the requirement are contacted by the manager to determine their suitability (e.g., do they have the specific skill or experience needed?) and their availability. If a short conversation is all that’s required, then it can take place immediately. If a longer involvement is needed, then the Fellow, in conjunction with their immediate supervisor, needs to determine if he/she is available for the effort required. If so, then an IOT or other applicable document can be processed to provide funding to the Fellow for the activity.

For those of you who are newer to the company, the process for becoming a Fellow can start immediately. You should look for opportunities to present at major conferences, and to become more active in outside professional and other organizations related to your skills. You should participate in gate reviews both as a member of a design team and as a member of a review team, thereby broadening your knowledge and experience. As you perform creative tasks on your projects, look for opportunities to submit invention/patent disclosures.

If you have any questions about the Fellows program, contact the Fellows program at corpeng@raytheon.com or at one of the phone numbers shown above. Information is also available on the Engineering and Technology Web site (http://home.ray.com/ rayeng) under the “People” area.

- Stan Nissen

**Fellows Profile – Linda Wagner**

Ms. Wagner is a Raytheon Engineering Fellow and the Director, Patriot Service Life Extension Program for Raytheon, Air and Missile Defense Systems (A/MDS) business unit, Raytheon Electronic Systems. In this role, Ms. Wagner is responsible to the vice president, Patriot Programs, for developing and executing a strategy to extend the service life of the PATRIOT Air Defense System that was fielded in the 1980s and must remain in service until 2032 or beyond. Aspects of the job include prioritization of modernization activities, insertion of technology to address obsolescence and changed service requirements, gaining developer and user support for modernization programs through briefings and demonstrations, working with Army officials to create appropriate funding, managing related internal development activities and internal team building. Ms. Wagner joined the Patriot Program Office in this capacity in August 2000. She also serves as a member of the diversity committee within A/MDS engineering, and the Engineering Fellow selection committee.

Her previous position was Director, Technology Development within A/MDS Engineering, responsible for developing and protecting intellectual property. Ms. Wagner directed the planning and execution of internal research and development (IRAD) and contract research and development (CRAD) programs. She served as a member of Raytheon’s Technology Leadership Council, chartered with enhancing the level of synergy and re-use across the diverse businesses and geographies within Raytheon. Ms. Wagner also served as a member of Raytheon Electronic Systems’ Radar/EW Product Strategy Team which pursues those activities that enable engineering to increase product re-use, decrease non-recurring and recurring product cost, reduce the cost of innovation and provide best value to Raytheon’s customers.

Prior to this assignment, Ms. Wagner had similar responsibilities as the Technology Director for the Surface Radar business unit within Raytheon Systems Company’s Sensors and Electronic Systems segment. Ms. Wagner was actively involved in bringing the various portions of Raytheon together to leverage each other’s technology. In particular, she organized and chaired the First Annual All Raytheon RF Symposium in which nearly 300 engineers from across the company, including 50% owned HRL and Raytheon Commercial Electronics GaAs foundry (now, Raytheon RF Components) met for three days in over 25 sessions sharing technical papers and demonstrating hardware.

“What I like best about working at Raytheon is the continuously changing nature of the work and the wonderfully talented team of people that I get to work with at all levels of the organization,” stated Wagner.

Ms. Wagner holds a Master of Science degree in solid state physics from West Virginia University (1978) and a Bachelor of Science degree in physics from the University of Connecticut (1976).
The Marriott University Park hotel in Tucson, Arizona, was the venue of the First Joint Raytheon Systems and Software Symposium on March 12-14. Over 500 systems and software engineers gathered in spectacular March weather to share experiences, lessons learned and large servings of southwestern hospitality. The Symposium Committee, led by John Rudy (Tewksbury, Mass.) and the dynamic tag-team of Ben and Sharon O’Neal (Tucson, Ariz.), elaborated on the theme of, “Combining Forces” to provide an array of keynote speakers, 18 tracks of engineering topics in five concurrent venues and five panel discussions, totaling more than 120 presentations. The event was jointly sponsored by the Software Technology Network (SWTN), the Software Engineering Council (SWEC), Systems Engineering Technology Network (SETN) and Systems Engineering Council (SEC).

Day one opened with a videotaped message of welcome from Dan Burnham, Raytheon’s Chairman and CEO, stressing the importance of this gathering in uniting systems and software across “One Raytheon.” Greg Shelton, Raytheon’s vice president of engineering and technology, who caught the attention of the plenary session with the “Neanderthal Provision Procurement” process flow, delivered the opening keynote address. “The boundaries of engineering are blurring,” stated Shelton. “Much of what we used to do in hardware is now in software, and 80 percent of our engineers have software tasks as part of their daily work.” Shelton’s emphasis on collaboration between systems and software engineering fed cleanly into the presentations that followed on CMMI – an engineering process model predicated upon the integration of these two disciplines. Shelton’s keynote address is available online at http://www.ray.com/rayeng/news/vpmessages.html.

The speaker during lunch was John Harbison, president of Raytheon Commercial Ventures, Inc. (RCVI), who spoke on “Working Together To Build Commercial Businesses.” For many, the perspective of working outside the context of a major DoD contract was refreshing. John provided a memorable quote from Norm Augustine, CEO of Lockheed Martin (1993) that we should seek to negate: “The track record of defense commercialization is unblemished by success.” John provided examples of RCVI participation in successful commercial ventures and described his model of the commercialization process. He lit the fire of entrepreneurial spirit for many of the attendees. John and his leadership team then hosted afternoon breakout sessions to zero in on the “killer applications” - technologies that may meet a compelling market need in the commercial world.
On day two, Dr. Steve Cross, director and CEO of the Software Engineering Institute (SEI), was the opening keynote speaker. He spoke about SEI’s role in supporting process transition and the need for commitment to process for continued success. Steve provided statistics that showed only 28% of 1500 sampled software projects finished on time and on budget. 49% were late and over budget and the remaining 23% were cancelled. He stressed the benefits of systems and software integration and the benefits of the CMMI model. Three “Big Ideas” were presented: Move To The Left (i.e., earlier involvement of systems and software engineering), Never Make The Same Mistake Twice (i.e., continuously improve quality) and Reuse Everything – Commonality is at the heart of a product line.

Reo Yoshitani, Raytheon Missile Systems technology director, presented an overview of technologies at Raytheon on day two. He spoke about the technology organizations at Raytheon, specifically the technology networks and their infrastructure, technology investments at Raytheon and how systems and software engineering can help the company grow. He challenged the audience to ensure that our products are “head and shoulders” above our competitors and that we meet our commitments on budget, schedule and performance.

On the final day, Peter Pao, vice president of Electronic Systems Engineering, spoke during lunch. He stressed the need for architects within the systems and software disciplines as a key prerequisite for developing and evolving product lines. His assertion was that Raytheon today does not have enough systems or software architects and that we must identify and mature individuals who have the skills and promise to leverage the engineering assets Raytheon has created.

The symposium was concluded with the presentation of Raytheon Systems and Software Symposium Best Paper awards listed below. The presentations are available on the web at http://www.ray.com/rayeng/technetworks/tab5/tab5.htm.

“Participants rated the symposium as an overwhelming success, with invaluable opportunities to share the latest technical information with engineers from across Raytheon,” said conference co-chair Sharon O’Neal.

**All Work – No Play? No Way!**

The social aspects of this gathering were times and places to remember. In addition to the opportunities to network between sessions, where the real connections are made, the Symposium Committee put together some unexpected fun. The social evening was held at the Tucson Historical Society Museum, right across the street from the conference hotel and provided a taste of the Old West. Southwestern and Mexican treats were served in the ambiance of structures and implements from the early days of Tucson and Arizona. For many of us it was a powerful introduction to the history and hardships of those who settled here.

The banquet at the Pima Air Museum was a thrill for everyone. Great food was served among aircraft that evoked either memories or dreams, but in all cases, awe. The technologies that made America the world’s leader in flight were all here to walk among and touch. Not models or mock-ups, but the real thing with bearings that leaked oil and tires you could kick.

Many of the Symposium attendees returned to the museum for a longer visit during their time in Tucson.

Among the aircraft at Pima, Raytheon engineers, managers and guests had the opportunity to “shoot themselves in the foot”. While not generally recommended for career development, shooting from the hip was exactly what was needed in the “Quick Draw” competition. As the breathless crowd stood by, not behind, the antagonists, John Rudy issued his challenge to Sharon O’Neal. In a flash, Sharon prevailed. Not to be outdone, the Battle of the Tech Nets followed with Steve Jackson (SWTN) and Roy Johnson (SETN). Steve Jackson won with a clean sweep.

Meanwhile, over at the Management Corral, Greg Shelton faced off against Peter Pao with all the chips on the table. Peter walked away the victor with Greg being carried to Boot Hill by his friends and associates.

For more information on the activities of both the Systems Technology Network and the Software Technology Network, visit the technology network Web site at http://www.ray.com/rayeng/technetworks.

— Richard Bolander
You have earned Raytheon’s highest honors. Your achievements are awe-inspiring…This is major league engineering, and you are the four hundred hitters,” exclaimed Dan Burnham, Raytheon chairman and CEO, in his keynote address at the 2001 Excellence in Technology Distinguished Level awards ceremony on April 10, 2002. His remarks set the tone for an inspiring evening honoring our peers, the award winning engineers and scientists of Raytheon.

The Distinguished Level Excellence in Technology award is Raytheon's highest technical honor established to provide visible, tangible recognition and reward for technical achievement. Eight individuals and 14 teams from the Raytheon businesses were honored for their technical advances at the Smithsonian Air and Space Museum (NASM) in Washington, DC.

General Jack Dailey (Ret., U.S.MC), Director of the NASM, opened the evening stating, “Tonight’s event is exactly what should be happening in this museum…Excellence in Technology is reflected in everything you see here. To be hosting this event tonight is a special privilege.”

“It is a real pleasure to be here this evening in this wonderful historic location to honor all of you…who are the Excellence in Technology award winners. Tonight you will see a world of dreams that were fulfilled by some of the best scientists and engineers of our time. Their products are here today representing past innovations, all of you here tonight represent the innovations of Raytheon…all of you represent the best of the best of Raytheon,” stated Greg Shelton, vice president of Engineering and Technology, as he welcomed Raytheon leadership, award recipients and their guests.

Dan Burnham hosted the evening and gave an inspiring address. “You are in the right place, at the right time, with the right skills to enhance our customers’ success and contribute to Raytheon’s success,” stated Burnham. He spoke about the need to work as “One Company” reaching across organizational boundaries to draw on the skill and desire of our peers across the company. “Raytheon's customers don’t care about our org charts or stovepipes; they just want our best solution, the Raytheon solution,” said Burnham. He also spoke about growth driven by Raytheon’s innovators and technology, meeting customer needs, and producing customer satisfaction. He challenged the winners to share their ideas and enthusiasm, be leaders, and mentor our young engineers and scientists to help retain a diverse engineering base. “Congratulations on helping us transform our company to meet the challenges, and also the great promise, of this new millennium,” stated Burnham as he closed his address.

Citations and presentation of the awards followed the keynote address. Dan Burnham, Greg Shelton and the respective business leaders and engineering and technology leaders congratulated each individual and team on stage. After the awards ceremony, the attendees enjoyed a buffet reception and the museum, which was open only to Raytheon employees.

“To love what you do and feel that it matters – how could anything be more fun?”

— Katherine Graham
Publisher of the Washington Post
The winners and leadership shared their thoughts on the awards ceremony, their accomplishments, the business impact of their technical achievements, and what they liked most about Raytheon.

Gano Chatterji and Kapil Sheth, from Raytheon Technical Services Company, worked as a team to develop “FACET”, for air traffic control systems. Gano remarked that their success was a team effort, that they inspired each other and at the same time made each other perspire. Kapil recommended that “Whatever you do, do it with passion.”

Kim Ernzen, from Raytheon Aircraft Company, said, “It is an exceptional evening. Just the fact that we are in the Smithsonian, which is basically the history of aviation, it’s everything that we (RAC) make and do. Being a part of this tonight is a neat experience, to be at the forefront of technology since we are a technology company.”

Peter Gould, a member of the SPY-3 Phased Array team from Electronic Systems, stated, “Technology is very important to this company, it is our core. This event highlights that to everyone.”

Navid Yazdani, a member of the Turbo coding for Milstar AEHF Satellite System team from C3I, was impressed by the Raytheon leadership presence at the event. The best thing about working at Raytheon for Navid was meeting his fiancée, an engineer at Raytheon, last summer.

Art Chester, president of HRL Laboratories, thought this event would be very hard to top. He encouraged teamwork for success, working with the exciting Raytheon programs for inspiration. He complimented Hans Brusselbach, the HRL winner, for managing to keep Raytheon a leader in the development of high power solid-state lasers.

Mike Cole, an individual winner leading the field of high power amplifier MMIC development from Electronic Systems, thanked his family for understanding the long hours he worked, being there when he came home with words of encouragement and picking him up when things weren’t going so well.

John Quillen and David Vallado, the Orbital Dynamics Specialist Team, from C3I in Denver, Colorado, thought the evening was exciting and energetic. “I was impressed with the scope of the company and didn’t realize the breadth of technology within the company,” said Quillen.

Raytheon is a technology company. This event was a celebration of how working together we can make great things happen. As engineers, we all value technology and understand its importance to the growth of the company. We understand the need for innovation and the importance of working as a team. The winners were inspiring. The passion for their work makes their ideas a reality. The support of their families and friends helps them get across the goal line. They are the leaders in their fields of expertise. Congratulate the winners and get to know them.

Take a moment and view highlights of the event, Dan’s keynote address and a special video/photo gallery of the individual awards available on the Engineering & Technology Web site at http://home.ray.com/rayeng/people/awards2001/awards2001.html
“RF technologies are basic to almost everything we do, from RF seekers, radars and communication systems to the underlying power supplies that drive these systems. We are now aligned with our customers’ highest priorities, and we are in a position to grow. Use this symposium to reach across our organization and truly create one company. Share best practices, exchange technologies and come up with new ideas. Renew old acquaintances and make new ones, and while you’re at it, have some fun.” – Dan Burnham, Raytheon Chairman and CEO.

In a videotaped message, Dan Burnham opened the fourth annual All-Raytheon RF Engineering Symposium held at Tucson’s Sheraton El Conquistador Resort, April 15-18.

Burnham’s message set the tone for the conference by highlighting its official theme: “Technology—The Key to Raytheon’s Future.” Aspects of this subject were evident in the technical sessions, workshops and social events.

Raytheon’s RF Systems Technology Network (RFSTN) and Analog, RF and Microwave Engineering Council (ARMEC) jointly sponsored the symposium, which is part of their ongoing commitment to foster communication and transfer of RF, microwave, optoelectronic and analog technologies throughout the company. These activities help to maintain Raytheon’s competitive advantages by leveraging technologies, fostering synergistic product development and facilitating technology reuse.

According to symposium coordinator Jim Kinzie, 380 technologists attended from 29 locations. “That was a fine turnout, and better than we expected, since the meeting was postponed from last fall because of the September 11 tragedy,” Kinzie said. To kick off the proceedings, RMS Engineering Vice President Paul Diamond welcomed the attendees and introduced the keynote speaker, Dr. Edgar Martinez. He is a program manager in the Defense Advanced Research Projects Agency’s (DARPA’s) Microsystems Technology Office, which focuses on complex, multidisciplinary RF technologies in the fields of monolithic microwave integrated circuits, electronics, simulations and advanced packaging.

His topic was “Technological Innovations for the Transformation of RF Systems.” He stated that new technology currently under development will radically change future military systems the nation will need to ensure continued battlefield superiority.

He then listed three major technical challenges for the next five years.

- Creation of macro- and micro-system networks that can adapt to meet changing operational performance requirements
- Network adaptation that is driven to the lowest possible levels
- Use of innovative materials to achieve performance enhancements

“The battlefield is unpredictable, asymmetrical and rapidly changing,” he said. “We must have new chips, devices and components that can adapt to these conditions.”

Tuesday evening, Raytheon Engineering and Technology Vice President Greg Shelton spoke to attendees at a western theme banquet. His subject was company growth and the need to work together as one company to achieve it. Many technological and business opportunities are currently available to us, he noted. We must seize them. Greg challenged the engineering
community to ask for help when needed, as well as offer help through mentoring of younger engineers. In closing, Greg reinforced the greatness of our company and his pride in both the company and our people.

These themes and others were addressed at the April 17 Wednesday evening panel session on “Enhancing the Technology Development Process.” Panel members included Shelton, Electronic Systems Engineering Vice President Peter Pao, Raytheon Missile Systems (RMS) Engineering Vice President Paul Diamond, and RMS Technology Director Reo Yoshitani. Electronic Systems Surface Radar Engineering Director Mark Russell also participated in the panel discussion along with Command, Control, Communication and Information Systems Engineering Vice President Robert McGurrin.

“We received many positive comments on these general sessions and also on the quality of the 156 technical presentations,” said Kinzie. “I especially want to acknowledge Randy Conilogue, Jo Ann Spangler, James Howell and all of the other support personnel who worked to make this event a success,” Kinzie noted.

RF Subsystems Department Manager Randy Copleman enjoyed the symposium and was particularly impressed with Dr. Martinez’s speech. “He really spelled out DARPA’s vision of the future and helped us determine where we should be channeling our efforts,” Copleman said. “I also liked John Harbison’s plenary session on Working Together to Build Commercial Businesses. He’s president of Raytheon Commercial Ventures Incorporated (RCVI), and he suggested that we all look for ways to adapt our products to commercial uses. He cited several successful business startups during the past year. His points started people thinking in new directions.”

Harbison and his leadership team held “killer application” break-out sessions with engineering designed to pull ideas on potential ventures from the technology community.

“All in all, the four days were highly profitable for both the attendees and the company,” Kinzie concluded. “New thinking and synergies should result from what took place here.”


For more information about the RFSTN, visit its Web site at http://home.ray.com/rayeng/technetworks/rfstn/rfstn.html.

– Mike Moody
How does CMMI affect Raytheon programs?

The current Department of Defense policy requiring SW-CMM Level 3 on all ACAT-I and ACAT-IA programs is being amended to also allow use of CMMI-SE/SW Level 3 to satisfy the policy as an equivalent measure. Once SW-CMM is fully "sunset," which begins in December 2003 and ends in December 2005, CMMI will be the sole Capability Maturity Model authorized under the policy. The Software Development Capability Evaluation (SDCE) method of external evaluation of software developer maturity is also an authorized equivalent government-initiated measure under the current policy. This is in use primarily by the United States Air Force, and the indication is that they will start to phase out SDCE usage in the near future. We do not anticipate that this policy will be made retroactive to existing programs.

Failure to demonstrate at least a Level 3 capability would result in additional risk factors being added to a Raytheon proposal. We will be at a competitive disadvantage if sites are not compliant with Level 3 CMMI process areas. Experiences with assessments to date in Raytheon indicate that CMMI "raises the bar" with respect to prior software CMM assessments. Because additional disciplines are included, and additional practices are examined, a site may not necessarily retain its prior SW-CMM Level after a CMMI assessment.

What is CMMI?

CMMI is a project that merges previously separate model-based process improvement efforts and provides a single integrated framework for improving processes in organizations that span several disciplines (software engineering, systems engineering, supply chain, program management, etc.).

The project is sponsored by the Office of the Secretary of Defense (OSD), and the National Defense Industrial Association (NDIA) and supported by the Software Engineering Institute (SEI). It replaces prior models such as the SEI SW-CMM and EIA/IS-731 for systems engineering.

CMMI Version 1.1 was approved and released in December 2001. It is a model representing 24 process areas. Five levels of process maturity/capability are defined within the model. A defined appraisal method (SCAMPI) is approved and released. This appraisal method includes both assessments (internal) and evaluations (external).

How does CMMI relate to Raytheon’s IPDS and Raytheon Six Sigma?

The Integrated Product Development System (IPDS) represents the compilation of Raytheon’s best practices - processes, guidelines, methods, tools, and other process execution enablers. It is the standard process for planning and executing engineering programs. Raytheon Six Sigma represents our standard method for improving processes and programs. CMMI is the government standard model-based method for assessing the goodness of processes and improvement activities related to product and services development, and
for defining the required set of processes that should be in place for mature organizations.

The figure above illustrates this relationship. IPDS 2.1.0 has been mapped into CMMI Maturity Level 3 Process Areas (with the exception of Organizational Process Areas; IPDS is project-oriented).

What is Raytheon doing about it?

Raytheon’s overall strategy for achieving high levels of CMMI compliance is to integrate CMMI goals and practices into our existing IPDS engineering/program management processes. In this way, we will meet CMMI requirements using the existing process framework of the company. Raytheon has been the industry leader in the development of CMMI. Bob Rassa, Raytheon El Segundo, is the NDIA Industry Co-Chair of the overall CMMI project. During the development, a number of Raytheon engineers contributed to the product development teams: Aaron Clouse, Ben Berauer, Jane Moon, and Gary Wolf. Dan Burnham, Raytheon’s Chairman and CEO, is committed to achieving and exceeding the DoD requirements for CMMI maturity in the engineering, supply chain, and program management disciplines. Site assessments and maturity status are regularly reviewed at the highest corporate levels. At the enterprise level a number of tasks, coordinated by a steering group from the business units, are being undertaken to achieve these goals. Tasks include extensive education and training of engineers, process specialists, and senior leadership. Data from SEI shows that Raytheon currently has the highest number of people trained in CMMI of any company in the world. We have over 20% of the people formally trained in the SEI Introduction to CMMI course. Led by Raytheon authorized CMMI Lead Assessors, seven site assessments have already been performed. Raytheon was the first industrial site to pilot the CMMI assessment method in 2000.

Raytheon is a CMMI Transition Partner for training. This authorizes us to conduct SEI-developed CMMI training courses internally. Our customers and subcontractors may attend these courses also. We are also a Transition Partner for assessments, permitting our trained Lead Assessors to conduct and register the results. Raytheon sites affected by CMMI have a designated CMMI Lead Point of Contact. Each site’s engineering manager can direct you to that person if you need additional information.

What are our customers doing regarding CMMI?

NAVAIR has a dedicated team at Pax River working on adoption plans for CMMI. NAVSEA also has a team working on CMMI. U.S.AF AFMC/ASC has a team in place developing a CMMI strategy. U.S. Army, Picatinny Arsenal is serving as Army lead for CMMI adoption. NASA is adopting CMMI at MSFC-Houston, and is planning to adopt CMMI at all NASA centers within the next few years. They have retained outside assistance (SAIC in the case of MSFC) to assist.

– Dan Nash and Bob Rassa

Editor’s Note: An online presentation of Enterprise Processes – Our Future, which details the relationships between IPDS, CMMI and Raytheon Six Sigma is available on the Engineering and Technology homepage at http://home.ray.com/rayeng

programs integrate R6σ, IPDS and CMMI into their plans

Internal Resources
Raytheon enterprise-wide CMMI web site http://cmmi.rsc.raytheon.com/welcome.html

Internal E-mail Mailing List, send an email to Pamela_J_Donaldson@raytheon.com requesting to be added to the list to receive additional information and updates

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External Resources
CMMI Web site http://www.sei.cmu.edu/cmmi/

Suggested Reading
CMMI Distilled, Dennis M. Ahern, Aaron Clouse (Raytheon), Richard Turner, 2001, Addison-Wesley, Boston, MA. - A good overview of CMMI available in paperback.
Over the past three years, Raytheon has transformed itself in many essential ways. Most notably, our commitment to customer success, and our performance for the customer, has made it possible to achieve the technological and financial success that has provided superior sensors, weapons, command, and control for our military in our war on terrorism, and lifted up our company to the financial well-being we enjoy today. This transformation has included organizing around our customers and our businesses, and the results have been terrific.

Organizing this way brings some challenges as well. Our company strategy of operating as “One Company” requires us to be able to share technology, information, processes, tools and people across these organizational boundaries with agility and skill. The Raytheon Technology Networks are designed to do just that.

We currently have seven Technology Networks. Each is made up of dedicated men and women who commit their expertise, skill, and time to promoting the “One Company” objective. And, while the accomplishments of these Networks are impressive, including five annual engineering symposia, many workshops and teaming to win technology contracts, they feel the need to improve their ability to meet this critical need. The corporation has to move data from business to business quickly and efficiently, and to put the best technology Raytheon has to offer in the hands of those who need it.

“The Technology Network leadership team is committed to making this company be the best in our industry, shaping technology to the need. However, we are still one of our company’s best kept secrets,” stated Jean Scire, manager of Raytheon Technology Networks. “We want every engineer to have knowledge of the networks and the value of technical information and knowledge sharing they provide. The Raytheon Six Sigma visionary planning exercise was used by the Engineering IPDS council (EIC) successfully in 2001 to baseline their best practices. The process is designed to help us understand our current reality, define milestones and develop action plans to meet our strategic goals.”

With this in mind, the Technology Network Chairs and Facilitators, along with representation from our corporate leadership, met in Lexington on April 9 and 10 to go through a Raytheon Six Sigma Visionary team planning exercise. The purpose of this ten step process was to define a vision of where the Technology Networks need to be in five years and one year, in order to meet the growing challenge of technology resource
sharing across the corporation. Led by Six Sigma Expert, Michelle Gauthier and facilitated by Lisa Mawn of RLI, the team identified four key areas challenging the success of the networks:

- **Effective interfacing and sharing with the businesses**
- **Effective organizing of the Technology Networks and their Technology Interest Groups (TIGs)**
- **Providing value to the engineering community**
- **Leading technology advancements**

The team has started down the path to this brighter future for the company. The Technology Networks worked together and developed a vision statement. Champions within the team have volunteered, and specific action plans with milestones and metrics are being formed.

"I am very pleased with the vision statement the team created," said Greg Shelton, vice president of Engineering and Technology. "It captures everything we need from the Technology Networks, and it also shows the team's commitment and willingness to strive for world-class greatness, and not be satisfied with the accomplishments of today. It is a commitment that we can all aspire to."

"I can assure you that they will get complete cooperation from me and the engineering and technology leadership team in this critical stage of their development," stated John Gatti, Raytheon Engineering Common Program (RECP) manager, who also participated in the session. "I encourage each of you who share their passion for technology greatness, and the company's passion for greatness in the eyes of the customer, to get involved in a Technology Interest Group. Write a paper for one or more of the many symposia, or participate in the monthly technology workshops they sponsor. You and the company will be better off for it."

For more information on the Raytheon Technology Networks, visit their Web site at: http://home.ray.com/ rayeng/technetworks/welcome.html or contact Jean Scire, Raytheon Technology Networks project manager at: jtscire@raytheon.com.

– Steve Jackson
Being a viable player within a climate of extremely intense competition from many directions is a difficult challenge. Every advantage must be explored and implemented to survive in today’s marketplace. This is especially true in the world of government and defense contracts. The consolidation of defense contractors coupled with a shrinking defense budget, has sharpened competition and capturing and winning proposals is more critical than ever to maintaining and increasing market share.

At Raytheon, this critical issue has been addressed with a dynamic approach to meeting these challenges. Determined to increase our win rate, a Capture/Proposal Integrated Product Team (C/P IPT) was formed to investigate the possible problems inherent in our approach. The team’s objective had been to observe and assess request for proposal (RFP) response techniques and compare them with approaches of other proposal professionals in similar industries across the nation. Raytheon’s Capture/Proposal process, now implemented in all facilities throughout the country, is a consistent, disciplined and orderly approach to grow business, to increase productivity, and to maximize cash. It focuses on identifying viable opportunities and incorporates best business practices to increase our chances of winning.

The Capture/Proposal process is a core competency of new business development at Raytheon. To encourage understanding and ease of implementation, a comprehensive Capture/Proposal Process Guide has been published covering all aspects of our approach to winning new business. The guide, available on the capture/proposal process Web site (http://home.ray.com/cp/), identifies the five interlocking process phases:

1. Market positioning and opportunity assessment  
2. Win strategy development  
3. Program/system concept refinement  
4. Bid/proposal development  
5. Post-submittal activities

The entire Capture/Proposal Process is now embedded in Raytheon’s Integrated Product Development System, at http://ipds.msd.ray.com. Each of the five phases is carefully and deliberately monitored before progressing to the next, with the implementation of a Business Decision Gate Review process. The four gate reviews are closely aligned with the five process phases and encompass:

**Gate 1** Opportunity Review: Examines the new business opportunity to ensure it aligns with a department’s overall business strategy. The capture team launches after a Gate 1 decision.

**Gate 2** Win Strategy Review: You should have a well-defined win strategy in place and you should also have a good understanding of program risks (to you and to the customers, as well as significant risks to the competition). This review also allows the opportunity to work some issues with the customer prior to RFP release.

**Gate 3** Pre-Proposal Readiness Review: At this stage in the process, your proposal development approach should be planned and ready for execution.

**Gate 4** Bid/Proposal Review: Allows the opportunity for a careful examination of your final offer and how it aligns with the customer’s evaluation criteria.

As the process has evolved, capture/proposal managers within the business units as well as senior management have voiced many concerns. As a result, a C/P IPT-formed Raytheon Six Sigma project team had been formed. This cross-functional one company team addressed review requirements for both competitive and non-competitive opportunities. Careful examination of the process revealed that the Gates 1 through 4 and management review processes were not aligned, creating a strain on capture/proposal development resources; gate and review processes were developed independently and at different times; each proposal had its own unique requirements and data formats; the capture proposal team had to execute two similar but non-aligned processes, causing confusion and wasted effort; and both processes were overly complex, containing minimal instructions and no tailoring guidance.

As a result, the C/P IPT has incorporated numerous improvements to the Gates 1 through 4 process to reduce non-value added efforts and to improve effectiveness. Realizing that one size does not fit all opportunities, the team redesigned the Gates 1 through 4 templates to ensure flexibility in determining which gates to execute and offered tailorability of review packages to align with specific opportunity attributes.

The new, streamlined gate process champions Raytheon’s One Company goal: one integrated, tailorable Gates 1 thru 4 review process that aligns all legacy processes. The new review process maps directly to the Raytheon Capture/Proposal Process and supports review requirements for all opportunity types for all Raytheon management levels; supports better bid/no bid decisions with the right information early; and requires fewer resources to create packages because each review builds on the previous review package. The team has integrated the new process into Stage 1.
of IPDS, has developed capture/proposal Gates 1 through 4 training materials, and has established a configuration change control board with representatives from contracts, finance, program management and business development.

Not only has the team reduced the quantity of templates and aligned them with program-specific attributes, but new features have been added to streamline the gate review process and to provide added value rather than burden the proposal staff with more paperwork.

As defined by corporate policy 53-0005-110, every opportunity must be categorized into one of the following three types: routine, non-routine, and strategic. The type of opportunity is a key factor in deciding the applicability the gates and determining the appropriate approval level required. The customer’s acquisition process and milestones will also dictate which gates to execute.

There are four separate gate template files – one for each gate. Templates are organized in an improved sequence to answer key business capture questions in a logical order, are in a user-friendly format that is flexible, and are aligned with the capture/proposal process. They focus more on what needs to be presented rather than on how to present. Also, for ease of use, they include embedded Word tables and Excel worksheets where appropriate to improve usability. Notes pages provide detailed instruction and guidance to complete each template.

All opportunities, regardless of size, type, or scope, need to address these fundamental business capture questions within their gate review package. Each section contains templates that address the primary requirements and key questions typically addressed for that section. Gate 1 is the only gate that does not address each section because it’s too early in the proposal process, mainly because a capture team has not yet been formed to develop the initial approach for our offering.

Template usage is criteria driven: specific attributes of the opportunity and the “criteria for use” guideline will determine if the template should be used. This provides the necessary flexibility in developing gate review packages. The criteria for use stated on the templates notes page provides guidance to help determine if the template should be used. Those templates identified as required must be used/addressed in the gate review package. These are applicable to all opportunities, regardless of type, size, scope, etc. Most other templates are used only as applicable, based on the criteria for use information listed on each template’s notes page. The number of templates does not necessarily equate to the number of charts that will be in a gate review package.

Templates are updated or added as you refine your pursuit proceeding through the Gates. Each gate has its own templates PowerPoint file. Some templates remain the same throughout the campaign. Most templates are updated upon each succeeding Gate. Some templates are similar in design and content, but not exactly the same, as you proceed to the next gate. Therefore, you need to ensure you use the appropriate gate template file accordingly when developing your gate review package.

For ease of use, notes pages provide detailed instruction and guidance for completing each template. Four elements are included on the templates notes page: management objective, criteria for use, description and instructions. Each section notes page includes: section page use, section objective, primary requirements and key questions addressed with section.

The C/P IPT has released the improved Gates 1 through 4 process/templates on their new company-wide Web site at http://home.ray.com/cp/. The Web site has been developed to provide capture and proposal teams with access to the latest company-wide processes, tools, resources, and best practices for capturing new business and developing winning proposals.

The Web site contains a detailed description of the common Raytheon Capture/Proposal Process; procedures and templates for Business Decision Gates 1 through 4; standard tools, templates, forms, databases and guides; courses available through RLI; a listing of Capture/Proposal Development Centers to assist capture and proposal teams through the process; and links to additional resources related to proposals.

Capture/Proposal training programs are currently being conducted and are available through the Raytheon Learning Institute (RLI). Courses available include Process Overview, Capture Management, Writing Winning Proposals, Proposal Management, Estimating and Pricing, and numerous supplemental courses. Course BD102 has been developed to acquaint those involved in capturing new business and developing winning proposals to Business Decision Gates 1 thru 4 and to provide insight into successful execution. This course is designed for any employee involved in executing Gates 1 thru 4 as part of the capture/proposal process, especially capture team leaders, proposal managers, program managers and other key capture/proposal team members. The overall objective of Gates 1 thru 4 is to reduce and ultimately eliminate the “surprises” traditionally associated with the capture/proposal process (i.e., inadequate resources, late start, no funding, no management commitment, unclear win strategy, underestimating the competition, etc.). Embedding discipline into a hitherto undisciplined capture/proposal process has proven to reduce “frenzy” and stress and effectively allocate resources. For additional information on course descriptions and schedules, please visit the RLI Web site at: http://rli.ray.com/.

– Linda D. Greenwood for the CIP IPT.
At Raytheon, we encourage people to work on technological challenges that keep America strong and develop innovative commercial products. Part of that process is identifying and protecting our intellectual property. Once again, the United States Patent Office has recognized our engineers and technologists for their contributions in their fields of interest. We compliment our inventors who were awarded patents from January through March 2002.

PATENTING YOUR INNOVATIONS AT RAYTHEON

The novel ideas that you develop are preserved as Raytheon’s intellectual property by your filing Invention Disclosures to start them on their way to becoming patents or trade secrets. Protected in this manner, your innovations add value by helping Raytheon win contracts, by putting competitors at a disadvantage, by generating royalty revenue from licensing, and sometimes by enabling the launch of new ventures.

The patent process begins with your novel idea and proceeds through the steps shown in the flow chart below. You can download the necessary invention disclosure forms from the Raytheon intranet under the Resource Center policies and procedures page or directly at http://www.ray.com/policy/forms.html. The forms are the Invention Disclosure Instructions (10-5876-1PC), the Invention Disclosure Questionnaire (10-5876-2P), and the Invention Disclosure Detailed Description (10-5876-3PC). Regional patent engineers are assigned and available to help at any point in the process. The contact information and the regions they cover are as follows:

- Arizona, California, ELCAN, Indianapolis, IN, Wichita, KS – John Moriarty, 781-860-2538
- Colorado, Florida, Maryland, Pennsylvania, Texas, Virginia – Mark White, 972-344-1210
- Northeast Region, Ft. Wayne, IN – Peter Dulchinos, 781-860-2553

For further information, contact one of the Intellectual Property & Licensing offices in Dallas, TX, El Segundo, CA, Goleta, CA, Lexington, MA or Tucson, AZ.

– John Moriarty
ROY P. MCMAHON
6337115
Shape-recovering material suitable for application of non-distorting printed matter, and its use

JOHN W. GERSTENBERG
HUNG P. VAN
6340912
Solid state magnetron switcher

THOMAS D. ARNDT
KENNETH S. ELLIS
DAVID J. KNAPP
JAMES P. MILLS
RICHARD A. PAIVA
SCOTT W. SPARROLD
6343767
Missile seeker having a beam steering optical arrangement using risley prisms

ANDREW B. FACCIANO
STEVE E. TAYLOR
6343954
Integral missile harness-fairing assembly

STEPHEN H. BLACK
WILLIAM J. PARRISH
JAMES T. WOOLAWAY
6344651
Differential current mode output circuit for electro-optical sensor arrays

JOSEPH M. FUKUMOTO
6344920
Monolithic serial optical parametric oscillator

THOMAS D. ARNDT
KENNETH S. ELLIS
DAVID J. KNAPP
JAMES P. MILLS
RICHARD A. PAIVA
SCOTT W. SPARROLD
6344937
Beam steering optical arrangement using risley prisms with surface contours for aberration correction

MARK E. BIANCO
6345359
In-line decryption for protecting embedded software

SIDNEY C. CHAO
NELSON W. SORBO
6346126
Acoustic-energy-assisted removal of soil from fabric in a gaseous environment

JOHN J. ANAGNOST
RE37547
Software-based resolver-to-digital converter

TOM P. E. BROEKAERT
6348887
Method and system for quantizing an analog signal utilizing a clocked resonant tunneling diode pair

CARL L. PETERSON
6350060
Dual load path spherical bearing and a method of coupling along a dual load path

ALBERT P. PAYTON
6351383
Heat conducting device for a circuit board

MARK A. LAMBRECHT
6351717
Method and system for enhancing the accuracy of measurements of a physical quantity

DAVID R. SAR
6353220
Shielding of light transmitter/receiver against high-power radio-frequency radiation

ROBERT S. BECKER
KELLY D. MCHENRY
FREDERICK J. WAGENER
6354222
Projectile for the destruction of large explosive targets

TODD R. GATTUSO
PETER F. KOUFOPOULOS
JAMES M. MCGRATH
ALAN PALEVSKY
6354897
Field emission displays and manufacturing methods

STEPHEN M. JENSEN
THOMAS K. LO
6355922
Imaging system and method for hardbody detection and sensor fixed artifact rejection

RANDAL E. ACKERMAN
TIMOTHY R. HOLZHEIMER
RODNEY H. JAEGER
WILLIAM E. RUDD
6356241
Coaxial cavity antenna

J. STEVE ANDERSON
CHUNGTE W. CHEN
STEPHEN C. FRY
6356396
Optical system having a generalized torus optical corrector

JOSEPH M. FUKUMOTO
JOHN J. TISCHNER
6358075
Mating alignment guide

JOHN C. EHMKE
6359290
Self-aligned bump bond infrared focal plane array architecture

DAVID J. LUPIA
6359495
Anti-saturation integrator and method

GARY FRAZIER
WILLIAM FRENLESLEY
6359520
Optically powered resonant tunneling device

GORDON O. SALMELA
6361237
Coupling device

GERALD A. COX
DOUGLAS A. HUBBARD
TIMOTHY D. KEESEY
STEPHEN R. KERNER
CLIFTON QUAN
DAVID E. ROBERTS
CHRIS E. SCHUTZENBERGER
RAYMOND C. TUGWELL
6362703
Vertical interconnect between coaxial and rectangular coaxial transmission line via compressible center conductors

LEON GREEN
6362774
Cooperative radar system

BARRY N. BERDANIER
6362872
Single aperture thermal image/laser

RICHARD L. O'SHEA
6362906
Flexible optical RF receiver

ROY P. MCMAHON
6337115
Shape-recovering material suitable for application of non-distorting printed matter, and its use
FUTURE EVENTS

Second Annual Mechanical and Materials Engineering Symposium
October 15 – 17, 2002
El Segundo, CA
Sponsored by the Materials and Processes Technology Network (MPTN), the Mechanical and Structures Technology Network (MPTN), and the Mechanical Engineering Council (MEC)
Abstract Submittal Deadline:
July 12, 2002
For more information on the symposium or to submit an abstract, go to:

Joint Quality and Supply Chain Forum
September 17 - September 19, 2002
Tucson, AZ
Sponsored by the Raytheon Quality Council and the Supply Chain Management Council

Composites Workshop
August 2002
Tucson, AZ
Sponsored by the Materials and Processes Technology Network (MPTN)
The purpose of this workshop on non-metallic materials is to familiarize the participants with the materials, the methods used to process them, their properties and their applications. Subject matter experts from across the company will work with the participants during the workshop to address program related issues on a real-time basis. Materials will include composites, thermosets, thermoplastics, and elastomers. Papers on real-time technology applications will also be invited.

For more information, contact:
Stan Stough
Workshop Chair
s-stough@raytheon.com

EKV Team presented with “One Company” Award
Becoming “One Company.” It’s an important part of Raytheon’s vision to become the world’s most admired defense and aerospace systems supplier. It is all about diverse thinking, and pooling our resources and expertise to provide superior solutions. On April 16, Raytheon Engineering leadership, Exoatmospheric Kill Vehicle (EKV) program managers and engineers gathered together for a video teleconference to celebrate the award to the EKV Infrared Detector Operability Improvement Team. The “One Company” team was comprised of members from Raytheon Infrared Operations in Santa Barbara, California, Raytheon’s Lexington Labs in Lexington, Massachusetts, Air and Missile Defense Systems in Tewksbury, Mass., and Raytheon Missile Systems in Tucson, Arizona.

EKV is a critical part of the U.S. Missile Defense Agency’s Ground-based Midcourse Defense (GMD) segment. Its mission is to acquire, discriminate and hit-to-kill ballistic missiles. This mission demands the highest quality product. The EKV infrared detector is critical to the systems success and it must function under difficult operational conditions, including an extremely wide temperature range.

The improvement team’s task was to understand, model and test all aspects of the detectors design, manufacturing and validation process. Three subteams were established for modeling, processes and material characterization. Team members set to work in May 2001, with weekly teleconferences and monthly face to face meetings finishing in six months. During this time, they:

- Developed and validated thermal and mechanical detector models
- Defined and completed design of experiments
- Reviewed and redefined complex detector manufacturing processes
- Supported technical interfaces with Raytheon, Boeing and the U.S. government

Bob Lepore, EKV Chief Engineer, made a special presentation to Elizabeth Kolvalcin, whose husband David lost his life on September 11, flying from Boston to Los Angeles to attend a team meeting in Santa Barbara. “David’s life was taken while he was in service to his company and the nation,” Lepore said. “We give his wife this award with Raytheon’s sincere appreciation.”

Chad Wassmuth, RMS Senior Mechanical Engineer stated “It was a privilege to meet so many talented people. For the first time, I could see the true potential of what Raytheon can become. If everyone works together and shares their expertise as this team has done, there is nothing we can’t accomplish.”

LEXINGTON LABORATORIES:
Kenneth Arnold
Todd Gattuso
Mark Kostyla
Roy Simonds
Lindley Specht

SANTA BARBARA, RIO:
Richard Bornfreund
Anthony Cavalli
Barabara Ceriale
Isabel Chin
Christina Childs
Paul Drake
Bruce Fletcher
James Fulton
Ricardo Garcia
Andreas Hampf
Gerry Hansen
James Herring

TEWKSBURY:
Michael Corbin
David Kovalchin (deceased 9/11)
Lisa Malay

TUCSON:
Kevin Brawner
William Burk
David Hatfield
Matthew Orzewalla
Chad Wassmuth