



# TechUpdate

A Quarterly Newsletter for MDA Technology Transfer

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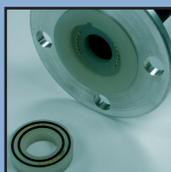
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▲ The L1000 system from Loea Corporation, a subsidiary of MDA-funded Trex Enterprises, offers a high-bandwidth, high-speed, wireless alternative to fiber-optic communications.

## Fiberless Data Made Easy

System holds promise for campus-like networks  
and cellular infrastructure.

by L. Scott Tillett/stillett@nttc.edu

*a* technology with a history of funding from the missile defense program has spawned a new product that should make high-speed, broadband wireless data communications easier and more viable for new users.

The product, developed by a subsidiary of Trex Enterprises Corporation (San Diego, CA), is a line-of-sight, millimeter-wave radio system that will compete with fiber-optic cable, offering data rates as high as 1.5 gigabits per second (Gbps)—the equivalent of transmitting the contents of a standard DVD in about 25 seconds.

The new offering, known as the L1000, is being marketed by Trex subsidiary Loea Corporation as a multirate product, meaning that the system also could work easily with more commonplace wireless networks that operate at 125 megabits (Mbps) per second (about one-twelfth the speed of a 1.5-Gbps network). The product recently received FCC certification.

The idea, according to Loea leaders, is to give users an easily configurable product that can plug into almost any network to create a fiberless link. Adding the L1000 to a network could allow city governments,

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Technology Applications Program  
[www.mdatechnology.net](http://www.mdatechnology.net)

# Toward a More Useful Web Site

Web presence of MDA TA program gets an overhaul.

by L. Scott Tillett/stillett@nttc.edu

The MDA Technology Applications program has redesigned and improved its Web site, www.mdatechnology.net. The newly revamped site retains nearly all of the information that visitors have come to expect from us—information on the business assistance we offer to MDA-funded researchers; publications and profiles on MDA-funded technologies; and other information about MDA technology programs. But the latest iteration of our site has reorganized information in a way that, we hope, will allow readers to find what they need more easily.

The newly redesigned banner introduces the program with a fresh and to-the-point description of our mission: “Helping researchers commercialize their MDA-funded technologies.” Those researchers will find the site easier to navigate as they seek resources to help commercialize and improve their MDA-funded technologies.

The Business Assistance section of the site leads quickly to information on TA program services such as Business Focus Workshops and Technology Applications Reviews, as well as information on TA program Outreach services. Meanwhile, a new Sign Up for Free Services section allows MDA-funded researchers to easily request commercialization assistance from the TA program. Also included under the Business Assistance section is a tightly focused Commercialization Guide, available to all Web site visitors.

We’ve also made browsing and searching the site easier for all visitors, including would-be partners of MDA-funded researchers. The site’s Publications section includes current and archived issues of the award-winning MDA TechUpdate newsletter, dating back to 1994. The site also features a host of recent Tech Profiles, which serve as quick-to-read back-grounders on MDA-funded technologies. Additionally, visitors can find PDF versions of 17 TA program Special Reports dating back to 1996.

Also, every single page of the redesigned Web site now provides users with two ways to find technologies: (1) a “Quick Search” function that allows visitors, with only two clicks of the mouse, to instantly find all TA program articles on specific topics and technologies such as focal plane arrays, radiation detection, and electronics; and (2) a standard “Search Word/Phrase” function that allows visitors to conduct searches tailored to more specific interests.

We hope the site proves useful to all of our audiences: MDA-funded researchers, their would-be partners, members of the general public who benefit from the commercialization of MDA-funded technologies, and MDA itself.

As the World Wide Web continues to develop, as our site’s content continues to grow, and as user needs continue to evolve, we will continue to improve mdatechnology.net. We welcome your feedback. 



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# Aculight's Laser Lineup

Beams of light illuminate new paths in research, medicine, and defense.

by Joan Zimmermann/zimmermann@nttc.edu

With an assist from MDA funding, Aculight Corporation (Bothell, WA) has parlayed its SBIR experience into a suite of laser products. While the company continues to actively pursue aerospace, defense, and medical laser technology applications, its current products address areas as diverse as underwater communications, noninvasive nerve stimulation, spectroscopy, and high-end physics research.

Aculight worked on the development of both high-powered and eye-safe infrared lasers for MDA applications in directed energy and laser ranging, respectively.

The technology behind Aculight's lasers has a history of funding from MDA and its predecessors. In 2007, the company received a Phase II SBIR contract to develop an eye-safe infrared laser for laser ranging. In 2003, a Phase II SBIR focused on high-energy laser diagnostics for space-based applications. In addition, the company licensed intellectual property (IP) from Vanderbilt University, which had received considerable funding for the Medical Free Electron Laser (MFEL) program from what was once SDIO in the late 1980s. This MFEL IP helped lead the company into medical applications, which it continues to pursue and expand.

Today, Aculight offers an array of products that are aimed at improving hearing, sensing pollutants, improving jet engine combustion, and advancing theoretical physics research. Capella™, an infrared laser for nerve stimulation, which replaces electrical stimulation, sprang in part from MFEL research. In initial studies, Capella has shown promise in auditory research in small animals, results of which hold implications for improving human hearing. Because there is no physical contact between the probe and delicate nerve tissue, the laser produces no electrical artifacts and does not damage residual hearing, so that these implants ultimately may be used in people who are hearing-impaired instead of only those who are profoundly deaf. This approach also allows for more independent channels to be stimulated, resulting in fidelity superior to existing electrical methods.

In neurological research, this technique results in better spatial selectivity for nerve mapping. For designers of devices such as vestibular or cochlear implants, a more precise neural map translates to better functionality with fewer side effects. Capella also allows for finer resolution and truer representation of nerve function as compared with electric stimulation.

Aculight's laser lineup also includes the Perseus™, a pulsed-fiber laser for use in LADAR, remote-sensing systems, and standoff detectors. Perseus is an eye-safe laser, designed to be a lightweight, environmentally hardened product for use in ground or aerial-vehicle sensors. Aquarius™ is a laser



▲ Aculight's offerings include Argos (shown here), which can be used in physics research as well as in industrial applications such as analyzing jet engine combustion.

developed for underwater communications. A green beam of light can efficiently carry information through the water, someday replacing acoustic networks in applications such as oceanographic data collection, pollution monitoring, offshore exploration, disaster prevention, assisted navigation, and tactical surveillance. Laser light can also transmit data faster and with less distortion from reflection and refraction. The Aquarius laser also can be used in micromachining applications and in nonlinear optical devices.

Argos™ is derived from optical parametric oscillator development with MDA; it produces a narrow linewidth for high-end spectroscopy measurements needed for physics research, laser traps, and such industrial applications as determining jet engine combustion products.

Aculight is also actively researching spectral beam combining (SBC), a method for creating high-powered lasers by combining an array of low-powered lasers. SBC increases the final power output without expense to beam quality. This technique can simultaneously achieve smaller spot sizes and deliver more energy to a target with less difficulty than competing techniques such as coherent beam combining. Applications of SBC techniques include higher-powered, highly precise lasers for drilling, materials modification, and manufacture of solar cells. 

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# Lumera Lights Up the Lines

New organic polymers stand ready to replace crystalline optical materials.

by Joan Zimmermann/zimmermann@nttc.edu

Development of a novel polymer, funded by MDA as well as other agencies, has opened the door to faster and more reliable switching in optical communications, with implications for numerous optical technology applications.

These polymers, known as electro-optic (E/O) polymers, are imbued with light-absorbing molecules called chromophores, which are found in nature in substances like chlorophyll and beta-carotene. The chromophores convert light into electrical current with high efficiency. E/O polymers have been known for some time to have the potential to outdo slower inorganic materials like gallium arsenide and lithium niobate. There are many applications for E/O polymers, including radio-frequency, microwave, and millimeter-wave power distribution; phased-array radar; photonic detection of electromagnetic radiation (such as radar signals); remote voltage sensing; flat-panel display modulators; and ultrafast analog-to-digital converters.

Offered by Lumera Corporation (Bothell, WA), electro-optic polymers have the potential for terahertz operational frequencies—two to three orders of magnitude beyond the capabilities of materials now available. These polymers can take the place of traditional crystalline materials such as lithium niobate, which is used in optical communications waveguides, switches, and modulators—devices that help route the light waves in optical communications.

The polymers were originally developed through an academic project, with funding from MDA predecessor BMDO. Beginning in the early 1990s, Professor Larry Dalton and colleagues oversaw a concerted effort to develop novel electro-optic polymers at the University of Southern California's Loker Hydrocarbon Research Institute. BMDO provided funding for this effort on the strength of its interest in radar, telecommunications, and remote-sensing technologies. Dalton's efforts in stabilizing and integrating the polymers into optoelectronic systems paved the way for Lumera Corporation to offer compact, high-bandwidth, optical communications links in a small space with very low losses, something that manufacturers of lithium-niobate-based modulators cannot hope to match.

Lumera, which acquired electro-optic polymer intellectual property as a young company in early 2000, worked steadily to develop and market products based on its purchased know-how. Today the company is offering a 40-gigabit-per-second (Gbps) electro-optic polymer modulator for optical-transmission systems.

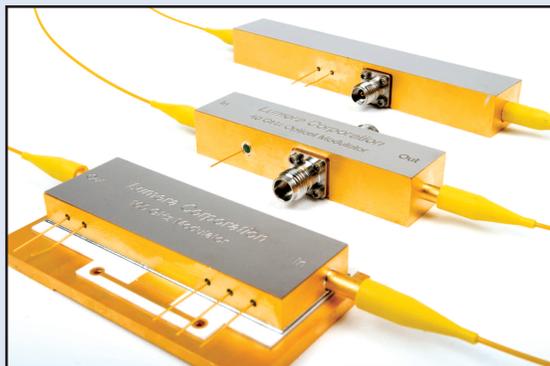
Ten-gigabit modulators have been the norm using crystalline optics, with current technology requiring four 10-Gbps modulators in series to do the same job as Lumera's one device. Lumera also introduced a 100-Gbps modulator, the first of its

kind in the world, in November 2007. These new modulators combine the fastest switching speeds with the lowest drive voltages (thus low heat) and optical losses in the industry, occupy a small footprint, and also offer frequency ranges (35-140 GHz) not available with current crystalline materials, enabling the creation of systems that can keep pace with the ever-increasing quest for more bandwidth.

Lumera recently introduced its Millimeter-Wave Communication System. The new product is a full-featured system that makes use of

E/O modulators, and it is now poised to address the growing need for wireless ultra-high-data-rate transfer for satellite communications, wireless enterprise networks, and extending existing fiber networks. The system can switch between frequencies as needed, offering security against interception, interference, and some forms of denial-of-service. This capability also serves to improve reliability and robustness, and to increase throughput when multiple frequencies are used simultaneously.

On the strength of what Dr. Dalton has described as a "disruptive" technology, Lumera transformed from a startup corporation in 2000 to an initial public offering in 2004. Lumera is looking to partner in new ventures to effect adoption of new materials. 



▲ The Lumera modulators pictured here are based on the company's electro-optic polymer.

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# Composite Lifesavers

Lightweight air tanks could reduce first-responder fatigue.

by Joe Singleton/jsingleton@nttc.edu

New linerless composite tanks developed with MDA funding could lighten the load for firefighters and rescue workers when responding to emergencies, thereby forestalling fatigue and allowing first responders to do their jobs more safely.

Developed by Composite Technology Development, Inc. (CTD; Lafayette, CO), the tanks are made of a carbon-fiber-reinforced epoxy, without the use of metallic or plastic liners. The composite tanks can provide a cost-effective and lighter option to currently employed air breathing systems, such as self-contained breathing apparatus (SCBA) used by firefighters and rescue workers.

MDA originally funded CTD's linerless composite tank technology through a 2003 SBIR Phase II contract. CTD's project focus included designing lightweight, composite cryogenic and chemical storage tanks for use in aircraft as part of the Airborne Laser program.

CTD's technology is driven by the concept that lighter is always better. To make the tanks light, company engineers start with a lightweight, carbon-fiber-reinforced epoxy made of resins designed not to microcrack when the tank shrinks due to temperature changes or expands to mechanical loading. These tanks, which use the composite materials not only as the structure but also as the permeation barrier of the tank, are engineered never to burst or explode, even if overpressurized or operated in abnormal conditions. Benign leaks are the most extreme damage the tanks could incur in such high-pressure or abnormal conditions.

Safety and weight savings are reasons first responders such as firefighters and rescue crews may favor CTD's technology over conventional tanks. Standard-issue tanks carried by firefighters generally have about a 7-liter capacity, and have a gross weight of about 8 pounds. CTD's tanks can provide firefighters with the same 7-liter capacity, but at a gross weight of less than 7 pounds—more than a 10 percent weight reduction. Saving just 1 pound can significantly reduce a firefighter's chance of exhaustion, should a tank be lugged around for hours or hauled up staircases, according to Mike Tupper, CTD executive vice president. The price tag on the composite tanks also would be competitive with conventional tanks.

While weight savings is a key selling point to many potential customers, size can be important, too. CTD can make tanks that have the same capacity and weight as conventional storage vessels, but are roughly 10 percent smaller in size. This feature may be of interest if constrained space is a factor in conducting a rescue.



▲ Firefighters could benefit from CTD's composite air tanks, which offer a 10 percent weight savings over conventional self-contained breathing apparatus.

Beyond the small tanks likely to hit the market, CTD is targeting the automotive industry. Fuel cells, a possible future power plant for vehicles, combine hydrogen and oxygen to create power, with water as a byproduct. Automotive manufacturers are looking for a safe and efficient storage apparatus for hydrogen, with the goal of enabling a car to travel roughly 300 miles per fueling. CTD is ready and able to manufacture pressure or cryogenic tanks for hydrogen storage in automobiles that can store more fuel than currently envisioned, weigh less than conventional tanks, and increase the range of travel, all at a competitive price.

Tupper said he expects the smaller composite tanks, or ambient pressure vessels, which would most likely be used for first-responder tasks, to be available within the next 12 to 24 months, depending on the company's funding levels. Cryogenic pressure vessels are available for commercial sale now, he added.

CTD is looking for strategic partners and product manufacturers that would be interested in further developing or integrating the composite tanks, as well as to help commercialize the technology. 

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# Canary in a Beam Line

A novel optical monitor helps fend off laser breakdowns before they happen.

by Joan Zimmermann/jzimmermann@nttc.edu

NovaWave Technologies (Redwood City, CA) has developed a real-time optical-health monitoring system, dubbed a “Canary in a Beam Line,” to fend off damage to laser components before it’s too late.

Based on a Phase II SBIR supporting the Airborne Laser (ABL) program, the system comprises an optical cavity that uses an optical coating very similar to that used in the ABL’s laser. When conditions are such that the cavity begins to deteriorate due to accumulation of contamination, the operator is immediately alerted, fast enough to avoid damage to the primary laser optics. The monitoring system functions on a microsecond timescale, can operate continuously for months at a time, and can detect destructive gases or particulates at parts-per-million to parts-per-billion sensitivity levels.

The SBIR award included plans for a commercial version of the device, which in its current form is highly specific to the ABL system in terms of its rigorous specifications, and is being considered for insertion through a Phase III project. Researchers for the Defense Department’s Advanced Tactical Laser program also have expressed interest in the sensor for land-based and airborne systems. In the future, a commercial version of this system could be useful for the in-situ monitoring of high-power commercial lasers such as those used in semiconductor fabrication and industrial welding.

The Canary system is based on cavity ringdown (CRD) spectroscopy, wherein a laser is injected into an optical cavity, quickly turned off, and the optical cavity “decay time” is measured. The high reflectivity of the mirrors in the cavity translates into high sensitivity to changes in the optic performance. The Canary cavities are extremely compact, all-fiber coupled, permanently aligned, and user-serviceable in a rapid fashion. Because the system is fiber-optic-based from end to end, it is also impervious to electromagnetic interference.

NovaWave also had an MDA Phase I SBIR for developing a system capable of determining coating loss in critical optical components. The company turned this item into its highly successful LossPro™ product. LossPro was designed to be used by technicians to precisely determine reflectance and optical losses in thin-film and optical sub-

strates. LossPro has thus far generated \$1 million in sales, and is being used internationally by manufacturers who fabricate lasers for the telecommunications market, as well as the generic neodymium yttrium-aluminum-garnet (Nd-YAG) laser market.

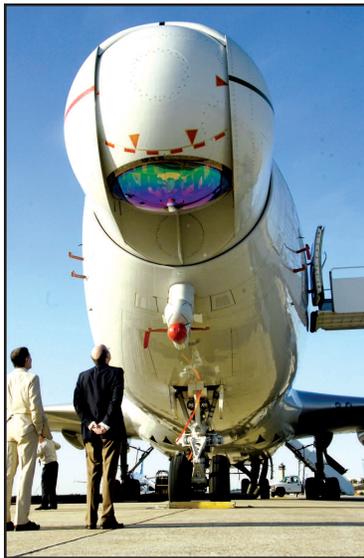
A third SBIR success story is NovaWave’s novel ammonia gas sensor, which can sniff out trouble in industrial, environmental, and general chemical-analysis applications. The ability to determine absolute concentrations of many gas species

can also be used for semiconductor gas purity analysis, medical diagnostics, and homeland security applications. Initially developed for ABL with Phase I and II SBIRs, the gas sensor platform can be configured as a dedicated product, according to individual specifications.

NovaWave is also working with the Department of Energy on a miniaturized analyzer for detecting greenhouse gases, and with NASA in developing a compact, cryogen-free mid-wavelength infrared spectrometer for detecting trace gases in planetary atmospheres. The reduced need for coolant and cooler brings down the weight, complexity, and risk of space payloads, thus helping to lower cost.

Other projects in the works include an ultrasensitive, fiber-laser-based explosives detector suitable for passenger and cargo screening. Two Army Phase II SBIRs, initiated in 2005, centered on developing a detector for chemical and biological agents in the field, with detection at the single-molecule/particle level, for monitoring pathogens in water-supply systems and in the air.

NovaWave has recently expanded its square footage on the strength of its tripled revenues from 2004 to the present, and is looking forward to healthy growth in applications for its core laser and sensor technologies. 



▲ NovaWave’s monitoring technology has roots in the Airborne Laser program, which incorporates a high-power laser in the nose of an airplane to defend against missile threats.

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# Outsmarting Chemical Leaks

New sensor-driven piping system detects and warns of toxic emissions.

by Joe Singleton/jsingleton@nttc.edu

A new sensor-enhanced piping system could soon improve the ability of heavy industry and local utilities to detect chemical spills, natural gas leaks, and groundwater contamination.

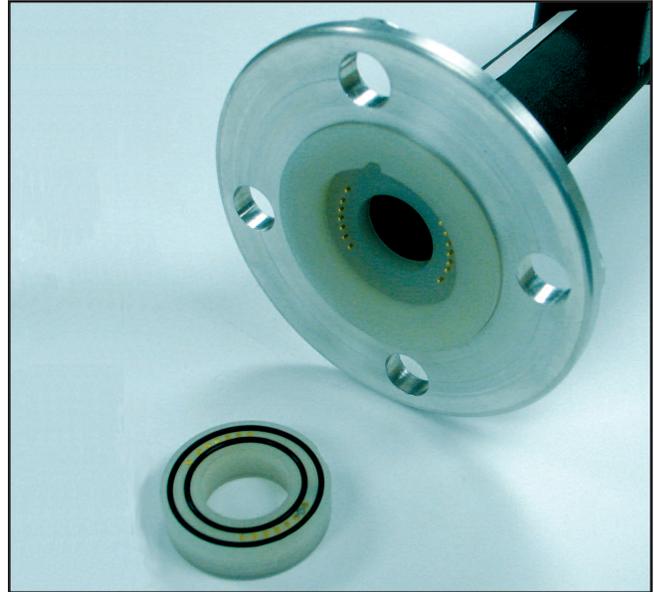
Odyssian Technology, LLC (South Bend, IN), is developing “smart” pipes, an innovative tubing system with embedded wireless, networked sensors that could be widely used for detecting chemical leaks of any kind. Smart pipes are manufactured from lightweight composites and could easily be installed to replace aging metal or copper piping, such as natural gas lines or piping used in municipal water systems.

MDA originally funded Odyssian’s smart piping system through a 2005 SBIR Phase II contract for developing a lightweight containment system to detect imminent leaks in high-energy, chemical-oxygen-iodine laser systems used aboard military aircraft. Odyssian is now doing further work through an extension to this Phase II project, due to be completed by August 2008.

The primary purpose of Odyssian’s smart piping system is to protect onboard personnel, electronic systems, and aircraft structure through leak detection of corrosive and toxic chemicals, such as chlorine. If leaked into the aircraft cabin, such chemicals can be a serious health and safety hazard to confined military personnel. Leaking of corrosive gases also can pose a threat to the structure and electronic systems by corroding aluminum, titanium, and nickel components. Odyssian’s sensor-laden seals and pipes that make up the smart-piping system have redundant containment structure and sealing surfaces as well as a sensor placement scheme that provides leak-progression detection, allowing for the detection of an imminent leak before a leak occurs. The smart piping system also allows the operator to monitor the operational status of the plumbing system by measuring and reporting system pressure, temperature, and vibration at each fitting and pipe segment.

The technology’s advanced sensor system uses an array of MEMS (microelectromechanical system) and other micro- and mini-sensors that are located inside the pipe’s composite laminar flow structure as well as within the specially developed seals. The sensor system is made up of networked sensor nodes that have unique addresses to provide correlation of sensory data to specific seals, gaskets, and pipes within the plumbing system.

Odyssian President Barton Bennett said his company’s smart piping system provides the added benefit of reducing weight. Because the system has sensors that detect the



▲ Odyssian’s “smart” seal and pipe technologies incorporate advanced sensors to detect and warn of chemical or toxic leaks.

presence of corrosive chemicals, Odyssian can use lighter-gauge metal and composite materials that would otherwise degrade from prolonged exposure. The company estimates that it can provide weight savings of between 30 percent and 40 percent over a baseline metallic piping system.

Having a solution that helps reduce global warming caused from greenhouse gas emissions is a significant commercialization priority for Odyssian. To help accomplish this goal, the company is developing smart seal and smart piping system technology for use with natural gas lines. A major constituent of natural gas is methane, which is a large contributor to global warming, second only to carbon dioxide. Odyssian’s work has included developing sensor-enhanced two-piece “boots,” which can be placed around the welded joints of pipelines.

Although the smart piping system for natural gas still needs a commercial benefactor, Odyssian has forged ahead, working with officials in South Bend, IN, to develop low-cost composite piping with integrated sensors and seals for the city’s municipal water system. The technology will provide almost instantaneous detection of leaks and early-warning notice of structural deficiencies in water lines. Such functions are not currently available with conventional infrastructure.

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# The Optimization Game

Software aims to improve sensor networks, logistics, and resource management.

by Keith Costa/kcosta@nttc.edu

Taking its cue from game theory and economics, an MDA-funded company has developed software that optimizes networked sensors by treating them like buyers and sellers in a virtual market. The approach also could be applied to optimizing the use of assets in commercial areas such as resource management, logistics, and manufacturing.

The company, Charles River Analytics (Cambridge, MA), received funding for the software from an SBIR Phase II contract in 2005. Its researchers focused their efforts on creating code that can boost sensor performance for missile defense.

From the start, they drew from the work and legacy of Nobel laureate John Nash, the mathematical genius whose struggles with schizophrenia were recounted in the 2001 film *A Beautiful Mind*. Although Nash did not invent game theory, a kind of applied mathematics, he is one of the pioneers. His work influenced countless economists in the last 30 years to re-imagine their discipline in terms of game theory.

Nash and those economists essentially provided Charles River Analytics with the intellectual foundation to create its software tool for MDA. The software, called SNOMAN, which is short for Sensor Network Optimization using Multi-Agent Negotiation, functions by allocating limited sensor resources to track multiple missile threats in the most efficient manner possible. The company's SBIR Phase II work led to the delivery of a SNOMAN prototype earlier this year.

Written in Java, the software runs an algorithm that can coordinate radar and other sensor tasking in real time. With minimal hardware upgrades to go along with the software, each sensor contributing to a missile defense network functions as an "agent" within a computer-generated marketplace.

Just like real-world stock exchanges, there are buyers and sellers in this market. The sensors are represented by "seller"

agents—selling information to the "buyer" agents that represent the command and control system or fusion systems that need data from the sensors, explained Christopher Farnham, a senior software engineer at Charles River Analytics. The continuous interactions, or "negotiations," between these buyers and sellers can deliver enough relevant information to produce, for instance, tasking plans for radars.

Utility functions built into the software give various sensors

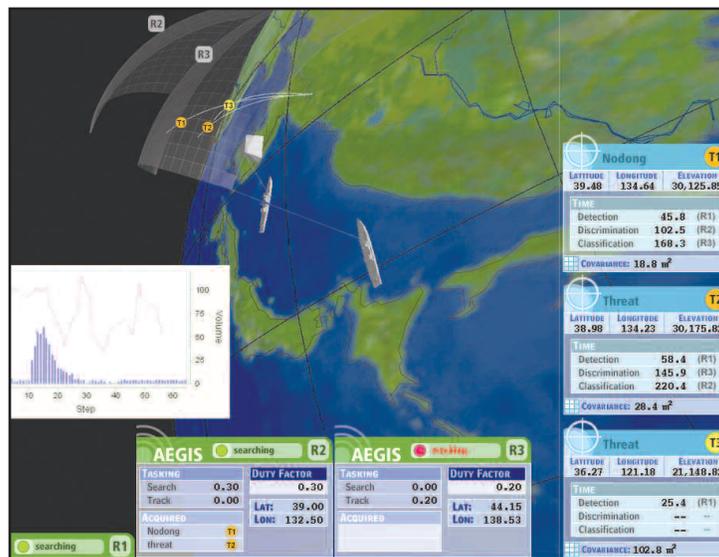
priority status for tasks that arise from the moment an enemy missile is tracked to the moment it is intercepted. SNOMAN assigns a higher value to information gathered from long-range radars when a threat is first detected. Shortly after, interceptor systems that would use the radar data start "buying resources"—in effect, "outbidding" lower-priority systems—to begin prepping the rockets that will destroy the threat, Farnham said.

Game theory, which examines the strategic interplay of agents in competitive environments,

is used by Charles River Analytics to model the kinds of scenarios that will be in play in a missile defense context and determine bidding strategies.

Although existing mechanisms for tracking an incoming missile are effective, Charles River Analytics' approach could offer improvements in certain conditions. Indeed, Farnham said SNOMAN could really shine when a missile defense system with limited sensor resources needs to track multiple threats, because the game theory and market-based mechanisms built into the software can ensure the most efficient allocation of those resources.

Some standard principles in economics apply to SNOMAN, according to Dan Schrage, a scientist who specializes in computational economics at Charles River Analytics. For example, the software produces an "invisible



▲ Charles River's SNOMAN tool can display missile and radar information alongside additional data that is used to help track threats efficiently.

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#### The Optimization Game from page 8

hand” effect that aggregates individual decisions—the interactions of agents—in a way that is globally optimal, he said, borrowing from 18th Century economist Adam Smith.

SNOMAN’s sensors-as-individual-agents approach would make it easier to deploy a distributed sensor system, Schrage said. Today, tasking of sensor networks is centralized; all the computation is done in one location. But SNOMAN pushes information processing outward to the sensor nodes, which reduces bandwidth requirements going across the network. In other words, SNOMAN cuts out the middleman.

Charles River Analytics already is looking beyond its Phase II project to additional sensor optimization tools and commercialization.

For MDA, the company will expand on ideas that led to SNOMAN in a Phase II SBIR project titled ALAMO, or Arbitrage Look-ahead Agents for Market-based Optimization. Again, the challenge is efficiently allocating sensor resources in real time.

While SNOMAN deals more with myopic or immediate planning, ALAMO will take strategies employed by traders in futures markets, like hedging against risk, to find out whether solutions with predictive information will achieve even greater sensor optimization.

Charles River is in the process of patenting SNOMAN. Farnham said the company is seeking patent protection that would cover the network protocol combined with the unique

way Charles River Analytics applies economic game theory to the missile defense domain.

The company is open to ideas for licensing the software for a variety of applications. SNOMAN can be used for any kind of resource management or allocation problem, according to Schrage. For example, a large organization with lots of independent contractors could use the software to manage their schedules and determine where they should be working.

SNOMAN also could be used for logistics management, controlling just-in-time manufacturing and coordinating sensors employed by the medical and law enforcement communities. Or the software could be used by Web sites to gather demographic data and information about buying habits to optimize page content for individual users, according to Farnham. Meanwhile, the company is making its programming interface as intuitive as possible, and creating tools that allow operators to see clearly what is happening in the virtual market, including the volume of trading and the “prices” of different “goods,” he said. 

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#### Outsmarting Chemical Leaks from page 7

The company also is considering applications in the automotive industry, specifically in the area of environmental cleanup. One potential application using the smart pipe technology involves developing smart gaskets—such as head gaskets, oil-pan gaskets, and fuel-filter gaskets—that could alert a driver of oil or fuel-system leaks. Bennett said the sensors’ ability to do this could help prevent possible groundwater contamination if the defective gaskets are promptly repaired.

Odyssian is interested in teaming with suppliers to develop smart systems that detect an imminent leak within an automotive air-conditioning system. Bennett said that mobile refrigerant-containment systems, such as those used in automobiles, are subjected to vibration and large swings in temperature that can cause leakage at threaded fittings. Refrigerants are known to cause depletion of the stratospheric ozone layer, and some of the new replacement refrigerants are potent greenhouse gases—up to 1,300 times as potent as carbon dioxide.

Another technology that the company has developed is a sensor veil for use with underground fuel tanks. This technology integrates a sensor grid, or veil, that can detect the presence of

leaks. Sensors in current technology are found only in dual-wall tanks, simply providing notice if gas already has leaked somewhere within the inner-wall space. The advantage of Odyssian’s sensor-grid technology is that it identifies the location of the leak within the tank, helping reduce the cost of excavation and repair.

Other opportunities envisioned for Odyssian’s smart-pipe technology include aircraft, naval vessels, chemical factories, and industrial refrigeration and chiller systems.

Odyssian was recently issued a patent on its smart-seal technology, and the company awaits further protection of other related technologies. Bennett said that to achieve commercialization, Odyssian will license its recently issued patent to seal and gasket companies. The company will also pursue contracts to engineer and install advanced containment systems and will entertain offers for exclusive partnerships. 

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for example, to beam data quickly among downtown office buildings instead of having to tear up streets to install fiber-optic cables. Or the new product could enhance high-speed data communications in other environments where running cable can prove costly or disruptive. Network overseers at universities, military bases, and other campus-like environments could find the L1000 useful. The product has been designed to operate with commercial off-the-shelf switches, routers, and encryption devices, according to Trex officials.

Trex, which previously has operated under the names Thermoelectron Technologies Corporation and ThermoTrex Corporation, has a long history of funding from missile defense programs. BMDO, a predecessor of MDA, originally awarded the company a series of Innovative Science & Technology contracts to develop communications systems that could transmit audio and video data at high rates. As the company worked on the various projects, the focus fell on millimeter-wave technology, which transmits data at extremely high frequencies and offers greater bandwidth capabilities than microwave communications.

### Commercial jumpstarter

For several years, Loea has been turning out commercially available data-communications systems built around its BMDO-funded technology. Loea products typically include a 2-foot dish for transmitting and receiving data. But the L1000 goes in a new direction. The product, which resembles a hobbyist telescope, has a 10-inch lens that serves as the antenna. Tom Fargo, a retired U.S. Navy admiral who serves as chairman and CEO of Loea, said the key to jumpstarting adoption of millimeter-wave technology is ease of use and affordability.

“By making it a little smaller, a little simpler, a little easier to align, and by reducing the cost—the cost has come down by over 60 percent—we are able to put it in more locations and adapt it to more applications,” he said. Loea has set the U.S. list price for the L1000 at \$24,000, which includes two antennas, each weighing only 12 pounds.

Company officials said the product requires no elaborate or expensive mounting gear. By comparison, using a more traditional fiber-optic connection instead of the L1000 could cost users as much as \$70,000 per mile (1.6 kilometers) just to trench the fiber-optic cable, according to Loea. As another example, company officials researched and determined that the average cost to connect a cell-phone base station using fiber is about \$300,000, compared with less than \$30,000 to connect the station using Loea’s products.

“Eventually, as people demand video and imagery over wireless circuits, you are going to have to get up into the

[gigabit-per-second] range, so you’ve got to drive the price down so the telecom industry will find this as a reasonable alternative,” said Fargo, explaining that wireless phone-service providers should find the technology especially useful for expanding and enhancing their networks. “And we’d like them to use it now as opposed to waiting until they absolutely have to have more bandwidth.”

### Addressing standards

The L1000 system produces 100 milliwatts of output power and operates in the radio-frequency band of 71–76 gigahertz (GHz), as well as the 81–86 GHz band. As the system transmits and receives data, the width of the data beam holds steady within a range of 1.2 degrees. The other dish-based Loea products, by comparison, have a tighter “pencil-beam” beam width of 0.42 degrees.

Loea maintains that the L1000 will perform well in all weather, with a 99.999 percent availability at distances greater than 1 kilometer. The product is compatible with data infrastructures and standards such as Sonet, Internet Protocol, Gigabit E, and other standard or proprietary data rates between 125 Mbps and 1.5 Gbps.

Trex and Loea have about 10 patents that cover the core technology behind the L1000 and its sister products. The companies have another handful of patent filings working their way through the approval process.

The companies are not alone in their pursuit of fiber-like capabilities via high-frequency wireless technology. But Fargo said he believes price and ease of use will distinguish the L1000 from other products competing in the market.

The L1000 joins an existing line of Loea’s products that already has been used by customers such as the U.S. naval base at Pearl Harbor. Loea’s products also have been used in a metropolitan area network for Santa Fe, NM, and for high-definition television “backhaul” communications for Super Bowl XXXVII (2003), transmitting data between remote sites and a central site.

Loea has deployed about 100 links throughout the United States and Mexico while working with customers in application areas such as enterprise architectures, telecommunications, cellular backhaul communications, and remote data storage, as well as military and emergency-responder communications. 



▲ A user installs the Loea L1000 communications system at a site in California.

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# Writing Your Success Story Before You're a Success

Know the answers to key questions that reporters might one day ask.

by L. Scott Tillett/stillett@nttc.edu

Success often begins with daydreaming—imagining a new idea for a business, a new way of doing things, a new product, or an improvement to an existing product.

But the daydreaming shouldn't stop there. If your business becomes a true success story, someone likely will want to tell your story to a broad audience. A local reporter might want to cover your business for your town's newspaper. A writer for a niche or specialty publication might want to interview you to craft a story suited to a very specific readership. And if your product or service has national or global impact, you could find yourself being interviewed by a major television outlet.

So it's not a bad idea to spend some time daydreaming about what you will say should you ever find yourself in the interview chair. And the best way to do that daydreaming is to focus on the questions that a reporter might ask. Answering those questions now could help you focus your business today for the success that you dream will come tomorrow.

Here are a few reporter's questions that you might encounter when you're successful enough to draw media attention:

- *What's the business problem that your technology seeks to solve?* Yes, a solution is always a solution to a problem. And problems are what businesses have. In the hospital business, the problem might be healing and treating patients effectively. In the business of government, the problem might involve efficiently executing an agency's core mission. Thinking in terms of helping your customer solve its problems and help its own customers is key. Being able to put that problem-solution scenario into a few words will help you create a mantra that will keep your business focused and that will allow you to explain succinctly to potential customers and the media what you do and how you do it. Example: "Civil engineers in the United States can't monitor every mile of our transportation infrastructure each and every day. But our company's embedded wireless sensor network can. And it can send alerts to engineers before structural problems turn into serious threats to drivers."
- *Who should care about this product (or technology)?* Like the previous question, this one drives at the problem your solution is addressing. Knowing who should care will help you keep in mind more than your frontline customer. Yes, civil engineers and the average commuter should care

about a monitoring system for bridges and highways. But so should transportation companies, first responders, elected officials, and companies that do business with the civil-engineering community. Being aware of those additional audiences can help you position your product to your primary customer. Those additional audiences also could give you needed feedback as you seek to perfect your product. And building awareness among those additional audiences also can help increase your profile among your primary customer audience.

- *What's the tallest hurdle your business has overcome to get where you are today?* A good reporter will ask that question because he wants to provide his readers with a lesson—some advice or "news you can use." Mistakes, hurdles, and how they are overcome also make for exciting tales. But to answer the "tallest hurdle" question in the future, you have to know what your tallest hurdle is today. Keep in mind that your greatest technical or technology challenge might not necessarily be the main obstacle between you and commercial success. You might be striving to make your technology smaller or faster. But a bigger challenge to commercial success might involve finding the right manufacturing partner.
- *How much?* Reporters ask this question a lot of different ways. How much does your product sell for? How much faster (or lighter or cheaper) is your product compared with similar competing products? How much money did it take you to get going with the business? How much did you do in revenues last year? When (how much time until) this product will be available? How big is the market for this product? How many people do you employ? How much other supporting equipment will I need to make use of your product? Daydreaming about these variations on the question of "How much?" will help you set goals and expectations today.

Even if no reporters ever come knocking on your door to record your success story, addressing these essential questions now should help you focus on issues that drive success. Spend some time today daydreaming about them. Don't wait until a reporter shines the "success story" spotlight on you to answer these questions. 

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