

SEA TECHNOLOGY

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2018

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Annual Review & Forecast

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

***Oceanology International*, March 13-15, Excel London, U.K.

***Canadian Hydrographic and National Surveyors' Conference*,
March 26-29, Victoria, Canada

MARCH

Electronic Charting/Vessel Management/Ports &
Harbors/Dredging/Homeland Security

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

***Offshore Technology Conference*, April 30-May 3, Houston, TX

***AUVSI XPONENTIAL 2018*, April 30-May 3, Denver, CO

***OCEANS '18 MTS/IEEE Kobe / Techno-Ocean 2018*,
May 28-31, Kobe, Japan

MAY

Communications, Telemetry, Data Processing

***BlueTech Expo*, June 4, Washington, DC

***CLEAN PACIFIC 2018*, June 19-21, Portland, OR

***UDT 2018*, June 26-28, Glasgow, U.K.

JUNE

Seafloor Mapping/Sonar Systems/Vessels

JULY

Deck Gear, Cable, Connectors, Power Systems & Salvage

AUGUST

Geophysical Exploration/Seafloor Engineering

***SEG 2018*, October 14-19, Anaheim, CA

SEPTEMBER

Ocean Resources Development & Coastal Zone Management

***Offshore Energy 2018*, October 22-24, Amsterdam,
The Netherlands

***EURONAVAL 2018*, October 22-26, Paris Le Bourget, France

***OCEANS '18 MTS/IEEE Charleston*, October 23-25,
Charleston, SC

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

***International Water Conference*, November 4-8, Scottsdale, AZ

***CLEAN GULF*, November 13-15, New Orleans, LA

NOVEMBER

Undersea Defense/Antisubmarine Warfare

DECEMBER

Diving, Underwater Vehicles & Imaging

***Underwater Intervention 2019*, February 5-7, New Orleans, LA

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Cellula Robotics' Imotus vehicle during a docking demonstration for Ocean Networks Canada in Burnaby, British Columbia, Canada, November 2017. Imotus-1 is a hovering AUV (HAUV) with 6 degrees of freedom for inspection and data acquisition missions in confined environments. Imotus-1 uses scanning sonars and proprietary simultaneous localization and mapping (SLAM) algorithms to provide navigational control and spatially referenced survey data.

NEXT MONTH

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Accelerating Capability At Sea

Smaller, faster, less expensive. That's the history of technology in a nutshell. The biggest consequence of these three developments is the additional access more people have gained to it. Most prominently, we've seen it in computers, where huge mainframes that were only available for a select few evolved into personal computers, tablets and smartphones.

There are now nearly 2.5 billion smartphones on Earth, and that number is heading rapidly toward parity with the global population. But even with all that capital invested, connectivity isn't universal. It's a comparable story in shipping for a very similar reason: It's not a simple problem. Getting internet access to remote regions requires substantial up-front costs, genuine market knowledge and years of technological expertise. On land, remote connectivity can be achieved through three ways: trenching fiber, point-to-point microwave towers or satellites. Needless to say, far out at sea, only the last of those is viable.

The challenge ships have today is getting connectivity at a speed that achieves the full potential of the ships' digital technologies at a price point that doesn't stifle return on capital invested. At the end of February, SES Networks demonstrated such connectivity capabilities at sea with a demonstration on board a cruise liner that verified a speed of more than 1 Gbps. In March, we continued our investment program with the launch of another four medium-Earth orbit (MEO) satellites, expanding our O3b constellation that delivers fiber-like connectivity. It was a very special moment watching them launch into orbit. The real magic, however, will be translating what happens in the sky into real impact on Earth. Connectivity opens a world of opportunities. This is why we're building: to expand the frontier of opportunity.

Whereas business insight has traditionally been about historical aggregates (How many tonnes of marine gas oil did my ship burn between Felixstowe and Rotterdam?), we're now seeing operators with the technology to answer much more interesting questions (How many tonnes of marine gas oil will my ship burn between Felixstowe and Rotterdam given the prevailing weather conditions?). One important implication of this is how the computer science field of machine learning is becoming a property of every application—not just an activity in itself. Enterprise applications will become more intelligent with every voyage as the machine studies data patterns and develops insights. But all of this forces, and benefits from, innovation at the infrastructure level.

The long and the short of it is that no shipowner or charterer will pay extra for semantics. Connectivity needs to be reliable, always available and ensure high-speed throughput. Providers that can offer multi-orbit (GEO and MEO) satellite-enabled connectivity solutions in multiple bands (Ka-, Ku- and C-band) will have the edge by being able to flexibly deliver the capacity that shipowners, operators and seafarers need to make better informed commercial decisions and enable them to remain competitive in an increasingly challenging and commoditized marketplace.

The 2020s will be shipping's first fully data-enabled decade, and success will come down to one simple, repeating loop: collect, analyze, predict. DNV GL estimates that, in two years, the data capacity of the VSAT network has increased from 8.7 to 16.5 Gbps—nearly doubling. If this trend continues—and there's no reason to think it won't from what we're seeing in terms of capacity usage—this capacity will reach 217 Gbps by 2025.

We're at the threshold of a significant acceleration in the capability of ships and shipping. In the same way that computing power is no longer the preserve of multinationals and governments, access to high-speed connectivity anywhere at sea is now available to all. The potential of every application is growing but will quickly reach a hard ceiling without the right supporting infrastructure. **ST**

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THE FUTURE IS ELECTRIC

)) Saying Goodbye to a True Champion: Marilyn C. Link. It's now been several weeks since we heard the unexpected news. It's still hard to imagine not seeing her roaming the halls of Harbor Branch or working the crowd at many local functions. It's hard to imagine she won't be stopping by my office or sitting next to me at our next board meeting. It's hard to imagine that this vital force, this wise woman with such a big heart, is no longer with us. The official accounting of her 94 years young was summed up in her obituary: Marilyn Calmes Link, sister of famed inventor Edwin A. Link, died March 19, 2018. She was born in Glendale, California in 1924. She graduated with B.S. and M.S. degrees in education. Her career included teaching and working in the airline industry. She was recognized with prestigious awards for her numerous accomplishments, including the University Aviation Association Award, the Florida Atlantic University (FAU) President's Distinguished Service Medallion, and honorary doctorate degrees from the State University of New York and Florida Institute of Technology. In 1974, she started serving as trustee and managing director of Harbor Branch Oceanographic Institution, now part of FAU as the Harbor Branch Oceanographic Institute (HBOI). After her retirement in 1982, she served on the HBOI Foundation and was named emeritus in 2008. She served as secretary-treasurer and trustee of the Link Foundation, an organization dedicated to the advancement of ocean engineering, simulation, aerospace and energy research, where she remained a special adviser until her death. Marilyn was deeply respected by so many colleagues and loved by so many friends and nieces, nephews and godchildren. She will be missed. *—Katha Kissman, president and CEO, Harbor Branch Oceanographic Institute Foundation*



)) Nine Teams Move to XPRIZE Round Two. XPRIZE announced nine finalist teams advancing in the \$7M Shell Ocean Discovery XPRIZE, a three-year global competition challenging teams to advance ocean technologies for rapid, unmanned and high-resolution ocean exploration. XPRIZE will award each finalist an equal share of a \$1 million milestone prize purse for the ocean mapping and imaging technologies they have developed. Round One testing demonstrated prototypes, and Round Two will test the finalists' technologies in a rigorous real-world world situation that will demonstrate their ability to rapidly map the ocean floor at 4,000-m depth. The finalists were chosen from a field of 19 semifinalists. The teams advancing to the final round are: ARGONAUTS (Karlsruhe, Germany)—creating two swarms: one swarm in the deep sea and one on the ocean surface; Blue Devil Ocean Engineering – Duke University (Durham, North Carolina)—working with heavy-lift aerial drones that drop retrievable diving SONAR pods; CFIS (Arnex-sur-Nyon, Switzerland)—building a fleet of AUVs to map and image the ocean floor using lasers; GEB-CO-NF Alumni (U.S., global)—integrating existing technologies and ocean-mapping experience with an innovative unmanned surface vessel; KUROSHIO (Yokosuka, Japan)—integrating technologies owned by Japanese universities, institutes and companies for a collaborative approach centered around AUVs; PISCES (Portugal)—aggregating Portuguese technologies to create the PISCES system that leverages cooperative robotics; Team Tao (Newcastle, U.K.)—developing an autonomous swarm system for rapid surface to deep-ocean exploration; Texas A&M Ocean Engineering (College Station, Texas)—using drone ships and AUVs to explore remote ocean habitats; and Virginia DEEP-X (Virginia)—developing small and low-cost underwater vehicles that operate in coordinated teams. Round Two, the final testing, will take place October and November 2018.

)) Maritime Blockchain Labs. Lloyd's Register Foundation and Blockchain Labs for Open Collaboration (BLOC) announced a funding partnership to set up Maritime Blockchain Labs (MBL), which will explore the use of blockchain for the assurance and safety of critical infrastructure and drive new business models for the global maritime industry. The collaboration will provide resources for Maritime Blockchain Labs to pursue three demonstrator projects focused on aspects of risk and safety where distributed systems can enable breakthrough solutions. MBL will foster innovation and collaboration between blockchain practitioners and industry actors, share knowledge and best practices, collectively define problems, and shape solutions that are open and interoperable.

)) World's First Autonomous Shipping Company. Wilhelmsen and Kongsberg are joining forces to offer a complete value chain for autonomous ships, from design and development to control systems, logistics services and vessel operations. Massterly is a new company that will establish infrastructure and services to design and operate vessels, as well as advanced logistics solutions associated with maritime autonomous operations. Land-based control centers will be established to monitor and operate autonomous ships in Norway and internationally. The new joint venture company will be based at offices in Lysaker, Norway, and be fully operational from August 2018. **ST**

Ocean Dashboard

Inexpensive Smart Sensors Could Revolutionize Ocean Sensing

By Marco Flagg

When University of Miami Professor Neil Hammerschlag tagged a tiger shark in the Bahamas with the first of a new generation of pop-up archiving satellite tags called SeaTag-MOD in late 2011, the primary purpose of the experiment was narrow: to track the migration of the shark. This would be done by tag transmissions to the Argos satellite constellation during brief opportunities when the fin-mounted tag broke the surface. In fact, only a few such opportunistic transmissions were received, but internally the tag scanned and archived sensor readings every 4 min. Timing dawn and dusk via light measurements served as the proxy of the shark's longitude, and the strengthening or weakening magnetic field would indicate transitions of latitude. Spurts of acceleration might signal hunting activity, and a pressure sensor along with a temperature sensor would reveal the vertical habitat and temperature preference of the animal.

A year onward, the tag separated from the shark, floated to the surface and, powered by its solar panels, provided a continuous stream of position fixes and basic status reports via Argos. Satellite localizing indicated a pop-up position in the northern Bahamas not far from the tagging location, with a drift north in the Gulf Stream. The following fall, as the tiny explorer drifted past Newfoundland, a growing fuzz of marine fouling dimmed the sunlight reaching its solar panel. Messages and location fixes became sparse and eventually stopped.

This would have been the end of the story, except that two years on Hammerschlag received an email from South Wales, reporting the tag had been found on the beach.

Back at the lab, the returned tag proved to be in good shape. All systems worked, and the tag resumed satellite reporting once cleaned and floated. More significantly, the tag's sensor scans had continued throughout the journey, the dimmed sunlight being sufficient for scanning the environment if not for transmission. The track estimation from the light and magnetic sensors revealed that the shark had resided in the Bahamas until spring. It then headed northeast, described by a loop north of Bermuda while probing depths to 800 m in brief dives. By summer, it took up residence at the continental shelf offshore Connecticut for the season, staying close to the surface and only once venturing deeper than 200 m. In the fall, it started its return journey south, tracing the continental shelf, again probing the depths, and ultimately returning with great site fidelity to the Bahamas, where the device popped off just tens of miles from the tagging position.

The following drift across the Atlantic was documented as well, and stormy winter seas and summer periods of glass calm were apparent in the accelerometer readings



as the tag bobbed on the waves. Fast forward in the observation record a year and a half, with the tag having completed most of its Atlantic journey and now west of Ireland, several pronounced depth spikes were apparent.

Desert Star Systems' SeaTag is equipped with a float, but sometimes an animal will ingest the floating tag and dive with it until regurgitating it some period later. This was not the case here. Upon reaching depths consistent with bathymetry at each site, the tag would remain still, at near constant or just slowly drifting depth for hours to a few days before suddenly surfacing again. Other sensor readings confirmed the validity of these square dives and ruled out causes such as heavy biofouling or float body loss until the seemingly most unlikely of explanations remained: The water encountered by the tag must have suddenly become lighter, causing it to sink to the seafloor. After some time, the tag must have returned to normal density, prompting the tag to rise from the seas again; a real-life enactment of old sailors' lore of ships suddenly and inexplicably sinking beneath the waves.

One explanation would be a methane seep, the mixture of gas and water being light enough to overcome the minimal flotation of the tag. As research showed, these

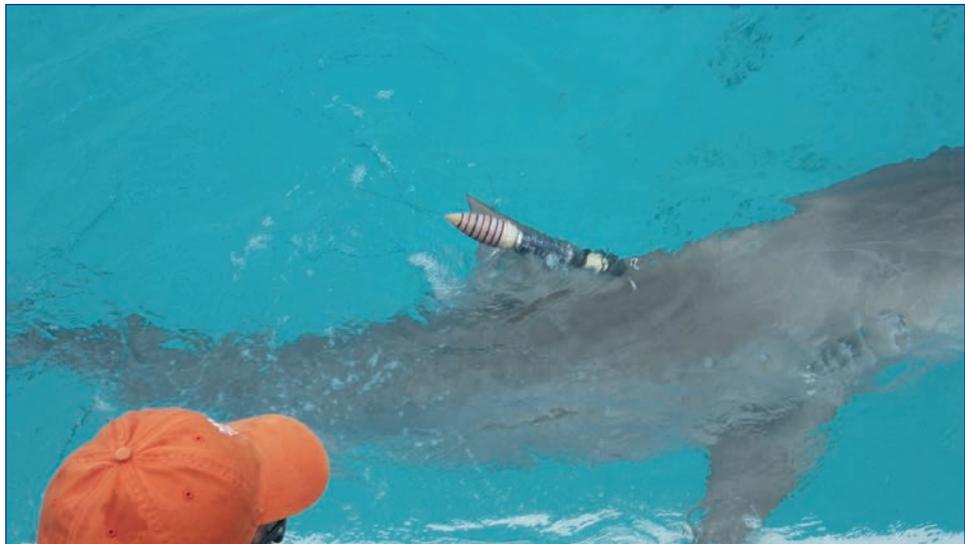
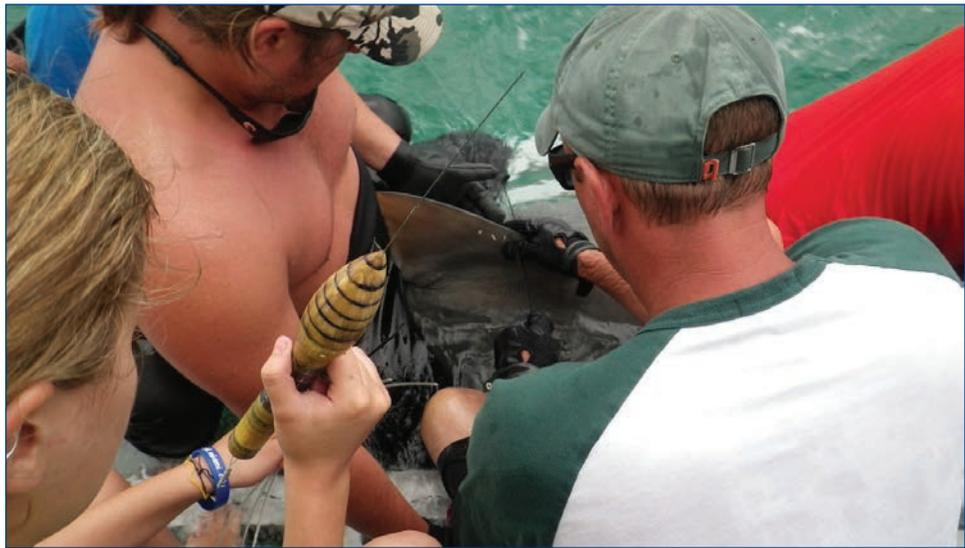
events all happened within the bounds of a recent offshore exploration. The tiny explorer, commissioned to track a shark, had inadvertently "discovered" the Porcupine Basin of Ireland, a large hydrocarbon field only recently explored. It had probed potential methane or gas seeps known in the area from the surface to the seafloor at depths up to 600 m.

A 'Smartphone' for Ocean Exploration

SeaTag-MOD somewhat resembles the fundamental design concepts of a smartphone specifically optimized for ocean exploration. At 145 g, weighing somewhat lighter than a smartphone, its cylindrical body is terminated with a syntactic float rated for service depth to 2,000 m through which runs the antenna for satellite reporting.

A thin-film solar panel covers the tag's body, and solar energy is stored in an internal ultracapacitor for use both in satellite reporting and ongoing sensor operation at night or during deep dives. A primary battery for extended operation in darkness is integrated in an exchangeable plug-in payload section. The solar and capacitor design has an unlimited recharge endurance. Thus, some users

A tiger shark is tagged with a SeaTag-MOD PSAT.



now routinely recover and reuse tags, achieving cumulative deployments of years. Solar energy collection is possible even underwater to a typical depth of twice the vertical visibility, but energy collection here becomes quite small, so the tag uses minimal power. Running the base profile of wake-up housekeeping every 16 sec. and full sensor scanning and flash memory archiving once every 4 min., averaged power consumption is only about 0.1 mW. Compare this to about 1,200 mW for a smartphone in typical use, meaning the draw of the phone in your pocket could alternatively power 12,000 tags. Thus, battery endurance in complete darkness and running the standard sampling and archiving profile is more than four years. Even a tag configured without a battery and using only its capacitor will maintain full operation for 30 hr. in darkness, plus another two weeks in standby mode. Yet, recharging requires only about 30 min. at the surface. The tag's internal sensor suite again resembles

that of a smartphone, including a three-axis accelerometer and magnetic sensor, temperature sensor and light and depth sensors. Archived data are stored on an integrated microSD flash card, its 2-GB memory enough for four years' worth of archived data at a full set of sensor scans every 2 sec.

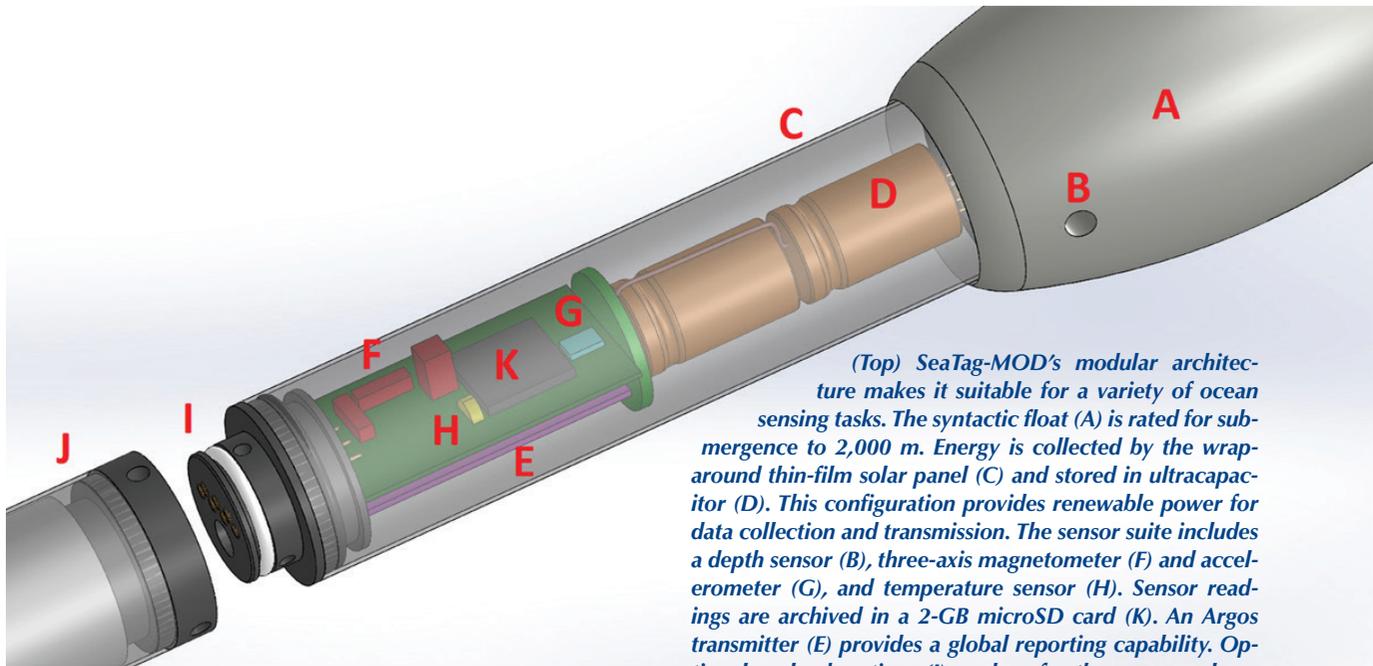
Reporting is based on the Argos satellite constellation, far slower than any cell phone connection but with global availability from pole to pole. Argos transmissions are short bursts of 0.91 sec. during which data are transmitted at 400 bits/sec. Yet given system-enforced minimum transmit intervals and sporadic satellite availability in the sparse constellation, effective throughput of user data is on the order of 1 bit/sec, i.e., slow even by Morse code standards. Still, the solar-powered tag manages to transmit an Argos packet with 31 user bytes a little faster than once every 2 min. when floating at the surface in broad sunlight. A packet is enough to transmit, for example, a full scan of all

10 sensor channels, including a time stamp and auxiliary information.

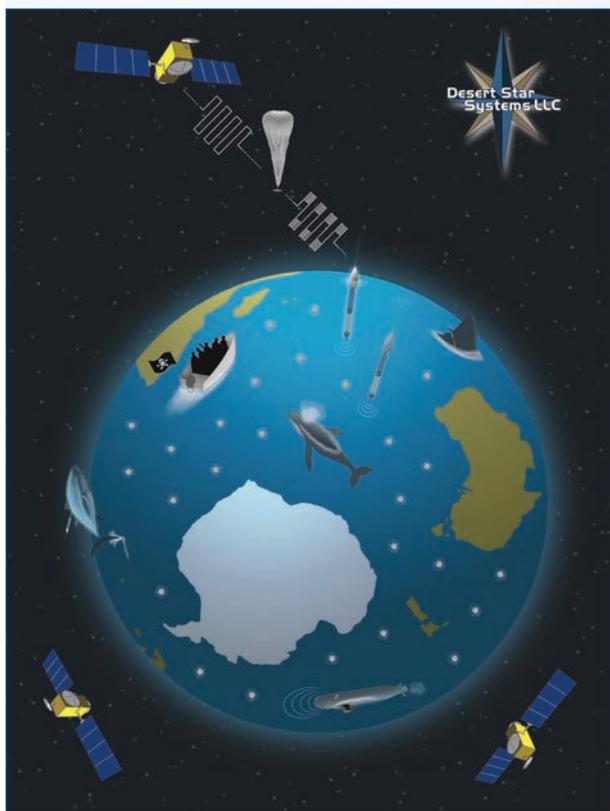
**Ocean Dashboard:
Toward a Fully Instrumented Ocean**

The U.S. Navy Strategic Studies Group (SSG) was a think tank charged to generate revolutionary naval warfare concepts. During the 2012 group review, Director Adm. James R. Hogg predicted that the Navy would become obsolete in its current composition within the next few decades. In the abstract, a navy might be considered a set of actuators, e.g., weapons linked to, and informed by, a sensor system. These include sonar, remote imaging, intelligence reports and the like. Hogg argued that while the Navy has very sophisticated sensors hosted on its ships, aircraft, drones, submarines, AUVs, satellites, etc., it also has very few of these platforms in relation to the size of the oceans. In fact, the detection range of underwater sounds and sonar is frequency dependent. Smaller targets such as speed boats or AUVs/UUVs tend to produce sounds at higher frequencies and lower source levels, thus limiting the detection range to a few kilometers or even into the tens or hundreds of meters. As asymmetric threats such as swarming attacks, piracy by speedboats or the use of AUVs/UUVs, etc. increases, the Navy's fleet of sensor platforms are becoming mere pixels of knowledge in the ocean. An early warning may be the maritime piracy situation in African waters. While piracy offshore Somalia declined to zero after the 2010 deployment of the international navy task force CTF-151, there was a spate of new attacks in 2017. Meanwhile, piracy incidents in West Africa increased from 54 in 2015 to 95 the following year. And, in California, cartels are using panga boats to land large quantities of drugs along the rugged Big Sur coast.

These trends indicate that instruments capable of more extensive sensing are needed for defense and law enforcement applications, such as detecting illegal fishing in remote waters. These instruments



(Top) SeaTag-MOD's modular architecture makes it suitable for a variety of ocean sensing tasks. The syntactic float (A) is rated for submergence to 2,000 m. Energy is collected by the wrap-around thin-film solar panel (C) and stored in ultracapacitor (D). This configuration provides renewable power for data collection and transmission. The sensor suite includes a depth sensor (B), three-axis magnetometer (F) and accelerometer (G), and temperature sensor (H). Sensor readings are archived in a 2-GB microSD card (K). An Argos transmitter (E) provides a global reporting capability. Optional payload sections (J), such as for the pop-up release function and a primary battery, are accepted by interface connector (I). (Copyright: Desert Star Systems) (Left) Under the Ocean Dashboard concept, widely distributed, miniature smart ocean sensors detect and report on a variety of events as illustrated. The envisioned WD-1 smart ocean sensor will incorporate sound detection, recording and localizing capabilities. A small buoyancy engine allows the sensor to dive to listen, then surface to report and recharge. Applying Desert Star's modular design, WD-1 will incorporate acoustic design blocks from Desert Star's SonarPoint system, thereby further building economies of scale and reducing the cost of the new device. (Copyright: Desert Star Systems)



are also needed to assess stocks of commercial fish and monitor the environmental impact of industrial activities. These applications point to the need for an Ocean Dashboard—a new capability to detect, monitor, track and report events in the oceans as they occur, powered by small, inexpensive smart sensors, like the SeaTag-MOD.

Breaking the Vicious Cycle of High Cost, Small Markets In Ocean Tech

Dense smart sensor networks are now the norm for resource, process and activity management on land. But

ocean technology is often caught in a vicious cycle in which the special nature and stringent demand on equipment results in high prices. This limits the applications and market for the technology, which in turn reinforces high prices.

Given the large size of the oceans and the sensor density needed for effective detection, how could a realistic network be established even for select ocean areas? Here, the economic history of the tiny ocean explorer points to a solution. SeaTag devices are the result of a 2009 NOAA Small Business Innovative Research (SBIR) solicitation that sought innovation and cost reduction in pop-up satellite tags (PSAT) so that this capable technology, typically priced at around \$4,000 per device, might be deployed in more significant numbers than the few to low tens of a typical study. Desert Star's modular design approach managed to break the high-cost cycle. We build new products not from scratch but in a modular fashion in which a typical new product is engineered approximately 85 percent cut-and-paste style from pre-existing design blocks with about approximately 15 percent new content added. These blocks include electronic circuitry, mechanical components, firmware and software

libraries, communication protocols and even text fixtures and procedures. While the market for an individual product may be limited, the cumulative use of each design block, manufacturing technique and test procedure as employed across multiple devices is much higher. The resulting economies of scale cut device cost and build demand, allowing further price reductions. The vicious cycle leading to high costs and limited use has been replaced with a virtuous cycle of lower costs and growing demand. Today, a SeaTag-LOT PSAT for stock assessment, basic migratory tracking and mortality studies is available for \$500, only about one-eighth the price of previous options. On the high end, SeaTag-MOD's reusable design has reduced the effective price per deployment to under \$1,000 in some cases. Consequently, the devices have now been adopted for species that have not previously benefited from PSAT technology, such as lake trout. Ongoing or proposed studies based on sample size exceeding 100 are becoming more frequent.



PSAT tags are most frequently used on large pelagic species such as tuna, billfish and sharks, but technical innovations, price reduction and reusability are now enabling tagging of other species such as lake trout, pictured here. This growing demand reduces cost, which may eventually enable widespread ocean sensing and reporting applications. (Photo Credit: Rick Goetz)

Deployment, Practicality and Implications Of Ocean Dashboard

The Ocean Dashboard would be powered by a soda can-sized device building on the SeaTag-MOD design, but also incorporating a digital acoustic recorder and signal-processing capability, plus a small, solar-powered buoyancy engine for controlled diving. Numerous of these WD-1 devices could be deployed cheaply as needed; thrown off the stern of patrolling ships or dropped from airplanes. Sinking to depth to listen quietly, observe, time and fingerprint acoustic events, a WD-1 may then surface to report, recharge its batteries and sink again to ride the conveyor belt of ocean currents to a new location in a targeted fashion. As with SeaTag, WD-1 will be designed in a modular fashion. It will draw long-endurance sound recording and localization design blocks from Desert Star's microMARS and SonarPoint systems, developed in recent years through NOAA's Advanced Sensor Technology Working Group (ASTWG) and the Office of Naval Research's Marine Mammal Program (MMP).

Of course, just like our smartphones are enabled by capable cell and Wi-Fi communication infrastructures, so will an Ocean Dashboard need adequate communication channels. Argos is particularly useful for very small devices, and Iridium yields faster rates for somewhat larger devices starting around the soda can size standard. As requirements grow, faster communication solutions that can produce cell phone-like bandwidth for small devices at sea are on the horizon or at least plausible. SpaceX recently launched the first two of its Starlink low-Earth orbit internet satellites. The satellites' steerable high-gain, phased-array antennas, while normally intended to communicate with similar pizza box-sized antennas on fixed stations or ships, might still yield cell network

equivalent speed when communicating with a practical low-gain antenna on a miniature sensor at sea. Alphabet X (Google) Project Loon involving steerable internet balloons is another option. In ocean areas of particular interest, networks of these balloons may work as a stratospheric "cell tower" network. In more remote settings, steerable balloons might be commissioned to visit smart sensors for rapid data retrieval in response to visit requests logged via a slow satellite link.

Ultimately, an Ocean Dashboard as a global maritime information utility is likely to be based on a multilevel structure, with small and inexpensive drifting devices such as WD-1, animal tags, etc. most pervasive but complemented by larger and more capable platforms. Boeing's recent acquisition of the Wave Glider manufacturer Liquid Robotics to boost autonomous surveillance at sea and the companies' glider-centric vision of the Digital Ocean is a recent such indicator.

The introduction of miniature ocean smart sensors, steep price reductions for ocean technology and the potential for faster communication options for maritime devices are placing us at a revolutionary threshold in ocean sensing.

On the defense front, Adm. Hogg's prediction may be set to come true as a Navy built around a limited number of very expensive and vulnerable sensor-hosting ships and other platforms is replaced by a fleet of relatively simple weapons carriers roaming the oceans; a fleet tying into and informed by a near invisible, virtually undefeatable and always present distributed ocean sensing network capable of identifying the type of new asymmetric threats that now increasingly evade detection.

Similar to GPS, as Ocean Dashboard capabilities grow and costs decline, such a sensing network will surely grow into a ubiquitous new global utility.

The journey and accidental "discovery" of the tiny ocean explorer may be a harbinger pointing out the opportunities and implications of a revolutionized ocean sensing infrastructure.

References

For a list of references, contact Marco Flagg at marco.flagg@desertstar.com. **ST**

Marco Flagg is the CEO of Desert Star Systems LLC. For the past 25 years, he led Desert Star's design team, building a broad but modular ocean technology product line. Today, his focus is leveraging this design base to introduce affordable and scalable solutions for current problems in ocean management.



High accuracy subsea positioning for scientific mission off the coast of Columbia

iXblue, a global company that provides innovative solutions devoted to navigation, positioning and underwater imaging, recently took part in a scientific mission to study marine ecosystems around the Malpelo Island, off the coast of Columbia. This mission was part of a three-year circumnavigation of the world's oceans and seas to study the overexploitation of marine resources, pollution, ocean warming and acidification, endangered species, coral reef bleaching as well as ecosystem imbalance. It is to learn, from the complex interactions between species and from the role of humans as they interact with the sea, as well as strengthen the tools for sustainable management and development, that Monaco Explorations decided to renew the long tradition of great explorations carried out over past centuries.

Onboard the Yersin, a vessel turned into a scientific boat by Monaco Explorations, iXblue's USBL (Ultra Short Base Line) positioning system, Gaps, provided accurate positioning of the ROV (Remotely Operated Vehicle) used by local

scientists invited to sample environmental DNA and film the seabed during the three-week mission.

For this mission, Gaps was installed on a pole lowered into the water thanks to the crane of the vessel. This allowed the easy use of Gaps that did not need to be mounted on the vessel itself, an operation that would have proven challenging on this type of ship. Such a use of iXblue's USBL antenna was made possible thanks to the INS (Inertial Navigation System) directly integrated within Gaps, and that provided permanent and accurate monitoring of the antenna's motion. Gaps thus ensured accurate positioning of the ROV, whatever its conditions of use (vertical or horizontal positioning) and offered a nominal range of 4000 meters and a positioning precision of 1 meter for 1000 meters of slant range.

Recent updates made to Gaps opened up the way to new functional capabilities such as a bidirectional acoustic communication link between the vessel and the underwater

vehicle thanks to the telemetry function. In addition to its positioning functionality, Gaps thus also acts as an acoustic modem, enabling various other features (recalibrating an INS while in position, retrieving sensors data, sending control command to a subsea vehicle, retrieving the subsea vehicle information). Gaps offers a robust acoustic communication link with a data transfer speed that can reach up to 500 bits/s even in harsh and noisy environments.

Gaps thus offers both the positioning and the telemetry functionality within a single device, making it possible to save space and energy on the underwater vehicle which only has to use a single beacon. This makes the management of acoustic resources much more straightforward as the transmissions sequencing of positioning and telemetry signals are controlled by a single device, eliminating risks of interference.

Adopted by over 120 companies, institutes and navies worldwide, iXblue's flagship subsea positioning system, Gaps, rapidly established itself as the new standard product for operations requiring the precise positioning of an underwater vehicle. It is now used in various applications such as subsea construction, offshore energy exploitation, deep sea mining, as well as other defense applications. ■



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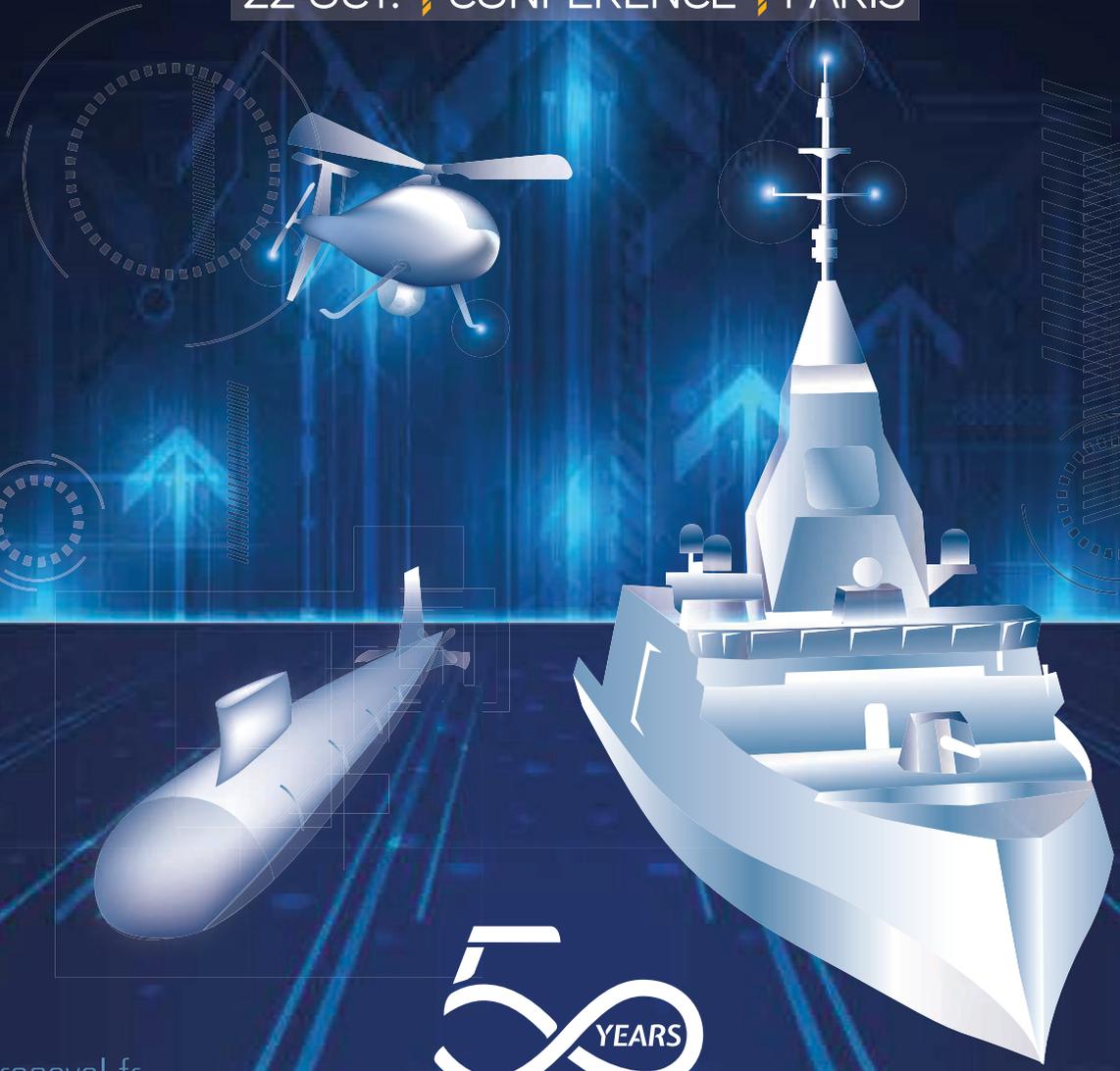


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CLEAN PACIFIC

The CLEAN PACIFIC Conference & Exhibition will take place June 20 to 21 in Portland, Oregon, at the Oregon Convention Center. It is a must-attend event for those involved in spill prevention and response for oil and hazardous materials in the marine and inland environment. CLEAN PACIFIC brings together stakeholders from government and the environmental, emergency planning and emergency response industries to share lessons learned, hear best practices and view new products and services. The goal of CLEAN PACIFIC is to deliver a valuable event that covers the most pressing issues in the western United States and Canada and offers ample time for attendees to network and cultivate the relationships that are crucial to a successful response.



Improve Emergency Management Team Response Capabilities; Applied Response Technologies; Prevention and Early Interdiction Response; Volunteer Management; and Surveillance and Visualization. The day will conclude with a welcome reception located on the exhibit floor.

On Thursday, June 21, the day will consist of conference sessions, including: Natural Disasters - How Prepared Are We Really?; Regulated Community Challenges - Changing Focus of Federal Preemption; Wildlife Response Issues; Oil Spill and HAZMAT Case Studies; Transboundary Issues - Mounting a Successful Response, Funding the Response; Risk Assessments as a Tool for Preventing Spills; Communications: Who's Doing It?; and Environmental Restoration and Recovery Promotion.

Show Program

Four concurrent tracks will take place at CLEAN PACIFIC: Prevention, Case Studies, Planning and Preparedness, and Response and Recovery. Over a two-day period, each track will hold multiple educational sessions led by spill prevention and response experts.

On Wednesday, June 20, the day will begin with the welcome and keynote address. Conference sessions will be held throughout the day, including: Derelict and Abandoned Vessel Prevention; Better, Faster, Newer: Innovations in Creating and Updating Geographic Re-

The Exhibition

The CLEAN PACIFIC exhibit hall will feature spill response organizations, regulatory agencies, suppliers/manufacturers and service companies showcasing their latest solutions and technologies.

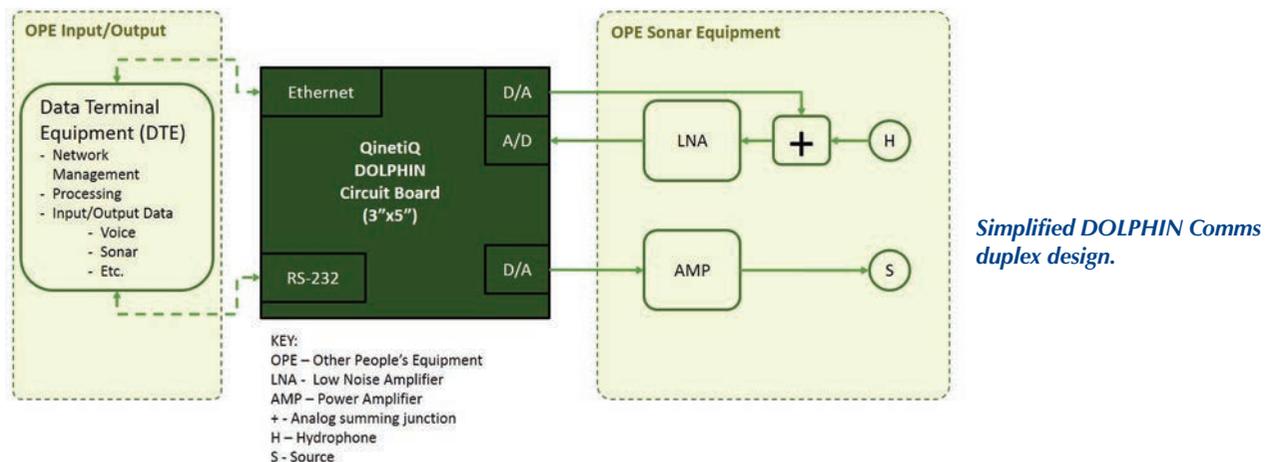
Attendees will have the opportunity to meet face-to-face with all of the exhibitors to discuss their unique challenges.

For more information, visit www.cleanpacific.org. **ST**

Full-Duplex Comms

Simultaneous Transmit, Receive for Static and Mobile Nodes

By Justin Manley • Michael Murphree • Greg Folts



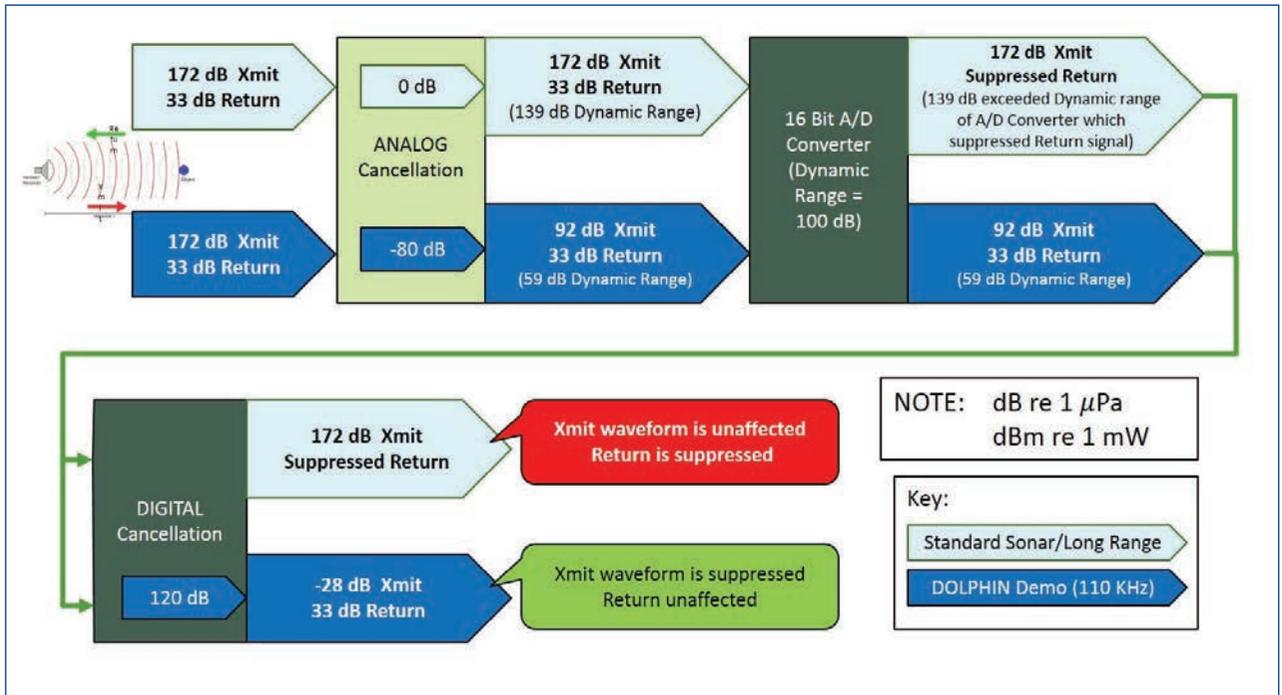
The significant growth in the use of UUVs and other underwater networks of nodes in the dynamic ocean environment requires communication systems with far greater capability than is currently available. Since the beginning of acoustic communications, the state-of-the-art technology has been limited to half-duplex signals: transmit with the receiver off and then turn the transmitter off and receiver on and wait to receive, because the direct transmission at the source saturates the receiver electronics if they are both on at the same time. Half duplex is simply accepted as “the way it is.”

There are three typical outcomes of half-duplex approaches. One is that time domain multiple access (TDMA) is the only practical approach for multiple nodes to communicate in a network. The “time slice” method of TDMA is a workaround to the limitation of using half duplex. The TDMA approach requires precise knowledge of the distance between communicating nodes so that the data will arrive at the node at the correct time slice when the node is ready to receive. TDMA networks containing

moving nodes, like UUVs, tend to fail because the moving nodes can't time their transmission correctly to arrive at the receiving node. The dynamic nature of the ocean makes TDMA networks fragile, even when the distance is well known and the nodes are stationary, and they are virtually useless for moving nodes.

Another typical outcome is that the communications channel capacity utilization is dramatically reduced due to the need to stop transmitting to receive data. This is exacerbated as the bit error rate (BER) increases and as the number of nodes increases. The additional retransmissions required to account for the BER reduce the channel capacity utilization, resulting in lower data exchange rates or throughput.

A third outcome is that adding and removing nodes in a network is problematic and disruptive due to the need to establish a new time slice slot for each node. This makes reliable self-forming mesh networks extremely difficult, if not impossible, to create in acoustic environments using half-duplex approaches.



(Top) How full duplex preserves dynamic range of returning signals. (Bottom left) DOLPHIN receive rate versus conventional receive rates. (Bottom right) Data throughput improvements for UUV case study.

Full Duplex Enabled

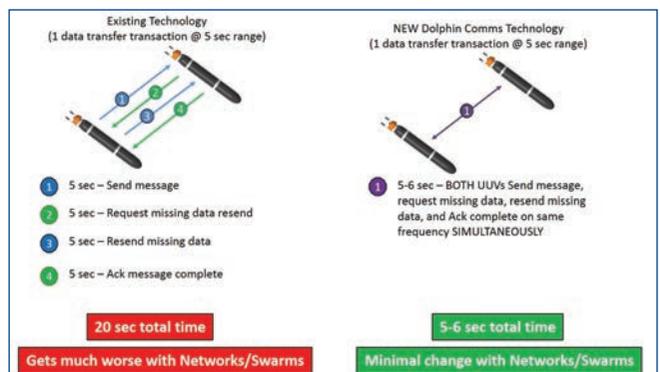
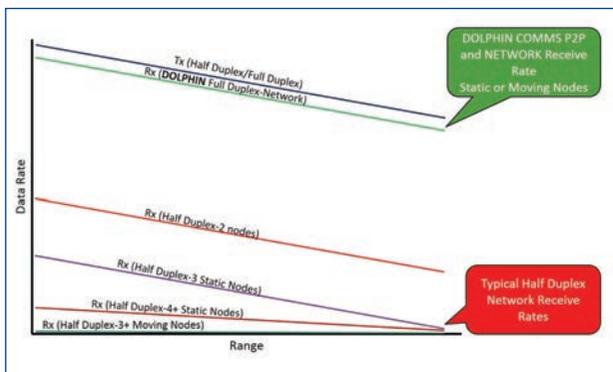
Acoustic modems generally use a single transducer for both transmitting and receiving, making full duplex impossible. It has not been reasonable or necessary to employ separate collocated transmit and receive transducers because, with current technology half-duplex communications, the receiver would be saturated by the very strong transmission signal. QinetiQ North America (QNA) and its partner Optimal Systems Laboratory (OSL) have developed DOLPHIN Comms, a patented method using analog cancellation that eliminates receiver saturation. The result is that DOLPHIN Comms enables full-duplex continuous underwater acoustic communications with collocated transmit and receive transducers.

DOLPHIN Comms addresses the receiver saturation problem by using a secondary transmission path to actively and adaptively cancel the local transmission at the

receiver. For undersea communication, active cancellation must provide a minimum of 40 dB of analog cancellation from the transmitter (including distortion products) to enable full-duplex communication. In testing, DOLPHIN Comms has demonstrated more than 80 dB of analog cancellation. The DOLPHIN Comms technology has shown that it is capable of in-band, full-duplex communication on a wide range of frequencies.

DOLPHIN Comms consists of a source with power amplifier and transmission transducer, along with a collocated receiving transducer and receiving system. The receiver is coupled to another, lower-powered transmitter. A feed-forward signal is applied to cancel the outbound signal at the receiver at the input to the low-noise amplifier (LNA), preserving dynamic range at the receiver. This method has been implemented for both continuous active monostatic sonar and full-duplex acoustic communication.

Full-duplex, in-band acoustic communication is possible when there is sufficient dynamic range in the receiving transducer and receiving electronics to permit detection and demodulation of the desired signal in the presence of the strong interference from the collocated transmission source. Digital cancellation and physical



separation are typically applied in today's systems, but do not provide enough dynamic range to enable full-duplex communications. DOLPHIN Comms technology provides the analog cancellation of the transmission source before the LNA in order to reduce the dynamic range of the combined signal to within the limits of the analog to digital (A/D) converter. Using analog cancellation to reduce the transmission signal by 80 dB, the overall dy-

“TDMA networks containing moving nodes, like UUVs, tend to fail because the moving nodes can't time their transmission correctly to arrive at the receiving node.”

amic range of the combined signal can pass through the dynamic limitations of the A/D conversion (typically 100 dB for a 16-bit A/D) without loss of the lower order terms from the receiver. The surviving digital signal after the A/D converter can be further improved with digital cancellation but only if the receiver content has not been suppressed by the A/D converter. DOLPHIN Comms ensures the receiver contents are preserved for the entirety of the bandwidth of the signal.

What Full Duplex Offers

While ocean physics are fixed, the development of DOLPHIN Communications technology enables true full-duplex acoustic telemetry. This new technology resolves many of the issues of half-duplex acoustic communications. DOLPHIN technology cancels the transmit signal at the receiver in real time. This eliminates the receiver saturation caused by self-signal and enables simultaneous transmitting and receiving on the same frequency, with collocated source and hydrophones. The DOLPHIN technology is frequency and range independent—thus yielding new approaches to underwater communications.

There are several immediate benefits of the DOLPHIN technology. Because all the nodes in a network can transmit and receive simultaneously, TDMA is no longer required to segregate the transmission of data among nodes, which are now all free to transmit data at will. Data can be sent and verification acknowledgments can be received simultaneously using the same frequency until the data transfer is completed. Robust assured data transfer (ADT) between nodes is feasible. Over a 400 percent increase in ADT throughput speeds has been observed using DOLPHIN Comms. It is no longer required to know the distance between each node. DOLPHIN-enabled communications can transmit to any node and to multiple nodes within range at any time necessary. Robust self-forming acoustic networks of randomly placed

and/or moving nodes (i.e., swarms of UUVs) can be implemented with full-duplex communications capabilities, much like radio-based mesh networks. Nodes can receive multiple incoming transmissions while they are transmitting. Mobile nodes can be fully accommodated in self-forming networks. Channel capacity utilization remains high and is only reduced slightly as the BER increases. DOLPHIN full-duplex technology is signal-agnostic. Multiple-access modulation methods such as CDMA (code-division multiple access), OFDMA (orthogonal frequency-division multiple access) and FHSS (frequency-hopping spread spectrum) can be chosen for their optimality for specific user requirements (high signal-to-noise ratio, high bit rate, many users, etc.). Accurate position, navigation and timing (PNT) are continuously available from all nodes but not required for effective communication to take place in the

network.

In practice, the impact of DOLPHIN full-duplex comms versus standard half-duplex comms can be viewed in terms of the change in data throughput (speed of transmission of meaningful information). This can be generically viewed in terms of data rate versus range. The positive benefits are particularly clear as the number of nodes in a half-duplex (mobile or static) network increases. While increasing nodes degrades the overall throughput of conventional networks, modeling and testing show that DOLPHIN Comms networks will maintain consistent performance. The receive rate is independent of the number of nodes in the network or whether the nodes are static or moving. If you start adding nodes to the network, the receive rate is decreased even more for half-duplex static networks, while the DOLPHIN Comms full-duplex receive rate is basically unchanged. This demonstrates the significant importance of the DOLPHIN Comms technology in enabling networks of moving nodes, like swarms of UUVs.

A more concrete example of the benefits can be seen by considering the case of two UUVs attempting to communicate using assured data communications (ADT). Traditional half-duplex approaches, with multiple cycles of transmission of packets that require a receive acknowledgment from the receiving node, can require up to 20 sec. to deliver a typical data message between UUVs. But using a DOLPHIN full-duplex approach can deliver about a 400 percent improvement of throughput. To be clear, this improvement is entirely due to the signal processing approach, but the overall limitations of acoustic transmission remain. To put it casually, while the laws of physics have not changed, DOLPHIN Comms provides better lawyers.

Lab, Field Testing

A DOLPHIN Comms and Sonar proof-of-concept (POC) demonstration was successfully completed in

“The DOLPHIN Comms technology can be applied anywhere there is a demand for ad hoc networks, high throughput, long range/high reliability and clandestine communications.”

Waltham, Massachusetts, September 2016 using the analog feed-forward technique for sonar and communications. The goal was to demonstrate sufficient active analog cancellation to enable full-duplex acoustic communications and continuous active sonar. The DOLPHIN Comms POC system was able to demonstrate 65+ dB of analog cancellation in a highly reverberant laboratory tank. This exceeded the goal of 40 dB and validated the concept of adaptive cancellation for full bandwidth. Full-duty continuous active sonar and communications using CDMA, OFDMA and FSK (frequency-shift keying) were all successfully demonstrated.

Following tank trials, the development program moved on to open water to evaluate potential to scale up in real water conditions using commercial equipment. This test included open water, omnidirectional transducers, realistic frequency ranges and bandwidth, useful range distances, and highly reverberant conditions. The goal was to demonstrate DOLPHIN Comms technology at 100-m range and maintain full-duplex acoustic capability providing data communications in challenging environments. The testing was performed in a very challenging shallow-water environment with many obstructions (pilings, floating docks and cables) in a marina in Boston, Massachusetts, March 2017.

The maximum water depth was 5 m at high tide. This condition was chosen to test common issues that often degrade acoustic communications, such as multipath and Doppler impacts. Stations A and B were 100 m apart, transmitting between and under docks with cables and pilings. This environment is among the most challenging for typical

acoustic transmissions, but testing was successful using the DOLPHIN Comms cancellation technology.

The test demonstrated 80 dB of analog cancellation in a dynamic environment and the ability to scale to useful distances using commercial equipment, while maintaining robust, reliable full-duplex communications. The test was performed at 6 percent power (60 mW or 160 dB) and demonstrated its expected 1.6 Kbits/sec data rate, full duplex, using binary FSK modulation.

Following the initial laboratory and open-water testing, the DOLPHIN Comms technology was demonstrated at the Annual Navy Test and Experimentation (ANTX) event in August 2017 and the Special Operations Command (SO-COM) Diver Comms demonstration in November 2017. DOLPHIN Comms successfully demonstrated an additional capability: clandestine, full-duplex communications in a network environment. DOLPHIN performed in less than 5 m of water and successfully delivered clandestine text messages in full-duplex mode.

Practical Applications

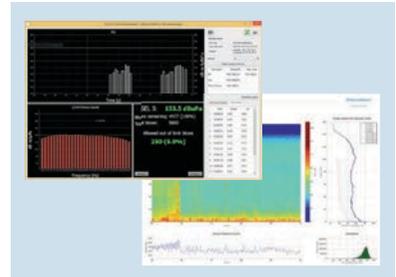
The DOLPHIN Comms technology can be applied anywhere there is a demand for ad hoc networks, high throughput, long range/high reliability and clandestine communications. This could include: homogenous networks of similar undersea nodes; heterogeneous networks of diverse undersea nodes (divers, UUVs, fixed stations); ad hoc networks of surface and undersea nodes, especially USV plus UUV system of systems; submarine communications systems; and diver communications. Such features will be of interest to divers.

Military operations will bene-



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“While the core technology is ready, the many layers of product and system-of-systems developments will evolve over time.”

fit from networking, clandestine communications, improved throughput and increased tolerance for difficult acoustic conditions. One could envision DOLPHIN-enabled networks of unmanned systems finding and neutralizing mines in deep waters and in the surf zone.

Commercially, the oil and gas industry and offshore renewables are looking to seafloor resident systems for installation and inspection, maintenance and repair. These applications will benefit from the utility, PNT and data connectivity taken for granted by mobile devices connected to conventional satellite and radio networks.

Scientifically, there is strong interest in local, regional and global ocean observing networks. DOLPHIN Comms will allow such networks to function as well under the water’s surface as they do above.

Conclusion

DOLPHIN Comms is a transformational new technology enabling full-duplex acoustic underwater communi-

cation between static or mobile networks of nodes, significantly improving throughput of the networks.

The technology has been validated in field trials, and there are ongoing defense applications and development projects planned. Commercial and scientific applications and trials are of great interest.

While the core technology is ready, the many layers of product and system-of-systems developments will evolve over time. A robust ecosystem of hardware manufacturers, software developers and end-users must mature around the underlying technology.

With appropriate, collaborative effort, it is reasonable to assume that a future “internet of ocean” will be feasible based upon this new technology. **ST**

Justin Manley is a technologist and executive with experience in start-up, corporate, academic and public sectors. After professional roles at MIT, supporting NOAA and in the private sector, he founded Just Innovation Inc. in 2015 to support a variety of clients with a focus on unmanned and undersea systems.

Michael Murphree is the communications and surveillance technology manager for maritime systems at QinetiQ North America. He has a wealth of experience in undersea systems engineering, software and automation, as well as his current work with acoustic communications.

Greg Folts is the director of business development for maritime systems at QinetiQ North America. He has more than 30 years of experience in unmanned systems and mine warfare as an engineer and a program manager for the U.S. Navy. Folts has been engaged in the private sector defense community, with a focus on sonar technology, since 2007.

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Undersea Defence Technology

Undersea Defence Technology (UDT) 2018 will take place in Glasgow, Scotland, from June 26 to 28. UDT strives toward and continues to deliver a platform for the subsea community to gather and discuss the industry's most pressing questions, prominent technologies and innovative solutions. The undersea environment is one of the harshest on Earth, and the technological complexities of operating in this environment mean it is essential to provide a forum for the entire community to share knowledge. UDT will enable international companies comprising prime contractors, systems integrators, service providers and small and medium enterprises to meet and network with more than 1,400 industry influencers, government decision makers and senior military officials.

In 2018, UDT enters its 31st year of providing the platform it does to industry and end-users alike. It is very important for UDT to stay relevant to the industry it looks to support, and this year is no exception, with various inaugural projects and topics for 2018.

Babcock Innovation Zone

The Babcock Innovation Zone, a bespoke exhibition space, will be available for start-ups and small businesses to promote their contemporary technologies, innovations and industry solutions.

Babcock, through a common interest with UDT, will provide a platform for pioneering industry contributors to the undersea defense market.

The Babcock Innovation Zone is ideal for collaborations from business and academia working on the latest technology, or small companies with a new product or service, to present their bespoke solutions. In parallel, an area has been created to allow researchers to present their work through post-



ers and discuss it in person. The organizers will provide a unique stage for systems integrators, service providers and small enterprises. At the heart of the Babcock Innovation Zone is an ethos to facilitate entry of even the smallest of companies into a competitive market, where many innovative and cutting-edge solutions can be difficult to uncover otherwise.

Military Diver Conference

UDT is launching the Military Diver Capabilities conference as a platform for discussion among those engaged in diving operations, diver training and diver equipment development and research in this most challenging aspect of undersea operations. The theme is



“Shining a Light on the Depths: Exploring the Evolving Role and Equipment of Military Diver Elements.”

This conference will explore three primary domains: Special Forces and Combat Divers; Explosive Ordnance Disposal and Clearance Divers; and Undersea Engineering.

The technology focus will be on research and development of products and systems aimed at improving the effectiveness, efficiency and safety of military divers across the spectrum of dive operations.

The conference will also provide a platform for interservice and international diver elements to meet and discuss capabilities and requirements in the pursuit of greater cooperation and interoperability.

Industry will be on hand to demonstrate how new solutions can solve these requirements and to share solutions for common problems faced by those working undersea.

Exhibitor Feature

This year will be no exception to the past success of UDT. The show continues to attract some of the leading thinkers behind our thriving industry. Industry leaders BAE Systems, Babcock and Saab all put their names to the UDT brand and will be attending with their latest innovations and technologies. Other industry leaders in

attendance will include Harris Corp., L3 Calzoni, Leonardo and Lockheed Martin.

Networking Events

UDT 2018 will host two networking events in Glasgow. The first will be hosted by BAE Systems. The second will be in the exhibition hall, which will remain

“The undersea environment is one of the harshest on Earth, and the technological complexities of operating in this environment mean it is essential to provide a forum for the entire community to share knowledge.”

open until 7:30 p.m. as exhibitors welcome visitors and delegates to their stands. Popular with the whole UDT community, the exhibit hall event creates a lively atmosphere as exhibitors offer international hospitality. It is this atmosphere that helps generate valuable interactions and maximize networking opportunities.

More Information

For more information about attending, exhibiting or speaking at UDT, visit www.udt-global.com. You can also contact team@udt-global.com. **ST**



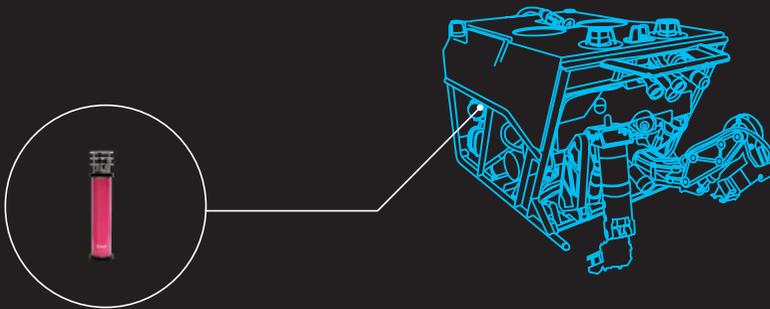
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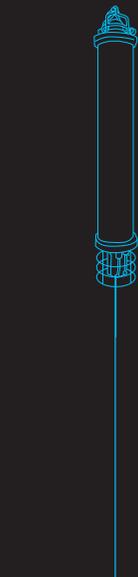
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Trump's 2019 Budget For BOEM, BSEE

U.S. President Donald Trump proposed a \$179.3 million fiscal year (FY) 2019 budget for the Bureau of Ocean Energy Management (BOEM).

In January 2018, Secretary of the Interior Ryan Zinke announced the Draft Proposed Program (DPP) for the 2019 to 2024 National OCS Program, which proposes 47 potential lease sales for consideration, the largest number of lease sales ever proposed for a National OCS Program's five-year lease schedule. Trump's budget request includes \$9.4 million to build a new National OCS Program that considers the 25 planning areas identified by the DPP and begins implementing the new program.

For the Bureau of Safety and Environmental Enforcement (BSEE), Trump proposed a \$199.9 million FY 2019 budget. This includes an estimate of \$67.9 million in off-setting collections. Offsetting collections includes \$20.3 million for rental receipts, \$3.8 million for cost recoveries and \$43.8 million for inspection fees.

Texas's First Federally Endangered Mussel Species

In February, the Texas hornshell mussel, *Popenaias popeii*, became the first among 15 state-threatened fresh-

water species to receive federal protection under the U.S. Endangered Species Act.

A team of Texas A&M AgriLife scientists led by Dr. Charles Randklev in Dallas now works alongside collaborators from Laredo Community College and the Illinois Natural History Survey to better understand the species' ecology and taxonomy. Their goal is to identify contributing factors to the Texas hornshells' decline and provide data to the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department to aid in its protection and recovery.

There are places where Texas hornshell occurs in the Rio Grande where it is clear increases in water temperature and salinity are occurring. Impacts on these populations will likely worsen with climate change and increasing human activity in these regions. These mussels provide important ecosystem services to humans, and their decline will eventually affect human health issues.

Grants Target Impacts Of Derelict Fishing Gear

The National Fish and Wildlife Foundation (NFWF) announced a request for proposals for the Fishing for Energy Grant Program, www.nfwf.org/fishingforenergy. Up to \$2 million in grant funding is available to support strategies that reduce the impacts of derelict fishing gear in marine and coastal environments. The majority of awards under this program will fall in the range of \$100,000 to \$500,000.

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Fishing for Energy launched in 2008 and provides anglers with cost-free solutions to dispose of old, derelict or unusable fishing gear.

Grants will target areas in U.S. coastal waters with state or regional plans that have identified and prioritized reductions in derelict fishing gear. Priority locations include: the Florida Keys National Marine Sanctuary and other important habitat for sea turtles and marine mammals in coastal waters along South Florida; the Gulf of Maine, in areas that are identified as priority for northern right whales; Puget Sound, in priority habitat for killer whales as referenced in management plans; Hawaii, within the borders of the Papahānaumokuākea Marine National Monument; and areas along Alaska that are important to marine mammals and have disposal access points through Dutch Harbor or Kodiak Harbor.

MarineCadastre.gov Team Receives NSDI Award

The Bureau of Ocean Energy Management (BOEM) and NOAA's Office for Coastal Management announced that the Federal Geographic Data Committee has selected the MarineCadastre.gov team to receive the 2017 Doug D. Nebert National Spatial Data Infrastructure (NSDI) Champion of the Year Award.

MarineCadastre.gov is a geographic information system containing authoritative data that are fundamental to supporting decisions about the development of U.S. offshore conventional and renewable energy resources;

use of Outer Continental Shelf (OCS) sand and gravel for shore protection, beach nourishment and wetlands restoration projects; and ocean coordination and planning efforts. MarineCadastre.gov provides data, web maps and specialized tools that are used by stakeholders to address national issues in the areas of energy infrastructure planning; ocean vessel navigation and safety; national defense; conflict avoidance involving ocean users; and maritime jurisdictions and limits.

FY 2018 Omnibus Bill Funds Science

The U.S. Congress has passed the fiscal year (FY) 2018 Omnibus Appropriations Act. It includes increases to key science agencies and programs, such as the National Science Foundation at \$295 million over FY 2017; NOAA at \$234 million above FY 2017; NASA at \$457 million above FY 2017; and the Department of Defense basic and applied research and technology development at \$16 billion above FY 2017 and the Navy at \$800 million above FY 2017. According to the Consortium for Ocean Leadership, the omnibus provides funding for regional-class research vessels, unmanned underwater vehicle research, the National Sea Grant College Program, aquaculture research, NOAA's Office of Education, support for implementation of the seafood monitoring program, and the establishment of the National Ocean and Coastal Security Fund to help better understand and utilize the ocean, coasts and Great Lakes. **ST**

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USS Lexington and USS Juneau Wreckage Found

EdgeTech side scan sonar technology was used by the RV *Petrel* in the discovery of the sunken remains of USS *Lexington* and USS *Juneau*. The USS *Lexington*, one of the first aircraft carriers built and commissioned by the U.S., was sunk during the Battle of the Coral Sea in 1942 off the coast of Australia. The USS *Juneau*, a U.S. Navy light cruiser, was sunk in November 1942 during World War II. Both discoveries used a 2-km swath to conduct search patterns.

MSI Transducers Allow Unmanned Tech To Go Full Ocean Depth

Airmar has significantly broadened its offerings to include a comprehensive suite of ultrasonic transducers that includes more than 150 different piezoceramic element and array options, an extensive housing portfolio and customized solutions for offshore platforms. The acquisition of MSI Transducers has significantly broadened the company's offerings to include MSI's design and manufacturing of high-performance composite transducers suitable for full ocean depth.

Quest Offshore Releases Data Platform To Assist Floating Wind Energy Industry

Quest Offshore Resources has released Quest Floating Wind Energy LLC (Q FWE), a data and analytical practice focused entirely on the resources driving the economics, technology and supply chain encompassing floating wind energy.

To aid industry in developing their strategies and targeting opportunities in this sector's supply chain, Q FWE has assembled the resources to connect various disciplines and services involved. The Q FWE platform, in conjunction with Q FWE's consulting practice, provides customized analysis.

Aquabotix to Install Norwegian GPS

Aquabotix has partnered with Norwegian technology supplier Water Linked AS and will integrate its GPS system with the Endura ROV to enable greater underwater positioning for tank and hull inspections, fish farm exploration and search and recovery missions.

The company also sold a hybrid vehicle to the Korea Institute of Geoscience and Mineral Resources (KIGAM), which will use the hybrid and its technology for ongoing geoscience and energy research in Korean waters.

Woods Hole Installs Hyperbaric Testing System

Woods Hole Oceanographic Institution (WHOI) installed a 20,000-psi hyperbaric pressure system as part of a new test building and pit.

The hyperbaric testing system supplied by Optime Subsea includes both a pressure vessel and a control system and more than triples high-pressure test capacity by enabling unattended 24-hr. operations. It replaces an outdated system that is more than 50 years old.

Modular Dry Stack Engine and Exhaust Installed on High-Speed Ferry

Seastreak's new *Commodore*-class high-speed catamaran ferry is launching with innovative Delta "T" Systems/Dinak modular dry stack engine and generator exhausts and ventilation equipment. The 150-by-40-ft., 600-passenger Incat Crowther-designed vessel is built by Gulf Craft of Franklin.

Industry Project to Tackle Propeller Issues

TrueProp Software LLC has launched an improved propeller inspection and metrology joint industry project (JIP). The project aims to resolve a number of identified deficiencies in metrology, compliance criteria and inspection practices to achieve improved workflow productivity, cost savings, better product outcomes and connectivity for new and legacy inspection devices. Members will participate in development, application and testing of new modules in the TrueProp inspection software.

Fugro Updates Cayman Islands Nautical Charts

Fugro recently completed the data acquisition phase of a hydrographic survey project that is designed to update significant portions of the nautical charts of Grand Cayman and Cayman Brac. The surveys were conducted on behalf of the United Kingdom and Cayman Islands governments after the project was awarded through a competitive bid contract, issued and overseen by the United Kingdom Hydrographic Office (UKHO).

Canada Tests aqua tools' Ballast Water Kit

The government of Canada is testing aqua-tools' B-QUA ballast water sampling and monitoring kit in the Canadian ballast water surveillance program. The trials compare the capabilities of sampling and analysis tools for measuring organisms of various sizes, zooplankton, phytoplankton and bacteria.

The Canadian laboratory carried out research to better understand the capabilities of tools, visiting multiple ships and taking samples of treated ballast water. B-QUA proved fully capable of providing analysis of organisms in the 10- to 50- μ m and >50- μ m ranges.

Samson Rope Sponsors Crossfire Yacht Racing

Samson Technologies is sponsoring Crossfire Racing, a Corinthian yacht racing program focused on competition at the highest levels in the sport while maintaining a commitment to sportsmanship and community development.

The boat is a Reichel/Pugh-designed and McCaughey-built custom race boat from Seattle, sailing under the Sloop Tavern Yacht Club burgee. The crew is a dedicated team of experienced sailors based in the Northwest, with a combined total experience of more than 300 years sailing.

28th Fast Response Cutter Delivered

Bollinger Shipyards delivered the USCGC *Nathan Bruckenthal*, the 28th fast response cutter (FRC), to the

U.S. Coast Guard. The 154-ft. patrol craft has a flank speed of 28 kt., command, control, communications and computer technology, and a stern launch system for the vessel's 26-ft. cutter boat. The vessel is named after Nathan Bruckenthal, who was killed in 2004 while conducting maritime intercept operations in the North Arabian Gulf.

Early Career Scientist Proposals Due June 15

Winners of the Early Career Scientist Contest earn free use of a battery-powered AZFP 125/200/455/769-kHz or 38/125/200/455-kHz mooring cage and battery for a three-month deployment period, along with support from ASL's team of experts. The instrument loan program is open to early-career scientists and engineers, graduate students, post-doctoral fellows and others involved in oceanographic or freshwater work.

Offshore LED Deck Lights, Wipers Installed on New England Lobster Vessels

IMTRA has provided its offshore series LED deck lights, Exalto and Roca windshield wipers, side-power thrusters and zipwake dynamic trim control systems to lobster vessels throughout New England. The newly launched lobster boat *Sailor's Way* from Stonington, Maine, is the latest fishing vessel to be equipped with IMTRA gear.

Marlink Moves to Houston

Marlink has moved to larger premises in Houston to meet the growing needs of its Gulf of Mexico offshore industry and shipping customers. The new facility includes expanded office space in addition to a new warehouse facility to support responsive bridge and satcom equipment installation and onboard services.

The Houston location allows the Marlink Group to support customers with operations, sales support and technical training, including delivery, field services engineers, service management and program management.

SSI President, CTO, CEO Move Into Ownership

SSI CEO Darren Larkins and President/CTO Denis Morais have acquired ownership of the shipbuilding software development company SSI from the company's founder Rolf Oetter.

Larkins and Morais have been managing SSI for the past seven years while Oetter has focused on other initiatives, such as the promotion of alternative energy. The change in ownership ensures the long-term stability of SSI with those actively involved in decision making and day-to-day operation now having ownership.

Phoenix Upgrades Quality System Certification

Phoenix International Holdings Inc. is transitioning from ISO 9001:2008 to ISO 9001:2015 certification.

The 2015 version of the quality management standard requires greater involvement of senior management and a broader understanding of supply chains. It sharpens a company's focus on risk, with the goal of an organization's many processes operating as a single, integrated system directed at meeting customer requirements. **ST**

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Inertial Navigation System

The Navsight Marine Solution provides real-time heave that is accurate to 5 cm, with automatic adjustment for wave frequency.

It is available as a motion reference unit, providing roll, pitch and heave, or as a full navigation solution using an external or embedded tri-frequency GNSS receiver. SBG Systems S.A.S.

LED Strobe Panel

NOVA provides ultrabright illumination to capture crisp still images on fast AUVs. Originally designed for integration with HUGIN AUVs, NOVA combines 36 custom-oriented LEDs to produce a powerful 450,000-lumen output. 2G Robotics Inc.

Real-Time Mapping

CARIS Onboard 2.0 dynamically controls and monitors automated survey systems. Products generated including surfaces, backscatter mosaics and survey track lines are live-

streamed during acquisition and accessed through a web browser. Teledyne CARIS Inc.

High-Performance Tile Server

TMS ChartServer with tile map service technology allows display of S-57/S-63 maritime charts at top speed, works with OpenLayers or Leaflet and is available as a hosting service, with easy configuration of chart settings. SevenCs GmbH.

Camera Lens Port System

A new range of lenses to use with FA6500 and FA6000 housings for the Sony a6000, a6300 and a6500 mirrorless cameras includes a mounting converter, fisheye zoom ring adjustment gear and macro lens focus ring gear. Fantasea Line.

Asset Data Platform



BMT Deep can store, manage, integrate, post-process and visualize vast data sets quickly. It facilitates data exploration with multiple sensor time series and post-processed and statistical data from a single asset or a fleet throughout its operational history. BMT Group.

Heavy Payload ROV

The Mako ROV for large instrumentation carries up to 22.5 kg, flies at 2 kt., has eight thrusters and a modular accessory bay. The standard version measures 840 x 635 x 674 mm, weighs approximately 72 kg and is compatible with other SEAMOR ROVs. SEAMOR Marine Ltd.

Sub-Bottom Profiler

The GeoPulse Compact has digital processing and waveform selection from 2 to 18 kHz for specific pulse-shape, power signature and configuration options, integrating continuous wave and frequency modulated systems. It is available in a compact, over-the-side, mounted version and a towed version. Kongsberg GeoAcoustics Ltd.

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Electric ROV

The XLe Spirit has an optional electric or hydraulic five-function manipulator arm and a self-regulating power feature that compensates for tether losses to ensure constant, stable power delivery to the vehicle regardless of tether length. Additional sensors allow autopilot and pilot assist modes. Forum Energy Technologies Inc.

Subsea Positioning System



Canopus is the next generation of Ramses transceiver with underwater acoustic communication between transponders, transceivers and surface equipment. It embeds temperature, pressure and inclinometer sensors. iXblue.

GNSS Receiver

The Vector V1000 GNSS receiver provides heading, position, pitch, roll, and heave data and supports multifrequency GPS, GLONASS, BeiDou, Galileo, QZSS and IRNSS for simultaneous satellite tracking. It is powered by the Athena RTK engine and is Atlas L-band capable. Hemisphere GNSS.

Advanced AUV

The Iver Precision Workhorse AUV has an extended range of more than 40 nmi on a single charge, with point-and-click mission planning and extended-range Nortek DVL. It has EdgeTech 2205B conformal side scan plus bathymetry transducers. L3 OceanServer.

Micro UUV

The MK II μ UUV offers a nearly 70% reduction in hotel load power to 3.5 W with open-source software for updated mission planning, vehicle checkout and mission sortie execution tools. It has a 300-m depth

rating, speeds over 10 kt., and operates more than 40 hr. at 2 kt. without a payload on alkaline batteries. Riptide Autonomous Solutions LLC.

Water Quality Multiprobe

Aqua TROLL 500 is a wireless instrument ideal for both spot checks and long-term monitoring that streamlines data collection and records data directly to a mobile device. The HydroVu platform provides 24/7 online data access for long-term monitoring. In-Situ Inc.

Wi-Fi Interface and Router

Tidal Wave provides high-powered dual-band 3G/4G Wi-Fi and allows for concurrent listening across 2.4 GHz and 5.1 to 5.8 GHz Wi-Fi channels along with SIM activated cellular data. MBR-550 is a compact multisource router with a built-in access point. Wave WiFi Inc.

Swarming Unmanned Vehicles

SwarmDiver is a micro USV and UUV that operates in a swarm. Multiple SwarmDivers function simultaneously as a coordinated entity controlled via one operator on the surface and perform dives on command to collect intelligence. Aquabotix Technology Corp.

Sonar Base Systems

Oculus M series multibeam sonars have a small form factor, weighing less than 400 g in water. Dual-frequency capabilities make them ideally suited for micro-platforms. Blueprint Design Engineering Ltd.

'Ocean Passages' Update

A new edition of "ADMIRALTY Ocean Passages for the World" (NP136) has route diagrams alongside tabulated waypoint data. It has additions for hubs in the Black Sea and Persian Gulf and ports in Asia, Africa and South America. UK Hydrographic Office.

Swath Bathymetry

EdgeTech 6205s produces real-time 3D maps of the seafloor while providing integrated swath bathymetry and a dual-frequency side scan sonar system. Swath coverage is up to 200°. EdgeTech. **ST**



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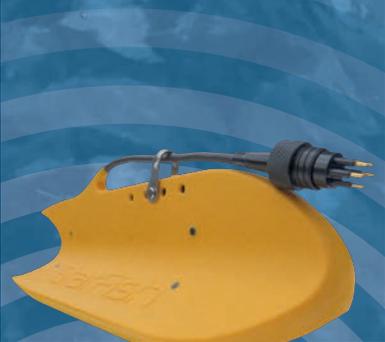
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Canadian FPSO Receives Digital Tool to Virtually Tour and Manage Its Vessel

UTECH has delivered a virtual asset management tool to an offshore operator in eastern Canada to allow its team to remotely access its floating, production, storage and offloading (FPSO) vessel. The field, located offshore approximately 350 km southeast of Newfoundland and Labrador, contains one of the largest FPSO vessels ever built: more than 290 m long, 40 m. wide and 18 stories high.

UTECH's iSite tool is a web-based system that provides the ability to tour the FPSO with 360° visualization and obtain accurate on-screen measurements, and it provides a central repository for drawings, 3D models, photos and reports for onshore and offshore teams.

Lloyd's Releases Underwater Noise Notation

Lloyd's Register released a new underwater noise notation and ShipRight procedure on underwater radiated noise to help shipowners minimize underwater noise emissions when operating in sensitive environments. The notation defines three criteria curves: transit, quiet and research, and includes a speed indication. For example, UWN-L(T20) would mean that a vessel meets the underwater noise criteria in transit (T) at a speed of 20 kt.

Ballast Treatment System Seeks Japanese Approval

Coldharbour Marine, a manufacturer of ballast water treatment systems based on inert gas technology, has engaged Japanese classification society ClassNK to assist in the process of obtaining Japanese type approval from the Ministry of Land, Infrastructure, Transport and Tourism. The type approval process, as required by Japan's Ship Safety Law and the Marine Pollution Prevention Law, will involve an independent assessment and verification of the technology and type approval of the product itself.

London's AgileTek Launches Data-Based Division

AgileTek has launched AgileDat, a new business division focused on using data to make decisions in the energy sector, noting that the shift toward operating in harsher and more remotely operated oil and gas fields also requires a move toward using modern, cloud-based enterprise applications. The new division is dedicated to software development, cloud architecture, data science, monitoring and the Internet of Things in the renewables and oil and gas sectors.

UK Ship Insurance Club Donates to Support Maritime Mass Rescue Ops

A donation from the UK P&I Club will provide support for the International Maritime Rescue Federation (IMRF) online resource library, which aggregates mass rescue operations (MRO) guidance material. The online library (www.imrfmro.org) is free and available to SAR professionals around the world. The donation will also support two scholarships for the IMRF MRO subject matter expert

course in September 2018, which offers a detailed study of MRO issues and skills for assessing organization's capability to respond to MRO events.

North Sea UXO Clearance Campaign Progresses

N-Sea is part-way through a multimillion-pound unexploded ordnance (UXO) clearance campaign for ScottishPower Renewables, including UXO inspection, identification and clearance on the array area and export cable route of the East Anglia ONE Offshore Windfarm. The Noordhoek Pathfinder, Neptunus, Siem N-Sea and Siem Barracuda ROVs have been utilized to unbury, inspect and identify items, and additional ROV and dive vessels will be brought in as the work progresses.

Broadband Processing and GMO Tomography Overcome Imaging Challenges Offshore Australia

ION announced a 3D multiclient broadband re-imaging program offshore Australia, covering the northern part of the Vulcan sub-basin in an area known for complex imaging challenges. The approximately 17,000-sq.-km program integrates and reimages data from 15 vintage surveys using modern depth imaging.

Rotterdam Invests in Dutch ESS

EST-Floattech is a Dutch company that develops energy storage systems (ESS) for fully electric and hybrid maritime applications, as well as mobile land-based applications. Its battery systems are based on the Li-NMC cell technology and have a high DNV GL type approval.

The company was founded in 2009. Participation from Rotterdam provides access to its port network and opens possibilities for the use of ESS in port cranes and trucks.

Middle East Trenching Project Complete

James Fisher Subsea Excavation (JFSE) has launched an integrated services package, Excavation Plus. The company also recently completed its largest integrated services project in the Middle East. Its Twin R2000 with ancillary jetting spread was contracted for shallow-water post-lay trenching and backfilling. JFSE is currently preparing for integrated projects in the Middle East, Eastern Asia and Gulf of Mexico and is planning to roll out the Excavation Plus service worldwide.

Hydraulic Thrusters Destined for French Subsea Trenching Vehicle

Curvetech engineers at Soil Machine Dynamics (SMD) have completed the build and test of a range of hydraulic thrusters for French subsea cable installation engineering firm Louis Dreyfus TravOcean. SMD's Curvetec HTE_500BA and HTE_430-63 thrusters are destined for use on a large subsea trenching vehicle designed and built by the Marseille-based company.

Damen Netherlands Companies Merge

Damen Marine Components and Van der Velden Marine Systems are now operating together as Damen Marine Components Netherlands (DMC NL) effective January 1, 2018. The Van der Velden Marine Systems brand will continue to be used for the new company's rudder

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Wärtsilä and Transas to Work Together To Advance Smart Shipping Solutions

Wärtsilä, a global technology group headquartered in Finland, has acquired Transas, a digital solutions provider headquartered in the U.K.

Through data integration, greater connectivity and cloud-based technology, Wärtsilä aims to resolve inefficiencies in the shipping sector resulting from overcapacity, suboptimal fuel consumption and waiting times at ports and other high-traffic areas. Transas is geared to accelerate the development of smart digital products, like Wärtsilä's Smart Marine Ecosystem, which connects smart vessels with smart ports.

Falcon ROV Added to Global Rental Fleet

Subsea Technology & Rentals Ltd. (STR) is adding an additional Saab Seaeye Falcon robotic vehicle to its global rental fleet of inspection-class vehicles, with planned investment for more Falcons in the near future. Falcon is an electric underwater robotic system with iCON intelligent control that offers precise station-keeping to allow the operator to concentrate on the task at hand, while the iCON system architecture allows easy role change and ready customization.

Awards to Honor Decommissioning Excellence

A membership organization for the oil and gas decommissioning sector, Decom North Sea, has launched the first industry awards dedicated to decommissioning excellence. The Decom North Sea Awards will recognize efforts of its members to innovate and collaborate within the sector, as well as an award for specific contribution to Decom North Sea. Winners will be announced at an awards ceremony and dinner in Aberdeen May 22.

Scottish Trenching Company Acquired

Oceaneering International Inc. acquired Ecosse Subsea Ltd., a provider of offshore engineering, seabed preparation, route clearance and trenching services, for approximately £50 million.

The transaction includes Ecosse's modular SCAR Seabed System, capable of completing the entire trenching work scope (route preparation, boulder clearance, trenching and backfill), and its newly developed SCARJet trenching system for jetting and post-lay trenching with standard work-class ROVs.

Rebranded Joint Venture Will Provide Operational Services in Australasia

A joint venture between Programmed Maintenance Services Ltd. and Netherlands-headquartered Atlas Professionals ANZ Holdings BV, Atlas Programmed Marine JV (JV) will now operate in Australasia under the name Atlas Professionals. JV currently provides services including manning, logistics support, agency, catering and other operational services, with offices in Australia and New Zealand. **ST**

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Shell Discovery in Gulf of Mexico

Shell Offshore Inc. announced one of its largest U.S. Gulf of Mexico exploration finds in the past decade from the Whale deepwater well. The well encountered more than 1,400 net ft. (427 m) of oil-bearing pay. Evaluation of the discovery is ongoing, and appraisal drilling is underway to further delineate the discovery and define development options.

Whale is operated by Shell (60 percent) and co-owned by Chevron U.S.A. Inc. (40 percent). It was discovered in the Alaminos Canyon Block 772.

This major discovery in a Shell heartland adds to the company's Paleogene exploration success in the Perdido area. Through exploration, Royal Dutch Shell has added more than 1 billion barrels of oil equivalent resources in the last decade in

the Gulf of Mexico. Shell currently has three Gulf of Mexico deepwater projects under construction, as well as investment options for additional subsea tiebacks and Vito, a potential new hub in the region.

TechnipFMC to Acquire Island Offshore Subsea

TechnipFMC has signed an agreement with the Island Offshore group to acquire a 51 percent stake in Island Offshore's wholly owned subsidiary, Island Offshore Subsea AS.

Island Offshore Subsea AS provides riserless light well intervention (RLWI) project management and engineering services for plug and abandonment (P&A), riserless coiled tubing and well completion operations. It employs approximately 80 staff.

In connection with the acquisition of the controlling interest, Tech-

nipFMC and Island Offshore will enter into a strategic cooperation agreement to deliver RLWI services on a worldwide basis, which will also include TechnipFMC's RLWI capabilities.

Island Offshore Subsea AS will be rebranded, and it will become the operating unit for TechnipFMC's RLWI activities taking place around the world.

Transocean Closes Songa Offshore Acquisition

Transocean Ltd. along with Transocean Inc. received all required regulatory approvals and has completed compulsory acquisition of all shares in Songa Offshore SE that were not already owned by Transocean.

Transocean pursued a delisting of the Songa Offshore shares from the Oslo Stock Exchange as soon as possible after the compulsory acquisition was complete.

Songa Offshore's shares remained listed on the Oslo Stock Exchange until March 28, 2018.

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Norwegian suppliers Framo, Maritime Partner, Norbit Aptomar and NorLense have come together to create the OSRV (Oil Spill Recovery Vessel) Group to offer a complete oil spill response solution.

The OSRV Group offers a package solution that covers everything from detection and containment to spill recovery, all conducted with

reliable equipment that can handle the challenges if an accident occurs. It operates with a delivery lead time of eight weeks for the full package.

Total Takes Over Maersk Oil

Total has closed acquisition of Maersk Oil, bringing to Total around 1 billion barrels of oil equivalent of 2P/2C reserves and resources, mainly in the Organisation for Econom-

ic Co-operation and Development (OECD) countries, and a production of about 160,000 barrels of oil equivalent per day (boe/d) in 2018, ramping up to more than 200,000 boe/d by the early 2020s.

The acquisition of Maersk Oil allows the group to reinforce its existing leading positions in the U.K. and in Norway, as well as to enter Denmark, making Total the second-largest operator in the North Sea with an output of 500,000 boe/d by 2020. The transaction also strengthens other growth areas of Total, particularly in Algeria and the U.S. Gulf of Mexico.

ABS to Class First Hybrid OSV in GOM

ABS was selected by SEACOR Marine to class the first offshore support vessel (OSV) in the Gulf of Mexico (GOM) to operate using hybrid power. SEACOR requested the BATTERY-Li notation for its *Maya* OSV currently operated by Mantenimiento Express Maritimo SAPI de CV (MEXMAR), SEACOR Marine's joint venture in Mexico. The OSV is being upgraded to use lithium battery power, with modifications expected to be complete in May 2018.

The hybrid power solution has the potential to reduce fuel consumption by as much as 20 percent.

Merger Enhances Offshore Install Delivery

Fara Holdco Ltd., owners of the Bibby Offshore group of companies, announced a merger with Rever Offshore AS.

Rever's subsidiaries include CECON Contracting AS, an international subsea and offshore contractor, as well as two vessel companies that own both the *Cecon Excellence* and *Cecon Sovereign*.

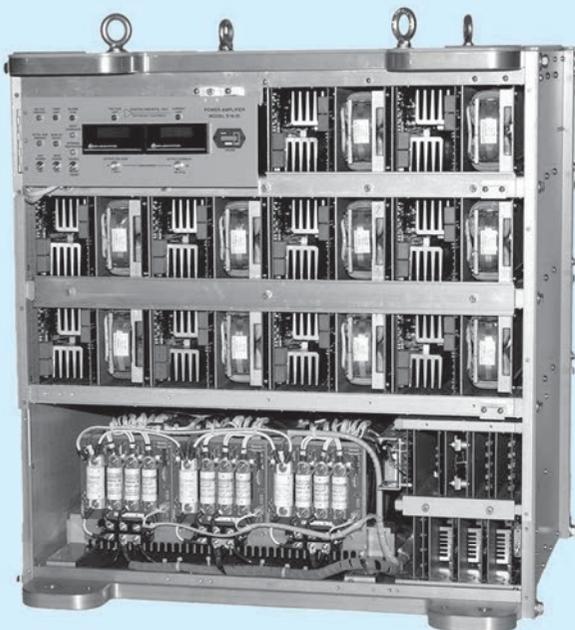
The combination of Bibby and CECON Contracting AS is set to create a larger and more robust offshore installation delivery business both in the North Sea and internationally.

The combined company will continue to evaluate growth opportunities in its core diving and subsea umbilicals, risers and flowlines (SURF) markets. **ST**

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First Commercial AIS Payload On Radar Sat

exactEarth Ltd. announced the successful launch of an advanced AIS payload, exactView-8 (EV-8), aboard the Spanish radar satellite Paz. The satellite was launched from the Vandenberg Air Base in California using the SpaceX Falcon 9 rocket and is owned and operated by Hisdesat Servicios Estrategicos S.A. The hosted AIS payload is owned by exactEarth and is expected to be commissioned in the coming months.

The EV-8 payload is part of exactEarth's first-generation constellation and is the first commercial AIS payload that has been launched on a radar satellite.

The Paz satellite was launched into the dawn-dusk sun synchronous orbit that is occupied by most of the world's radar satellites and will be uniquely positioned to provide high-quality AIS vessel data fully time synchronous with the Paz radar and near synchronous with synthetic aperture radar (SAR) imagery from other radar satellites.

The fusion of these two data sets for enhanced vessel identification is expected to be an important element of future maritime surveillance capabilities as authorities can now rapidly correlate two data sources to identify nonreporting or noncooperative vessels.

Globecomm Network Joins Amazon Web Services

Globecomm has joined the Amazon Web Services (AWS) Partner Network (APN) as a Standard Technology Partner. This agreement will enable Globecomm to seamlessly interoperate its global satellite and fiber network with AWS's storage, compute and cloud content delivery services.

With multiple direct connections to AWS, Globecomm can provision customer content, work processes and resilient network connectivity into AWS. Customers already using AWS to support their processes

can benefit from seamless access to Globecomm's teleports, satellite capacity, fiber points of presence and cloud software applications running on AWS.

Globecomm is expanding its existing global points-of-presence with AWS within the North America, Central Europe and Southeast Asia regions.

The company anticipates deploying hybrid cloud-satellite-fiber solutions for customers in media and entertainment, enterprise video and IoT.

These hybrid solutions will reach beyond the edges of the network to remote facilities, ships, offshore platforms and vehicles in motion around the world.

IoT Pushes Forward In Marine Space

Danelec Marine has teamed up with NAPA to deliver a complete cloud-based Internet of Things (IoT) solution for ship performance analysis and optimization.

The new shipping IoT package combines Danelec's efficient, low-cost shipboard data collection and data transfer platform with NAPA's advanced analytics and optimization tools.

The integration with DanelecConnect allows NAPA to offer its shipping customers a comprehensive turnkey IoT package encompassing numerous elements from onboard data collection to actionable ship and fleet performance analysis. The DanelecConnect platform makes it easy for NAPA to capture data from shipboard sensors to use in cloud-based applications, thanks to the inclusion of an application programming interface (API) tool.

A recent Gartner report predicts that 5.5 million new IoT devices will come online every day in 2018, with more than 20.8 billion connected items by 2020.

While other industry sectors around the world are embracing IoT solutions as a central part of their business, the maritime mar-

ket has lagged behind. By bringing together the shipboard and shore-side components in a cost-effective integrated cloud-based package, the shipping industry can now become part of the IoT revolution with far-reaching benefits across all aspects of ships, shipping and the logistics value chain.

The first joint NAPA/Danelec Marine IoT solution has undergone successful sea trials on a vessel, with further installations scheduled in 2018.

Asset Owners Need Better Digital Strategies

Shipping should prepare for a future where total emphasis will be on the efficient and digitized movement of goods along the supply chain, rather than on the individual components of the chain such as the ships themselves, according to Morten Lind-Olsen, Norwegian entrepreneur and CEO of Dualog.

He said that the drivers for greater innovation and efficiencies are now the asset owners because they know that which ever among them has the better digital strategy will be the one to succeed because companies such as Amazon will demand that the perception of logistics from their point of view is fully understood.

"This means that the value will be derived from the goods themselves benefiting from the whole supply chain being digitized," Lind-Olsen explained.

"People talk about digitization and the exciting opportunities it poses for shipping, but the real challenge so far has been to have enough IT connectivity between ship and shore. Now shipping has made this 'big leap' towards more stable and improved IT connectivity, the ships are able to react more in the same way its terrestrial counterparts have reacted over recent years," he said.

This raises the question as to whether large IT and logistics powerhouses like Amazon will start to become shipowners. "I wouldn't be surprised if Amazon owns a shipping company soon, if they don't already," Lind-Olsen said. **ST**

Equipment for New Zealand Navy Training

Boat-handling technology from Vestdavit is playing a central role in The Royal New Zealand Navy's drive to operate realistic working environments (RWE) at its new Devonport Naval Base training facility, Auckland. RWE uses "like for like" equipment installed on board Navy ships, working within a controlled training environment.

The new center includes a purpose-built, land-side facility housing a replica inshore patrol vessel, plus an innovative Seamanship Training Aids Facility Pontoon (STA). The STA is kitted out with a range of equipment designed to allow new trainees to develop their seamanship skills in boat handling, rope work, anchoring, berthing and towing through repetition.

ONR Awards for 2018 Young Investigator Program

The Office of Naval Research (ONR) announced awards of \$16 million through its 2018 Young Investigator Program (YIP). The awards were made to 31 scientists whose research holds strong promise across a wide range of naval-relevant science and technology areas. Typical grants are \$510,000 over a three-year period. The YIP is a highly competitive process, rewarding the achievements

made by young faculty members. This year's candidates were selected among more than 340 highly qualified applicants based on past performance, technical merit, potential for scientific breakthrough and long-term university commitment. All are college and university faculty who have obtained tenure-track positions within the past five years.

Mooring Buoys for US Arctic Study

DeepWater Buoyancy's StableMoor mooring buoys have been chosen to support the Stratified Ocean Dynamics of the Arctic (SODA) initiative headed by the U.S. Office of Naval Research. The buoys were custom-designed and built to specifications provided by the University of Washington Applied Physics Lab and the University of New Hampshire. These buoys will support instrumentation that will map the underside of sea ice in support of the research project.

GE Propulsion for Chilean Navy Antarctic Vessel

GE's Marine Solutions was chosen by ASMAR Shipyards to provide the complete scope of an integrated marine propulsion system for the Chilean Navy's new Antarctic icebreaking polar-class vessel. It will replace the retired icebreaker to continue the Navy's Antarctic expedition for search and rescue missions, scientific research, logistic support and resupplying bases in the Chilean Antarctic Territory.

The 110-m-long vessel will have GE's full marine propulsion system to power and propel the vessel, including diesel electric propulsion, GE's International Maritime Organization's (IMO) Tier 3-compliant diesel engine, a complete propulsion shaft line and propeller, a tunnel thruster, SeaLyte Dynamic Positioning (DP) and vessel automation system.

The vessel has received Lloyd's Register PC 5 polar-class notation, reflecting the strong icebreaking capability of the vessel. With an installed power of 14.5 MW, it will be capable of breaking 1 m of ice at 3 kt.

Naval Group Acquisition Plan For Future French Frigates

Naval Group has started to select the first equipment suppliers for the five future intermediate-size frigates (FTI) intended for the French Ministry of Defence. The first of these frigates will be delivered to the French Navy in 2023. Naval Group has chosen the suppliers: Axima for heating, ventilation and air conditioning (HVAC) systems; CNIM for sonar hatches and torpedo hatches; iX-blue for navigation units and their computers; Leonardo for 76-mm medium-caliber artillery systems; MBDA for integration and services relating to missile-firing installations; MTU for large diesel engines; Safran Electronics & Defense for the optronic identification system incorporating the very long range of the PASEO XLR (eXtra Long Range) sight; and Thales for the sonar suite, electronic warfare suite, IFF (identification, friend or foe) and the communications system. **ST**

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contracts

ABB, Billingstad, Norway, will provide power, automation, propulsion and digital solutions for a polar exploration cruise vessel to navigate through sea ice. The vessel, to be delivered in 2020, must meet Arctic and Antarctic operating regulations. Lindblad Expeditions Holdings Inc.

MacArtney, Esbjerg, Denmark, is changing the name of its German operation to MacArtney Germany GmbH. Once a joint venture of the MacArtney Group, the German operating sales and consultancy offices for marine and underwater technology are based in Kiel and Bremen. MBT GmbH.

Unique Group, Sharjah, United Arab Emirates, received two 110VAC HydroPACT 660 small form-factor pipe and cable tracking systems, with pulse induction technology and operation depths to 3,000 m. Teledyne Marine.

Soil Machine Dynamics, Newcastle upon Tyne, England, announced the successful delivery of two 1,000-m Atom Mk1 work-class ROV systems that are optimized for submarine rescue operations: each carries three emergency life support pods. JFD Ltd.

Kongsberg, Kongsberg, Norway, signed a cooperation agreement for technology development within defense, maritime industry and digitalization in Qatar for approximately 15 billion NOK over eight years, the largest in the company's history. BK Systems.

AXYS Technologies, Sidney, Canada, signed an eight-year framework agreement for supply of TRIAXYS directional wave buoys, which use satellite telemetry, to build a wave measurement network along the coast of France. Météo-France.

Enpro Subsea, Aberdeen, Scotland, will see its flow intervention services and flow access modules technolo-

gies deployed from an international subsea fleet of construction and intervention vessels through an agreement pursuing targets in the Atlantic region. DOF Subsea.

Saab Seaeye, Fareham, England, received an order from a leading company for the first in a planned fleet of its Sabertooth underwater electric robotic vehicles that can operate in both fully autonomous (AUV) and tethered (ROV) modes. Undisclosed.

ASV Global, Portchester, England, won a contract for the provision of a C-Worker 5 18-ft. USV to be used for testing, training and establishing procedures and protocols for use of the system by NOAA on future hydrographic programs. University of Southern Mississippi.

Deep Sea Mooring, Straume, Norway, and Vryhof Anchors, Capelle a/d Yssel, Netherlands, have secured a contract to provide full-scale mooring and anchoring services to an Australian energy company. The contract is a first for Vryhof offshore Victoria, Australia. Cooper Energy. **ST**

meetings

JUNE

June 4—BlueTech Expo, Washington, D.C. 202-389-9009, rich.lawson@iostia.org or www.bluetechexpo.org.

June 5-7—Capitol Hill Ocean Week, Washington, D.C. 301-608-3040, info@marinesanctuary.org or https://capitolhilloceanweek.org.

June 11-13—Global Offshore Brazil Summit, Rio de Janeiro, Brazil. 281-491-5900, Exhibits@questoffshore.com or www.globaloffshore-brazil.com.

June 12-14—International Conference on Ocean Energy, Cherbourg, France. +331 85 09 68 53, s.pe-seux@bluesign.events or http://icoe2018normandy.eu.

June 12-14—Klein Marine Systems Sonar Training, Rye Beach, New Hampshire. 603-893-6131 ext. 272 or Sales@KleinMarineSystems.com.

June 17-22—International Conference on Ocean, Offshore and Arctic Engineering, Madrid, Spain. 778-338-4142, omae@seatosky meetings.com or www.omae2018.com.

June 18-20—ASNE Technology, Systems & Ships, Washington, D.C. 703-836-6727, asnehq@navalengineers.org or www.navalengineers.org/Symposia/TSS2018.

June 19-21—CLEAN PACIFIC, Portland, Oregon. 713-343-1891, cda vie@accessintel.com or http://2018.cleanpacific.org.

June 26-28—UDT, Glasgow, Scotland. team@udt-global.com or www.udt-global.com.

JULY

July 3-5—Seawork International, Southampton, England. +44 1329 825335, info@seawork.com or www.seawork.com.

July 5-6—Oil Spill India, New Delhi, India. +91 11 43013474, ravi@iten media.in or www.oilspillindia.org.

July 17-19—Multi-Agency Craft Conference, Baltimore, Maryland. 703-836-6727, meetings@navalengineers.org or www.macc2018.org.

SEPTEMBER

September 4-6—ENGenious, Aberdeen, Scotland. +44 (0)20 8271 2124, chris.brand@bigpartnership.co.uk or www.engenious global.com.

September 4-7—SMM, Hamburg, Germany. +49 40 3569 2445, nora.ebbinghaus@hamburg-messe.de or www.smm-hamburg.com.

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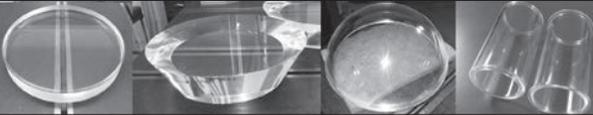
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Brian La Shier leads the Environmental and Energy Study Institute's (EESI) Energy and Climate Program, which focuses on renewable energy development and climate mitigation and adaptation. He has previously worked at the Department of Energy, the Office of Management and Budget, and the Virginia State Senate. He holds an M.S. in environmental policy from the University of Michigan.



In its 2010 Quadrennial Defense Review, the U.S. Department of Defense (DOD) officially recognized climate change as a factor worthy of consideration in future national security planning: “Climate change and energy are two key issues that will play a significant role in shaping the future security environment...climate change, energy security, and economic stability are inextricably linked.” The report describes the vast geopolitical impacts of climate change anticipated by the intelligence community, including sea level rise, increasing temperatures, food and water scarcity, the proliferation of disease vectors, and the risk of mass migration by vulnerable populations. These risks led DOD to declare that “while climate change alone does not cause conflict, it may act as an accelerant of instability or conflict, placing a burden to respond on civilian institutions and militaries around the world.” DOD leaders recognized that the U.S.’s existing role in responding to extreme weather events, delivering humanitarian assistance and preserving national security would be made all the more difficult by climate change. Despite the urgent need to deal with these risks and a military highly motivated to adapt, the Trump Administration has chosen to retreat from this issue. By failing to recognize climate change as a global threat in

its latest National Security Strategy, the White House has again contradicted the advice of military leaders. Instead, the administration has sought to aggressively dismantle the nation’s climate mitigation policies, slash funding for humanitarian aid and eliminate Earth observation programs that provide essential data to national security agencies.

Undeterred, DOD has continued to better integrate climate risk across its operations and long-term planning and has pursued climate mitigation and adaptation measures in accordance with a broad set of (pre-Trump) Executive Branch initiatives designed to move the entire U.S. government toward a lower carbon footprint, more efficient resource consumption and improved resilience against extreme weather events. The institutionalization of these measures has transformed how DOD does business and has resulted in a more sustainable and agile military. Responsibilities for the development and implementation of these measures have been distributed across the Pentagon. In addition, each of the five service branches has established its own clean energy goals to be achieved through physical infrastructure upgrades, as well as training to adjust behaviors and risk perception among its personnel.

The Navy, at the forefront of climate change awareness, integrated climate considerations into its strategic planning years before DOD-wide policies were enacted. The Navy established Task Force Climate Change (TFCC) in 2009 in response to changing conditions in the Arctic and other regions due to climate change. TFCC would go on to publish the Navy’s 2009 Arctic Roadmap, which served as the key operating guide for the Far North until publication of a DOD-wide Arctic Roadmap in 2014. TFCC also published a broader Climate Change Roadmap in 2010, two

years before the first DOD-wide edition was released, which called for improved climatic prediction capabilities and the integration of climate impacts into training exercises and strategic guidance documents. The Marine Corps and Coast Guard are also actively working to address the operational challenges of climate change. The Coast Guard has published an Arctic Strategy and concentrated most of its efforts on increasing its operational capacity there. The Marine Corps has focused on energy efficiency and supply chain vulnerabilities.

Extreme weather events are projected to increase in severity and frequency over the next several decades and will place a greater burden on DOD units, personnel and assets tasked with responding to such events and delivering humanitarian and disaster relief, both in the U.S. and abroad. Climate change consequences will likely heighten the risk DOD infrastructure already faces from severe weather events. Sea level rise and extreme weather could also be disruptive to training operations that rely on reliable access to land, air and sea-based training facilities. DOD retains one of the largest real estate portfolios in the U.S. government, encompassing 562,000 buildings and structures distributed across 4,800 sites worldwide. Extreme weather events could hinder acquisition and supply chain operations that maintain these facilities, potentially influencing the types of equipment DOD acquires and the ways that goods are transported, distributed and stored.

The U.S. military will have to face the fallout of these impacts, with its operations in vulnerable, potentially volatile places. DOD’s ability to meet mission objectives will be strained globally. To succeed long term, DOD must continue to adapt operations, strategies and physical infrastructure to a world shaped by climate change. **ST**

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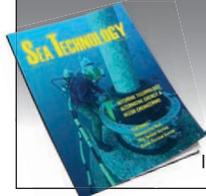
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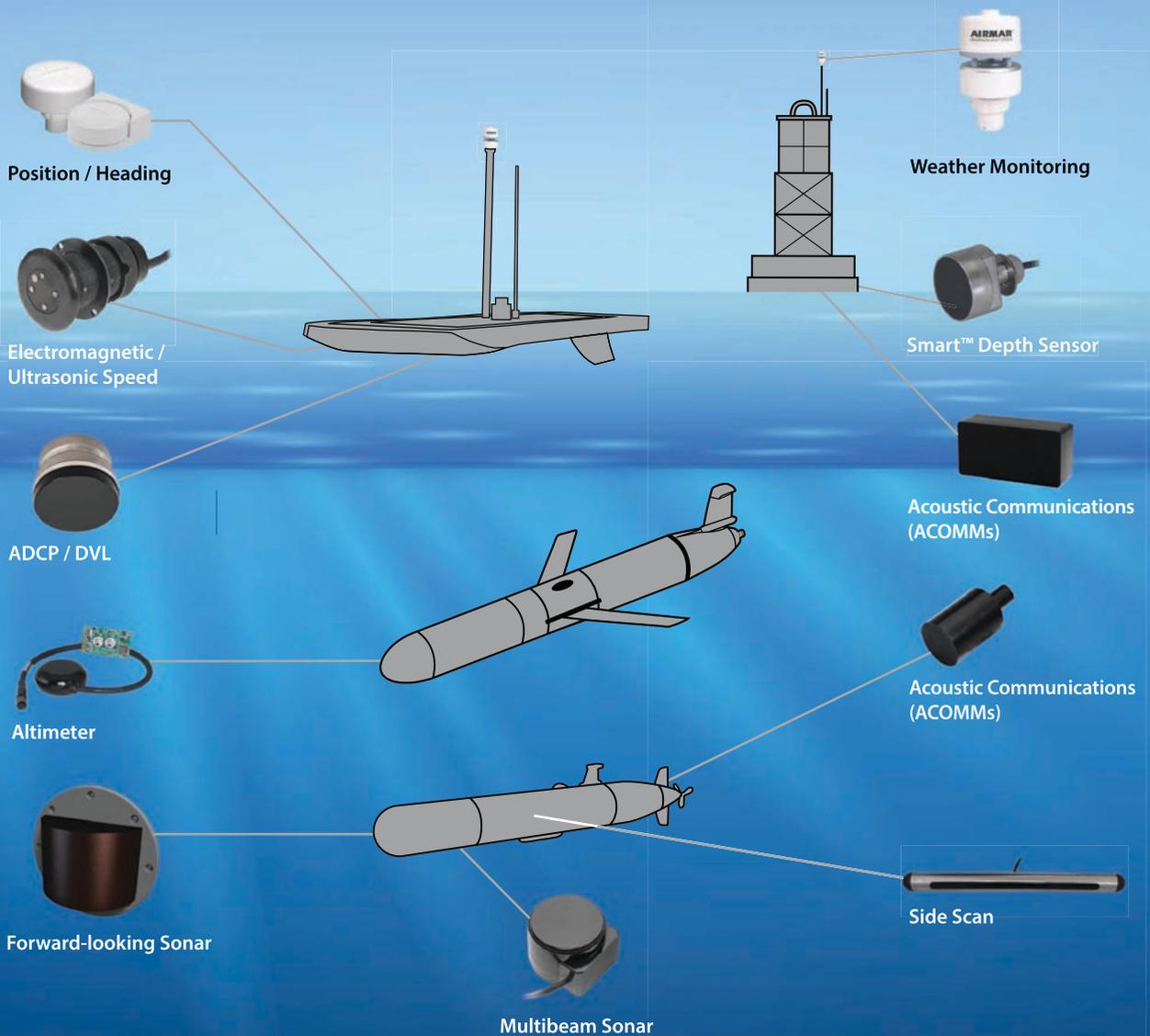
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