# Subsea communications

In a world where two thirds of the surface is taken up by water, the ability to monitor the seas is a vital part of defence forces everyday operations. Working in harmony, aerial, land and subsea vehicles must be able to provide complementary capabilities. While providing communications in the air or on land is now fairly well-covered by satellite services, subsea communications options are still in their infancy. There's a long way to go, and innovators are pushing forwards with increasingly complex solutions.

**The ability to communicate effectively and efficiently** at sea is paramount for oil and gas, scientific research, maritime, fishing, government and defence forces. However, subsea communications systems are much more complex than their above-water analogues, since water and unknown obstacles distort wireless transmissions, reducing their effectiveness. Fibre-optic, ocean-bottom cable systems are one widely-adopted option, however, they take a long time to install and are more expensive than wireless options, in addition to having their own technical limitations including noise interference and higher power consumption.

Today's subsea wireless communications options include:

- Radio frequency (RF);
- Acoustic;
- Free space optical (FSO); and
- Hybrid (iterations of the above three).

Each solution has its own strengths and limitations, including effective range, bandwidth, data rate, immunity from noise, interference or turbidity, and power requirements. Given the limited options available and the challenges and limitations of each, more effective solutions are still being developed today.

## Unmanned underwater vehicles (UUVs)

Unmanned underwater vehicles (UUVs) have been utilised by the military for some time and are becoming increasingly popular in the commercial and scientific subsea exploration fields. They hold a number of key advantages over manned subsea vehicles, including reduced risk to staff, reduced personnel costs, and providing access to new territories.

UUVs fall into two categories:

- Remotely operated underwater vehicles (ROVs): Controlled by a remote human operator; and
- Autonomous underwater vehicles (AUVs): Operate independently of direct human input.

Both ROVs and AUVs can be used for search and reconnaissance, to inspect underwater infrastructure, take water samples, assist with oil and gas exploration, create bathymetric maps of the ocean floor, and map marine life. The development of AUVs, which have been put to excellent use for detecting and terminating subsea mines, is a heavy focus within the military, while commercial companies and scientific institutions are more interested in ROVs.

Whatever their application, all UUVs must be able to relay data to and from a manned headquarter for decision-making. Some underwater vehicles come close to the surface of the ocean, where they deploy long antennas capable of data relay over satellite, however, this is a relatively slow solution. While the unmanned aerial vehicle (UAV) market is booming right now for both military and commercial applications, the lack of effective communications systems is putting a dampener on the UUV market. This is a significant problem, as UUVs capable of

*Ocean Aero Submaran. Photo courtesy of Ocean Aero*

# If this is **your office...**

## these are **your HPAs.**

**Superlinear® TWTAs**
LEFT: 2.5 kW X-band
CENTER: 750 W Ku-band TWTA

**Solid State BUCs**
RIGHT: 160 W peak Ka-band GaN BUC

### HPAS FOR MILITARY APPLICATIONS

- Up to 700 W Ka-band TWTAs
- SuperLinear® TWTAs in Ku- and Ka-band, delivering 25 to 540 watts of linear power
- C- and Ku-band HPAs for troposcatter applications
- 400 to 750 W C-, X-, and Ku-band indoor and outdoor TWTAs
- 2500 W SuperLinear® and CW X-band TWTAs
- X-, Ka- and Ku-band GaN BUCs

### Warfighters shouldn't have to fight against their equipment.

That's why CPI amplifiers feature better efficiency and unmatched reliability even in the harshest of climates, keeping you connected anywhere at any time.

CPI offers:

- Better efficiency
- High reliability
- Rugged designs
- TWT, solid state and klystron technology
- Linearizer, BUC, and integral switch control options
- More than 20 service centers worldwide
- 24/7 technical support

For more information, please visit **www.cpii.com/satcom**, contact your local sales representative, or call us at **+1 (650) 846-3803.**

**Download our new app!**
**Search: CPI Satcom**

Download on the App Store

GET IT ON Google Play

Communications & Power Industries

satcom products

seamless communications with manned and unmanned subsea, surface and aerial vessels could provide a key strategic advantage for military operations.

## A growing market

The latest research from IndustryARC, *'Unmanned Underwater Vehicles (UUV) Market: By Type (AUV, ROV, Hybrid), By Applications (Defense, Scientific and Academic Research, Commercial Exploration, Retrieval System), By ROV Class (Work, Observation) – With Forecast (2018 – 2023),'* states that the UUV market is showing sustained growth.

The Americas hold the largest market share and is expected to grow at a CAGR of 10.96 percent to US$1.8 billion by 2023. South America is leading the scoreboard in growth, with an expected CAGR of 14.99 percent to reach US$917.44 million by 2023, with key applications including defence and government, as well as academic and scientific research. Notably, global oil and gas operations account for almost 50 percent of ROV sales. Factors including higher oil demand, increased offshore drilling, and technological advances improving capabilities are all helping boost ROV sales volumes.

Going forwards, the AUV market is expected to grow at a CAGR of 21.85 percent to US$668.08 million by 2020, while the ROV market is expected to grow at a CAGR of 7.87 percent to US$198.89 million by 2020.

## Riptide launches new deep water UUV

Riptide Autonomous Solutions is an expert in the field of subsea UUVs, providing highly flexible, open source AUVs that deliver a state-of-the-art, low cost development solution well-suited for developers of autonomy and behaviours, power systems, subsea sensors and new payloads.

Back in April 2018, Riptide introduced a new variant of its UUV product line, a deep rated version to support acoustic telemetry research programs. The deep UUV is rated for 1,500m depth, but still only 7.5 inches in diameter. Its payloads include CTD, acoustic modem and a custom towed acoustic receiver array. With industry-leading low power hotel load, this system can still deliver more 48 hours of endurance for field testing.

"The purpose of the current vehicle is to demonstrate long range, medium data rate acoustic underwater communications for a mission critical project. To accomplish this, we needed to operate for long periods in the deep sound channel," said Dan Lawrence, Field Operations at Riptide. These waters, around 1000m deep, are typically out of reach of compact UUVs.


*Revolutionary new subsea robot, Aquanaut. Photo courtesy of Houston Mechatronics*

Riptide's open source software and flexible mechanical design enabled the rapid development of this custom UUV and ensured the research program could be executed as planned.

Like all of Riptide's UUVs, the new variant features open hardware and software interfaces to provide users a reliable and robust platform to advance technology development. The vehicle design is optimized for high efficiency with the best hydrodynamic signature in its class. Riptide's new UUV features three individually actuated control fins providing active roll stabilization. An active GPS antenna, WiFi communications, and vehicle status LED's are integrated into the vertical control fin, reducing the vehicle's hydrodynamic signature for maximum efficiency. Open system design provides for easy, user modification and customization, making this an ideal platform for a wide variety of development needs. Multiple energy source options allow maximum flexibility for endurance, safety, shipping, and mission optimization. The Aluminum-Seawater Battery from Open Water Power provides unparalleled energy density (endurance) and safety.

## Houston Mechanics introduces Aquanaut

Houston Mechatronics is a USA-based start-up company that creates UUVs and software packages for the defence, oil and gas, renewable energy and mining industries. In May 2018, Houston Mechatronics launched a revolutionary new subsea robot, Aquanaut. The multipurpose subsea robot which employs a patented shape-shifting transformation from an AUV to a ROV, removing the need for vessels and tethers. The vehicle enables both the efficient collection of data over long distances as well as manipulation of subsea objects at a significantly lower cost than today's technology. The UUV communicates acoustically through the water.

"We firmly believe that this technology is a revolution in subsea robotics. Aquanaut, and our tightly coupled over-the-horizon software Commander, enables Houston Mechatronics to deliver more feature rich, safer subsea services to commercial and defense customers that demand it," said Houston Mechatronics CEO Matthew Ondler. "Our team developed some of the most advanced robots that NASA ever produced and has been developing advanced subsea robotics technology for confidential customers for years. Aquanaut represents the pinnacle of our company's expertise and experience and we are beyond excited to introduce this vehicle to customers."

Aquanaut was designed to operate over-the-horizon with onshore operator supervision. Houston Mechatronics has removed the need for onsite vessels (and people) from subsea work while still maintaining the operator's situational awareness and the ability to modify missions. For the warfighter, this means increasing the standoff distance therefore resulting in safer conditions, while for commercial customers, enhanced capabilities can be provided for a lower cost.

We can expect to see a lot more from Houston Mechatronics going forwards. In May 2018, Houston Mechatronics announced a US$20 million Series B investment from Transocean and Schlumberger. According to Houston Mechatronics President Matt Ondler, the funding will be directed towards the commercialization of Aquanaut. Beyond Aquanaut, Houston Mechatronics will continue to develop novel subsea capabilities and other robot technologies.

## Ocean Aero Submaran faces rigorous testing

USA-based start-up, Ocean Aero, is another company that's recently become involved in the design and manufacture of UUVs. The company's flagship product, the Submaran, is a hybrid platform powered by solar and wind energy, integrating the capabilities of a surface vessel and submarine in order to travel on the water's surface and submerge beneath it. The Submaran delivers autonomy, self-sufficiency and survivability for a wide range of government and defence applications.

The UUV can gather a wide range of data, including

environmental monitoring and sampling, remote area monitoring, oceanographic data gathering and hydrography. Its applications include coastal enforcement, defence, surveillance, asset monitoring, and environmental monitoring. Available in small 4m and larger 12m versions, the Submaran is a game-changer for defence forces.

In March 2018, the Ocean Aero Submaran completed a rigorous, 11-day endurance test along the coast of California. The Submaran autonomously navigated its way from the renowned Monterery Bay to west of the Channel Islands near Long Beach.

"The Submaran succeeded across multiple tests, ranging from solar-power efficiency to communications to structural integrity to software operations." said Eric Patten, CEO of Ocean Aero. "We learned a lot and confirmed that our technology continues to perform at peak levels as we improve our production capabilities."

During the test, the Submaran encountered a wide range of ocean conditions, from near calm wind and seas to Sea State 6, which featured winds in excess of 35 knots and wave heights more than 15 feet. The Submaran's sailing speed ranged from one to more than five knots during the deployment. Other operation milestones included:

- Operated (on the surface) in Sea State 6 with 15-foot waves and more than 30 knots of wind around the infamous Point Conception.
- Demonstrated the ability to efficiently transform to a low-profile state in Sea State 6 and quickly return to sailing state when seas abated.
- Saw very little to no biological growth on hull.
- Tested and evaluated electrical loads and demonstrated the ability to reduce loads ('hibernate') to manage energy levels and fully recover with solar energy.
- Tested the ability to operate both autonomously (most of the journey) and remotely – Conducted mission changes and controlled and monitored the Submaran with several (dispersed) operators in both California and Australia.
- Used the AIS system to identify nearby ships and allow operators to monitor navigation through one of the busiest shipping routes in the United States.
- Monitored the vehicle with the backup tracker.
- Validated ease of recovery in open-ocean conditions with safe, efficient, single-point lift from water to on-deck of research vessel in less than less than 10 minutes.

Towards the end of September 2017, Lockheed Martin announced its belief in the Submaran UUV with a strategic investment in Ocean Aero, making it Ocean Aero's second significant investor after Teledyne Technologies invested back in 2014. "Ocean Aero represents the next generation of environmentally powered, autonomous ocean systems," said Chris Moran, executive director and general manager of Lockheed Martin Ventures. "Our investment will allow us to better respond to customers' maritime needs with technology solutions for a diverse set of missions." **GMC**

*Photo courtesy of Houston Mechatronics*