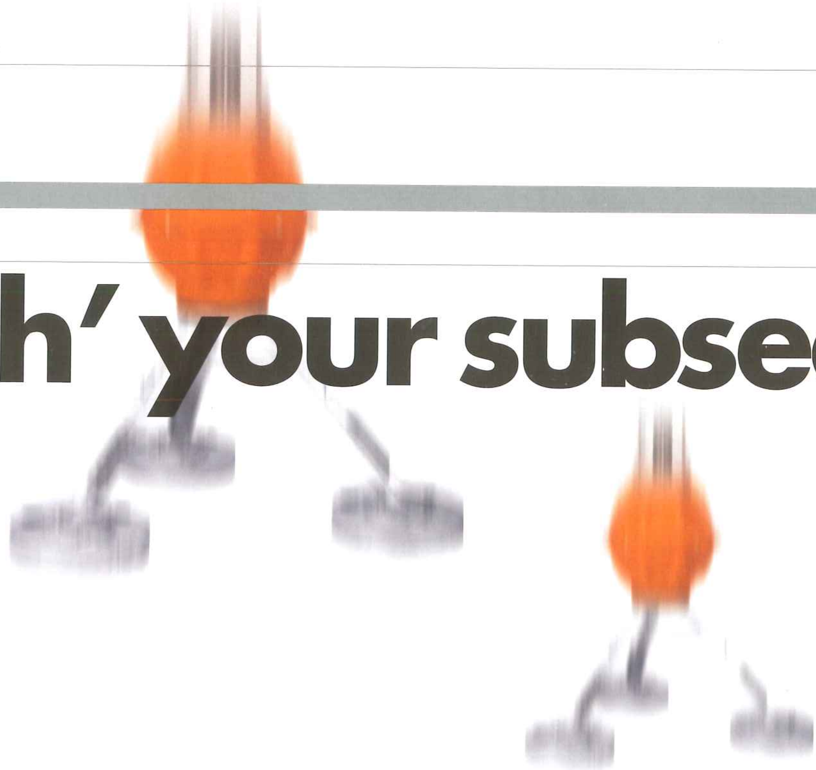
Technology

Autonomous data acquisition

Wireless autonomy: Go

Shaun Dunn, Engineering Business Development Manager specialises in acoustic modem technology.

'Fetch' your subsea data



The world's appetite for personal electronics and mobile devices has driven the development of ever smaller, lower power and higher speed digital signal processors (DSPs). Modern DSPs have been fully embraced by subsea instrumentation manufacturers due to their outstanding energy efficiency and have rapidly become a key enabling technology in the offshore energy and oceanographic sectors writes **Shaun Dunn**, Engineering Business Development Manager at Sonardyne.

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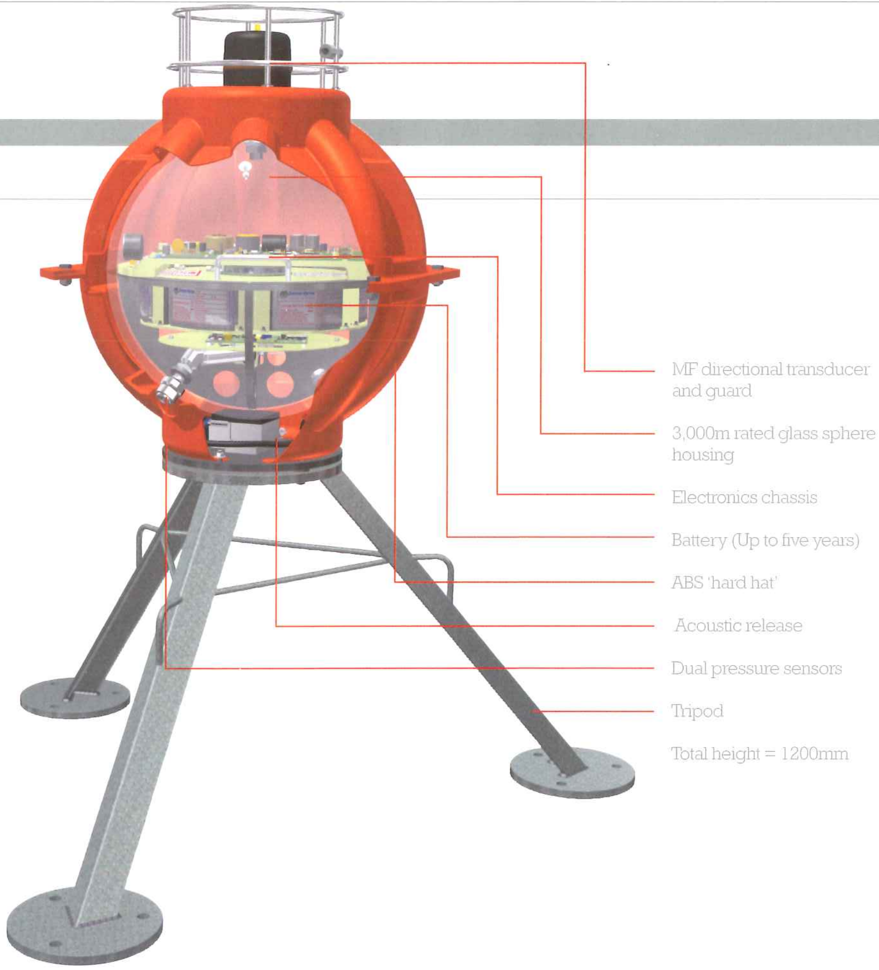

UNTIL VERY RECENTLY, subsea sensor systems relied exclusively on marine cables to provide communications and power to each instrument. Despite the fact that subsea cables are notoriously expensive to install and highly vulnerable to damage, there was no viable wireless alternative that could be relied upon to deliver error-free data to the surface in a timely manner.

Today, the story is very different. Innovations such as Sonardyne's 6G technology (page 12) mean that wireless subsea instruments are rapidly becoming mainstream items due to their versatility and cost effectiveness for sensor data acquisition and long term monitoring roles. They offer high precision, accuracy and long term repeatability; important considerations as many physical phenomena in the subsea world are tiny in magnitude, slow to change and require a good deal of patience from those who require access to the data.

The fundamental component of these systems is the seabed deployed acoustic transponder. A unit such as Compatt 6 is a small, highly reliable and extremely low power instrument capable of precisely measuring ranges to neighbouring units, acquiring and logging a variety of sensor data and then transmitting it on command to the surface.

The DSP in each transponder is tightly coupled to all electronic sub-systems. It deals with every aspect of the instrument's operation from controlling efficient usage of battery power, interfacing with internal and external sensors and perhaps most importantly, supporting integrated wireless communications without requiring a separate external acoustic modem to provide this vital function

Versatile and cost effective

It is this tight integration between power management, sensors, acoustic systems and instrument mechanics that makes Sonardyne's latest 6G transponders extremely versatile, reliable and energy efficient.

From an acoustics perspective however, the subsea environment is fickle, with problems such as high levels of ambient noise, acoustic refraction due to non-constant sound velocities and hard surfaces causing acoustic reflections

(Above) Fetch is packaged in a spherical pressure housing made from highly pressure tolerant and corrosion-proof glass. It has sufficient battery endurance for deployments of up to five years. (Below) Recent science cruises provided NOC scientists with their first opportunity to carry out tests on Fetch.

(multipath propagation). So our acoustic specialists have focused their attention towards determining the best signalling schemes, frequencies and transducer configurations to suit robust communications in a very wide variety of acoustic environments.

Sonardyne Wideband 2

Our latest generation of Wideband communications schemes support data rates as high as 10,000 bits per second for use when the environment is relatively benign, reducing in discrete intervals to 100 bits per second for the most complex of acoustic conditions. This flexibility ensures communication is achieved at the highest rate possible for any given environment whilst still maintaining error-free data transmission.

Autonomous Monitoring

We have developed our core transponder technology to provide a number of new wireless instruments that can function for many years without user intervention and are designed to meet our clients' specific subsea measurement needs.

The Autonomous Monitoring Transponder (AMT) operates as a network making hundreds of thousands of measurements from a variety of sensors, it logs data securely and, on command, transmits it wirelessly to the surface error-free and in an energy efficient manner.

The AMT's unique autonomous operating mode enables it to 'wake up' at pre-programmed intervals and acoustically interrogate neighbouring AMTs and precisely measure the distances (ranges) to them. These ranges, along with precise pressure (depth), temperature, inclination and sound velocity are stored to the AMT's internal memory ready for acoustic extraction by a passing surface vessel. The resulting data can be used to detect any deformation of the seafloor or subsea structure with remarkable precision.

Fetch Your Data

To substantially reduce costs, by eliminating the need for ROVs and large deployment vessels, Sonardyne has now developed 'Fetch'; a lightweight autonomous sensor node whose primary role is to measure pressure at the seabed very accurately. This data can be used to monitor seabed deformation, determine mean sea levels and detect Tsunami waves.

Fetch is packaged in a spherical pressure housing made from highly pressure tolerant and corrosion-proof glass. It has sufficient battery endurance for deployments of up to five years depending on measurement type and frequency. Encased in a plastic hard hat it is connected to a small disposable tripod via a bespoke acoustic release mechanism.

Its glass sphere contains similar autonomous sensor measurement and wireless acoustic control systems as an AMT but at only 1.2 metres tall when deployed, it is not designed to support acoustic range measurement to neighbouring instruments. Instead, Fetch relies solely upon precise pressure measurement to monitor for changes to depth and is therefore an appropriate instrument for wider area coverage with reduced resolution compared to the AMT.

Fetch starts life negatively buoyant and is literally dropped off the back off the surface vessel by a small crane or davit. Careful control of its centres of gravity and buoyancy means that it freefalls gracefully to the seabed at around one metre per second and always lands feet first with its transducer pointing up.

The position of the instrument can be tracked acoustically from the surface during the descent to allow the effects of prevailing currents on final landing position to be compensated for. With practice, Fetch can be repeatedly deployed to significant depths within a 50 metre radius of a desired location.

When Fetch's mission is complete, an acoustic signal is transmitted to actuate the release mechanism which separates the housing from the tripod so it can float back to the surface for collection.

Data Harvesting

Acoustic to satellite communications 'gateways' can be fixed to a convenient surface platform or a permanently deployed buoy and mooring, and can be used to upload the data to the surface for onward transmission.

Often, however, instrument networks are spread out over considerable distances and the acoustic ranges involved are too great for reliable data transmission to a single surface gateway. Acoustic 'hopping' of data across a network provides a degree of improved range performance but at the cost of substantially increased system complexity. Therefore, moored gateways tend to be used only in conjunction with single or small numbers of closely packed seabed instruments.

Data harvesting in large area networks is currently undertaken using a surface vessel fitted with an acoustic transceiver which makes periodic visits to each instrument in turn. Upload costs can be substantial if the instrument network is large, a long way offshore, and the analysts require regular access to the most recent data.

It is clear that a method of harvesting data without requiring operator intervention has obvious merits, especially if such data simply arrives at analysts' computers with short latency and without them needing to leave the office.

Sonardyne is evaluating the use of mobile gateways that can be programmed to navigate endlessly around a network of subsea instruments, autonomously harvesting their data and forwarding it for analysis. These mobile gateways will be extremely cost effective compared to using surface vessels for data harvesting and we consider them a firm future component of wireless autonomy. **BL**

Fetch passes first NOC tests

NOC scientists were keen to get their hands on Fetch at its launch at Oceanology 2010

Recent science cruises on the Woods Hole vessel *Atlantis* and the NERC vessel *Discovery*, provided scientists from the National Oceanography Centre (NOC) in Liverpool with their first opportunity to carry out tests on their newly acquired Fetch instruments.

The tests were conducted to increase familiarity with the instrument and assess its potential for integration in NOC's Ocean Observatory science

"Our next step is to do a short term full deployment of Fetch on one of our future cruises."

programs. Dr Stephen Mack from NOC reported, "Fetch was lowered to a depth of around 1,000 metres and a number of tests were carried out including status reports, data logging, ranging and data transfer using Fetch's high speed telemetry. Tests were also conducted on the release mechanism using a 'test disc' to simulate release at depth from the ballast weight."

He added, "These tests produced very good results and all operations were thoroughly examined. Our next step is to do a short term full deployment of Fetch on one of our future cruises."