Bandweaver

CASE STUDY

SUBSEA CABLE MONITORING USING FIBER OPTIC DISTRIBUTED ACOUSTIC SENSING

The Scenario

This client manages more than 724,000 km of fiber optic network across more than 60 countries, including multiple subsea cables. Of the 428 subsea cables around the world there are on average 100 cable faults every year. The challenge of frequent faults is faced by many subsea cable operators.

Around 70% of all cable faults are caused by fishing and anchoring activities (man-made) and around 12% are caused by natural hazards (current abrasion or earthquakes).

Damage from Anchors

Commonly, large anchors of fishing vessels and merchant vessels cause cable damage - 25% of subsea cable damage is caused by ship anchors. Anchoring outside designated areas causes damage, as does dragging anchors in error during passage. Recent fault records show that merchant ships sometimes do not fasten their anchors securely during short passages, which often causes damage.

Natural disasters and Undersea Landslides

Most faults caused by seabed movement occur in deep water - 8% of damage is caused by the environment but can impact multiple cables.

Current Abrasion

Around 6% of cables are damaged through the current and cables scraping against rocky surfaces.

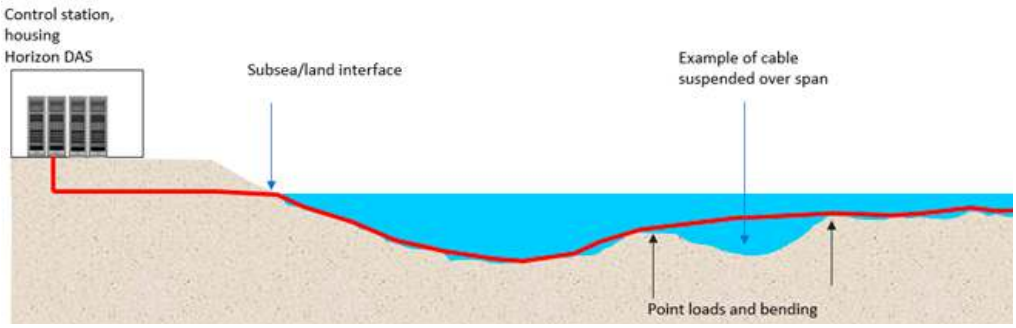
Fishing Activity from Trawlers

Trawling and fixed nets including stow nets cause damage. Over a 3rd of all cable damage is caused by fishing activity.

Client Requirements

The client's cable was located in an area of particularly high shipping traffic. This meant the cable was susceptible to damage from both fishing nets and passing vessels anchors dragging. Alongside this, the client frequently experienced cable spans forming. This lead to higher tension points in the cable and subsequently potential failure points.

The client wanted to monitor one of their more high risk cables using the Bandweaver Horizon DAS. This enabled them to carry out a health check of the cable and ascertain the cables risk scenario.



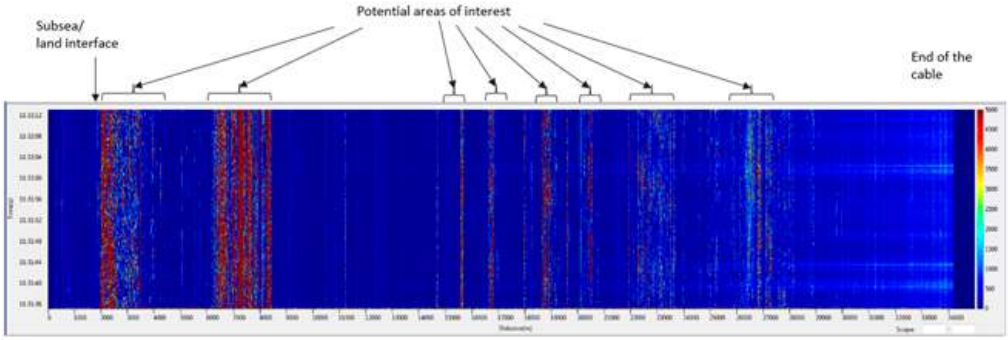
What Did We Do?

Bandweaver installed a Horizon Distributed Acoustic Sensing (DAS) systems at the client's control station, connected to one of their spare fiber optic cores. The length of the cable in this specific example was around 34km.

In order to ascertain acoustic activity and to identify key risks to the subsea cable, the system acquired data over the space of a few days.

Identification of Key Way Points on the Cable

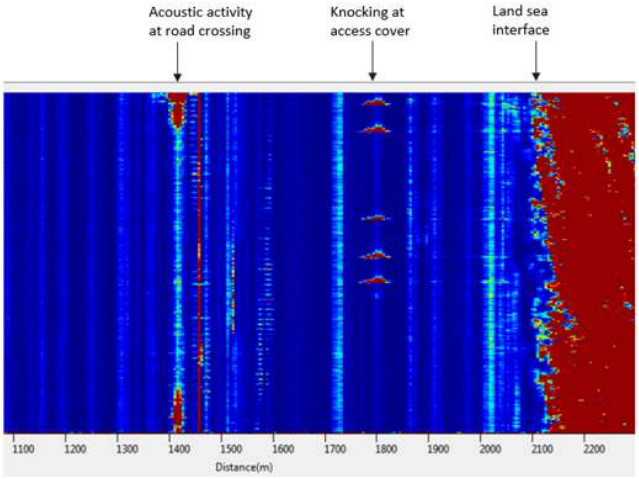
The first stage was to identify key features along the cables route. This enabled the client to identify areas of potential interest for further analysis. In the diagram (right) you can see the subsea land interface at 2km and a number of regions of acoustic activity following this.



Measurement of Signals on Land

In order to verify the performance of the system in a controlled manner, some measurements in the land based section of the cable were taken. There were a number of access points to the cable which contained a metal access cover.

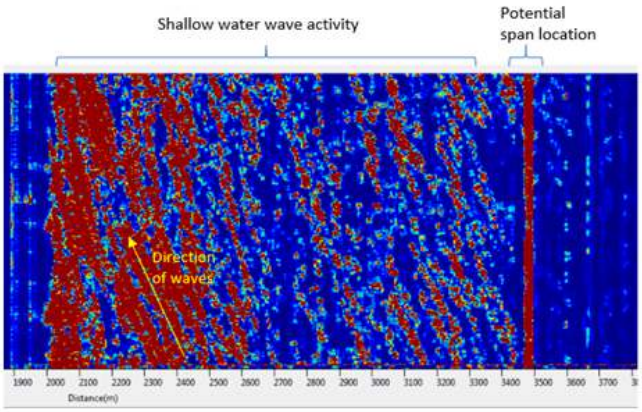
Some of the site personnel knocked on the access covers in order to generate an acoustic reference signal. This can be clearly seen on the trace (right). Note you can also see acoustic activity at road crossings along the cable length also.



Shallow Wave Activity and Potential Span Location

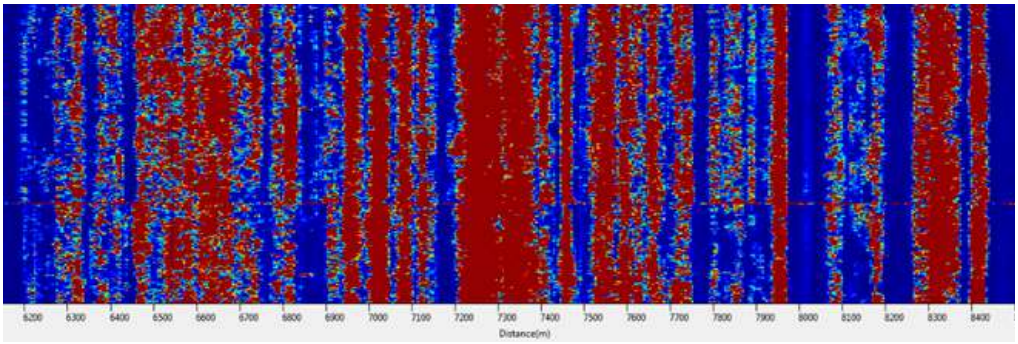
The land sea interface is clearly identified at 2km along the length of the cable. For the next 1.4km (i.e. 2 – 3.4km) the acoustic signature of the shallow wave activity and the direction and speed of the waves is evident.

At around 3.5km along the fiber you can also see a source of consistent and high acoustic activity. It was believed that this was a potential span location.



Acoustic Activity Due to Debris

One of the key areas of interest for the cable route was the section from 6.3 – 8.5km. Based on verification by ROV (remote operated vehicle), this was known to be a section where there was a lot of subsea debris and where fishing nets had become tangled in the cable. This made this an area of high risk.

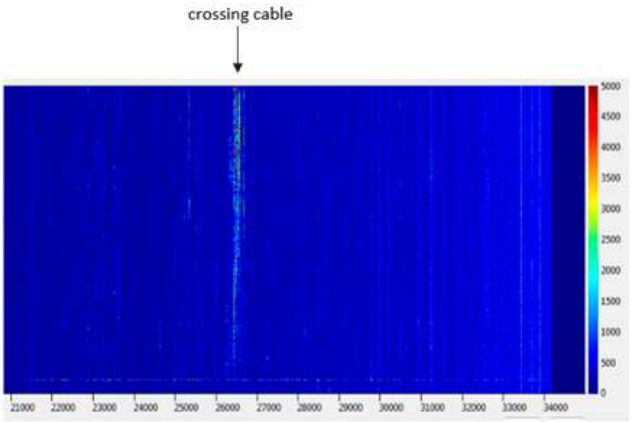


Location and Identity of Vessels

The client also wished to identify the location of passing vessels. By comparing marine traffic information and local radar in the area it was possible to locate the crossing of the vessel the 'Graceful Leader' over the cable. The visual on the right is the acoustic profile of the vessel.

This was a significant finding. It meant that in the event that a cable is damaged (by fishing nets or anchor drag) then through comparing marine traffic records, the client could identify the specific vessel and the vessel operator could then be held liable for any damage to the cable.

The size and capacity of the Graceful Leader is detailed below, for reference:



Graceful Leader Size

Carrying capacity = 20986 t DWT
Draught = 9.1 meters
Length overall (LOA) = 199.96 meters
Width = 32.28 meters.

Monitored | Secured | Safe

Benefits to the Client

The information provided helped the client make a number of subsequent operational decisions . In particular it provided valuable information when replacing the cable section between 6 to 9km.

Broader Applications

In addition to this specific cable, the client has also decided to make wider use of technology in 3 other areas:

1

Permanent Monitoring of Cable

The cable operator will install DAS technology - in areas of high risk - on a permanent basis to monitor the cable. This can then identify cable damage and in some cases preventit altogether. In the cases of vessels causing damage (e.g. by fishing nets or anchor drag) the specific vessels can also be identified.

2

Risk assessment reports

Similar to this case study, the DAS will continue to be used on a survey type basis. This provides an initial assessment / benchmark of acoustic activity. Depending on the specific risk assessment, follow up surveys will be scheduled to help assess the ongoing risks.

Some of the key risks that typically will be assessed are sea bed erosion (leading to span formation) and also build up of debris / net entanglement. The DAS surveys can be used in conjunction with conventional diver and ROV based inspections.

3

Operational assistance

In addition to general risk assessment reports the client also intends to use the DAS for assistance with repair and maintenance operations. The DAS can also provide valuable information to help before, during and after the operations (e.g. span remediation) in order to provide an assessment of the reduction in vibration to the cable.