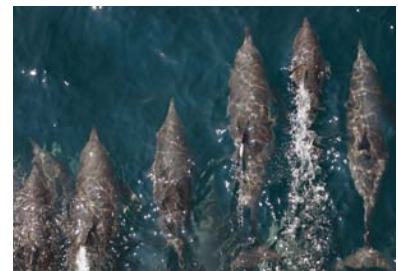
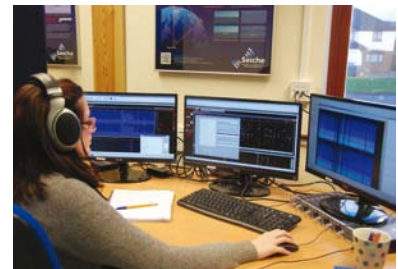
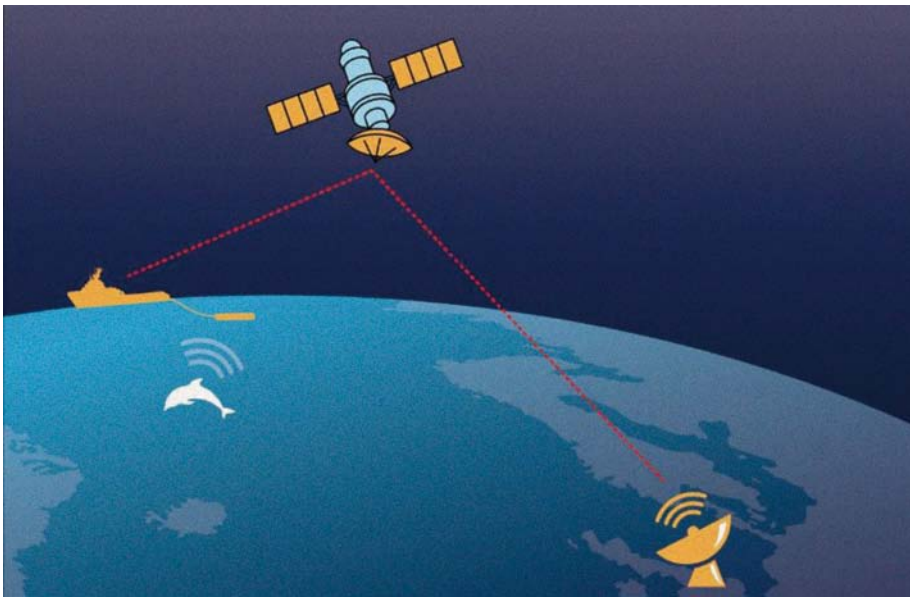


REMOTELY MONITORED PASSIVE ACOUSTIC MONITORING



Remote PAM (RPAM) is a technology, pioneered by Seiche, which enables on-board PAM equipment to be remotely monitored in real-time via a WiFi, cellular network or satellite link.

RPAM operations offer a fully flexible shift system to ensure focused operators and provide 24/7 coverage. Further Seiche expertise in bio-acoustics, mitigation and technical aspects is available on-site. RPAM can be utilised for sole mitigation purposes and/or to provide excellent live support and back-up to onboard PAM operators.

Its advantages include:

- Reduced need for/or number of operators at sea
- Round-the-clock monitoring
- Well trained and equipped operators
- Independently operated
- Can serve as a training platform for upcoming PAM operators
- Readily available support for technical issues



APPLICATIONS

- Marine mammal monitoring
- Protected species mitigation
- Ambient noise measurement

SATELLITE RPAM APPLICATION FOR OFFSHORE RENEWABLES

Satellite RPAM is achieved by utilising shared bandwidth from a vessel's existing system. The set-up configuration ensures that there is no data conflict or access risk to the ship system. The live data flow is constantly monitored to ensure high consistency and quality. A further option is to provide client and regulator access to the live data stream (subject to additional bandwidth).

The PAM monitoring station (central hub) is based and set up onboard a piling vessel, and support vessels will each feed the live stream acoustic data to the main station onboard the piling vessel.

The onboard configuration of the RPAM PC uses a Seiche PAM system with the addition of a cable connecting the output of a RME Fireface sound card to the PC. This provides the audio source for the remote audio stream. Audio streaming and visual/desktop control is achieved using remote desktop software such as TeamViewer.

The RPAM PC is connected to the vessel's network and routed through its existing satellite internet connection. LF-MF audio is streamed at sampling rates up to 96 kHz. It is impractical to stream HF audio data over the internet due to the bandwidth requirements. Instead, the remote operator onboard the piling vessel uses the remote desktop to view and control the RPAM PC which processes and displays the HF signals locally. Dedicated bandwidth on the vessel's VSAT link is arranged during a test phase, prior to the commencement of pile-driving operations.

The PAM system is configured for both onboard PAM and RPAM. The PAM station is based onboard the main piling vessel in a quiet space that enables effective acoustic monitoring, and the lead PAM



operator is provided with a suitable means of communication (radio/satellite telephone/instant messaging) which can be used to contact the support vessels if needed.

Marine mammal detection events are archived as wav-format sound files, which can be reviewed offline using Raven software. Time-stamped screenshots of the PAMGuard displays are also recorded.

The PAM monitoring station onboard the piling vessel will require a satellite link from each support vessel. Sometimes, RPAM shares bandwidth of the vessel's existing VSAT link, and in other circumstances a dedicated SAT comm system is installed on the vessel for use with RPAM. If utilising a dedicated satellite communications system, this would require the fabrication and installation of a pedestal upon which to mount the satellite dome antenna (with a clear unobstructed line of sight to the overhead satellite network), and associated cabling back to the vessel PAM monitoring station.