Sentinel is the world’s most widely deployed intruder detection sonar, developed to meet the underwater security requirements of private, commercial, government and naval end users. The system reliably detects, tracks and classifies divers and small underwater vehicles approaching a protected asset from any direction and alerts security personnel to the potential threat. Whether it is protecting a critical infrastructure facility, offshore platform, sea port or super yacht at anchor, Sentinel’s autonomous monitoring capabilities, long range detection and proven low false alarm rates, provide a rapidly deployable, 360° underwater security solution for any application.

System Overview
Sentinel takes reliable, long range underwater intruder detection to a new level and since its first introduction in 2006, has been shown to outperform far more expensive and complex technologies. The system is small, lightweight, has a low false alarm rate and once configured, can be left to operate autonomously.

Three variants of Sentinel are available. The base system, Sentinel, is configured to meet the needs of most commercial and infrastructure facility protection projects. It includes support for networked sonar arrays so that entire waterfronts can be protected and integration with third party C2 (Command and Control) systems.

Sentinel RD (Rapid Deployment) meets the need for a simple, low cost solution. Its small system footprint means it can be easily installed in yachts, deployed from small patrol boats or setup to provide underwater security at a temporary site or smaller permanent installation. Sentinel XF (eXtra Functionality) is available to military and government security agencies as it has both active and passive detection and classification modes and can protect an area of greater than 7 km² underwater from a single sonar location.

What you need to know
- Fully automated underwater security solution
- Scalable protection; network sonar head to protect the largest of sites
- Easy integration into third party C2 systems
- Long range detection with low false alarm rates
- No specialist operator training required
- Flexible deployment options; vessel, harbour wall, seabed frame
- Easy to use software
Key Product Features

Long Range
Sentinel features an extended range capability that can detect and classify underwater divers and vehicles at ranges up to 1,500 metres. This provides a total underwater protection area of greater than 7km².

Flexible System Architecture
Whether it is a rapid deployment expeditionary requirement or a multiple head fixed head deployment, Sentinel offers full architectural flexibility with modular system components that can be easily modified to meet changing customer requirements. Sentinel is unique in that multiple heads can be deployed to offer a configuration with no blind spots. A single command workstation can control and display up to 10 heads with no interference issues.

Sonardyne provides a world class planning and support team that works with clients to plan the most efficient and cost effective solution for the protection of an asset.

Deployment
The small and lightweight form factor of the Sentinel sonar head enables multiple deployment configurations ranging from cable suspension over the side of a yacht to permanent seabed mounting in a busy container port or military harbour.

Sonardyne can provide a range of off the shelf or custom engineered solutions for mobile and permanent subsea deployment. The sonar head design can be supplied in different housing material to suit the specific operating environment (e.g. warm, shallow water) and length of deployment.

Through intelligent design, Sonardyne has created a sonar head that requires no more than 65W of power during normal operation. This creates a unique ability to deploy Sentinel sonars at substantial distances from the nearest network and power access points, enabling the sonar to be deployed at the optimum location delivering enhanced area coverage.

Sonardyne has developed cabling solutions that match operational requirements ranging from simple copper to bespoke long range combined fibre-optic/power armoured underwater cables.

For expeditionary and vessel based operations, Sentinel features built-in attitude and heading sensors to enhance the dynamic performance of the sonar. Alternatively, external ship-based heading sensors can be linked to the sonar or, for the best dynamic performance, the Sentinel head can be configured with high grade inertial sensors.

Autonomous Operation
Once deployed, Sentinel requires minimal user intervention. The system has been designed to transmit and receive acoustic signals through the entire water column within a few metres of the head. This removes the need for complex and costly beam steering, and the frequent repositioning of the sonar which leads to high through-life costs.

After only a few hours training, Sentinel can be operated by security personnel with no previous experience of sonar systems. The autonomous features of the detection, tracking and classification algorithms provide a structured threat assessment. Built upon an open architecture Windows-based system, raw data and track information can be exported to external Command and Control systems (e.g. Flir NIDAR) for integration with electro-optic and radar systems.

Command Workstation and Sonar Processor
The Command Workstation (top) is composed of three, separate, 2U high units: the System Router (SRU), Control & Display Processor (C&D), and the slide-out display. The Sentinel Sonar Processor is used to perform signal and data processing on the raw sonar data received via the Sonar Cable from the Sonar Head.

Sentinel Sonar Head
The compact Sentinel Sonar Head offers complete 360 degree, long range detection and tracking. It is available in both a lightweight aluminium housing (shown above), suitable for mobile use, and in a super-duplex housing for permanent installations.

Seabed Deployment Frame
For expeditionary or temporary installations, a lightweight and very stable seabed frame is available to deploy the Sentinel sonar head.
Acoustic Signature Classification
Sentinel can determine whether the threat is a scuba or closed circuit diver or a machine which could be a swimmer delivery vehicle.

Advanced Sonar Features
Available in the Sentinel XF variant are additional software tools designed for experienced sonar operators. This includes ‘A’ and ‘B’ scan displays with zoom functions to enhance manual target verification for increased functionality. Manual track manipulation with features such as track stitching, track history display, eternal tracks, manual status change, track kill and database purge are also available. Users also have the ability for manual set-up and configuration of system parameters, filter settings and screen set-up.

Automatic Detection and Tracking
Sentinel features an intuitive Automatic Detection Tracking algorithm that only displays genuine tracks with threatening intent. At any point, the software will be tracking in real-time, but not displaying, potentially thousands of returns that are present in the zone covered by the sonar. These will be presenting no threat, for example objects on the seafloor, fauna, cetacean, fish, flotsam. For the user, this creates a tactical display that is free of clutter.

The user interface can be configured to display only threat data or the complete sonar picture as a transparent overlay onto a satellite image or electronic chart background. Track data can also be exported via an open, industry standard, interface to an external C2 system. If required, the data can also be transmitted across the Internet to a remote C2, viewed via an Internet browser.

Sentinel has been designed from first principles to not only successfully detect and track contacts automatically, but to classify and filter the tracks to ensure false alarm rates are kept to very low levels. Threat alerts are displayed in a colour/icon coded elevating format depending on their intent and range to protected asset, target information including range, history, speed, bearing and position is displayed automatically.

Acoustic Signature Classification
Sentinel can determine to a high degree of probability the type of threat that has been detected using a passive method of Acoustic Signature Classification. The system can provide confirmation that the threat is a scuba or closed circuit diver or a machine which could be a swimmer delivery vehicle.

Advance Software Features
Software tools available to experienced sonar operators include manual track manipulation with features such as track stitching, track history.
System Diagram
(Far left) is an example of a multi-sonar head networked solution providing a comprehensive underwater intruder detection capability for a large port. The system is scalable and can also be deployed as a single head solution from a vessel or mobile installation.

ADT Software
The Sentinel software (left) can be configured to display only threat data or the complete sonar picture as a transparent overlay onto a satellite image or electronic chart background. Track data can also be exported via an open, industry standard, interface to an external C2 system. If required, the data can also be transmitted across the Internet to a remote C2, viewed via an Internet browser.

(Below left) Sentinel XF satisfies the needs of the military customer. Sonar trained operators will appreciate the additional features offered including; A-scan, B-scan, zoom and Doppler Velocity display and track manipulation.

(which could be a surface craft, underwater vehicle or assisted diver). This additional capability utilises a ground-breaking new software processing capability that is unique to the Sentinel product family.

Response
Threat alerts generated by Sentinel can be displayed both locally or exported to an external command and control system. This includes transmitting range and bearing information to Sonardyne BARTT, a Windows mobile application that guides security teams in to intercept the intruders before they reach the protected asset. Sentinel can also be configured to automatically trigger Scylla, an underwater loud hailing device. Pre-recorded or live broadcasts provide audible early warning to the incoming threat that they have entered a protected area. If the target ignores such warnings, further actions via optional third party deterrents, can be initiated.

Response
Sonardyne provides worldwide, around the clock customer support via a network of wholly owned international operating subsidiaries around the world. Sentinel users have unrivalled access to Sonardyne’s in-house engineering teams, manufacturing capabilities, operator training and global product assistance. Sentinel has been designed with 100% line replaceable units to minimise downtime providing spares are held locally.
### Sentinel Performance Summary

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<tr>
<th>Parameter</th>
<th>Value</th>
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<td>Array Diameter</td>
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<td>Centre Frequency</td>
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<td>Bandwidth</td>
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<td>No. of Rx Channels</td>
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<tr>
<td>No. of Tx Channels</td>
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<tr>
<td>Azimuthal Bearing Accuracy (SNR dependant)</td>
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<tr>
<td>3dB Vertical Rx &amp; Tx Beamwidth</td>
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<tr>
<td>Normal Source Level</td>
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<td>Maximum Operating Depth</td>
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<td>Maximum Diver Detection Range</td>
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<td>Maximum Vehicle Detection Range</td>
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<tr>
<td>Network Capable</td>
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### Sentinel Equipment List

- **Key:** ● = Required   ○ = Optional

- Software ADT
- Type 8161 Command Workstation
- Type 8160 Sonar Processor
- Type 8160 Sentinel Sonar Head
- Cable Subsea Copper Up to 65m
- Cable Fibre Optic Up to 2,000m
- F/O Converter Surface or Subsea Options
- Type 8165 Seabed Frame
- Type 7950 Deployment Machine
- Type 8169 Stem Tube Deployment Pole
- Type 8097 Over-The-Side Deployment Pole
- Type 8165 Permanent Seabed Tower
- Type 8165 Harbour Wall Deployment Rail
- Type 8165 Underwater Loudhailer
- Software BARTT Target Locator

### Other Sonar Systems from Sonardyne

- Solstice Side Scan Sonar
- NOAS Obstacle Avoidance System
- ALDS Automatic Leak Detection Sonar

### Sentinel Key Technology

#### Autonomous Operation
Sentinel’s automated detection tracking and classification software removes the need for security personnel to monitor the system. With the sonar deployed and operational, the system can be left alone to keep watch over the underwater domain.

#### Size
The compact size of the Sentinel sonar head makes it ideal for expeditionary operation as it is capable of being easily palletised and rapidly deployed. The system can be mounted in many different ways, including suspension by its own cable, pole mounted or on the seabed.

#### Low False Alarms
Sentinel’s advanced detection, classification and tracking filters mean that thousands of targets can be simultaneously monitored in both shallow water and acoustically complex operating environments with only genuine threats creating an alarm condition.

#### Threat Warning Level
Elevated threat warnings provide security personnel with an aggression status of the target being tracked allowing an appropriate response to be mounted.

#### Sentinel Performance Indicator (SPI)
With the optional SPI, Sentinel users can determine instantaneous Sentinel performance that can be expected in the current operating environment.