Advances in Subsea Data Harvesting Technology
Oi China 2018, Qingdao
Autonomous and Remotely Operated Underwater Vehicles and Vessels Sensing Session

Jose M Puig
Regional Sales Manager
Sonardyne Asia Pte Ltd
What is data harvesting?
Why is data harvesting important?
The ocean depths are relatively unknown in comparison.
Why?

70% WATER
HIGH FREQUENCY ATTENUATION
Challenges: Unforgiving Environment

PRESSURE
Challenges: … and difficult to sense
Challenges: ... Expensive

FIRST CAMPAIGN
- 60,000 km²
- $56 Million USD

SECOND CAMPAIGN
- 106,200 km²
- $70 Million USD

• 0.04%
• $274,364,620,924.00 USD

Source: Australian Transport Safety Bureau / Ocean Infinity
Faster Surveys at Extreme Depths

Getting to the Bottom of Our Ocean.
Technology challenges

- More autonomy (Robotics)
- Better navigation (For Robots)
- Smarter instruments
- Efficient and Reliable Comms (Better Data Harvesting)
DATA HARVESTING TECHNOLOGY
Current Data Harvesting Applications

- Seabed Mapping
- Environmental/Oceanography
- Plate Tectonics
- Tsunami Early Warning
- Subsea Structure Monitoring
- O&G Reservoir Monitoring
- Defence
- Subsea Mining
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Overview

70+
The number of countries where we operate

100%Deep water fields where Sonardyne technology is used

10mmPositioning accuracy of 6G acoustic technology

~18 Mb/sThe speed we can transfer data subsea

300+Sonardyne employees worldwide

12,000 mHow deep our equipment can operate

80%Percentage of products we export

>45The age of our company

156,000Total square footage of our facilities

10,000Transducer manufactured each year

24/7Support any time you need it
WIRELESS COMMS
Where did we start?
Narrowband signal (tone) – Legacy, no longer used
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Wideband 1 – Dramatic performance improvement over tone signals
Where did we start?

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Wideband 1 – Dramatic performance improvement over tone signals

Wideband 2 - Longer codes for robust comms in harshest environments
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Narrowband signal (tone) – Legacy, no longer used by Sonardyne

Wideband 1 – Dramatic performance improvement over tone signals

Wideband 2 - Longer codes for robust comms in harshest environments

Where are we now?
Sophisticated coding techniques **BUT** still limited to 18kbps due to Physics
Effective Bandwidth Use

- **Digital**
  - Combine Telemetry & Tracking

- **18000 bps**
  - From 200bps to 9000bps effective bandwidth

- **Vessel, USV & AUV**
  - Choose the right platform for your harvest (or hop from shore)

3,000 metres: 9,000 bps
5,000 metres: 3,000 bps
11,000 metres: 1,000 bps
HD VIDEO

2 MINS IN > 34 hrs
Subsea Wireless Communications

Free Space Optics

Combining Acoustics & Optical

- **500Mbps**: Free space optical bandwidth
- **50Mbps**: Acoustic bandwidth
- **5Mbps**: EM/Radio bandwidth

Distance (log scale):
- 10m
- 100m
- 1km
- 10km
- 100km

Data Rate (log scale):
- 500Mbps
- 50Mbps
- 5Mbps
- 500kbps
- 50kbps
- 5kbps

Key Features:
- **11,500m**: Longest Acoustic Data link
- **10mm**: Positioning accuracy of 6G acoustic technology
- **9kbps**: 6G effective user bandwidth

From 5 to 500Mbps: Optical data bandwidth
Subsea Wireless Communications

Free Space Optics

Effective Bandwidth Use

Large Bandwidth
Use optical modulation to enable larger data transfers

500 Mbps
10Mbps at >100m
500Mbps at <7m

AUV or ROV
Choose the right platform for your harvest

150 metres

7 metres
HD VIDEO

2 MINS IN < 2 MINS
SMART SENSORS
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Smart Sensors

On board Processing

Different Form Factors and Battery Pack Opt

Range of Internal Sensors External Input Also

Integrated MF Transducer/Modem

FFT spectral, Statistic and bespoke

Dual 32GB Cards
  • Optional 200 GB

Future Optical Comms

10 YEAR BATTERY

Modem
  9Kbs

UPTO 6000M RATED
Tsunami Detection

- 2-way satellite comms link
- Direct control of acoustic transceiver
- Allows acoustic commands to be sent to subsea unit
  - to alter set-up parameters
  - diagnostics
  - to Force or Cancel Events

Buoy System:
- not supplied by Sonardyne

- Wideband signal technology
- Lightweight - 9kg in water
- Low power - 1W at 24V
- Acoustic baffle
- 5km+ acoustic range
- Armoured cable to buoy

- LMF – 15kHz
- High speed 100-9,000 bps
- Forward Error Correction (FEC)
- Wideband technology

- 6000m rated housing
- Lithium battery pack for ~8 year deployment from dual battery pack
- Optional acoustic release
Mediterranean - Bottom Pressure Recorders have been integrated into an undersea cabled warning system for the region.

USA - A deployed Tsunami Compatt recorded a small meteo-tsunami event during technology trials.

Equador – Tsunami detection buoys deployed in the Ring of Fire protect Ecuador’s coastal communities from tsunami threats.

India - A wide area network of Tsunami Compatts in the Indian Ocean provide early tsunami warnings for the Bay of Bengal.
Shell’s Ormen Lange field in the Norwegian North Sea

– 220 seabed transponders spread over an area of 50km x 20km
– >600 million observations
– Ca. 1 Gb of data uploaded acoustically
– Recently recovered after 6 years deployment
Waveglider uses triangulation to determine the position of Fetch on the seafloor.

RTK GPS Positioning of USV and terrestrial receivers

GPS ground-deformation monitors

GPS detects ground deformation due to locked portion below

Fetch

Subducting Oceanic plate

Continental Plate

Locked portions of fault
Optical communication system expands CORK seafloor observatory's bandwidth

N. Farr, J. Ware, C. Pontbriand, T. Hammar
Applied Ocean Physics and Engineering
M. Tivey
Geology and Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 USA

<table>
<thead>
<tr>
<th>Max Range (meters)</th>
<th>Data transfer rate (mbps)</th>
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<tbody>
<tr>
<td>108</td>
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<tr>
<td>118</td>
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<td>128</td>
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![Graph showing receiver altitude vs. horizontal distance from CORK with color scale indicating optical power (Watts).]
Autonomous Surface/Sub-surface Survey (ASSS) Project

- ASV Surface Vessel
- AHRS, INS & 5 element phased array
- Master Emitter
- Master Receiver
- Slave Emitter
- Slave Receiver
- Satcoms
- High data rate optical comms
- Acoustic comms & positioning
- Solstice sonar
- NOC Autosub Long Range

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WORLS FIRST AUV INTERVENTION @ NASA NEUTRAL BOUYANCY TANK

Video available at https://www.youtube.com/watch?v=RaV9ZFGilBc
WHAT CAN YOU DO WITH IT?
Thank you for your time today
Any questions?