Reduced cost subsea condition monitoring using ‘Send and Forget’ acoustic communication

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CEO Aquatec Group, UK
Overview

• Introduction to Aquatec Group
• Acoustic telemetry
  – pros and cons
  – ‘Send and forget’ concept
• AQUAmodem 500 system
• Case studies
• Summary
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Aquatec Group Ltd

- Founded in 1990 by Andy Smerdon
- Based in UK, 40 miles SW of London
- Primary expertise:
  - Subsea instrumentation
  - Underwater acoustics
  - Low power autonomous systems
- Design and manufacture all products and engineered solutions
- Products sold worldwide
Aquatec Group Ltd

CREATORS OF INNOVATIVE INSTRUMENTS, SERVICES, AND SOLUTIONS FOR YOUR MEASUREMENT, MONITORING, AND COMMUNICATION NEEDS UNDERWATER

We provide instrumentation solutions for all water environments:

- Offshore structures and pipelines
- Oceans, estuaries, rivers, and lakes
- Marine mammals and fisheries

as well as

- Wireless communication, data transfer and control solutions

Customers in the offshore market
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# Acoustic Telemetry: Pros & Cons

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>✅ Long range potential</td>
<td>✖ Slow</td>
</tr>
<tr>
<td>✅ Cheaper than long cable runs</td>
<td>✖ Needs power: even more for 2-way</td>
</tr>
<tr>
<td>✅ Cheaper to install than cable</td>
<td>✖ Busy communication channel</td>
</tr>
<tr>
<td>✅ Can be more robust than cable</td>
<td>✖ Acoustic path can be problematic</td>
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Subsea Survey IRM, Houston
Send & Forget Telemetry
‘Send and Forget’ concept

- **System Analogies**
  1. Static meter display - check when passing or on a schedule
  2. Heartbeat monitor
     - periodic tick shows system is healthy
     - alarm and increased data when faulty

- Measure data at preset rate
- Transmit data infrequently if all is well
- Increase update rate when alarm conditions are met
- Transmission is automatic – no interrogation needed from the surface
- Only powered up when reading data or transmitting
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1st AQUAmodem 500 System

- Manufacturer of marine hoses for offloading
  - Double carcass
  - Outer carcass unstressed
  - Has same rating as inner hose to contain leak

- Needed warning system
  - Need to know leak has occurred
  - Diver operated tap on one-way valve
Concept Development

- 1990’s Aquatec underwater comms: Cathodic protection monitoring with acoustic-linked data acquisition units
  - Data rates up to 1kbps
  - Long deployment time
  - High power requirement
  - Large housings
  - Expensive to build
Concept Development

• Previous Aquatec acoustic products:
  AQUAmark marine mammal deterrent

  ✔ Very low power
  ✔ Long deployment time
  ✔ Semi-random transmission
  ✔ Low cost
Concept Development

• Previous Aquatec data acquisition products: AQUAlogger 520 pressure/temperature data loggers
  - Very low power
  - Long deployment time
  - Precision measurement
  - Low cost
Concept Development

• Combined the AQUAlogger & AQUAmark to produce the AQUAmodem 500P

  ✓ Low power telemetry
  ✓ Low power pressure measurement
  ✓ Long deployment time
  ✓ Small size
  ✓ Semi-random transmissions
Mode of Use

• Pressure telemetry system
  – Replace tap with subsea pressure telemetry unit
  – Integral pressure transducer
  – Measures pressure and transmits as acoustic signal
  – Signal received and decoded at surface
Mode of Use

Rope to suspend surface unit

Cable (not under tension)

Surface Unit

Send & Forget Telemetry
AQUAmodem 500P Acoustics

- ‘Send and forget’ principle
- Read every 5 minutes
- Transmit every 30 minutes unless alarm condition is detected
- Transmit every 5 minutes if alarm is detected
- Message collision avoidance:
  - Two transmissions every update period
  - Separated by random interval
- Message includes error checking and correction
- Decoding includes multiple validation stages to minimise false alarms
- Range up to 400 m
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Case Study 1: Karan Temperature

- Karan jacket
  - Gas production platform
  - Offshore Saudi Arabia
  - Seabed (pipeline) temperature used in pipeline gas leak detection system calculations
  - Avoidance of cable use provided simpler and less expensive solution for customer

- Specification
  - Monitor temperature at bed (-50m LAT) to ±0.1°C
  - Transfer to DCS as 4-20 mA signal
Case Study 1: Seabed Temperature

- Karan gas platform
- Offshore Saudi Arabia
- Sea bed temperature monitoring required for pipeline gas leak detection system
Case Study 1: Seabed Temperature

- Temperature measurement of water near mud line
- Transmission of data to surface for relay to platform computer system
Case Study 1: Seabed Temperature

- Measurement is transmitted from acquisition system clamped to 24” member every 10 minutes.
- Receiver is mounted on flanged I-tube then cabled to DCS as 4-20 mA signal.
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Case Study 2: Pipeline Temperature

- Asian subsea installation
  - Retrofit heated pipe in pipe
  - 50 to 60m water
Case Study 2: Pipeline Temperature

- Semi-remote temperature feedback required to
  - Maintain flow assurance
  - Calibrate field production operations
- 8” and 4” pipes to be monitored
Case Study 2: Pipeline Temperature

4” temperature monitor & surface receiver
Case Study 2: Pipeline Temperature

- Temperature sensor in base of instrument
- Insulation layer to allow pipe temperature to be measured
- Custom saddle for each pipe
- Saddle strapped on to pipe
- Transmits every 5 mins
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Case Study 3: CP Monitoring

- UK North Sea platform
- 25 years old
- New impressed current cathodic protection system installed
- Require near real-time cathodic protection potentials for closed loop control
Case Study 3: CP Monitoring

- Cathodic Protection PSU & Control Software
- Hydrophone
- Anode Sleds
- CP1
- CP2
- CP3
- CP4
- CP5
- CP6
- CP7
- CP8
- CP9
Case Study 3: CP Monitoring

- 9 AQUAmodem 500CP modules
- Steel case in contact with jacket through clamp arrangement
- Monitor jacket potential with respect to Zinc electrode & Silver/Silver Chloride cell
- Transmit data every 15 mins
Other Applications

- Leak detection
- Hydrotest monitoring
- Level or attitude sensors
- Intelligent pig pingers
- ...
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Present Limitations

• Range versus Power
  – Smallest instruments 400m
  – Maximum range 3-4 km with appropriate power

• Acoustic Path
  – Cannot bend the laws of physics, or acoustic rays

• Data
  – Typically 1 or 2 values measured and transmitted

• Number of Units
  – 64 maximum

• Update Rate
  – Aim for not more than one unit per 20s
Summary

• Measurement and transmission integrated into one unit
• Low power, long life
• Multi-point data acquisition
• Removes need for unreliable or costly cabling
• Cheaper and more efficient than general purpose acoustic modems
Manufacturers of:
Hydrotest Instrumentation - Temperature and Pressure Data Loggers
Leak Detection Systems – Vibration Monitoring Instruments
Cathodic Protection and Monitoring Systems
Acoustic and Optical Suspended Sediment Profilers and Instruments
Underwater Acoustic Data Telemetry

Thank you.
Any questions?
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Subsea Survey IRM, Houston
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