Acoustic ranging

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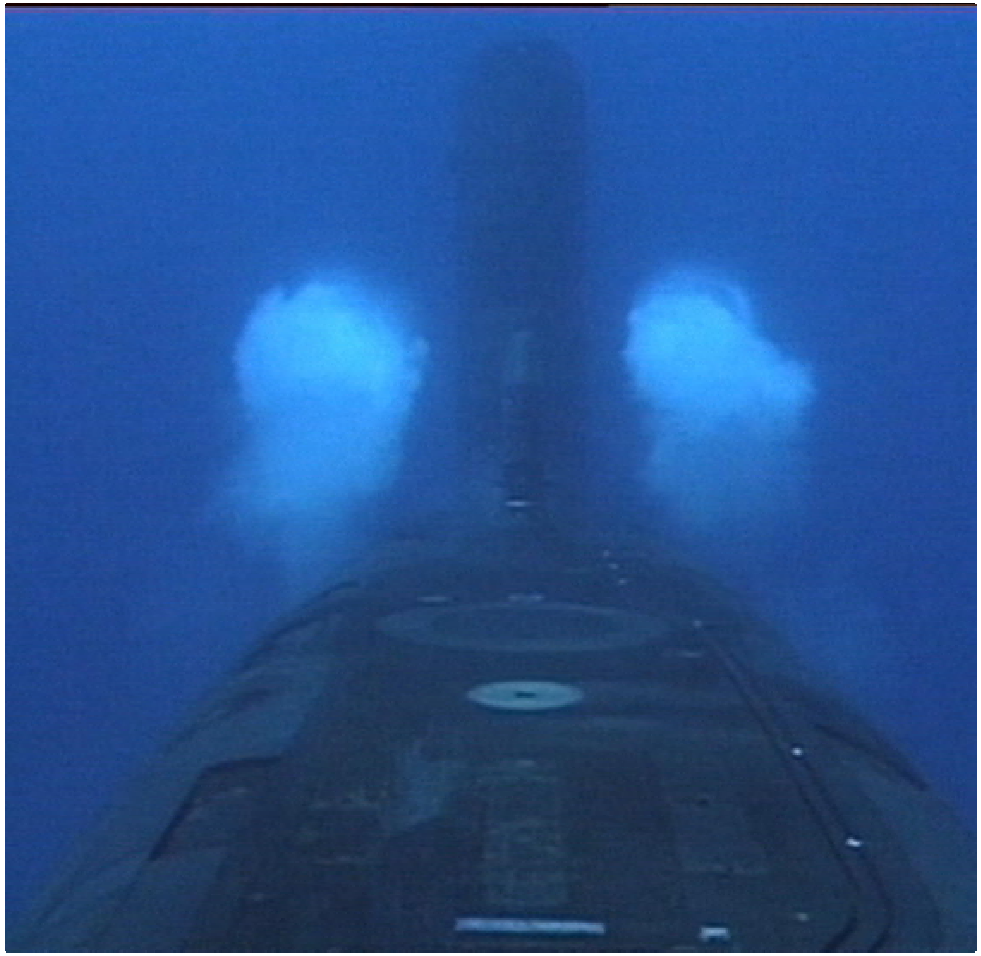


Acoustic ranging

01 The reasons / requirements for ranging

02 The UK acoustic ranging capability

03 Data acquisition, processing and display

04 Summary

01 The reasons / requirements for ranging

What is acoustic ranging?

- Acoustic ranging is the determination of the underwater radiated noise from any platform, measured over a wide frequency range, as a function of direction (aspect), over the full operational envelope, and determination of the sources that produce the various components of the signature.

01.1 The reasons / requirements for ranging

From:

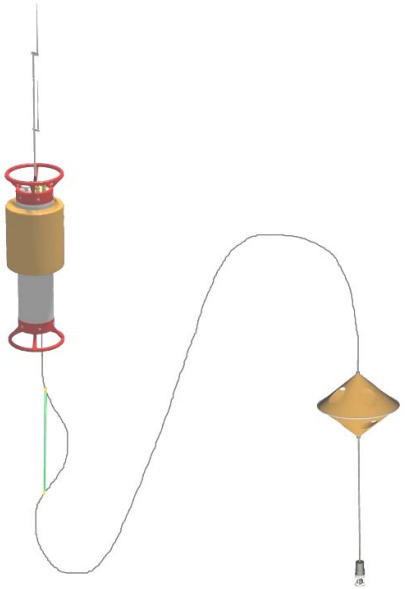
- Simple determination of the signature at a single speed:
  - Comparison with a previous measurement
  - To meet a target, e.g. a curve of one-third octave band levels
  - Underway only

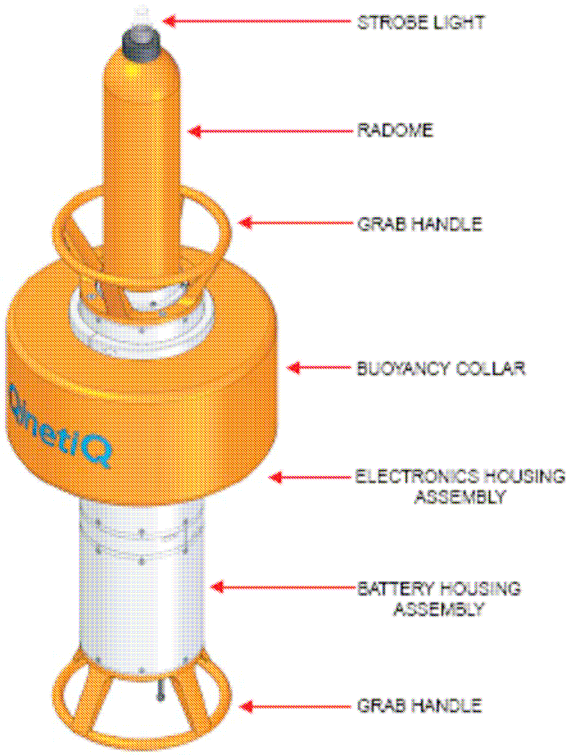
To:

- Full decomposition of the signature:
  - For all operating states
  - Through the full speed range
  - Broad band and narrow band features
  - Provide recommendations for reducing the signature
  - To achieve acceptance into service
  - Underway and static

01.2 Measurement systems

- Simple measurements:
  - Single-use
  - Transportable:
    - Organic / mobile
    - Shallow water
- Full decomposition:
  - Fixed range





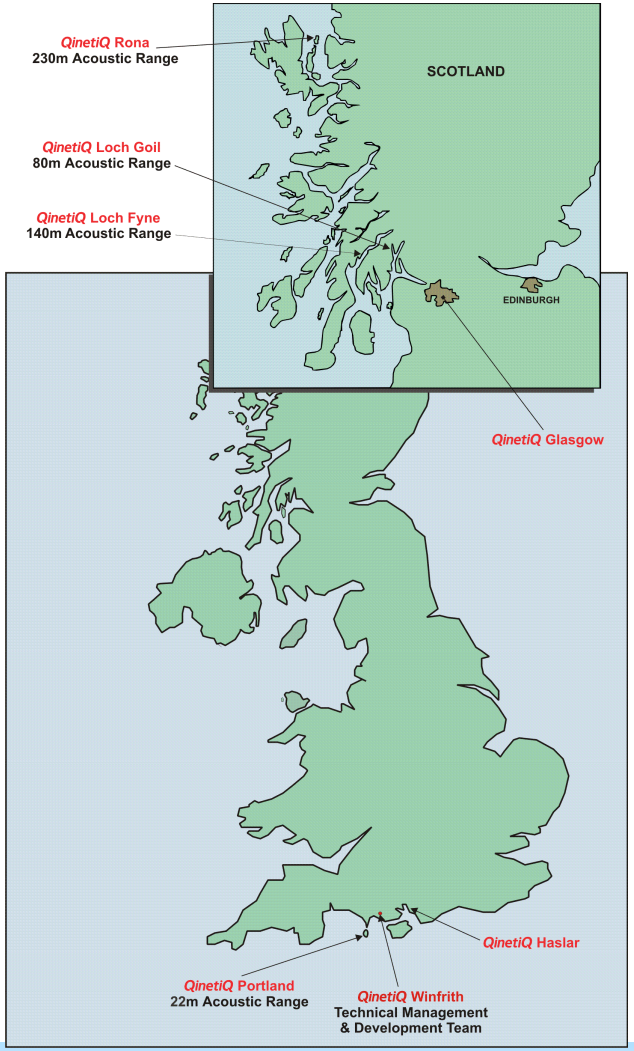
02 The QinetiQ Acoustic Ranges capability

Four fixed ranges

Developed to offer different capabilities, for all platform types

Static & underway

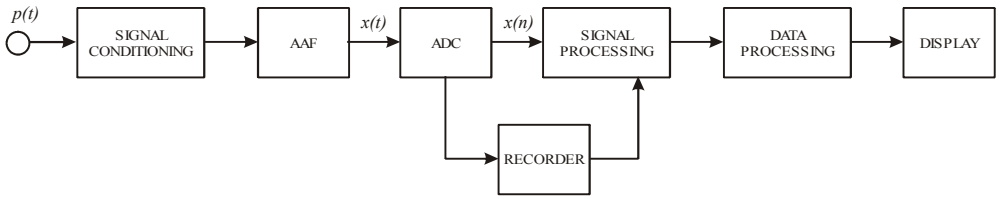
Transportable range

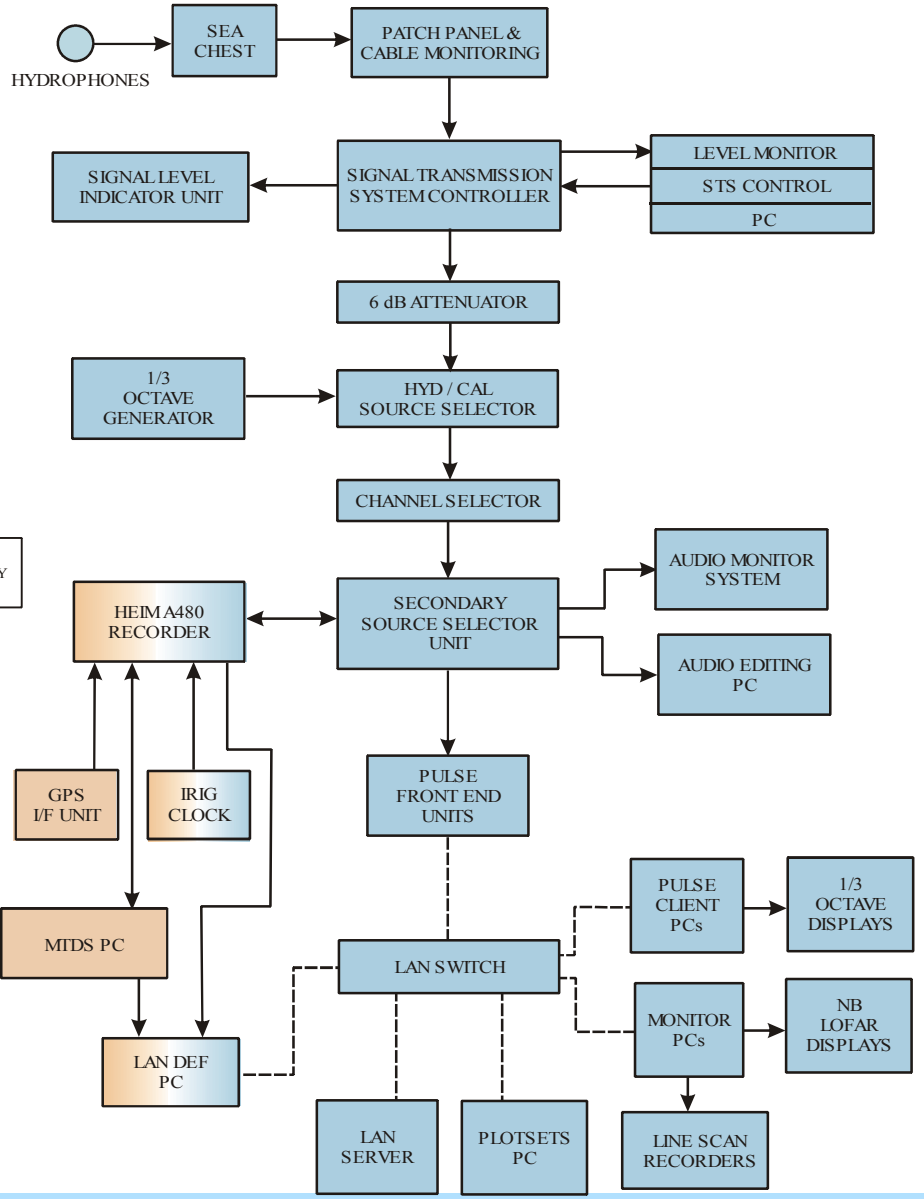


02.1 Fixed ranges

- More hydrophones
- Known acoustic environment
- More on-line analysis
  - Real-time
  - One-third octave
  - Narrow band
  - Vernier
  - Time histories
  - Vessel track
- Repeatability

02.2 Fixed ranges





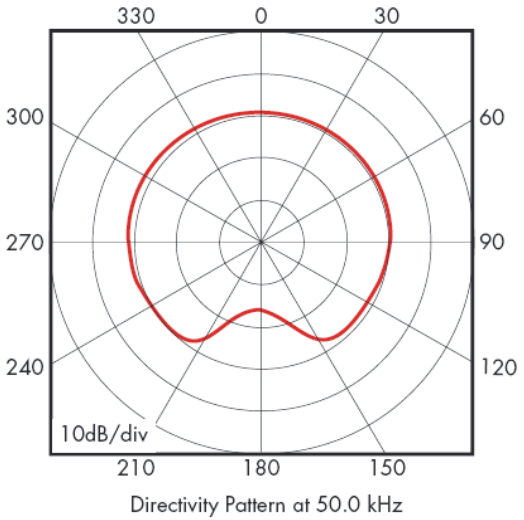
02.3 Fixed ranges

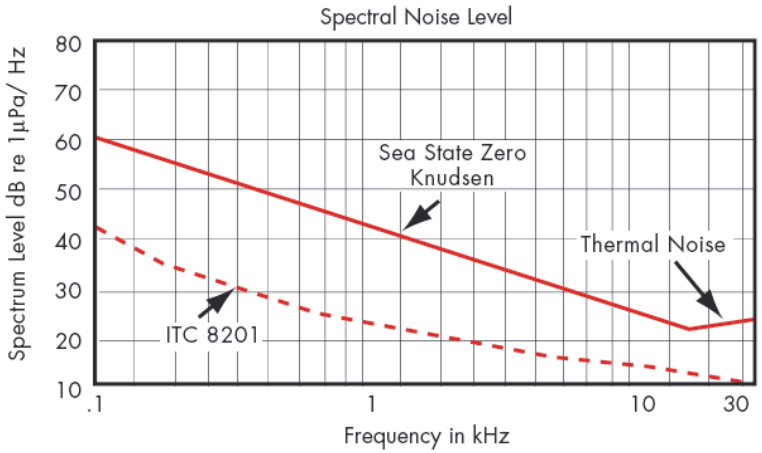
03 Data acquisition, processing and display

- No standard methodology
- Factors include:
  - Sensor selection
  - Data acquisition
  - Tracking (speed, accuracy)
  - Distance correction
  - Background ambient noise
  - Data processing & averaging
  - Data display
  - Data storage, raw and processed

03.1 Sensors and data transmission

- Hydrophone – bandwidth, sensitivity and noise floor trade-off
- ITC 8201
- Spheres (22mm or 15mm)
- Analogue and digital transmission (fibre optic)
- System calibration





03.2 Data acquisition

B&K 3110

- Signal conditioning – anti-aliasing and high-pass filters
- Analogue to digital conversion
  - 24 bit < 25.6kHz and 16 bit > 25.6kHz

B&K 3560

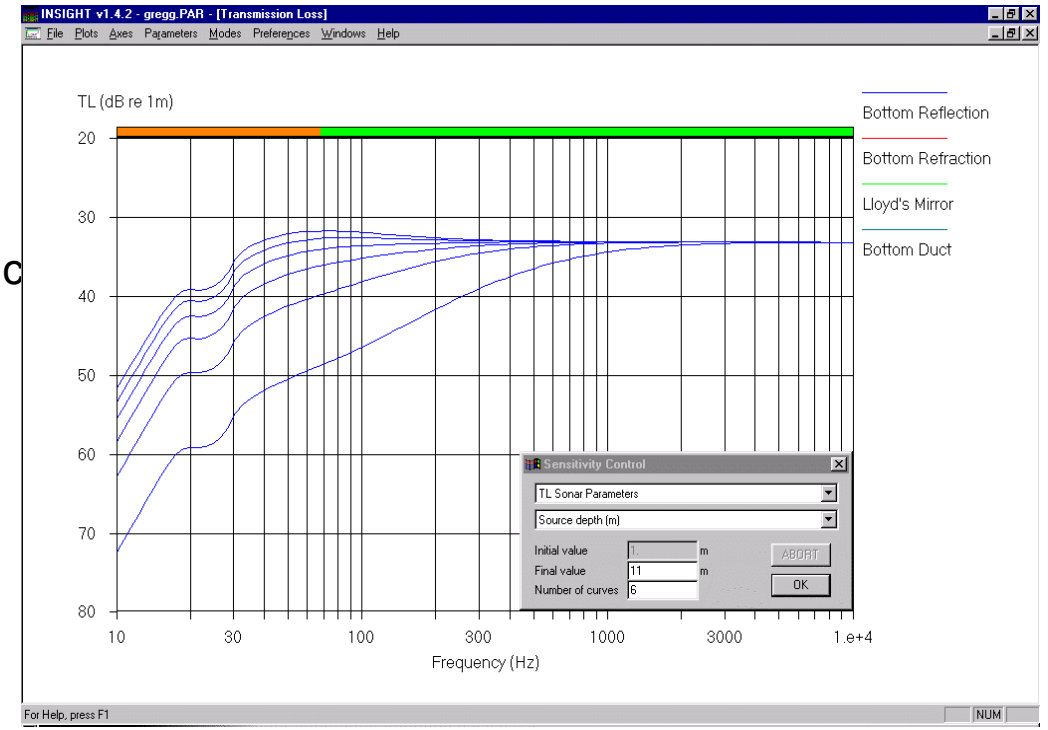
- LAN module
  - Communication with the PULSE software and PC

03.3 Tracking

- GPS adequate for surface ships
- “Pinger” or Transponder systems for underwater platforms
- Recorded in parallel to acoustic data and time
- High platform speeds
- Input other tracking data:
  - Platform GPS
  - EOT
  - Radar

03.4 Distance & background noise correction

- Distance correction:
  - Corrected to 1m from an assumed radiation point
  - Spherical or cylindrical spreading
  - Site-specific spreading laws
- Background noise correction:
  - Background measurement taken with vessel at a distance
- Each data sample corrected for distanc and background level (OTO)
  - Confidence values



03.5 Data processing and averaging

- Aspects (directions):
  - Beam (port & starboard), bow, stern and keel
  - Azimuth and vertical directivity
- Averaging rules (e.g. beam aspect):
  - Arc, centred on an Assumed Radiation Centre at CPA
  - Length of the platform
  - Time
- Data sampling and averaging
  - Data acquired (sampled) continuously
  - 50 ms to 2 s sampling times
  - Exponential averaging, 2 s update rate

03.6 Data presentation

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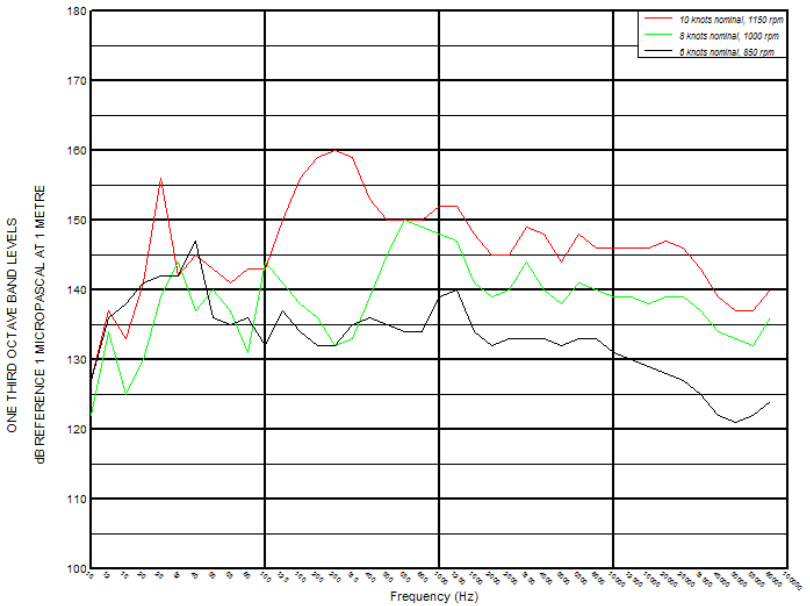

Figure Effect of speed Port aspect
Range testing vessel May 2005 Portland

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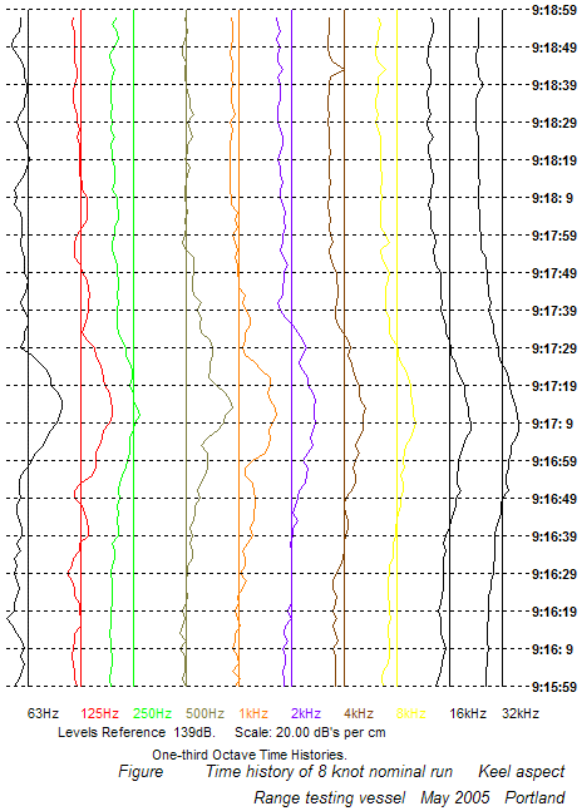

Figure Time history of 8 knot nominal run Keel aspect
Range testing vessel May 2005 Portland

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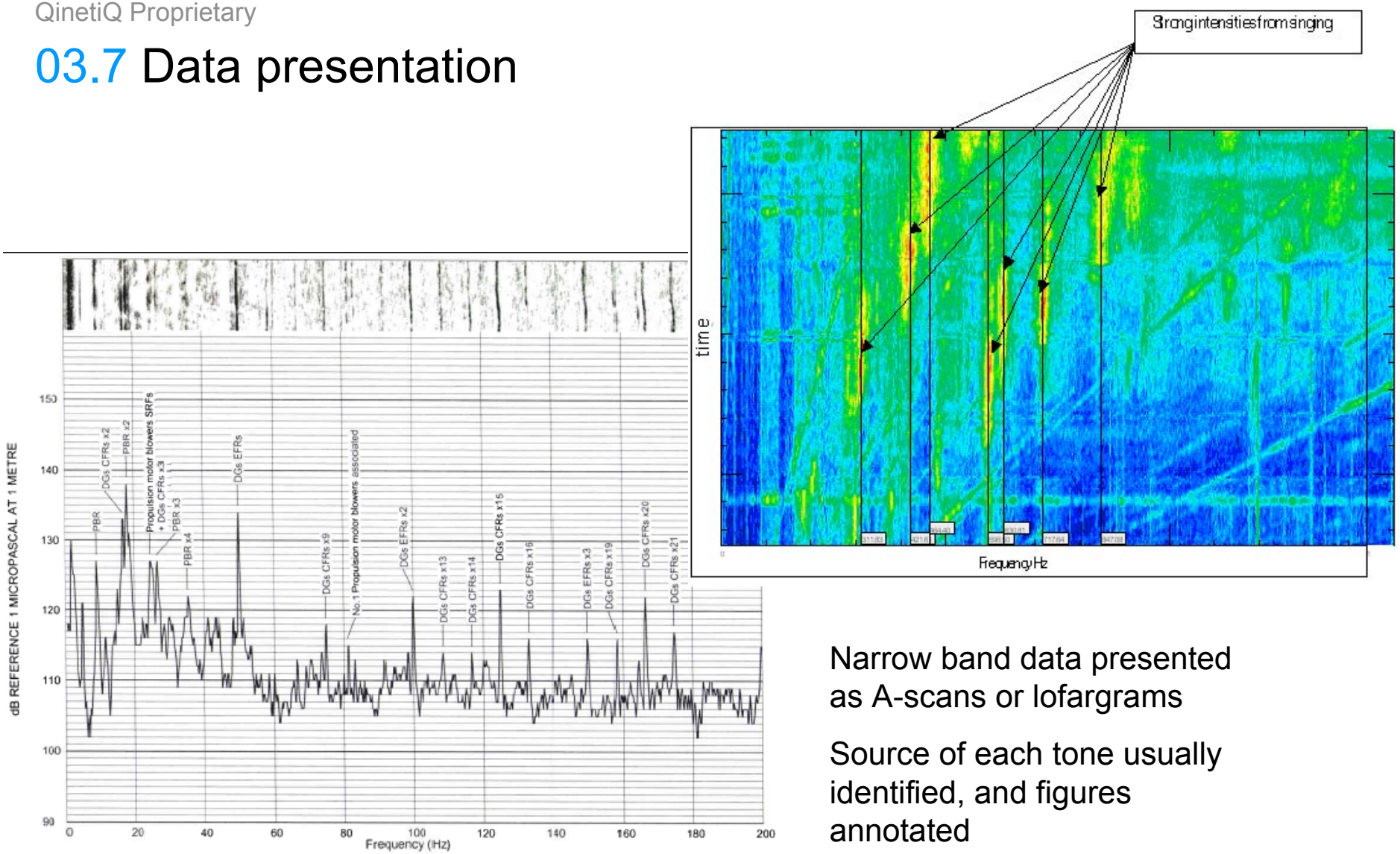
One-third octave (OTO) plots (various types)

OTO time histories

03.7 Data presentation



Narrow band data presented as A-scans or lofargrams

Source of each tone usually identified, and figures annotated

03.8 Data presentation

- Tone levels:
  - Rules for measurement bandwidth:
    - Frequency / speed dependent
    - Levels may differ with different bandwidths
  - Tabulated
  - Mean value from all appropriate measurements
  - Levels relative to last ranging, vessel quartiles and class quartiles

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03.9 Deliverables

- Deliverables :
  - Trial Orders & Run Plans
  - Briefings
  - Ranging
  - On-board VA
- Hot de-brief (Quick-Look Signal)
- Technical reports
  - Full details of measured levels
  - Source identification
  - Recommendations for signature improvement
    - De-brief
    - Databases and trend analysis

04 Summary

- Measurement system matched to requirements
- Sufficiently versatile to be adaptable for new requirements
- Ranging processes must provide Consistency & Repeatability
- Heavy investment

Independent expertise where it matters most.

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