

**NASNet® DPR:
NASNet® as a Deepwater Acoustic DP
Position Reference**

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Overview



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- **Offshore positioning introduction**
 - **Considerations of acoustic positioning**
 - **Concepts and technology behind NASNet®**
 - **Review of offshore deep water positioning data**
 - **Summing up**
-

The background of the slide features three overlapping, semi-transparent wireframe spheres. Each sphere is composed of a grid of small squares, creating a mesh-like appearance. The spheres are arranged in a row, with the middle one slightly behind the other two, creating a sense of depth. The overall color palette is light blue and white.

Offshore Positioning Introduction

Real World Challenges



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Developments in the industry:

Deeper water

Increased SIMOPS

Increased CLOSEOPS

Increased focus on positioning and Station keeping

The requirements?

- **Reliable**
- **Accurate**
- **Interference free**



Positioning Options

Satellites

GPS, GLONASS, COMPASS

Acoustics

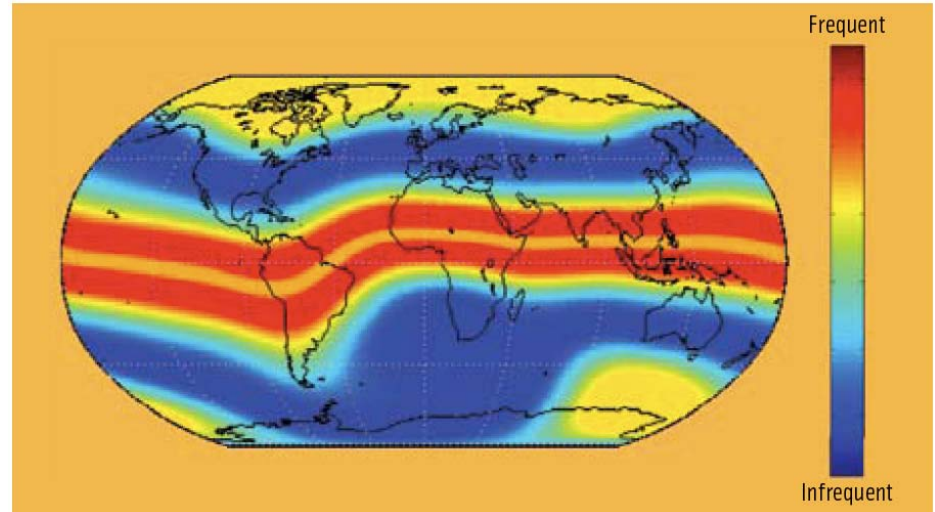
LBL, SBL, USBL

Relative sensors

Laser systems

Radio Systems

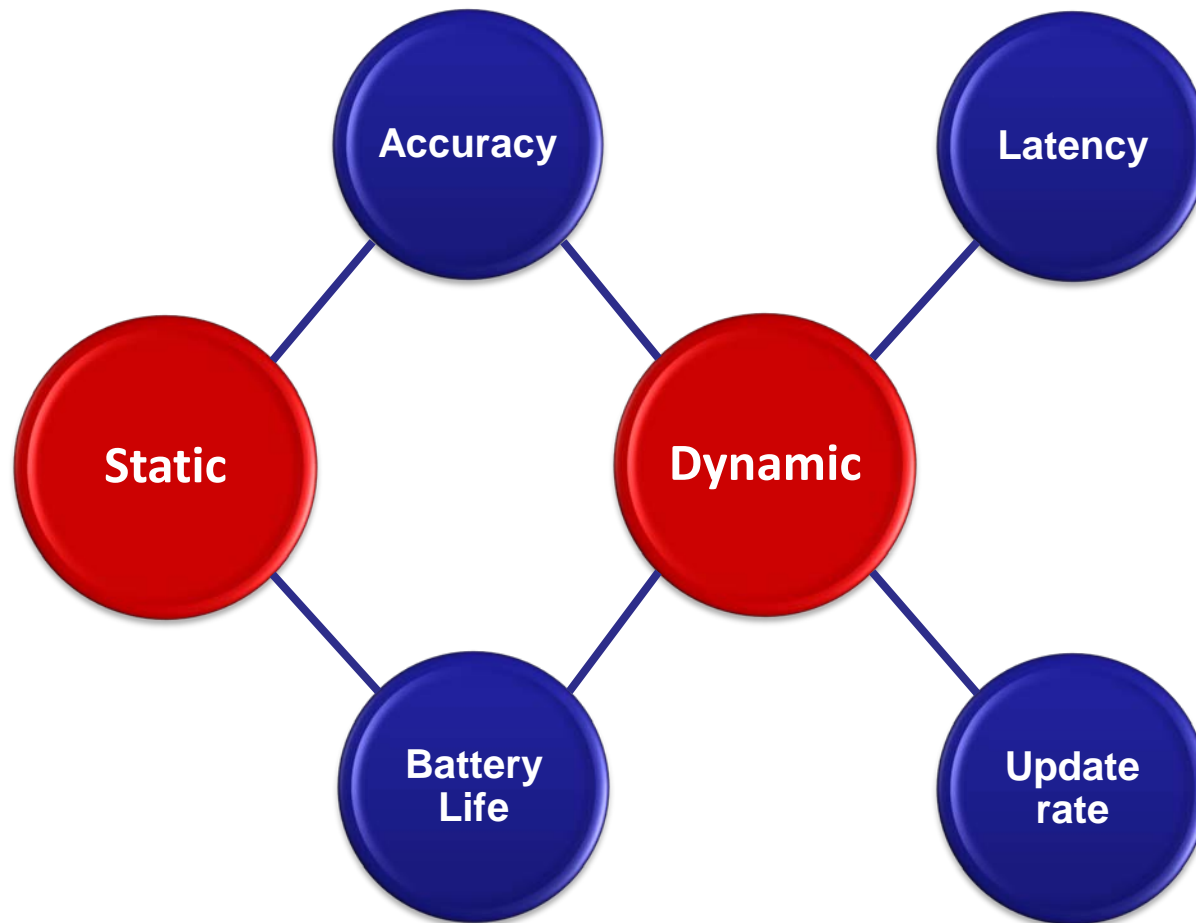
Inertial Navigation Systems



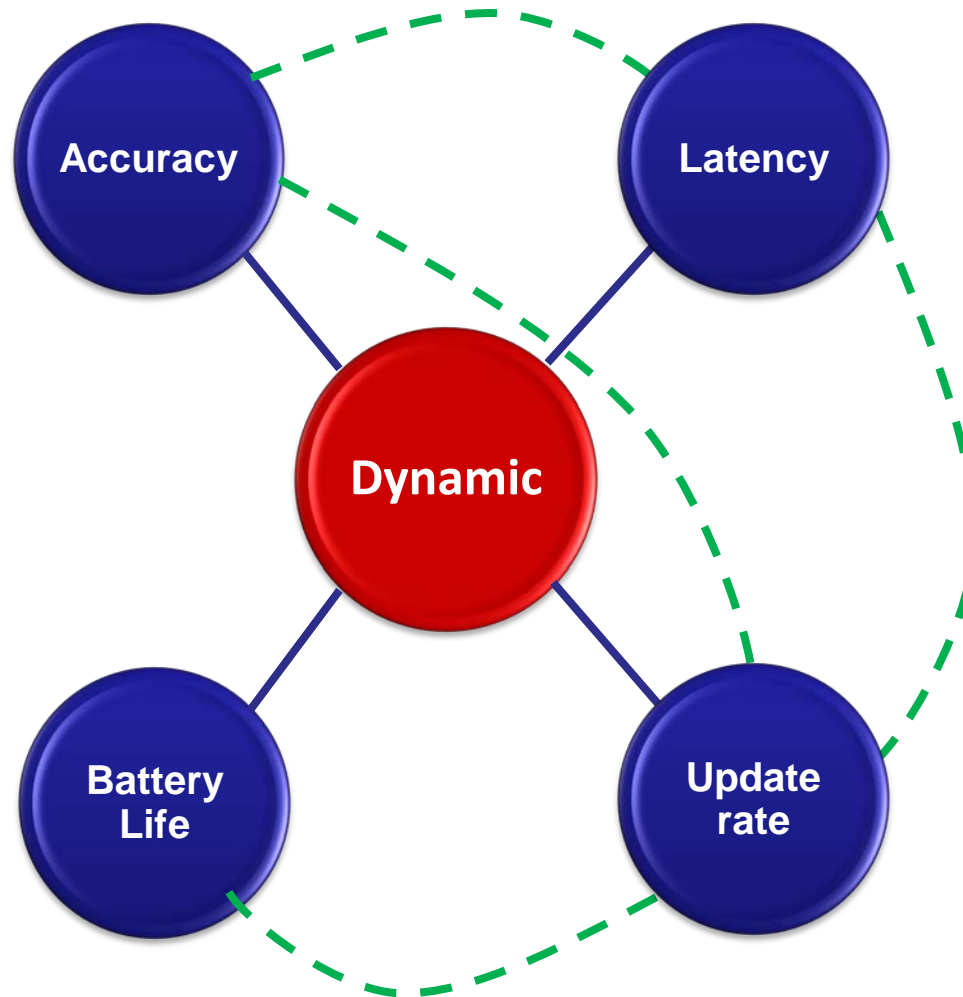
The background features three overlapping spheres, each rendered with a fine grid of light blue lines. The spheres are positioned horizontally across the page, with the middle one being the most prominent and slightly offset to the right.

Considerations of Acoustic positioning systems

Acoustic Positioning Systems



Acoustic Positioning Systems



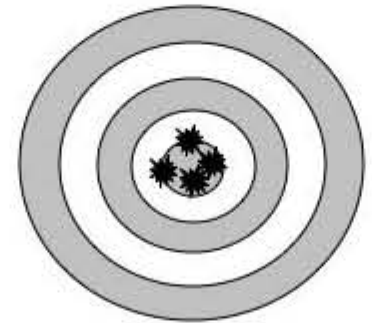
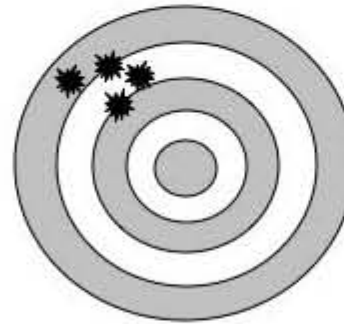
Accuracy

Accuracy is the closeness of the calculated position to the true position

Accurate Measurement = Accurate Position?

Dependent on many variables

- Sound velocity
- Geometry
- Range measurement accuracy
- Latency
- Update rate
- Calculation method



Accuracy - Sound Velocity



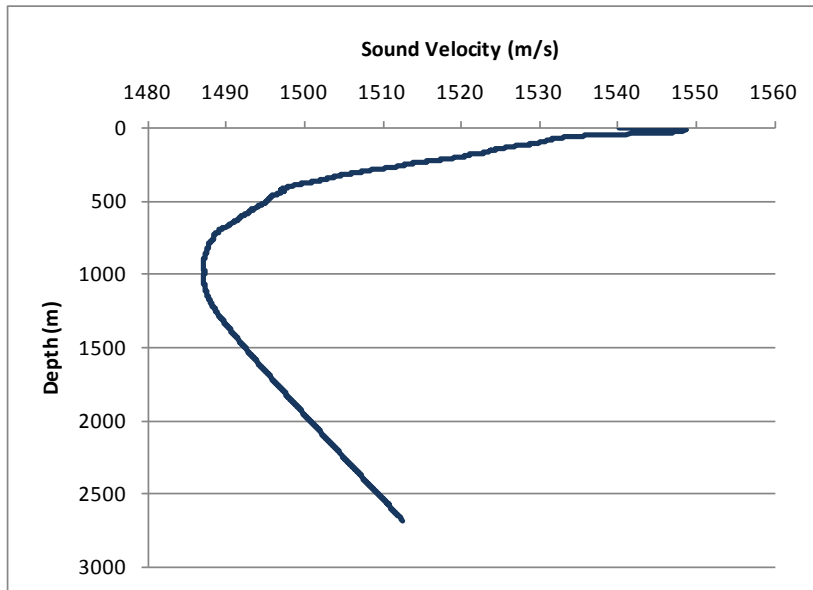
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Acoustic systems measure distances (and sometimes angles)

Distance = time x speed (velocity)

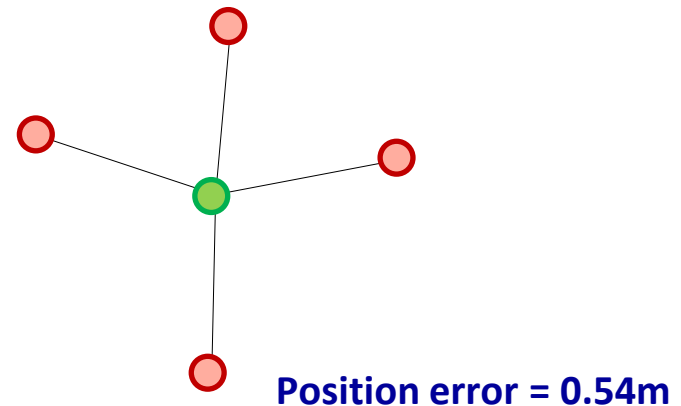
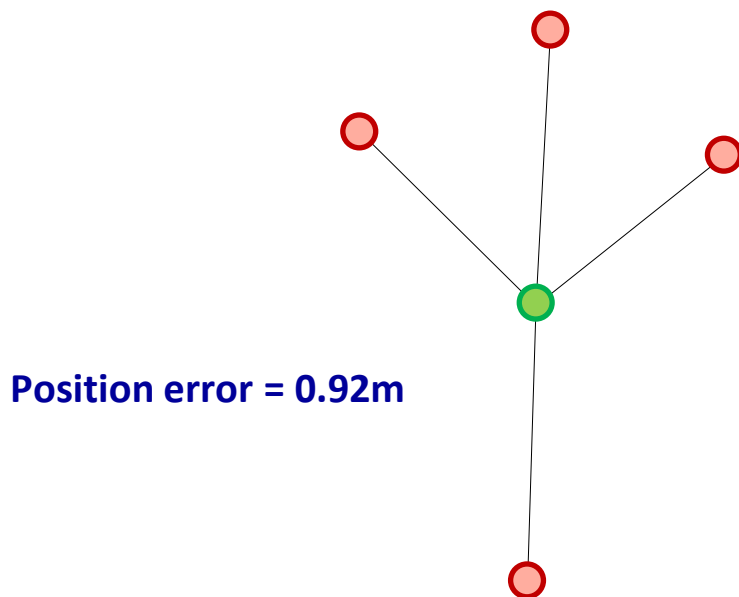
SV in water approx 1500m/s

- Travel time 4 seconds in 3000m water



Accuracy - Geometry

- Poor geometry doesn't mitigate against range errors
- Hypothetical Example – assuming a 2m range error common to all ranges



Update Rate



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The frequency with which new positions are generated from new data

- Provides more accurate dynamic positioning
- Increases consistency between sensors - reduces DP alarms!
- Improves fuel economy
- Allows increased weighting of acoustics in DP system

Workarounds

- Add additional, relative, sensors to 'fill in the gaps'
 - Use 'stacking' of acoustic pulses in the water column
-

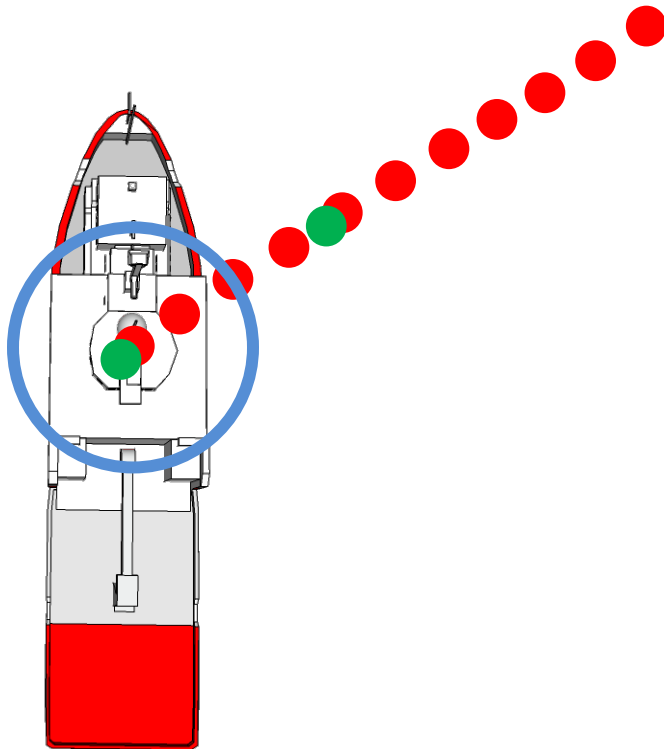
Update rate effects on DP

Vessel drive-off scenario

Delay in acoustic position means DP rejects solution

Can make drive-off worse if GPS has a problem

Correct acoustic solution rejected



Latency

“The time delay between the moment something is initiated, and the moment one of its effects begins.”

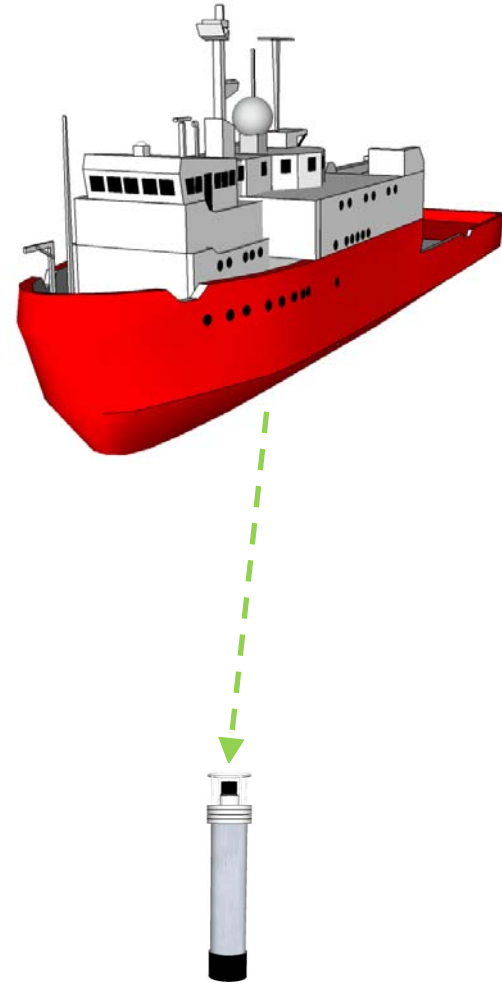
Effectively the age of the position

An accurate but latent measurement can lead to an inaccurate position



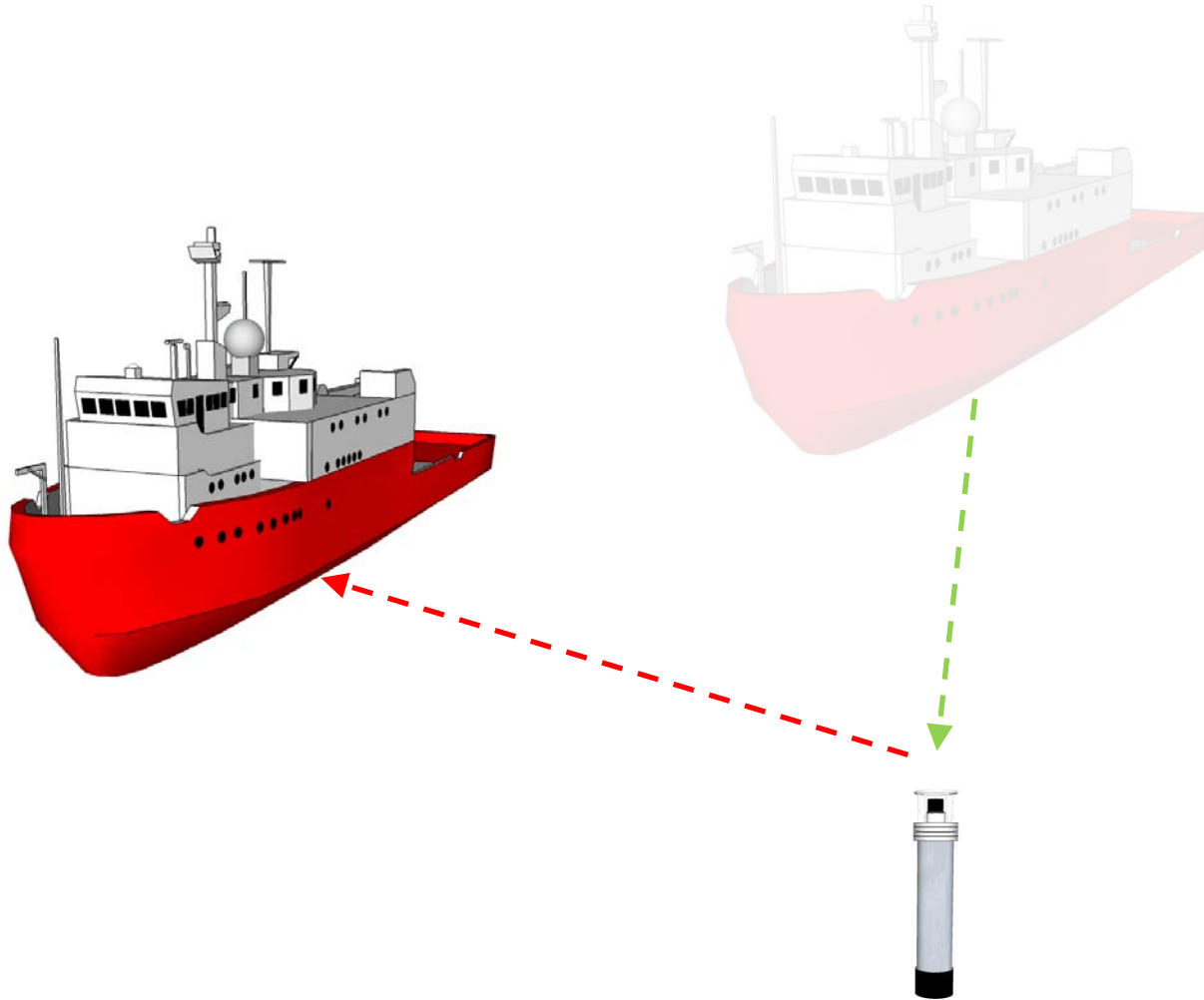
Latency

Interrogation



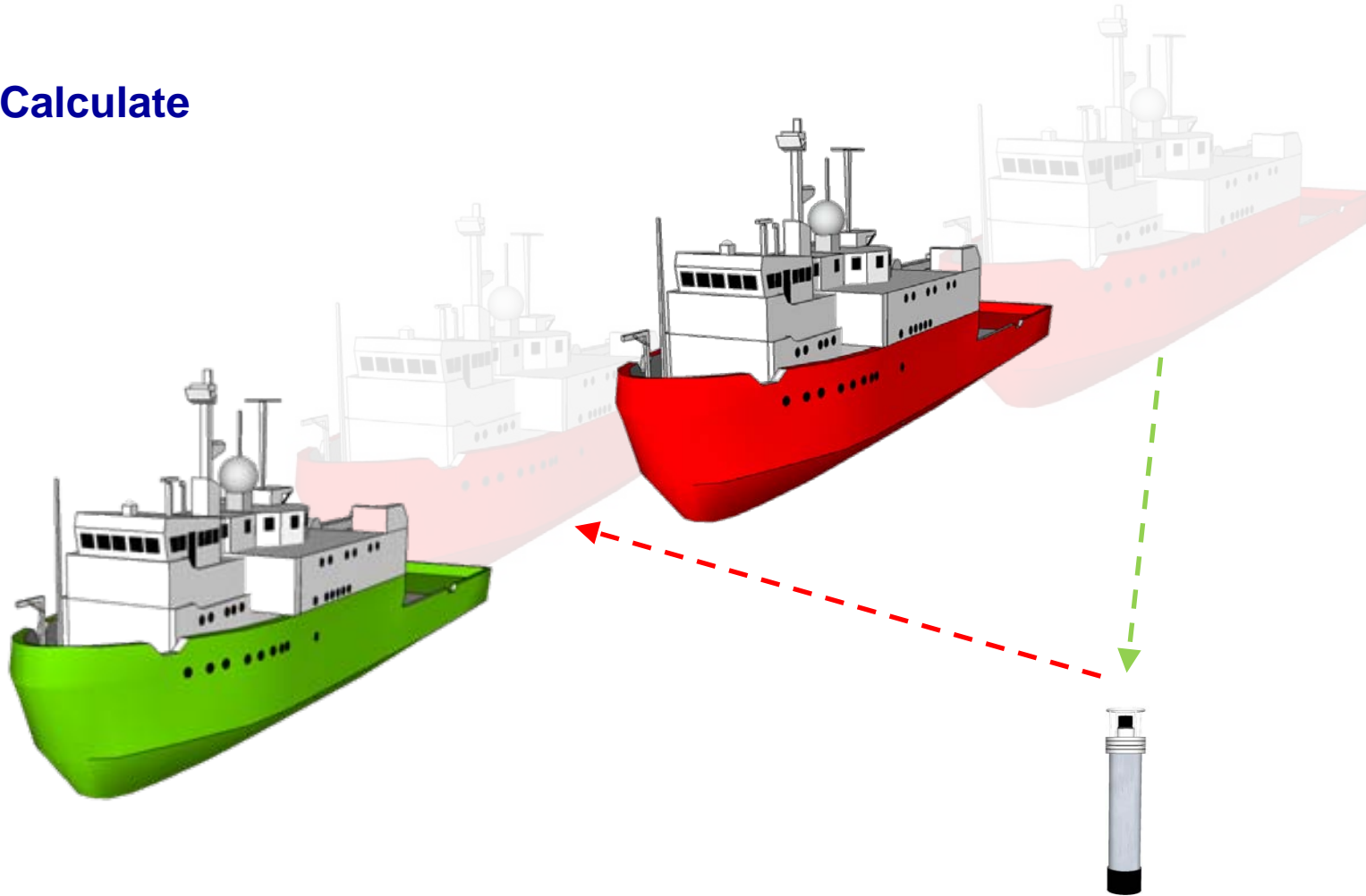
Latency

Reply



Latency

Calculate



Battery Life



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Battery life is approximately inversely proportional to power used

Therefore

- **As volume and/or transmission rate goes up**
- **...battery life goes down**

Reasons:

- **Acoustic Noise**
- **Carelessness**
- **Multiple users (interrogators)**

How do we make best use of the energy contained within the batteries?

Battery Life



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Smart adjustment of power

- **Topside adjusts transponder power based on received S/N value**
- **Not good for multiple users of a transponder**

Efficient and reliable signalling technology

- **Spread spectrum – various flavours**
- **Prioritise from: distance, reliability & data transfer rate**

More efficient use of each transmission – multiple users

The background features three overlapping, semi-transparent wireframe spheres. Each sphere is composed of a grid of small squares, creating a mesh-like appearance. The spheres are arranged in a row, with the middle one slightly behind the other two, creating a sense of depth. The overall color palette is light blue and white.

**NASNet® -
Nautronix Acoustic Subsea
Network**

NASNet® - The Concept

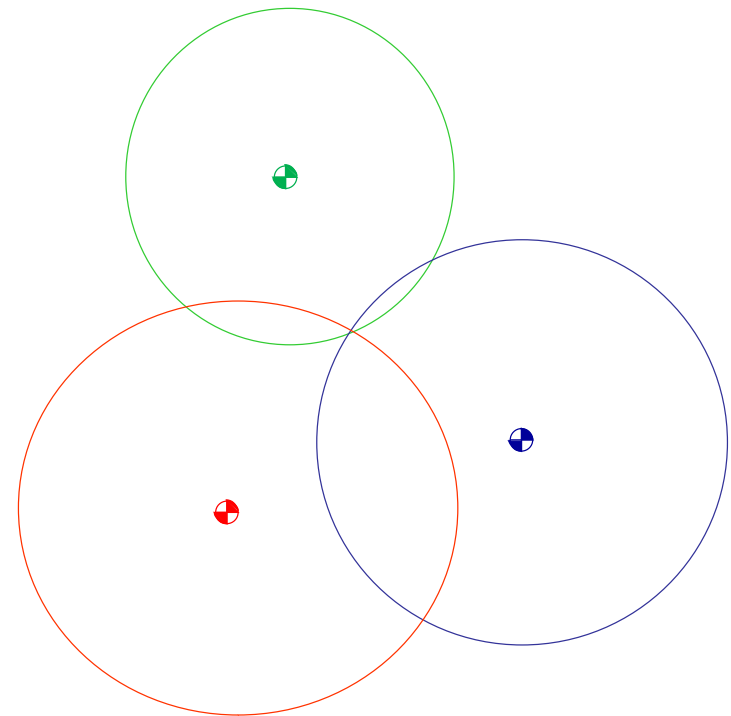


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Acoustic Long Baseline (LBL) subsea positioning system

- Long range
- High accuracy
- True multi-user
- High signal integrity

- Stations are deployed on the seabed like traditional systems
- Ranges measured from multiple Stations to mobile objects
- Positions calculated from range measurements



Station broadcast 'transmit only' technique

- Passive receive allows multiple simultaneous users (no 'Frequency Management')
- High update rates for all positioned objects (1-2 seconds)

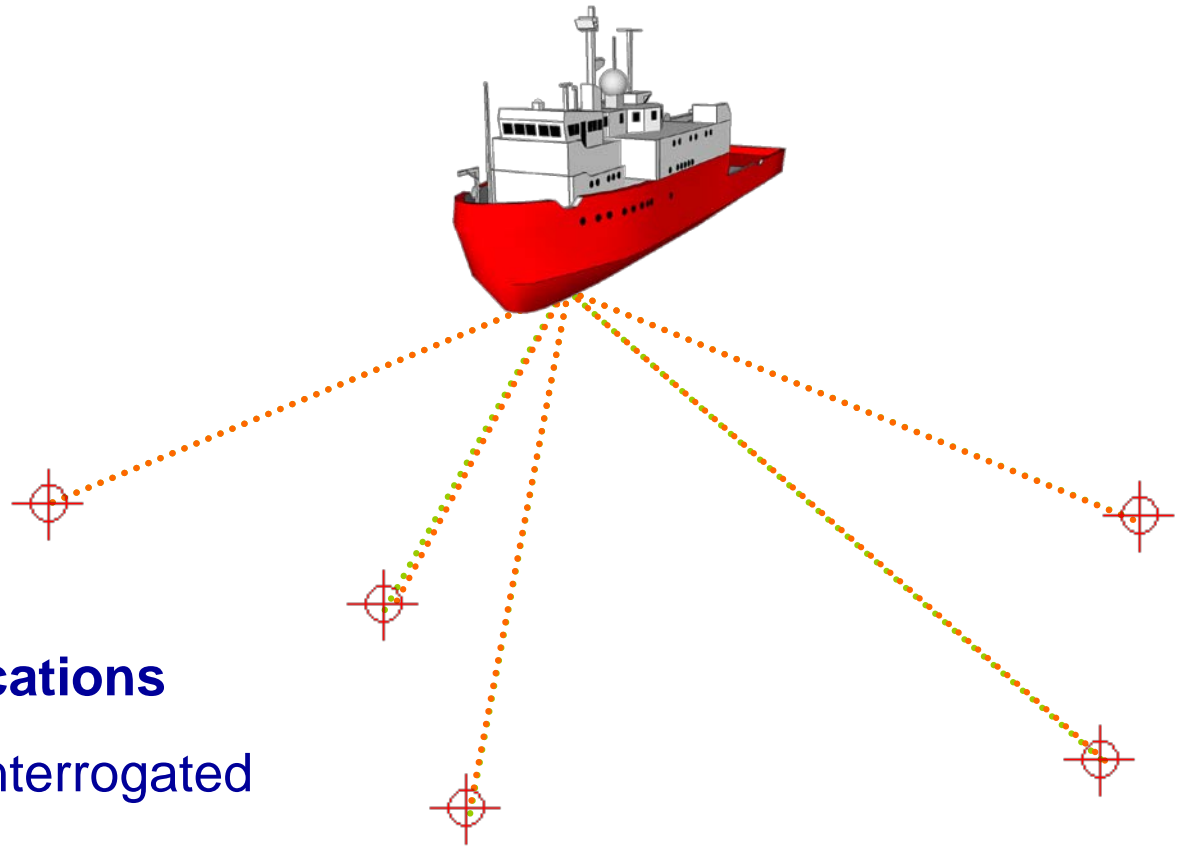
ADS² (Acoustic Digital Spread Spectrum) signalling

- Low Frequency reduces signal loss to absorption
- Accurate distance measurements and positioning
- Increased reliability with no interference to/from other systems

Long range capability

- Reduced numbers of seabed assets
 - Time and cost savings for installation, calibration and maintenance
-

Traditional LBL Concept

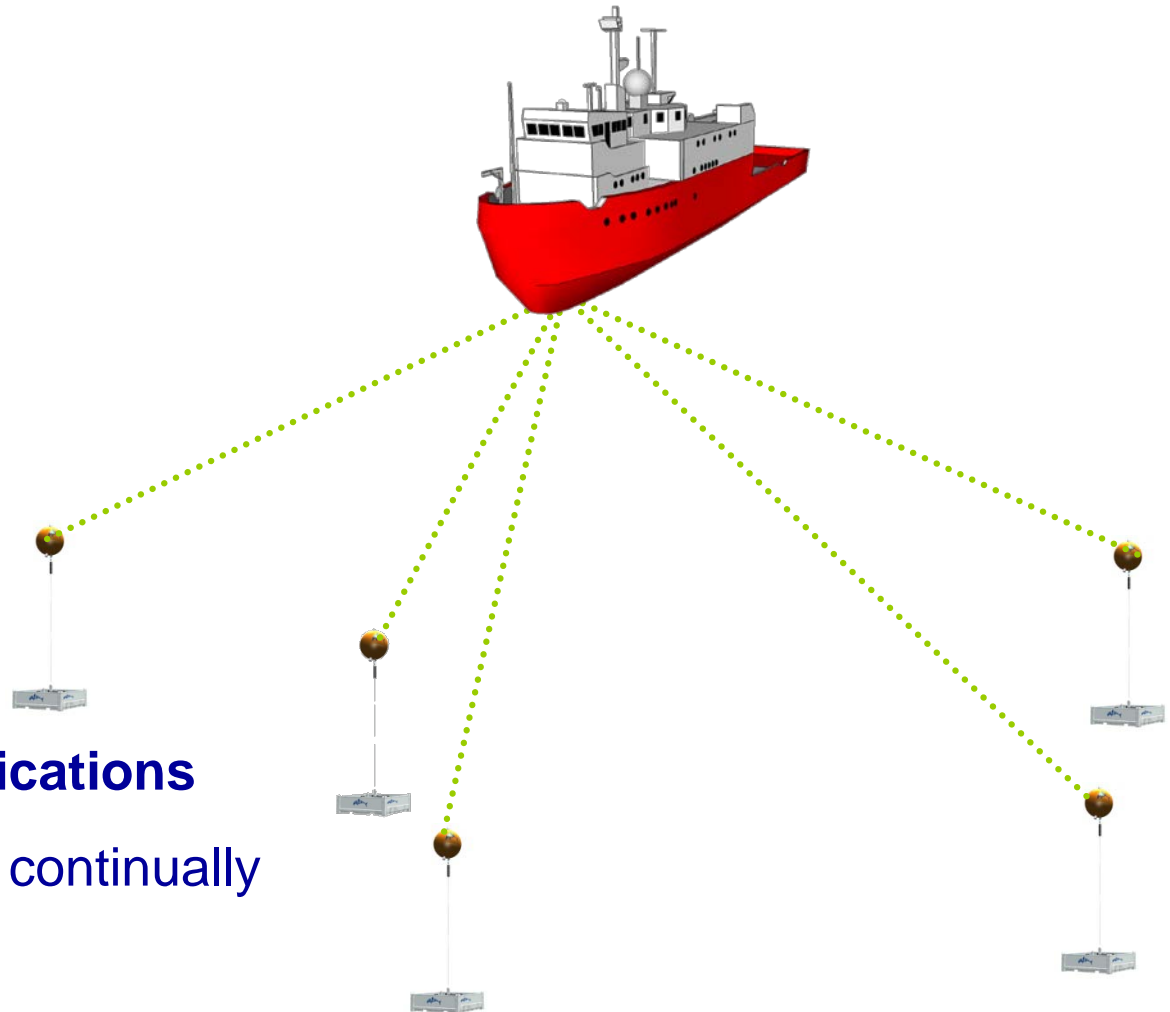


- **Two way communications**
 - Station has to be interrogated before transmitting

NASNet® Concept



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- **One way communications**
 - Station transmits continually

NASNet® DPR Approach



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LBL array of seabed units – Stations or Mini Stations






When turned on, Stations transmit without interrogation

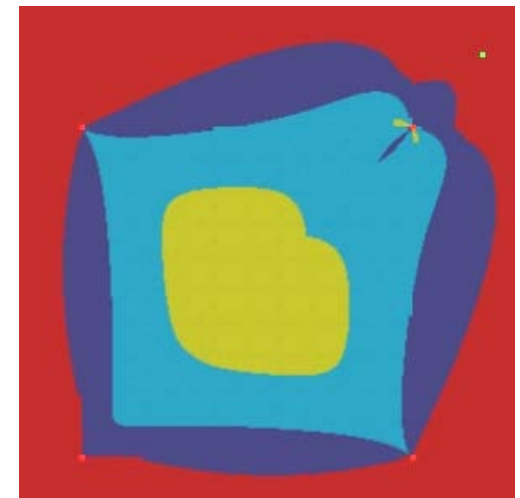
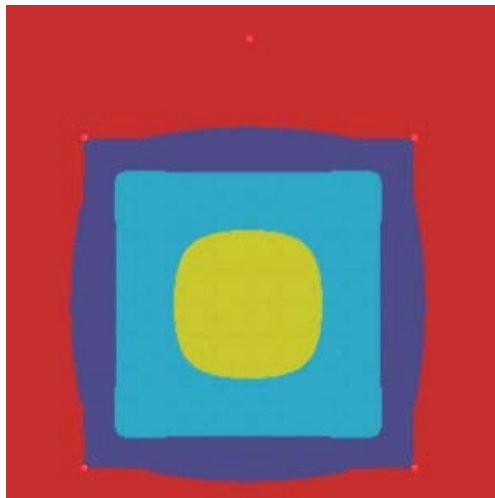
- **Battery**
 - Multiple receivers can use the same signal
 - Advanced digital signalling techniques
 - **Latency**
 - One way ranges correct at moment of reception
 - **Update rate**
 - Position recalculated on reception of new range
 - **Accuracy**
 - QC information fed back to user
 - Geometry monitored by system
-

Geometric Support - GSUP

Example values

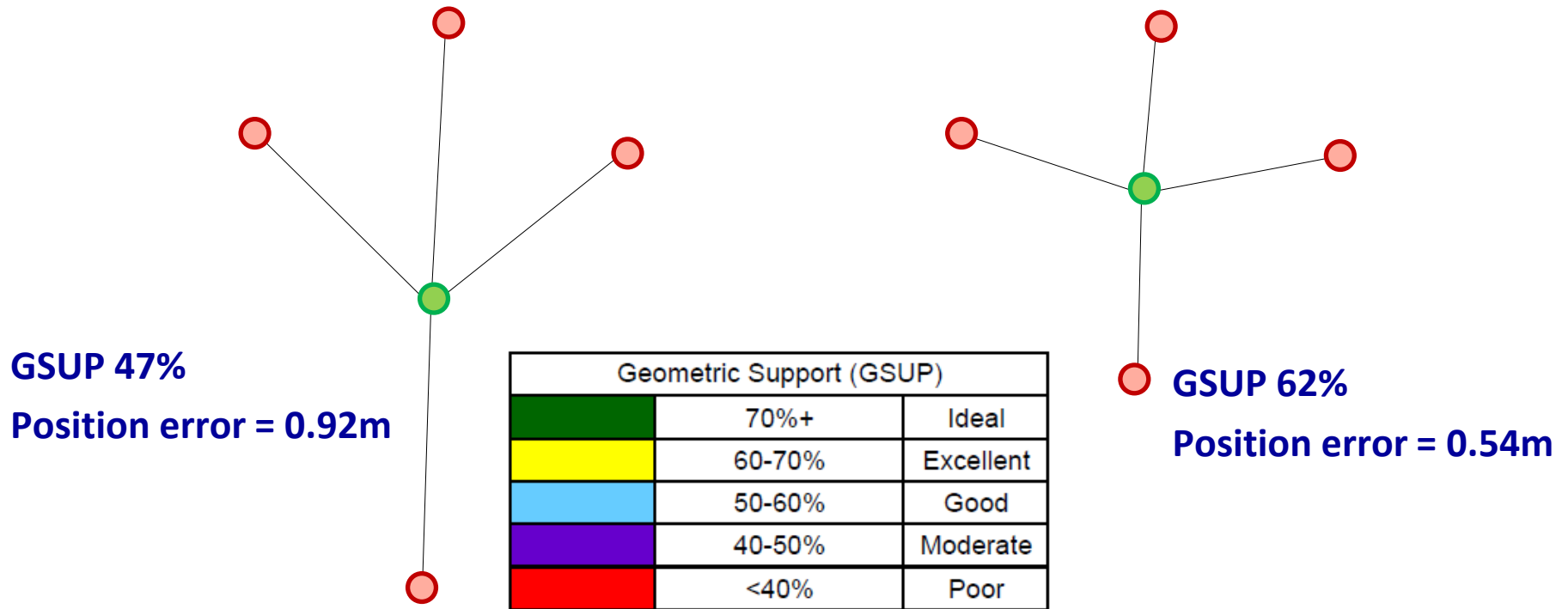
- Centre of equilateral triangle = 41%
- Centre of Square = 63%
- Outside of array extents = <50%

Geometric Support (GSUP)		
	70%+	Ideal
	60-70%	Excellent
	50-60%	Good
	40-50%	Moderate
	<40%	Poor



GSUP example

- Hypothetical Example Revisited – assuming a 2m range error common to all ranges



Geometry in NASNet® DPR



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Ship

E: 747840.1
N: 2954770.1 RMS: 2.7

No Ranges: 12 HDOP: 2.0
No Stations: 5 GSUP: 75%
No Rejects: 8

● STN 1
Range: 4045.8 Res 2.8

● STN 4
Range: 3705.5 Res -66.2

● STN 5
Range: 3330.0 Res 4.1

● STN 6
Range: Res

● STN 7
Range: 3375.3 Res 2.6

● STN 10
Range: 3398.4 Res 1.8

● STN 11
Range: 5919.8 Res 2.7

Ship Positioning

Stations

- 02
- 03
- 04
- 05
- 07
- 10
- 14

Sensors

Gyro

VRU

Reference Position

S/P

F/A

Position Quality

HDOP

GSUP

Save Cancel

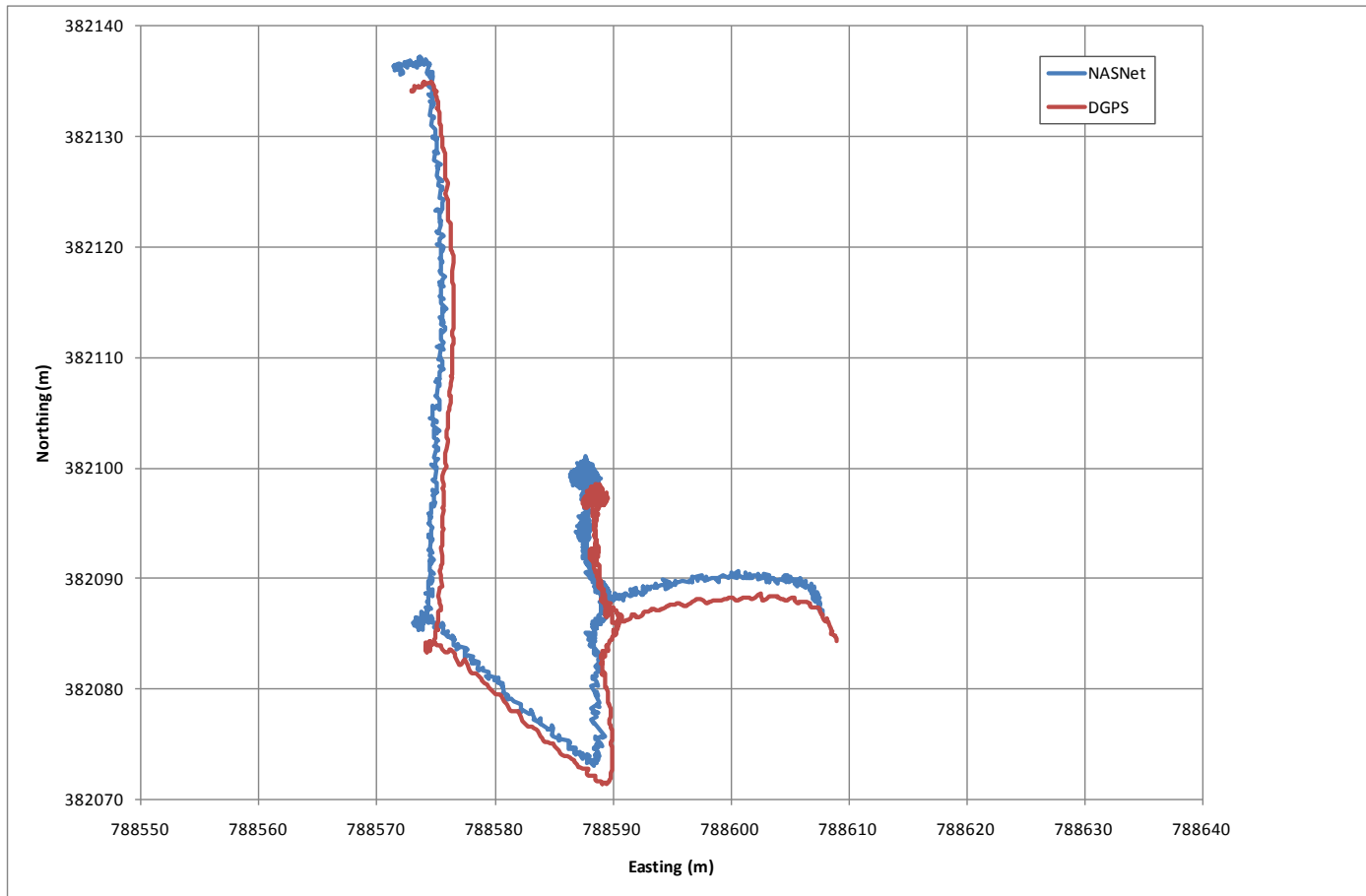
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**NASNet® -
Offshore Data Review**

NASNet® Vessel Positioning – 1500m WD



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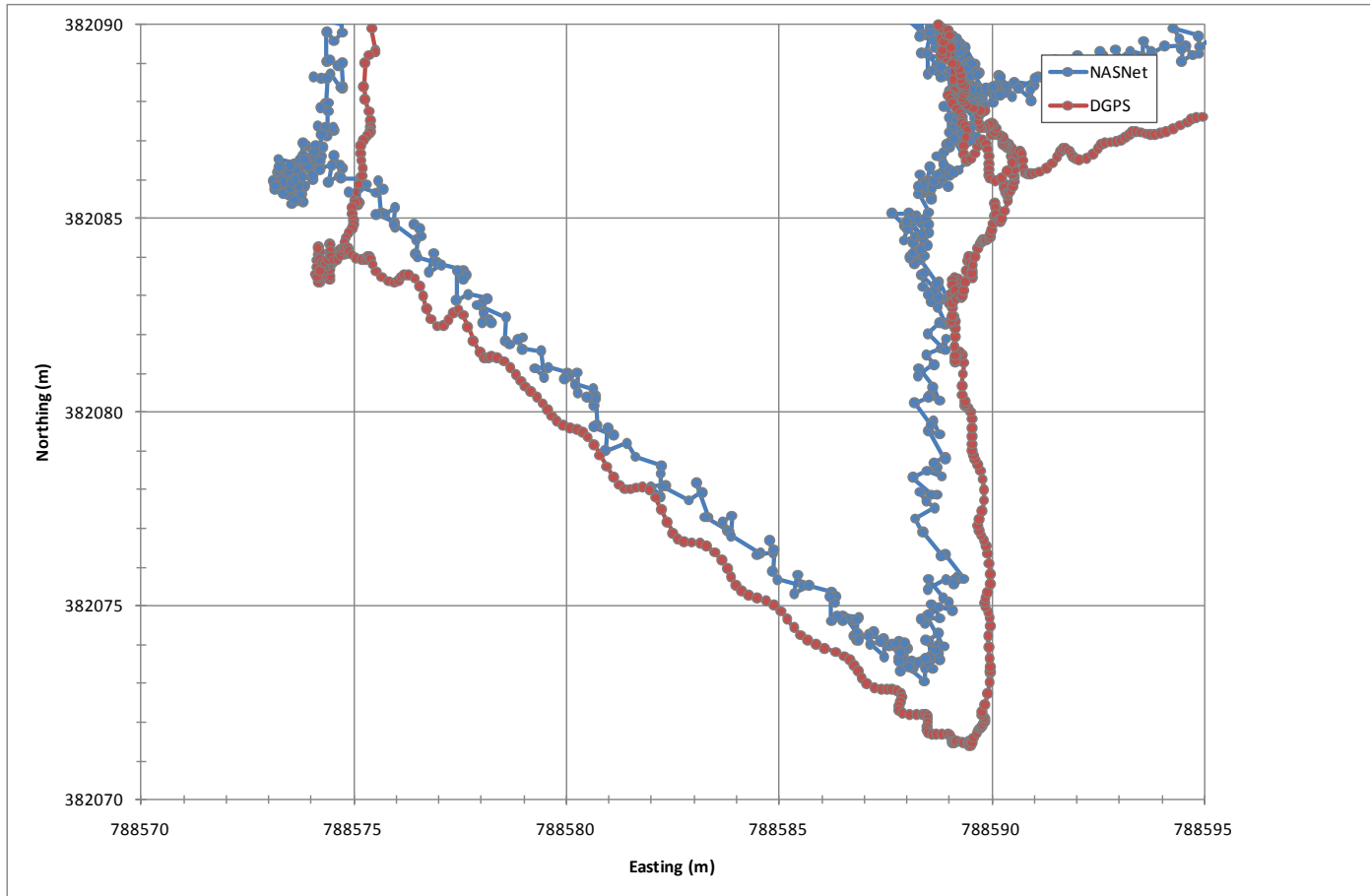
Effects of SV error and weak geometry on positioning accuracy

Stability, latency and update rate unaffected

NASNet® Vessel Positioning – 1500m WD



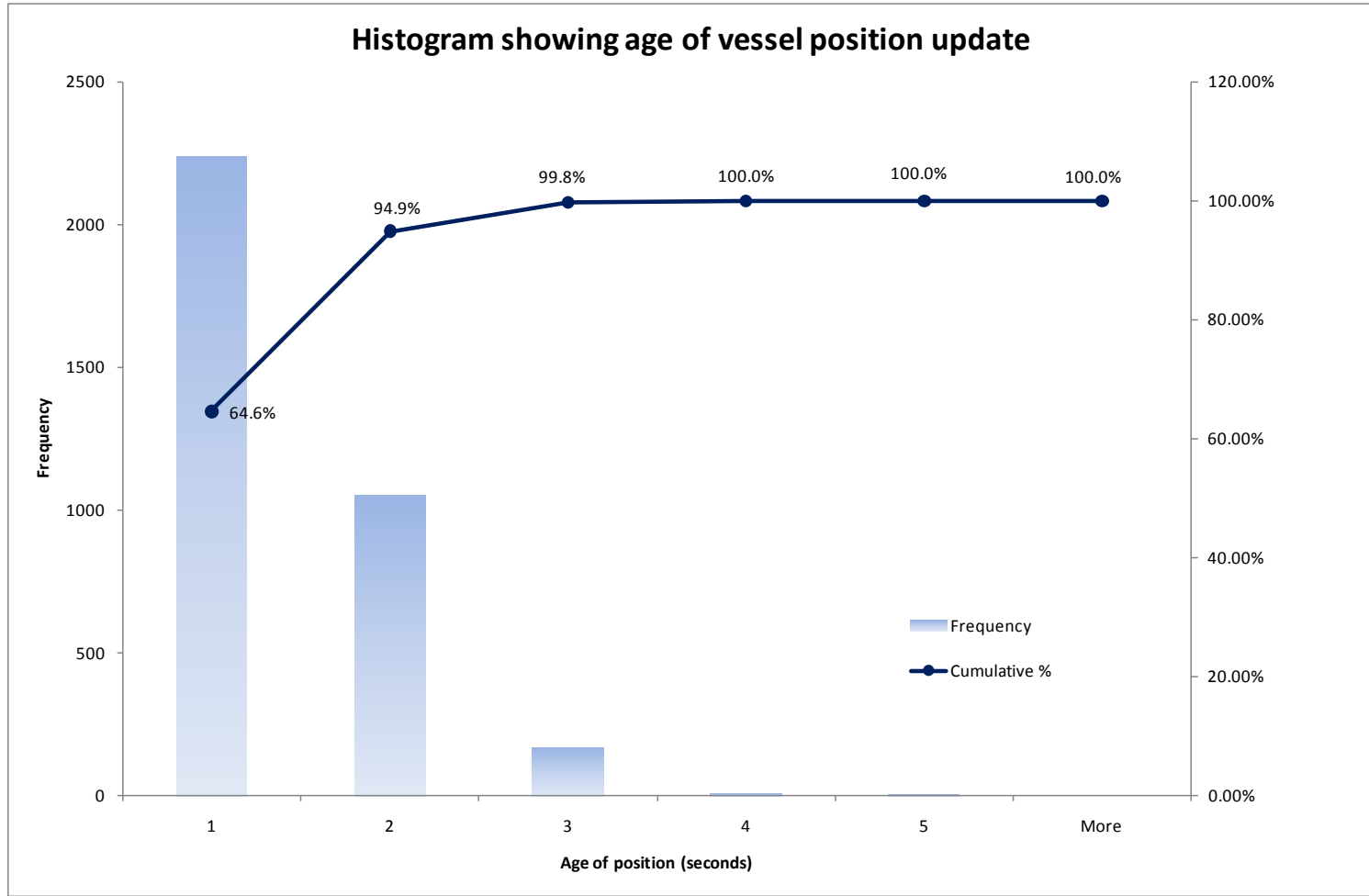
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NASNet® Vessel Positioning – 1500m WD



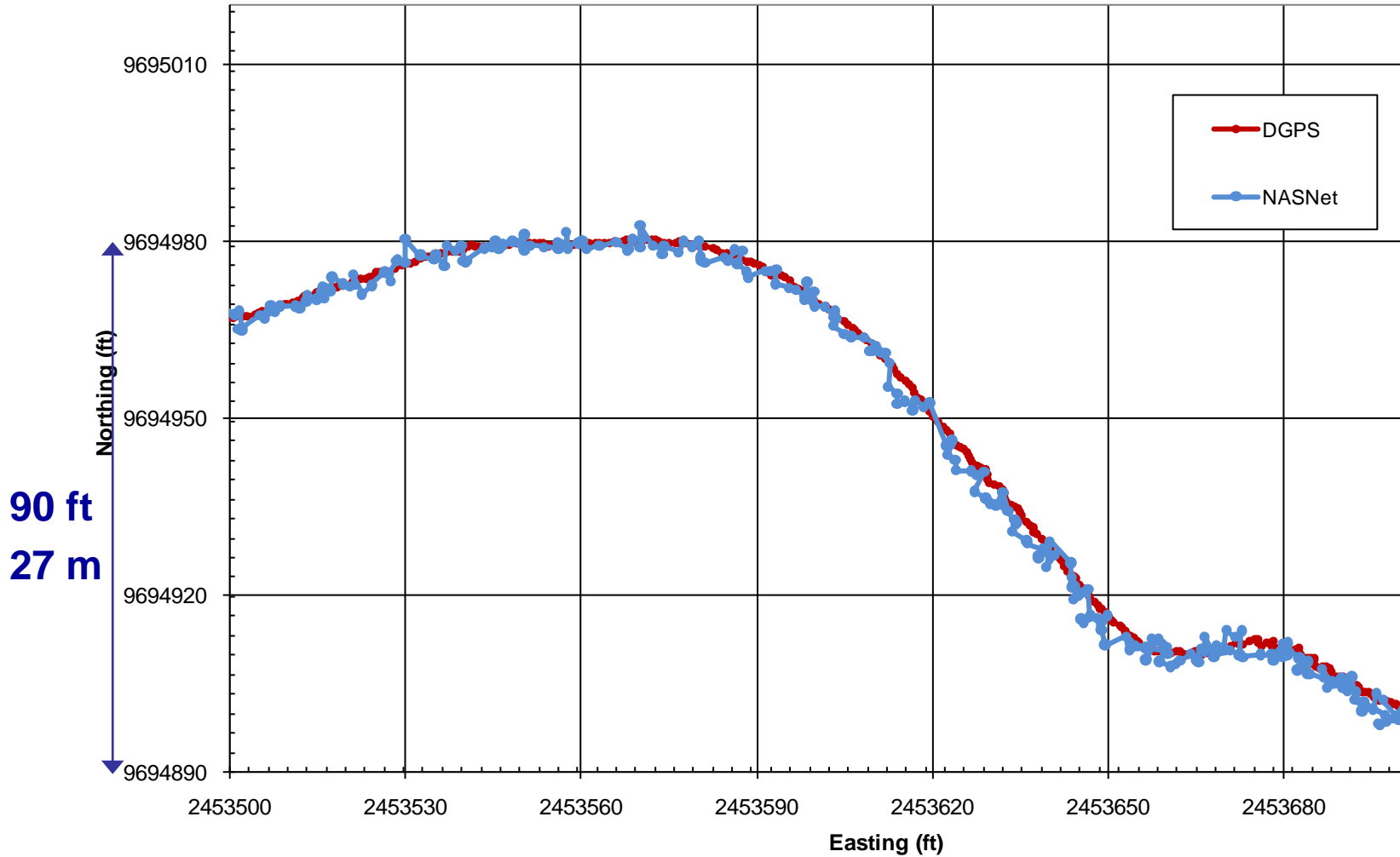
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NASNet® Vessel Positioning – 2500m WD



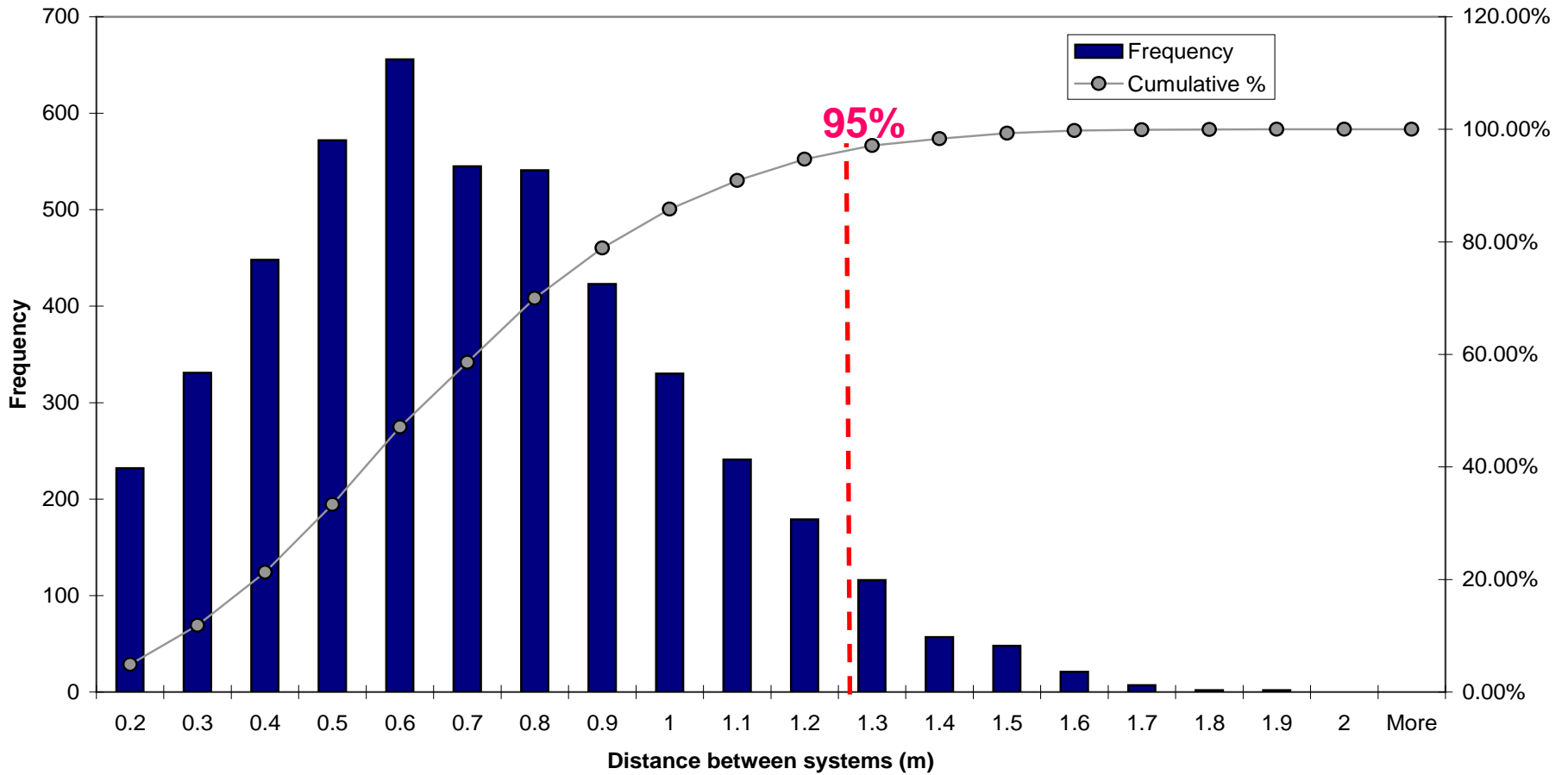
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NASNet® Vessel Positioning – 2500m WD



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Three overlapping wireframe spheres are arranged horizontally across the slide. Each sphere is composed of a grid of light blue lines. The spheres overlap in the center, creating a sense of depth and motion. The text 'Summing up' is positioned in the lower right area of the central sphere.

Summing up

In conclusion



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SIMOPS and CLOSEOPS are an increasing fact of life

Reliable positioning is essential in these scenarios

Satellite systems are good... but not perfect

Acoustics can be good, but traditional approaches have limitations in multi-user and deep water applications

NASNet® DPR provides solutions to these constraints. The result?

DP positioning back-up - satellite quality using acoustic technology

Thanks for Listening

Questions?

Aberdeen

Houston

Brazil