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

Overview

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

Offshore Positioning Introduction

Real World Challenges

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

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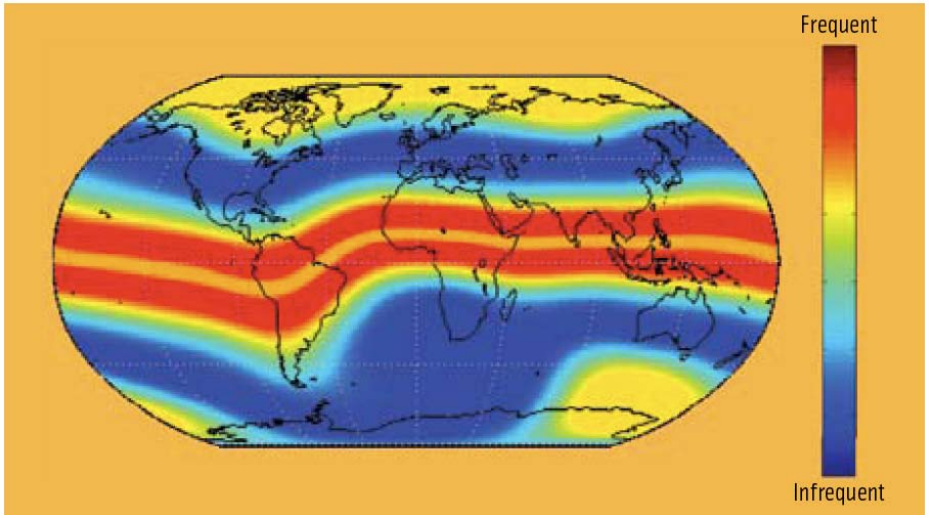
Satellites
- GPS, GLONASS, COMPASS

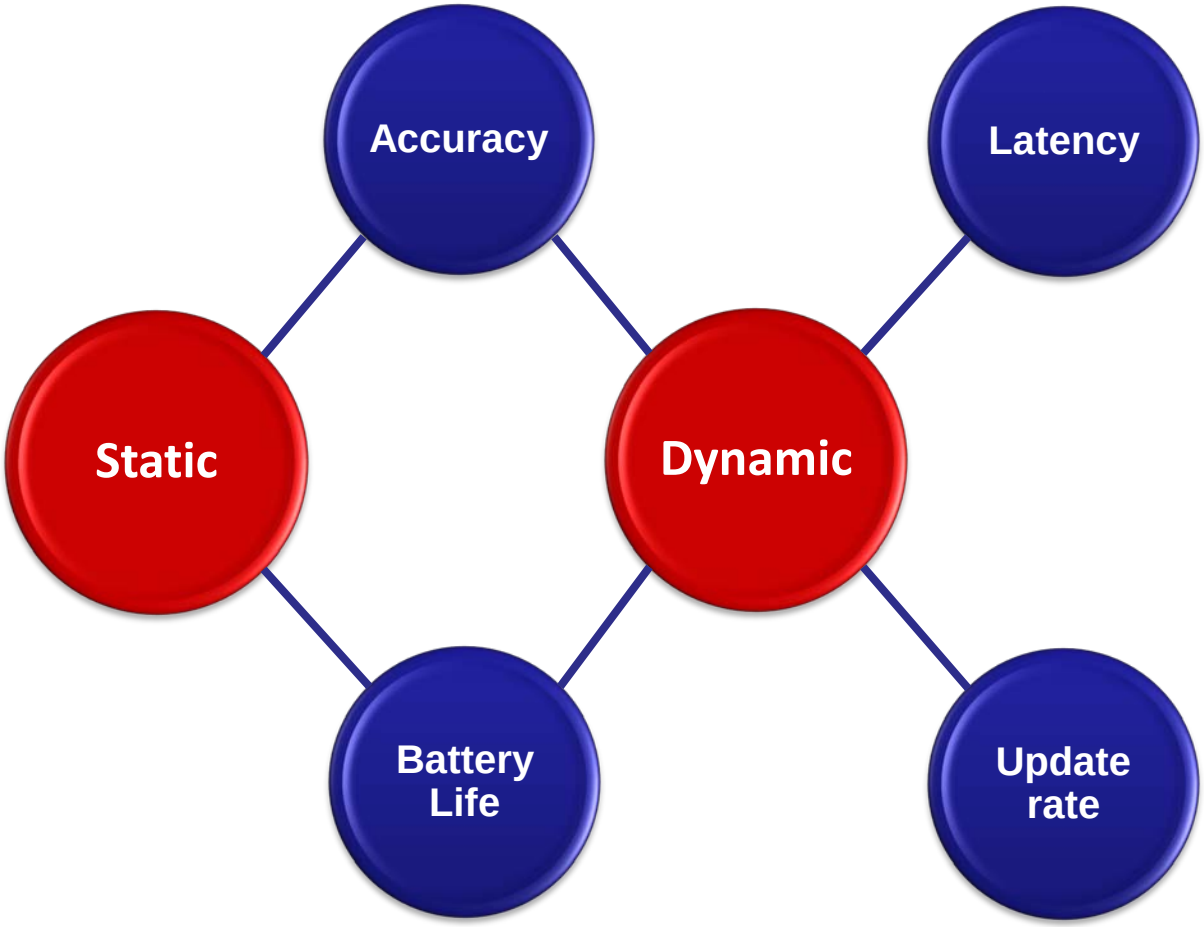
Acoustics
- LBL, SBL, USBL

Relative sensors
- Laser systems
- Radio Systems
- Inertial Navigation Systems



Considerations of Acoustic positioning systems

Acoustic Positioning Systems



Acoustic Positioning Systems

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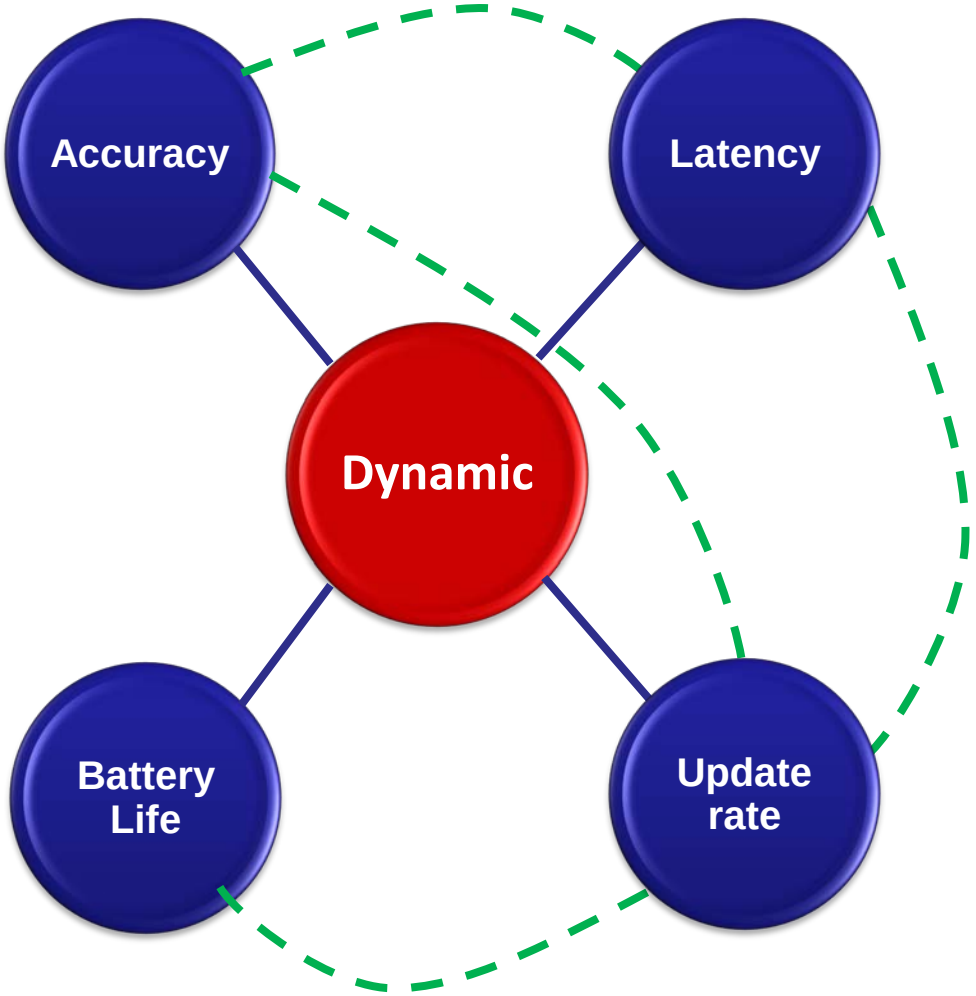
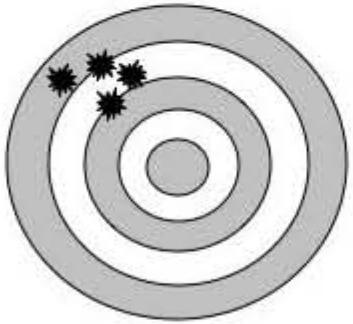
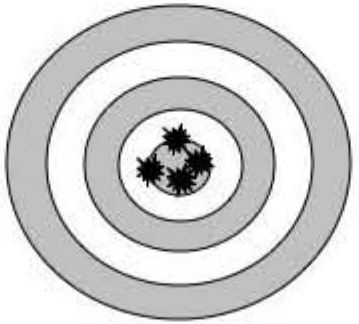


Accuracy

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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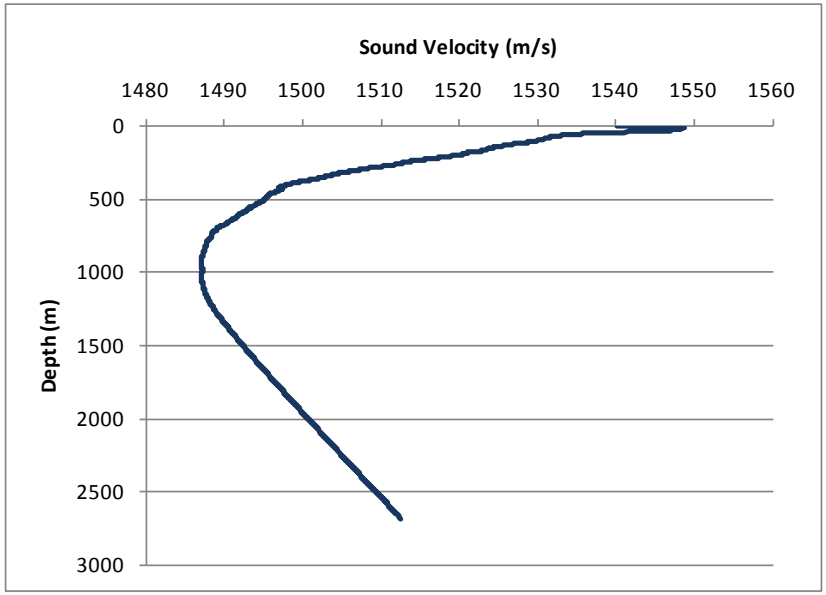
Acoustic systems measure distances (and sometimes angles)

Distance = time x speed (velocity)

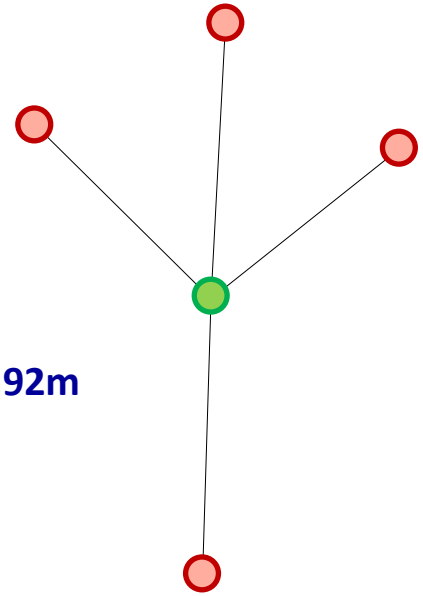
SV in water approx 1500m/s

- **Travel time 4 seconds in 3000m water**

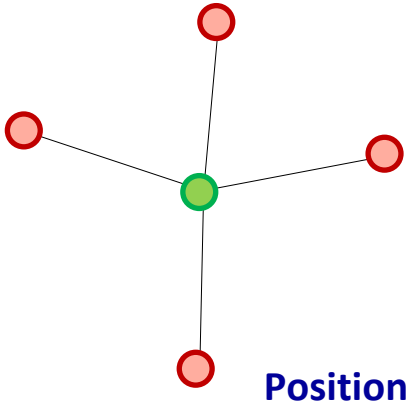


Accuracy - Geometry

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



Position error = 0.92m



Position error = 0.54m

Update Rate

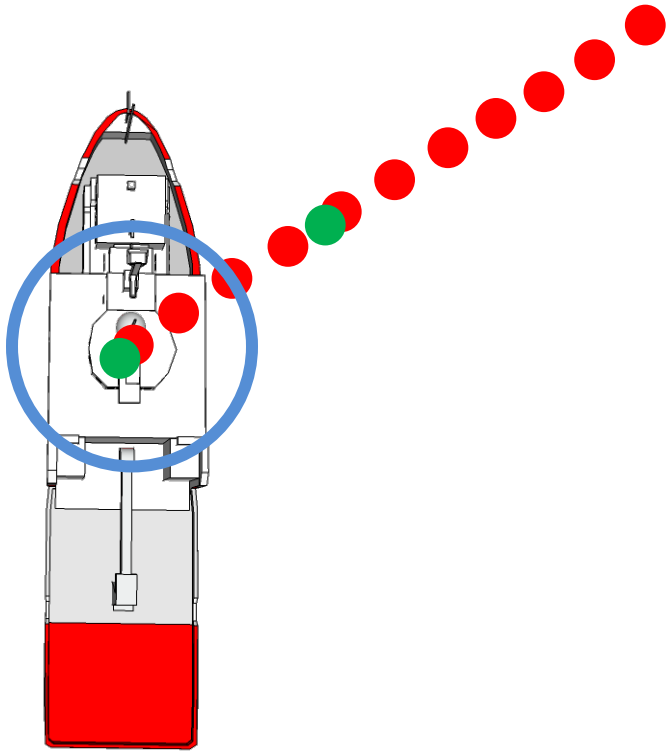
The frequency with which new positions are generated from new data

- **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

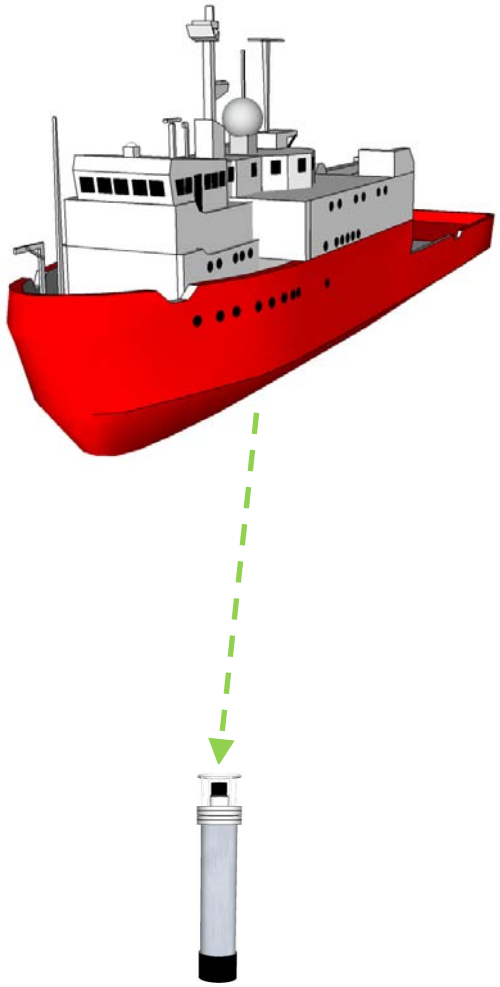
“The time delay between the moment something is initiated, and the moment one of its effects begins.”

Effectively the age of the position

An accurate but latent measurement can lead to an inaccurate position

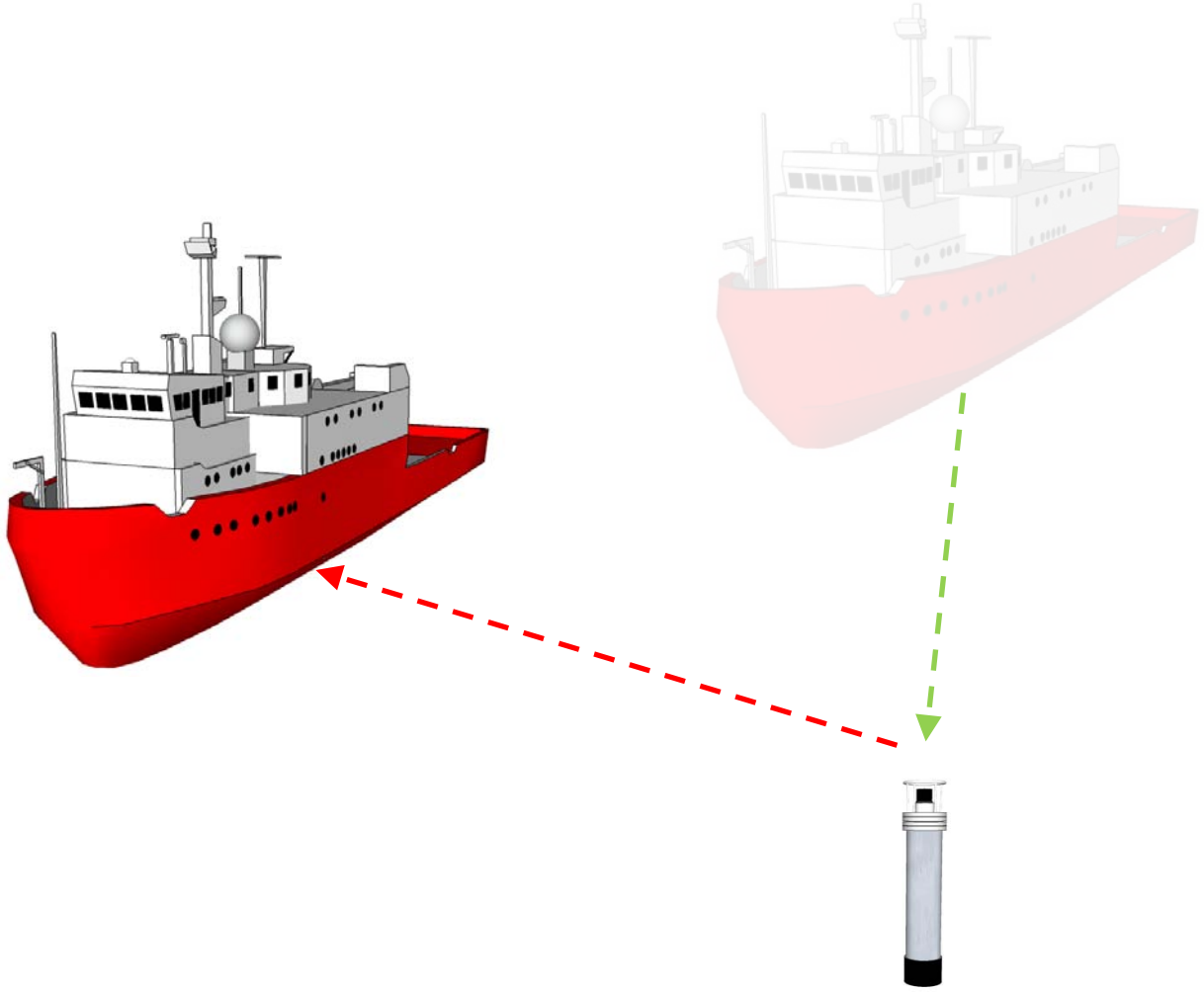
Latency

Interrogation



Latency

Reply



Latency

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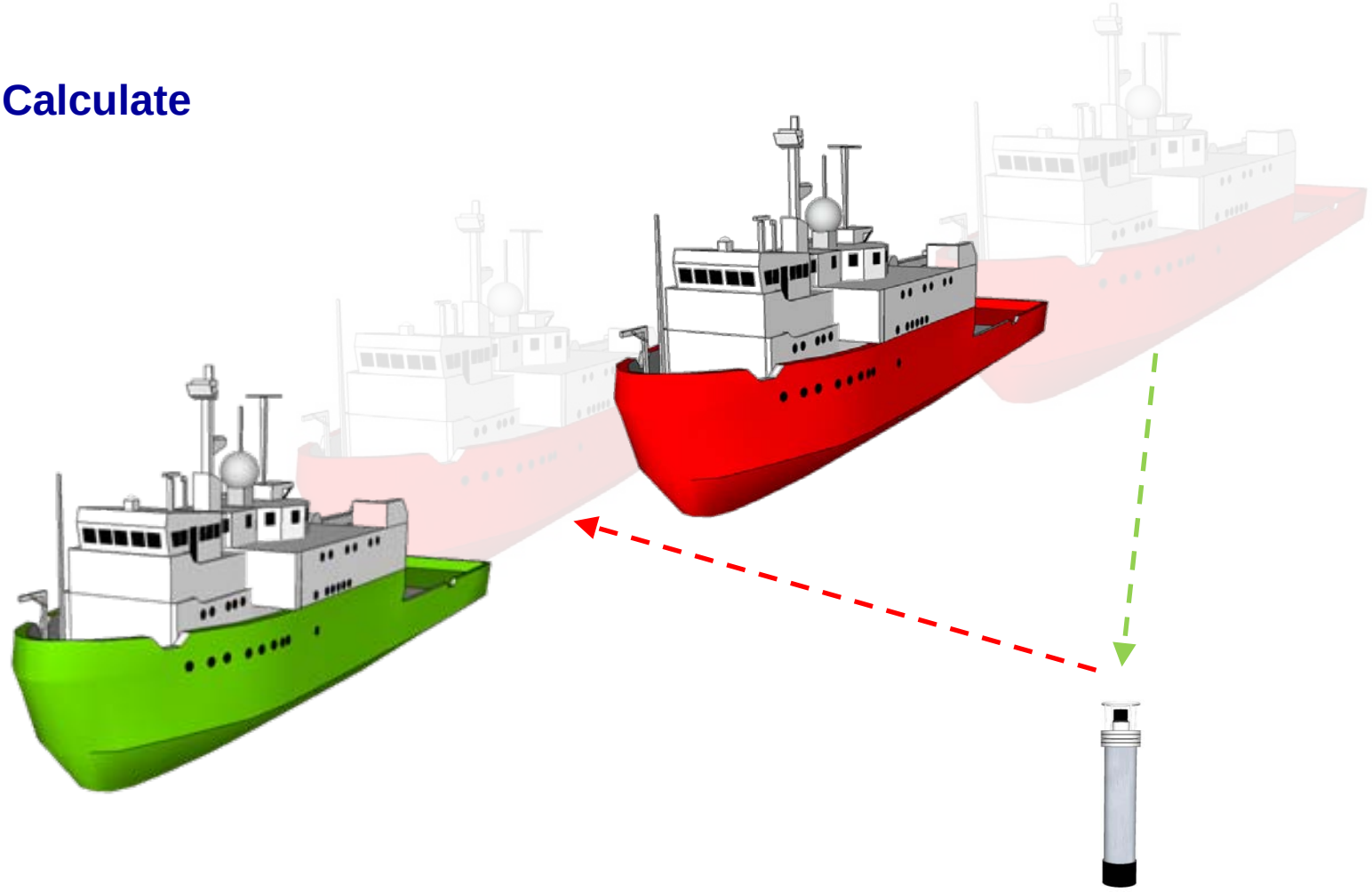
Calculate



Battery Life

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

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

NASNet® - Nautronix Acoustic Subsea Network

NASNet® - The Concept

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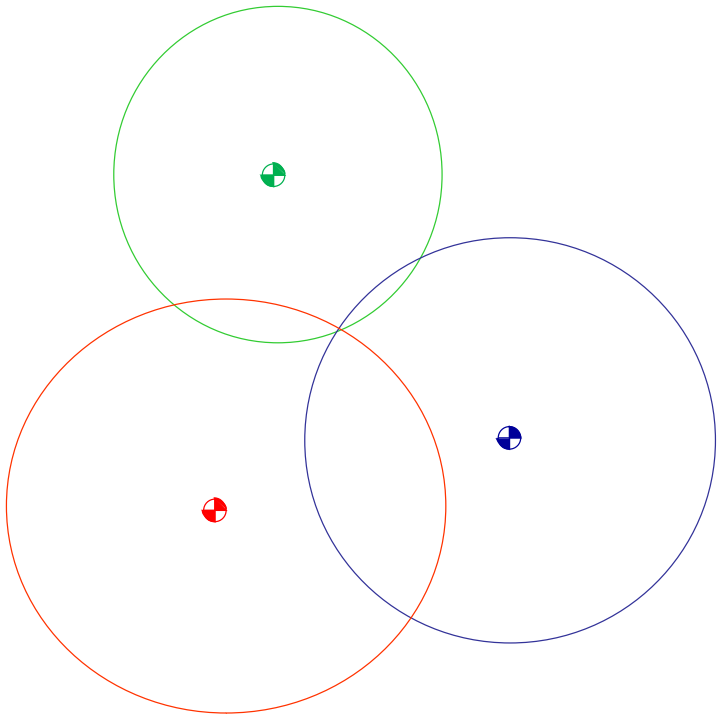
Acoustic Long Baseline (LBL) subsea positioning system

- **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**



NASNet® DPR

Station broadcast ‘transmit only’ technique

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

ADS^2 (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

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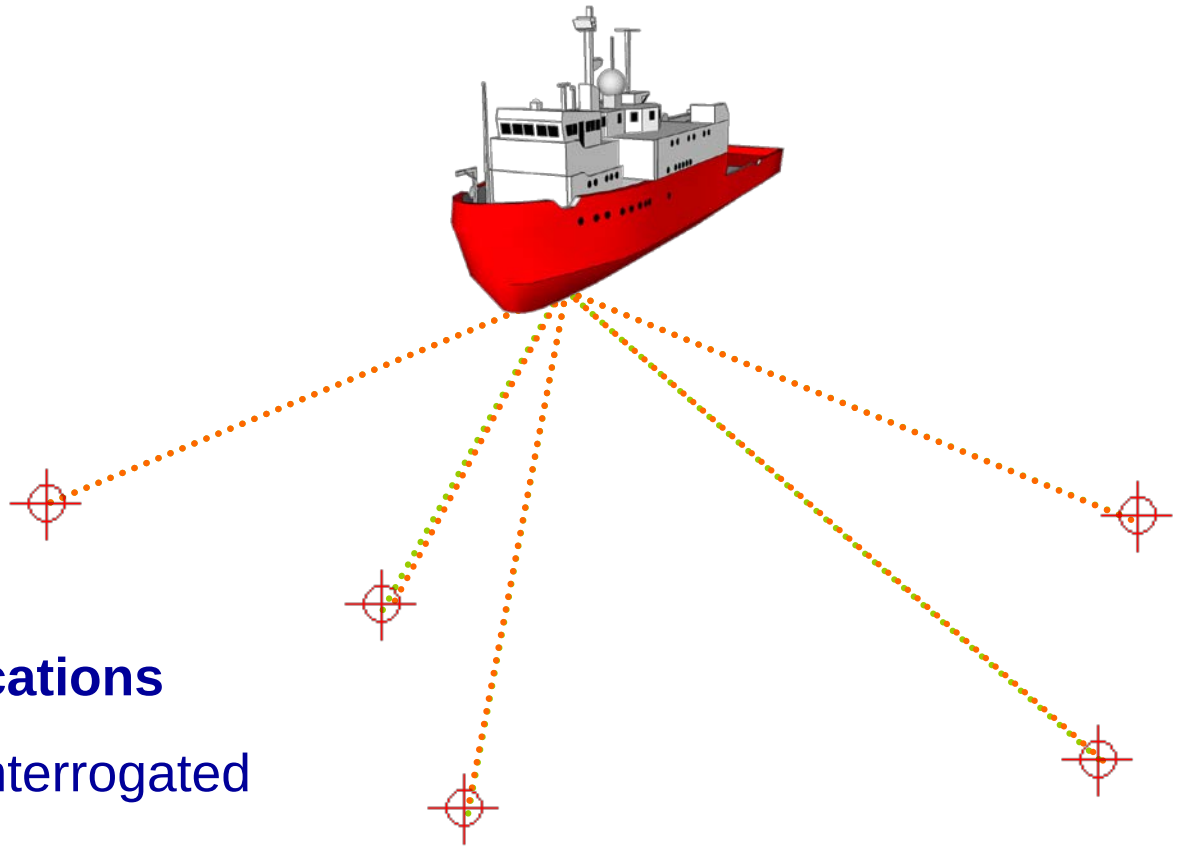

- **Two way communications**

  – Station has to be interrogated before transmitting

NASNet® Concept

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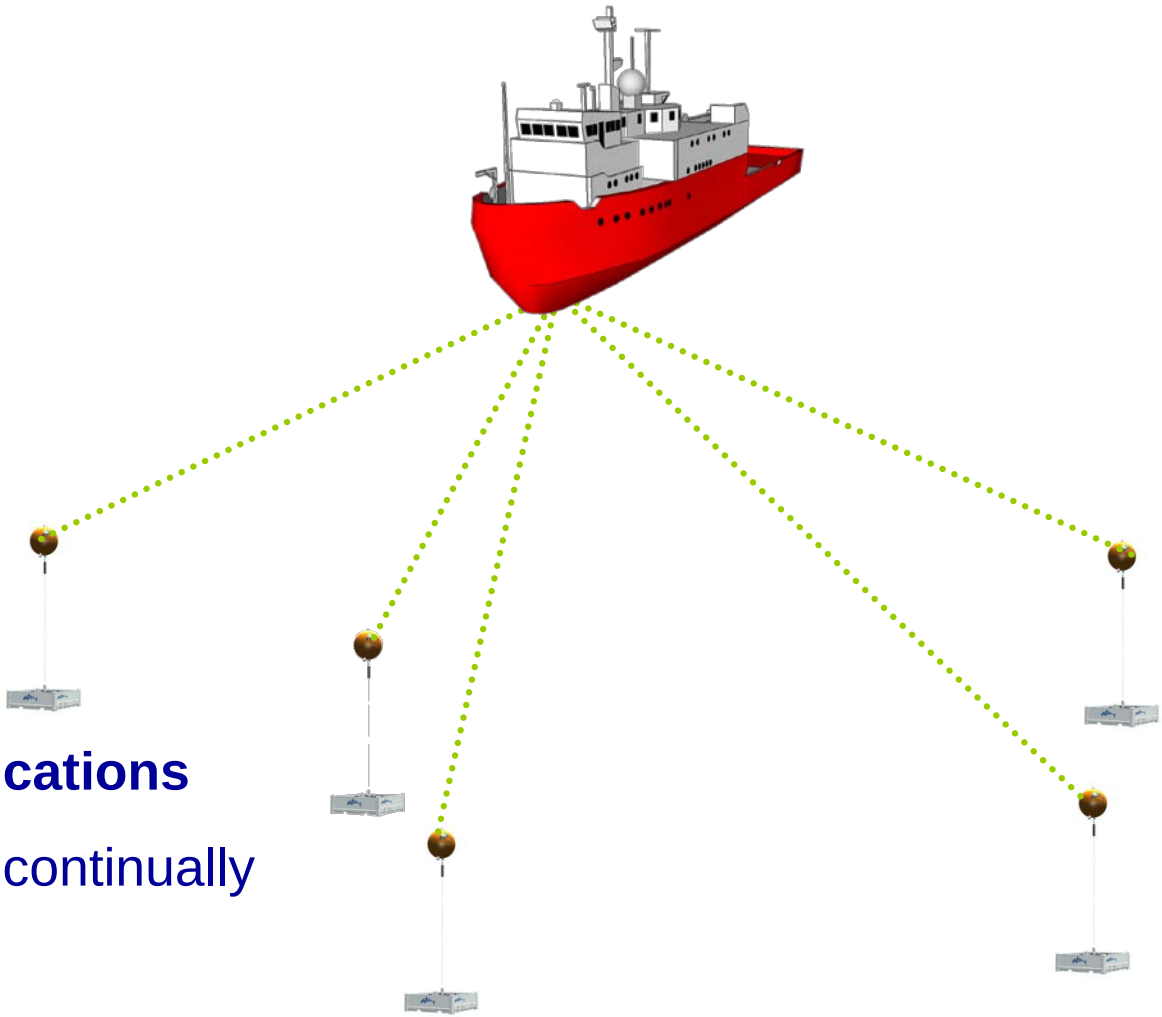

- **One way communications**
  - Station transmits continually

NASNet® DPR Approach

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

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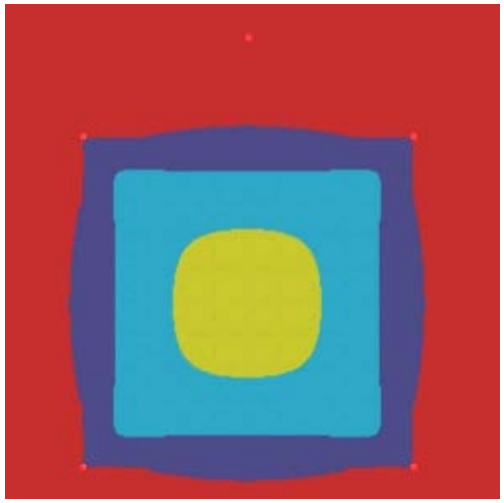
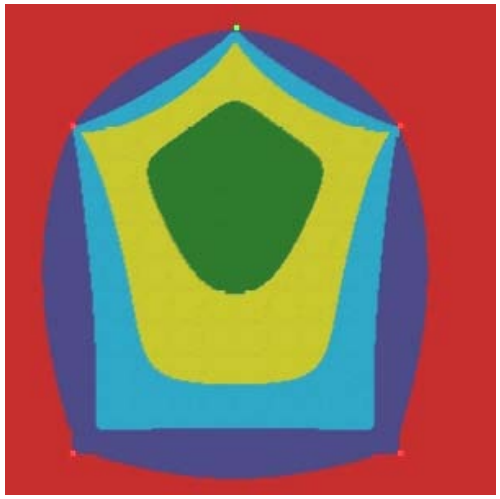
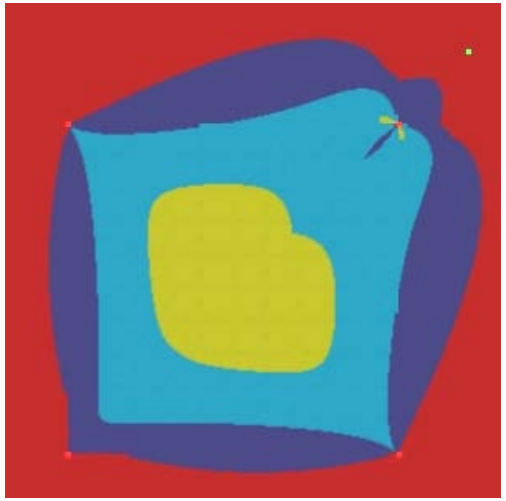
Example values

- 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

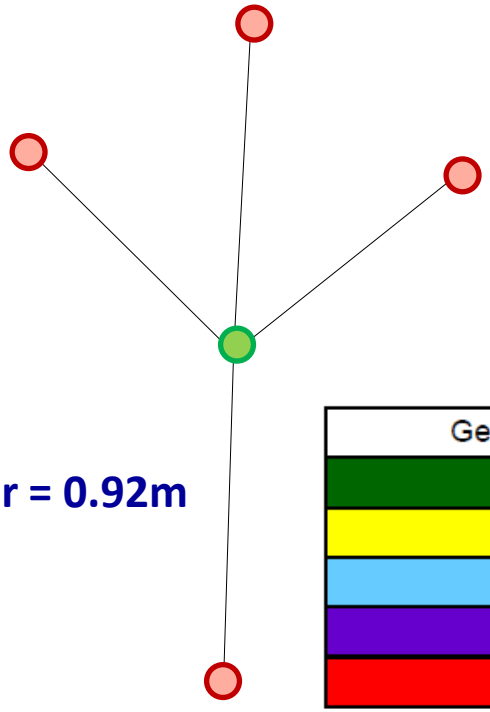






GSUP example

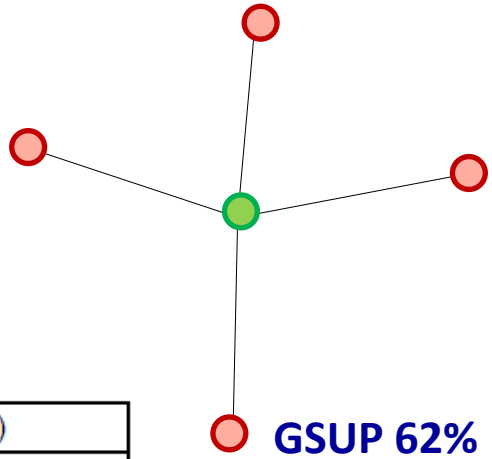
- **Hypothetical Example Revisited – assuming a 2m range error common to all ranges**



GSUP 47%

Position error = 0.92m

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



GSUP 62%

Position error = 0.54m

Geometry in NASNet® DPR

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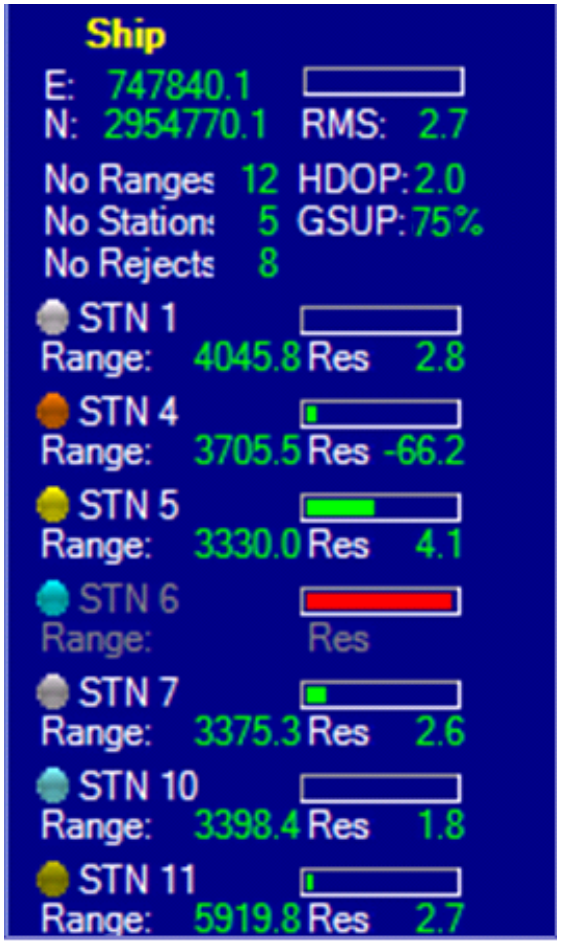

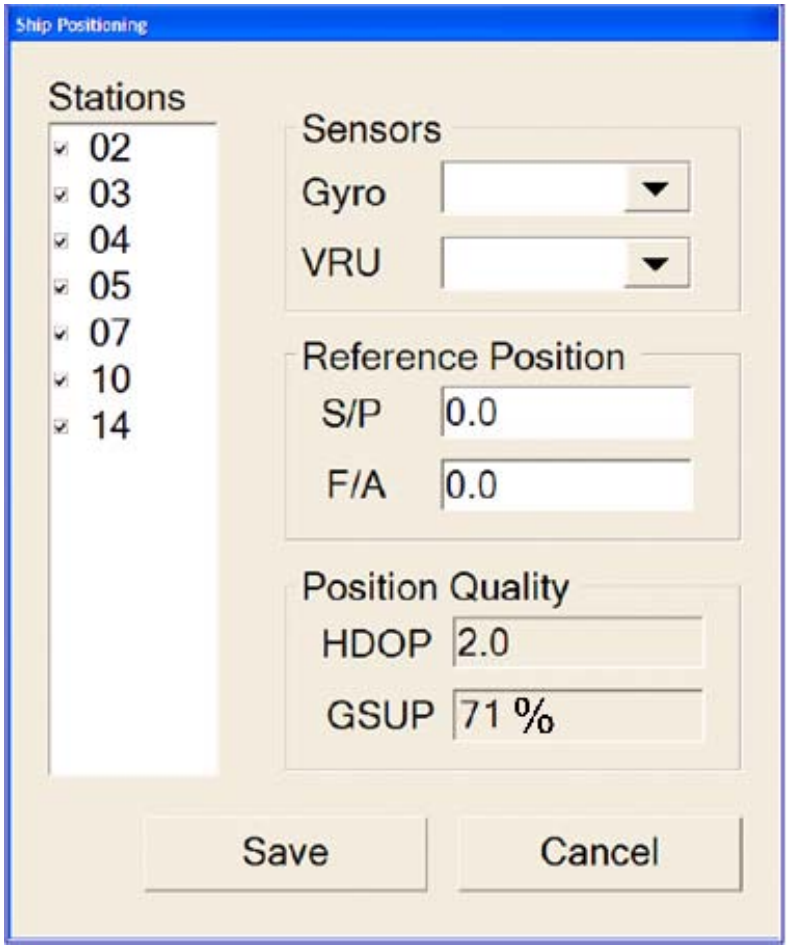

NASNet® -
Offshore Data Review

NASNet® Vessel Positioning – 1500m WD

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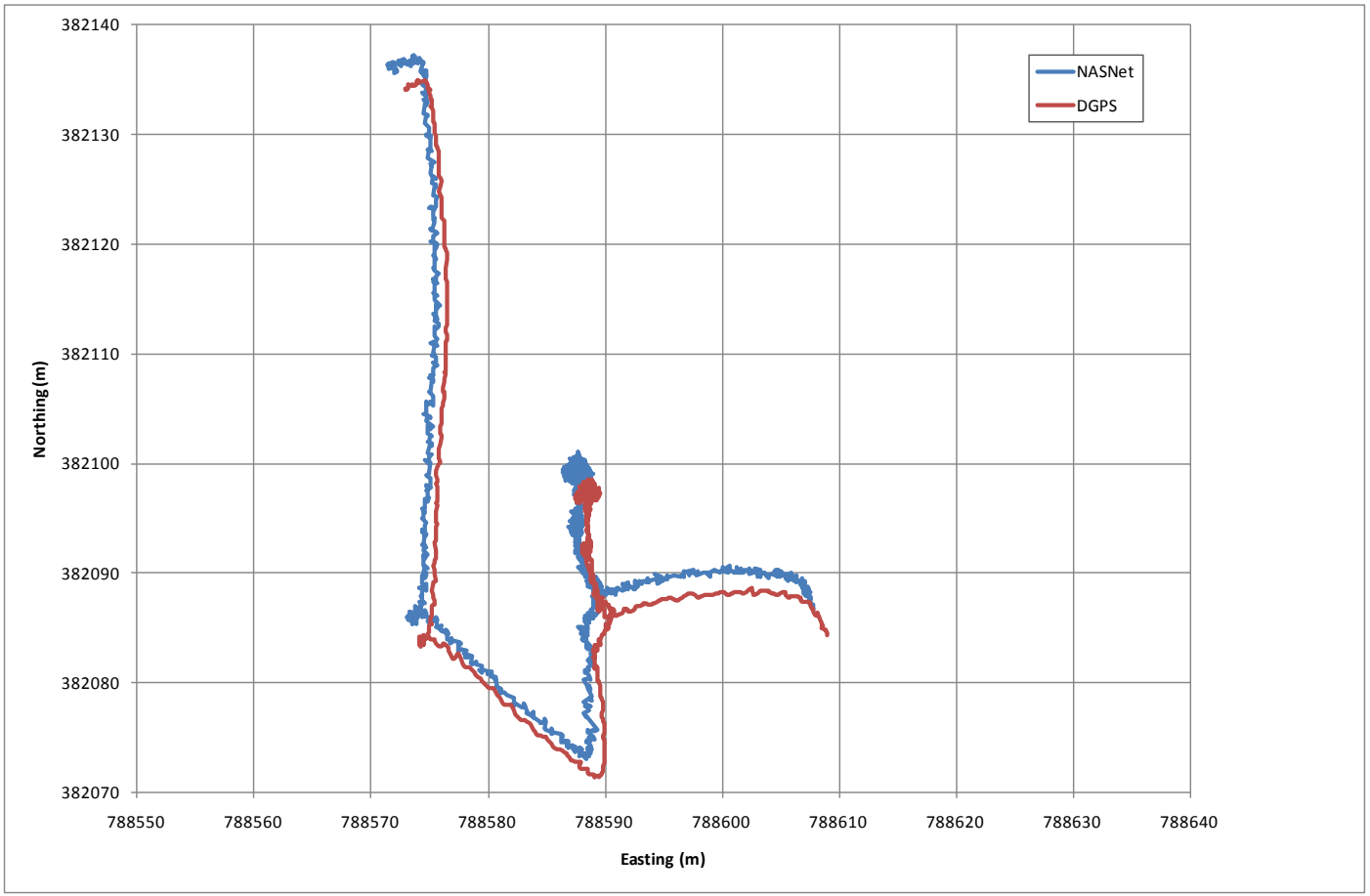

Effects of SV error and weak geometry on positioning accuracy

Stability, latency and update rate unaffected

NASNet® Vessel Positioning – 1500m WD

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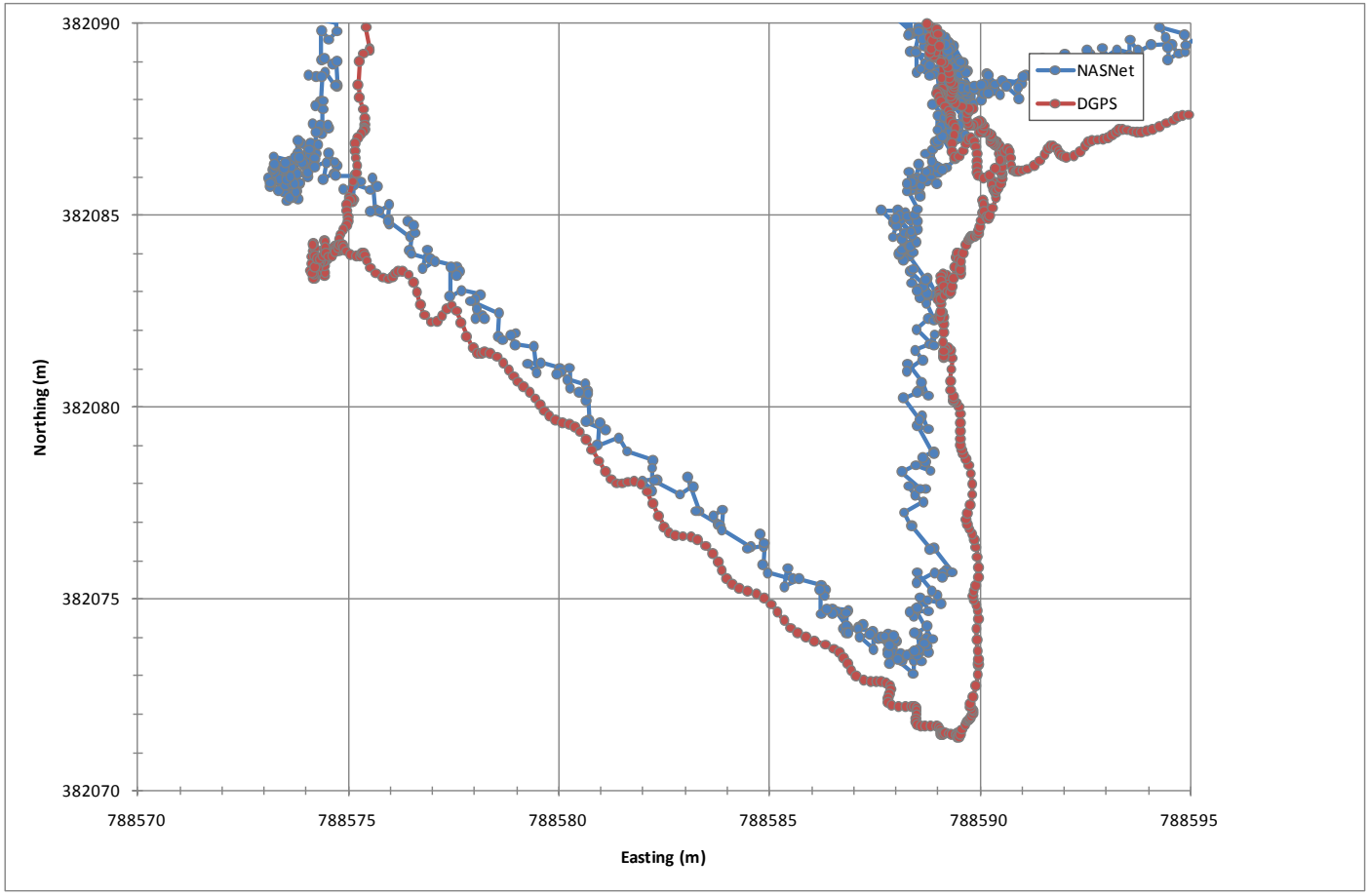

NASNet® Vessel Positioning – 1500m WD

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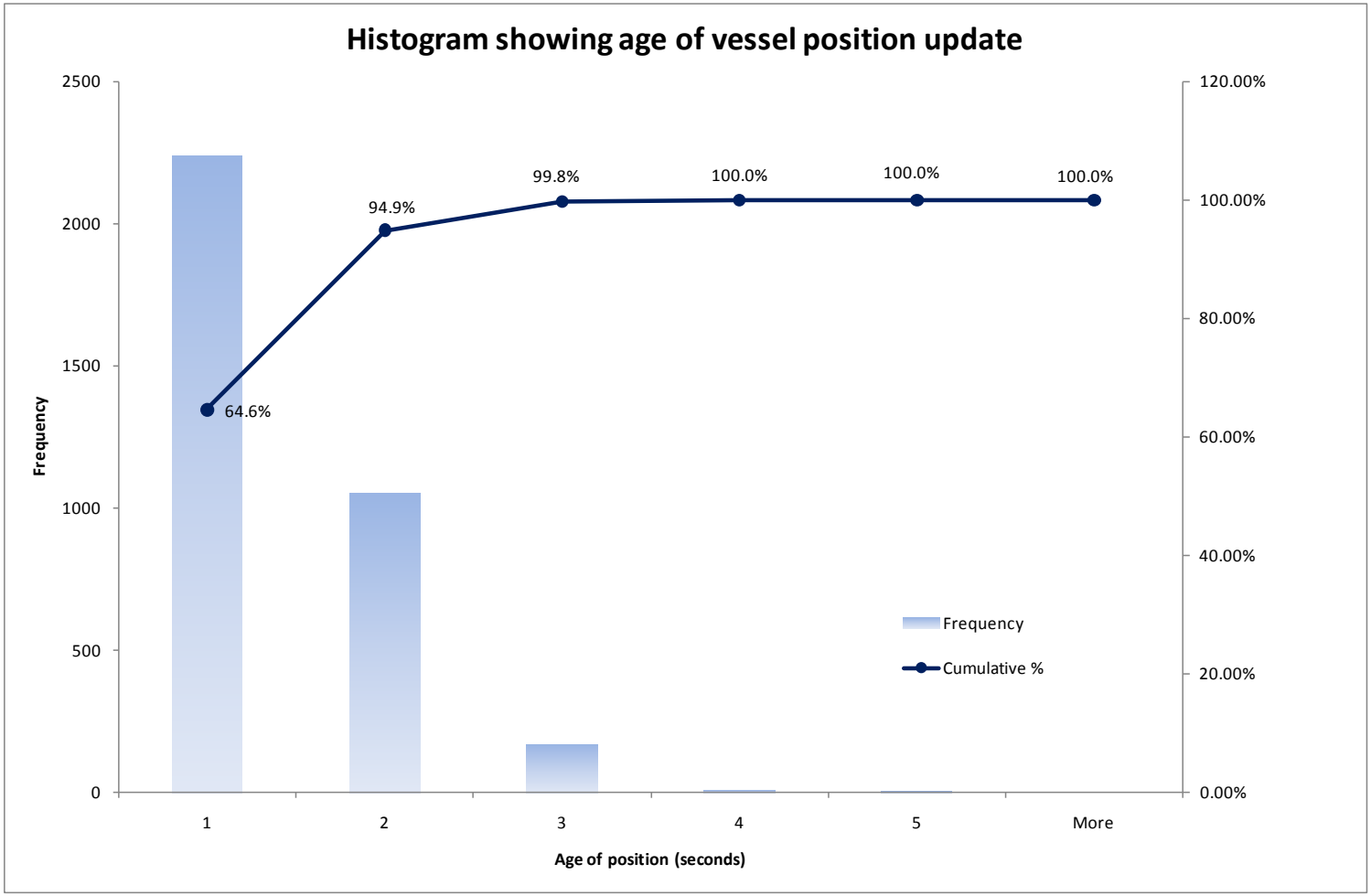

NASNet® Vessel Positioning – 2500m WD

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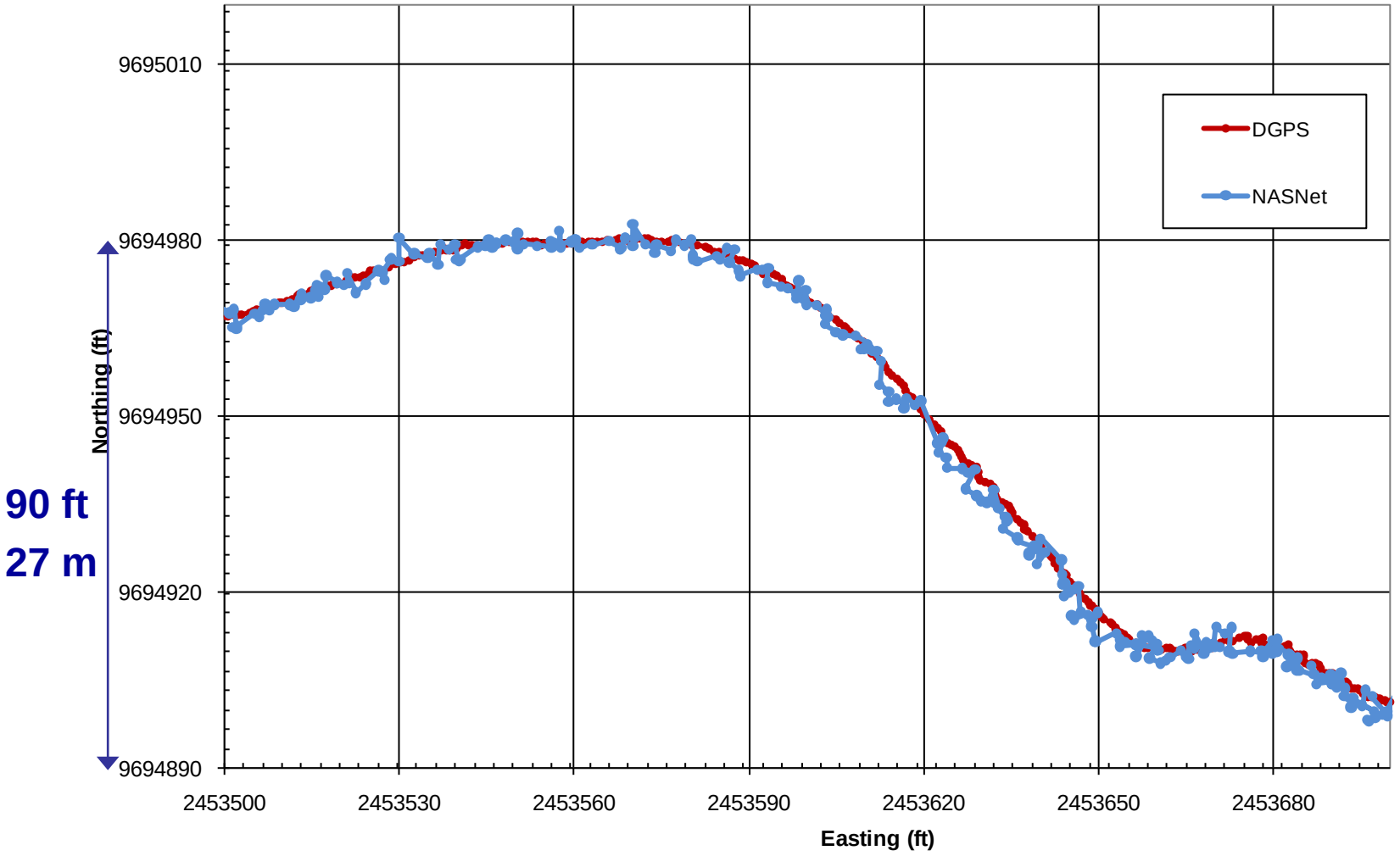

NASNet® Vessel Positioning – 2500m WD

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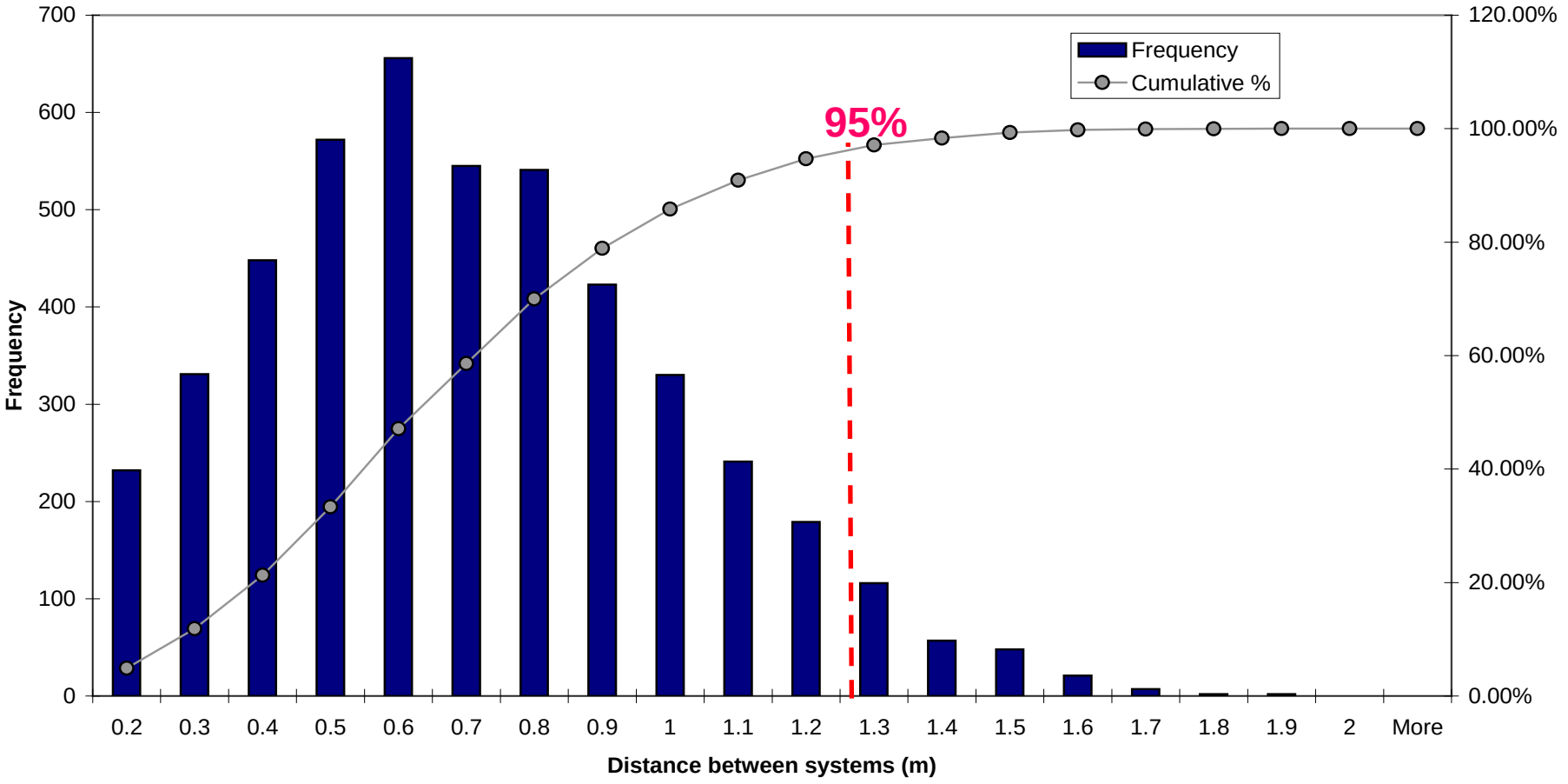

Summing up

In conclusion

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?