

# Fugro's Precise (Point) Positioning Services

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# Profile



Mission is to be the world's leading service-provider in the collection and interpretation of data relating to the Earth's surface and sub-surface, and in the support of infrastructure developments on land, at the coast and on the seabed.

# Client sectors



**Oil & gas**



**Mining**



**Building, infrastructure & telecommunications**



**Water, weather & environment**



**Renewable energy**



**Maritime**



# Resources



**13,700** employees



**60** vessels



**75** trucks



**27** laboratories



**29** jack-up platforms



**60** aircraft



**250** land-based drill rigs  
**15** offshore drill rigs



**150** ROVs



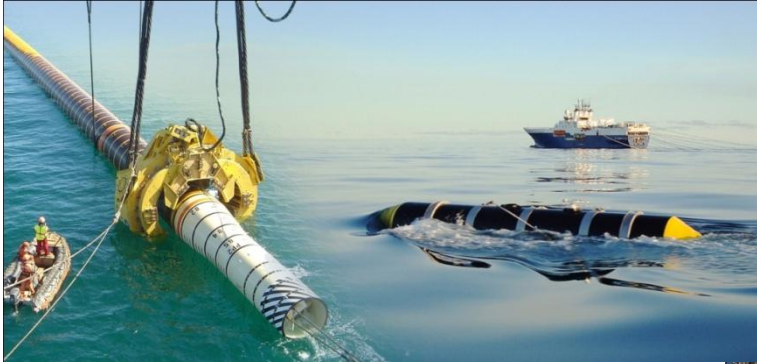
**8** AUVs



**278** offices

AUV – Autonomous Underwater Vehicle  
ROV – Remotely Operated Vehicle

# Offshore positioning

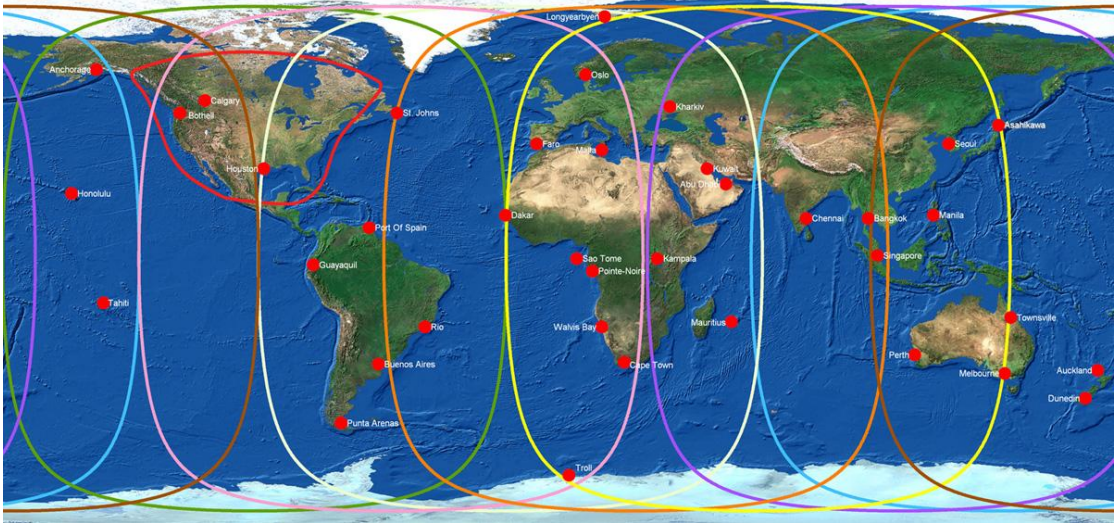




# GNSS services

Service	Accuracy	Correction source	Navigation satellites	Satellite frequencies	Positioning mode
<b>L1</b>	Meter	Reference stations	GPS	Single	Differential
<b>EPlus</b>	Sub-meter	Orbit & clock (Fugro)	GPS & GLONASS	Single	PPP
<b>HP</b>	Decimeter	Reference stations	GPS	Dual	Differential
<b>XP</b>	Decimeter	Orbit & clock (JPL)	GPS	Dual	PPP
<b>G2</b>	Decimeter	Orbit & clock (Fugro)	GPS & GLONASS	Dual	PPP

# Infrastructure

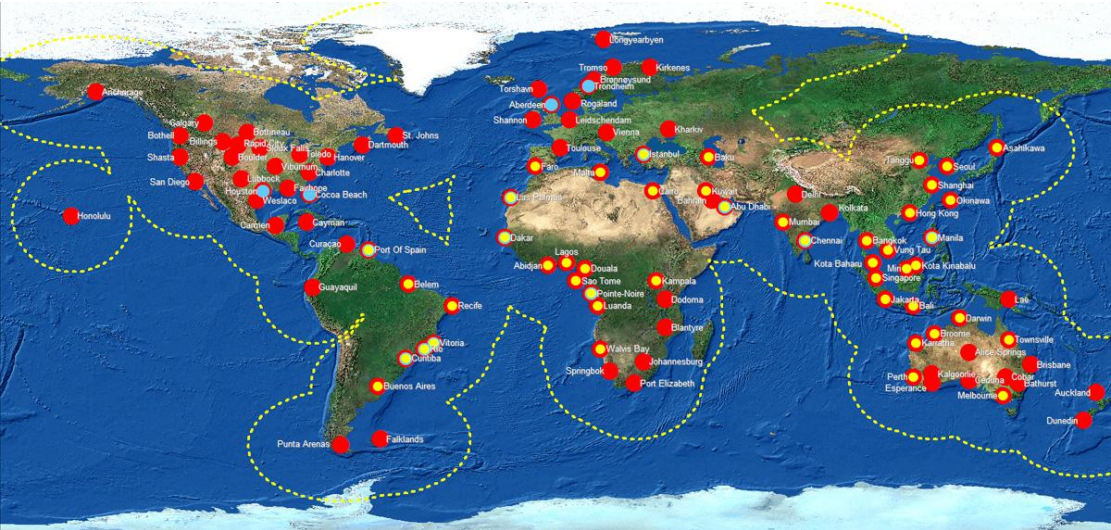


G2 reference network and satellite broadcast coverage

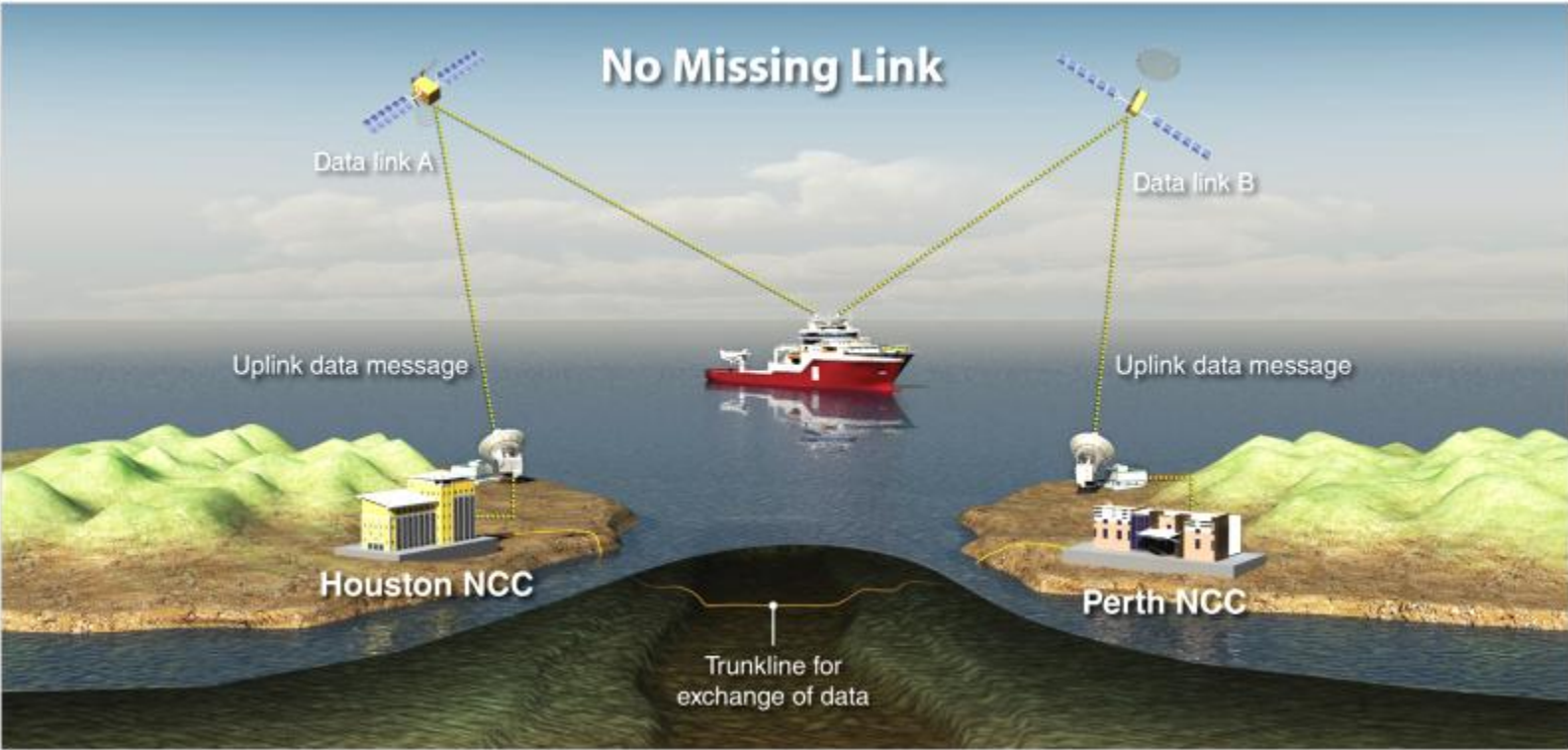
L1 and HP reference network



Network Control Center (NCC)



# Independence and redundancy

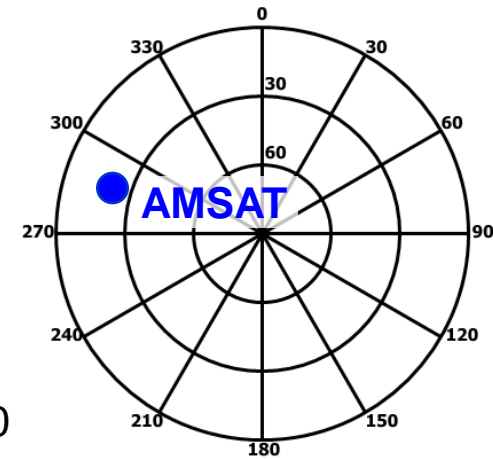
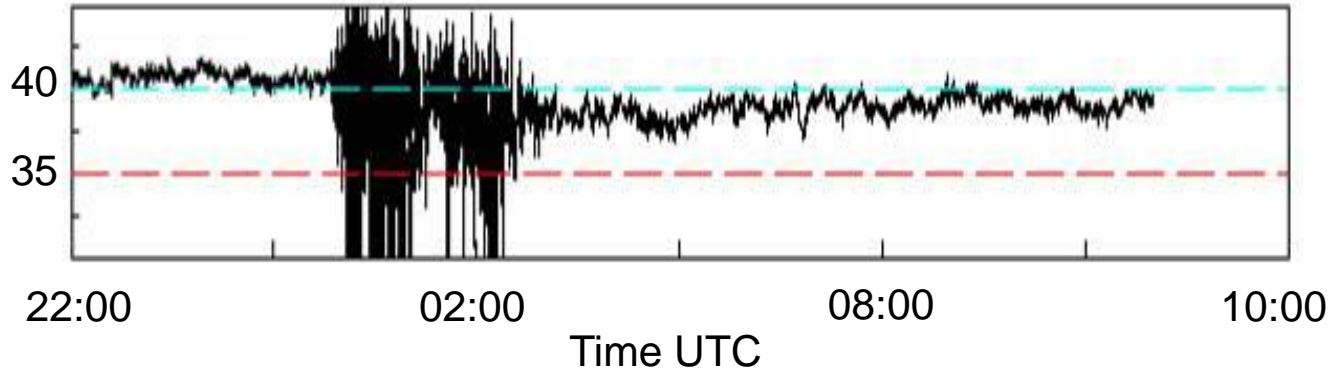




# Importance of redundancy – scintillations

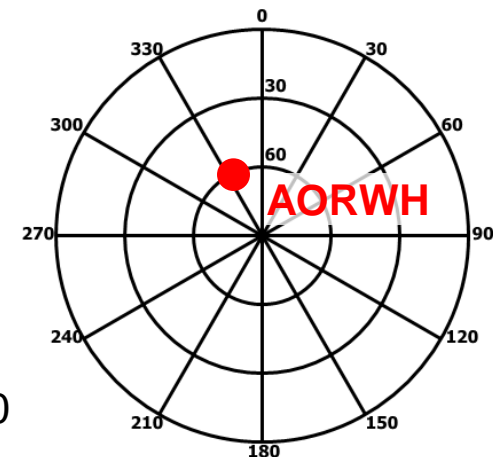
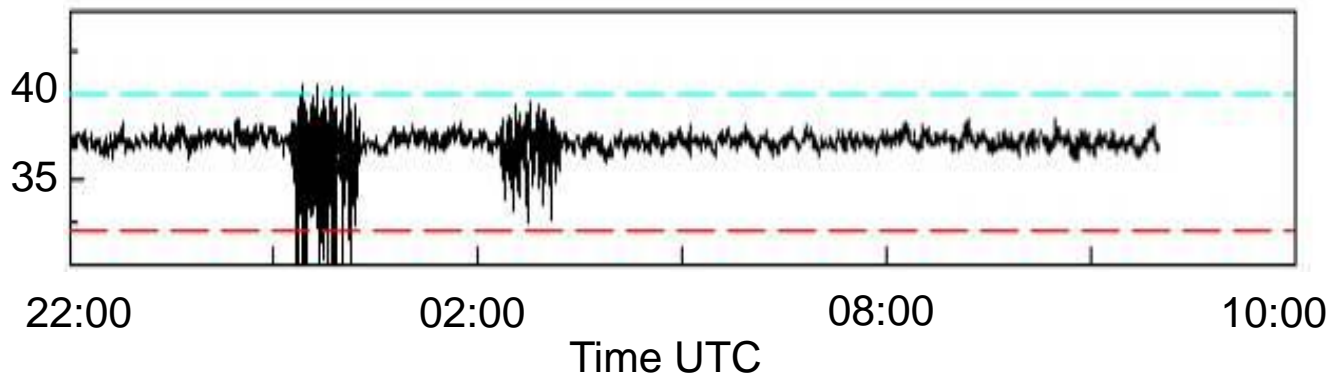
AMSAT (corrections from geostationary satellite)

C/No (dBHz)



AORWH (corrections from geostationary satellite)

C/No (dBHz)



# New signals and systems

## GPS L2C and L5

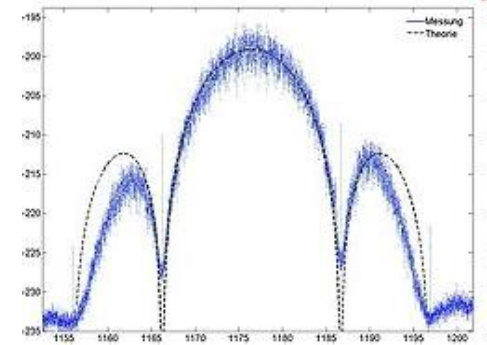
- Supported

## GALILEO

- ICD (Interface Control Document) implemented

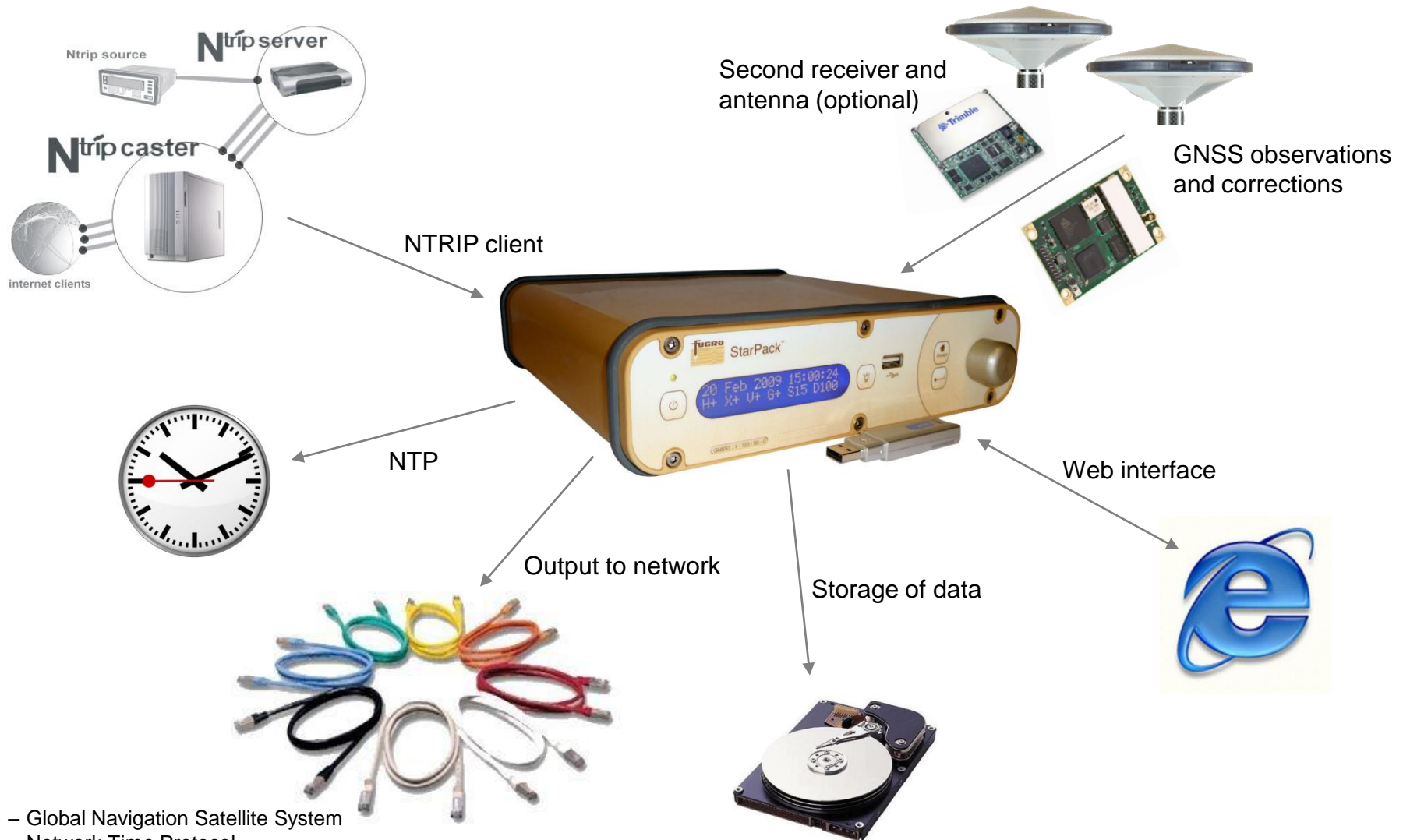
## COMPASS

- Cooperation with Wuhan University
- Access to reference station data





# StarPack



GNSS – Global Navigation Satellite System  
 NTP – Network Time Protocol  
 NTRIP – Network Transport of RTCM via Internet Protocol



# StarPack – web interface

StarPack  
 IP: 192.168.63.156  
 base port: 17500  
 UTC: 10:07:15 3 Nov 2010

- Status
- All Positions
- Starfix XHP/XP/G2/HP
- SkyFix XP
- Starfix L1/EPlus
- SkyFix G2
- GNSS
- Best Position
- ProTrack Heading
- Corrections
- COM I/O
- Predefined LAN I/O
- User LAN I/O
- MUX
- NTRIP
- Hardware
- Subscription
- NTP

**Starfix HP**

52° 05' 46.5539" N SD = 0.04m  
 4° 24' 21.8528" E SD = 0.03m  
 + 58.30m SD = 0.07m

Age :13s Resets :11  
 PDOP :2.1 Locked :19h  
 Satellites :7  
 F-test :0.8

HP Stations  
 521 571 580 530

**SkyFix XP**

52° 05' 46.5540" N SD = 0.04m  
 4° 24' 21.8529" E SD = 0.02m  
 + 58.25m SD = 0.06m

Age :10s Resets :12  
 PDOP :2.1 Locked :19h  
 Satellites :7 Clock & Orbit :XP  
 F-test :0.0 Corrections

**Starfix L1**

52° 05' 46.5287" N SD = 0.60m  
 4° 24' 21.8465" E SD = 0.44m  
 + 58.38m SD = 1.10m

Age :4s  
 PDOP :1.3  
 Satellites :8  
 F-test :0.2

L1 Stations  
 521 571 580 530  
 434 480

**SkyFix G2**

52° 05' 46.5534" N SD = 0.04m  
 4° 24' 21.8540" E SD = 0.02m  
 + 58.18m SD = 0.06m

Age :10s Resets :2  
 PDOP :1.6 Locked :19h  
 Satellites :13 Clock & Orbit :G2  
 F-test :0.0 Corrections

**Configuration**

**GNSS**

52° 05' 46.4921" N SD = 1.94m  
 4° 24' 21.8703" E SD = 1.30m  
 + 59.08m SD = 3.22m

PDOP :1.2 Satellites :14

**Quality Control**

**ProTrack Heading**

131.66° SD = 10.00°

Distance O-C : 0.00m ΔEast : 0.00m  
 Satellites : 7 ΔNorth : 0.00m  
 ΔUp : 0.00m

**Help**

StarPack  
 IP: 192.168.63.156  
 base port: 17500  
 UTC: 10:17:55 3 Nov 2010

- Status
- All Positions
- Starfix XHP/XP/G2/HP
- SkyFix XP
- Starfix L1/EPlus
- SkyFix G2
- GNSS
- Best Position
- ProTrack Heading
- Corrections
- COM I/O
- Predefined LAN I/O
- User LAN I/O
- MUX
- NTRIP
- Hardware
- Subscription
- NTP

**SkyFix G2**

52° 05' 46.5531" N SD = 0.04m  
 4° 24' 21.8540" E SD = 0.03m  
 + 58.14m SD = 0.07m

Age :20s Resets :2  
 PDOP :1.7 Locked :19h  
 Satellites :13 Clock & Orbit :G2  
 F-test :0.1 Corrections

**Configuration**

- StarPack
- GNSS Cards
- Config Backups
- Maintenance
- Security
- FTP
- Web Interface
- QC Settings

**Quality Control**

- All Positions

**Help**

**Clock & Orbit Corrections, Max Age = 5m**

Network	Age	Channel	Quality
G2	20s	2	100%

**GPS Satellites, MIN Elevation = 5°, Almanac Age = - 2d**

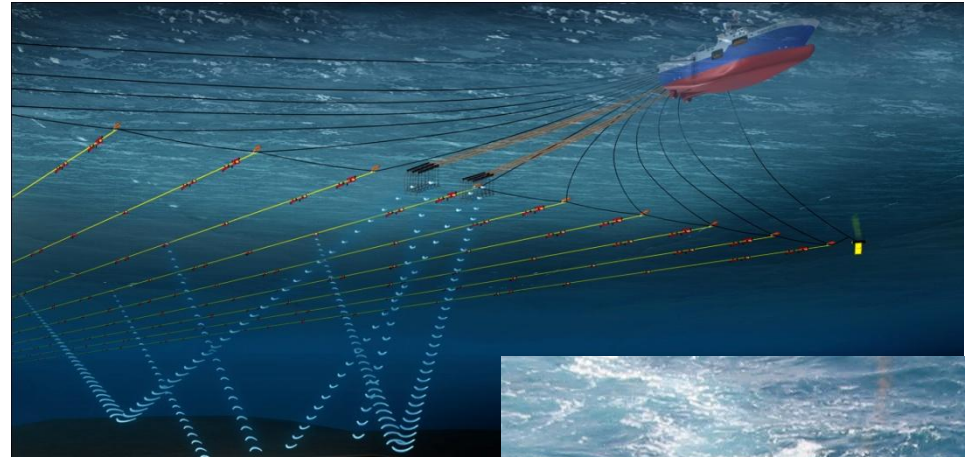
Nr	Azimuth	Elevation	SNR L1 [dBHz]	SNR L2 [dBHz]	Locktime L1	Locktime L2
5	66°	16°	44	41	39m	39m
16	295°	31°	45	41	44m	44m
21	168°	41°	51	47	1h	1h
22	317°	11°	36	0	26s	0ms
25	120°	33°	50	46	5h	5h
29	69°	65°	51	52	3h	3h
30	126°	62°	52	50	3h	3h
31	234°	53°	51	50	2h	2h

**GLONASS Satellites, MIN Elevation = 5°, Almanac Age = 8h**

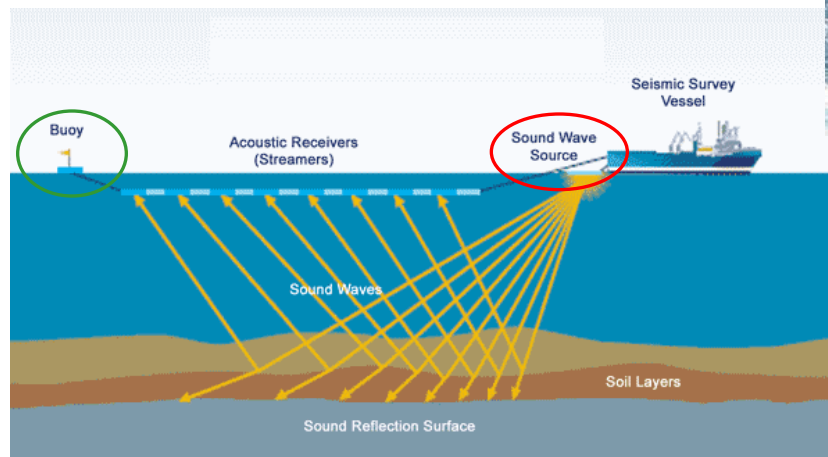
Nr	Azimuth	Elevation	SNR L1 [dBHz]	SNR L2 [dBHz]	Locktime L1	Locktime L2
5	2°	11°	44	40	1h	1h
12	185°	46°	48	49	3h	3h
13	292°	62°	51	50	1h	1h
21	55°	15°	41	43	9m	9m
22	36°	67°	51	51	3h	3h
23	251°	51°	51	50	1h	1h



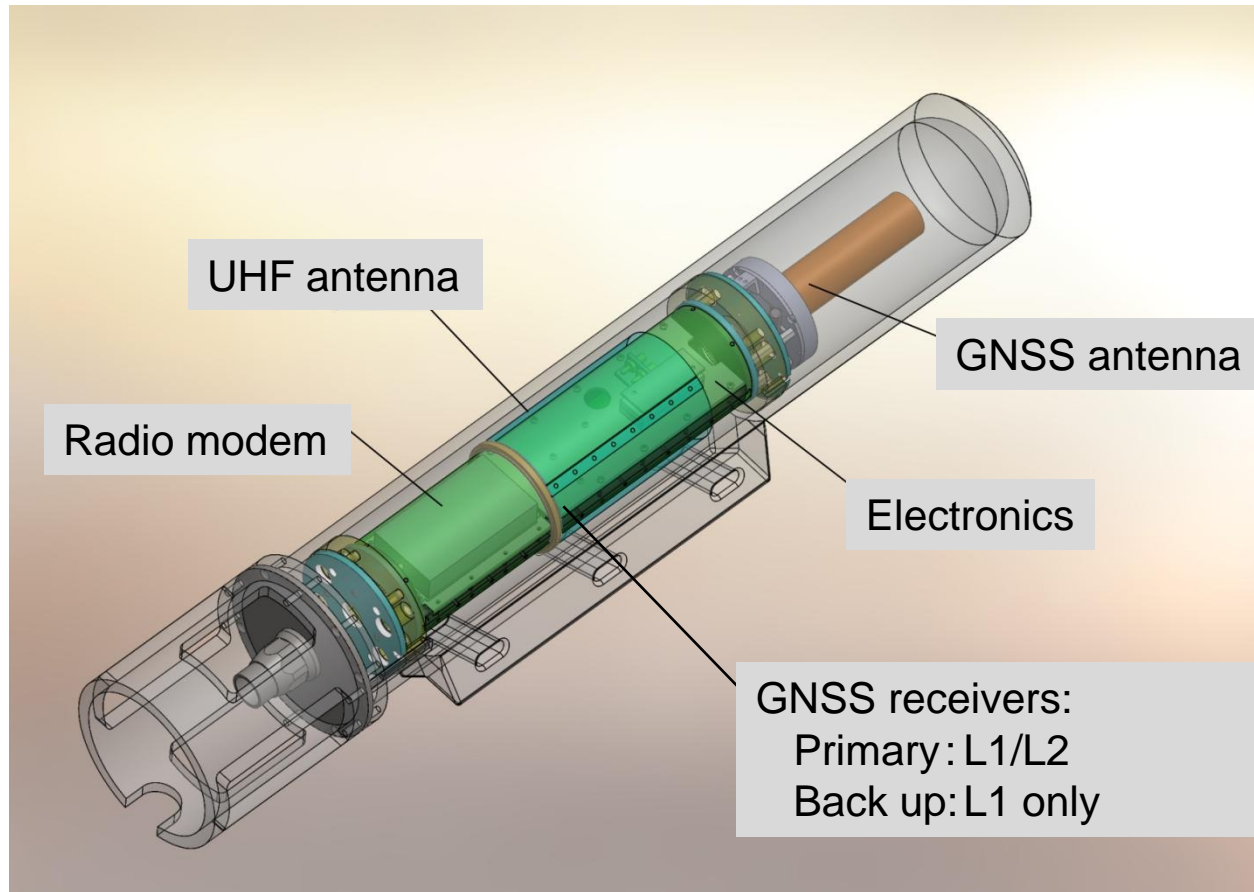
# StarTrack – Seismic streamer positioning



Positioning of **gun float** and **tail buoy**

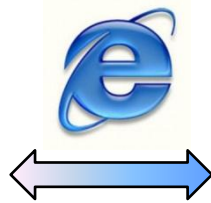


# StarTrack Remote Unit (SRU)





# Web interface



**StarTrack SCU** StarTrack 1  
serial: 00001  
IP: 192.168.63.81  
base port: 50000  
UTC: 15:03:27 7 Nov 2011

<b>Status</b>	<b>Hardware</b>	<b>Network</b>
All Positions Starfix XHP/XP/G2/HP Skyfix XP Starfix L1/EPlus Skyfix G2 GNSS Best Position ProTrack Heading Corrections COM I/O Predefined LAN I/O User LAN I/O MUX NTRIP Hardware Subscription NTP StarTrack Telemetry	<b>Identity</b> Hardware Type : StarTrack SCU v1 Serial Number : 00001 Firmware Version : 08.00.02 Firmware Revision : 5247 Firmware Release : trial	DHCP : Off Base Port : 50000 Mac Address : 00:d0:c9:c6:49:bf IP : 192.168.63.81 Subnet : 255.255.255.0 Gateway : 192.168.63.10 DNS : 10.10.101.1
<b>Configuration</b>	<b>GNSS Card 1</b> Type : NovAtel-OEMV3 Serial Number : BFN10470266 Firmware Version : OEM060100RN0000 Options : D2LB0G5SR Connected To : Internal USB1 Output(tx) : 0 Input(rx) : 3653	
StarPack GNSS Cards Config Backups Maintenance Security FTP Web Interface QC Settings StarTrack	<b>Raw Internal Datalogging</b> Path : spmb0715.spm File Size : 4.02Mb Free Space Left : 83.67Gb	

**StarTrack SCU** StarTrack 1  
serial: 00001  
IP: 192.168.63.81  
base port: 50000  
UTC: 12:09:27 7 Nov 2011

<b>Status</b>	<b>StarTrack Telemetry</b>
All Positions Starfix XHP/XP/G2/HP Skyfix XP Starfix L1/EPlus Skyfix G2 GNSS Best Position ProTrack Heading Corrections COM I/O Predefined LAN I/O User LAN I/O MUX NTRIP Hardware Subscription NTP StarTrack Telemetry	Radio 1,2 = 457.50000 MHz GF 00002 1 SN: 2 2Hz LU: 0.1s GF 00003 2 SN: 3 2Hz LU: 0.1s GF 00004 3 SN: 4 2Hz LU: 0.1s GF 00007 4 SN: 7 2Hz LU: 0.5s TB 00009 5 SN: 9 0.5Hz LU: 1.3s TB 00011 6 SN: 11 0.5Hz LU: 1.2s TB 00019 7 SN: 19 0.5Hz LU: 0.8s TB 00020 8 SN: 20 0.5Hz LU: 0.3s TB 00022 9 SN: 22 0.5Hz LU: 0.2s TB 00024 10 SN: 24 0.5Hz LU: 1.8s
<b>Configuration</b>	Radio 3,4 = 458.50000 MHz GF 00001 11 SN: 1 2Hz LU: 0.2s GF 00021 12 SN: 21 2Hz LU: 0.1s GF 00023 13 SN: 23 2Hz LU: 0.1s GF 00018 14 SN: 18 2Hz LU: 0.4s TB 00005 15 SN: 5 0.5Hz LU: 1.3s TB 00026 16 SN: 26 0.5Hz LU: 1.1s TB 00027 17 SN: 27 0.5Hz LU: 0.7s TB 00012 18 SN: 12 0.5Hz LU: 0.3s TB 00025 19 SN: 25 0.5Hz LU: 0.5s TB 00028 20 SN: 28 0.5Hz LU: 0.9s
<b>Quality Control</b>	

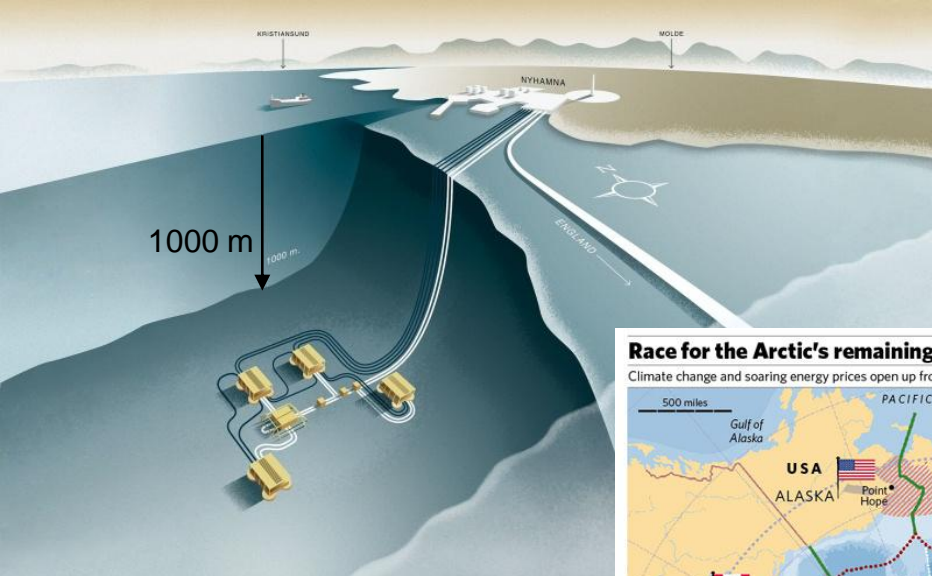
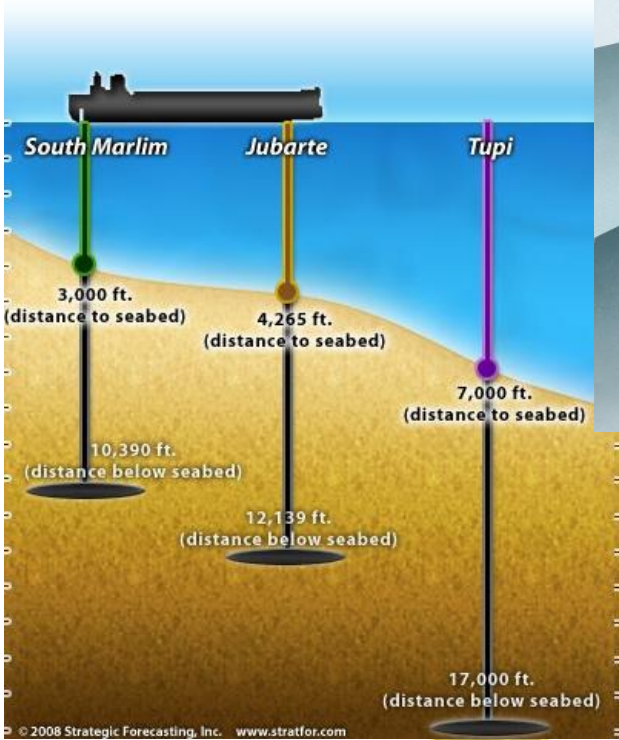
**StarTrack SCU** StarTrack 1  
serial: 00001  
IP: 192.168.63.81  
base port: 50000  
UTC: 12:09:27 7 Nov 2011

<b>Status</b>	<b>GF 00007</b>	<b>Telemetry</b>
All Positions Starfix XHP/XP/G2/HP Skyfix XP Starfix L1/EPlus Skyfix G2 GNSS Best Position ProTrack Heading Corrections COM I/O Predefined LAN I/O User LAN I/O MUX NTRIP Hardware Subscription NTP StarTrack Telemetry	<b>Relative Position</b> 2D Range : 7.56m SD N = 0.00m Bearing : 336.99° SD E = 0.00m dHeight : 0.41m SD H = 0.01m Fix quality: Code and carrier L1+L2	Last update : 0.5s Radio transmission power : 100mW
<b>Configuration</b>	<b>Absolute Position</b> 52° 05' 46.7609" N SD N = 0.02m 4° 24' 21.6505" E SD E = 0.02m 58.59m SD H = 0.03m	<b>Status</b> Internal temperature : 44.74°C Internal humidity : 12% Incoming voltage : 22.91V Power consumption : 13.87W Max shock/10min : 2.66g Total amount of shocks : 0 Amount of shocks since last reset : 0 Total number of power cycles : 1 Total boot count of CPU : 2 Total run-time : 2d Total operational run-time : 2d Run-time since last power-cycle : 2d Operation run-time since last CPU reset : 2d
<b>Quality Control</b>	Weighting: Skyfix XP : 29% Skyfix G2 : 39% Starfix EPlus (G2) : 1% Starfix G2 : 32% GNSS (uncorrected) : 0%	

Detailed information about each tracking unit can be accessed by clicking on the unit box.

# Subsea challenges

## BRAZIL'S DEEP WATER OIL FIELDS



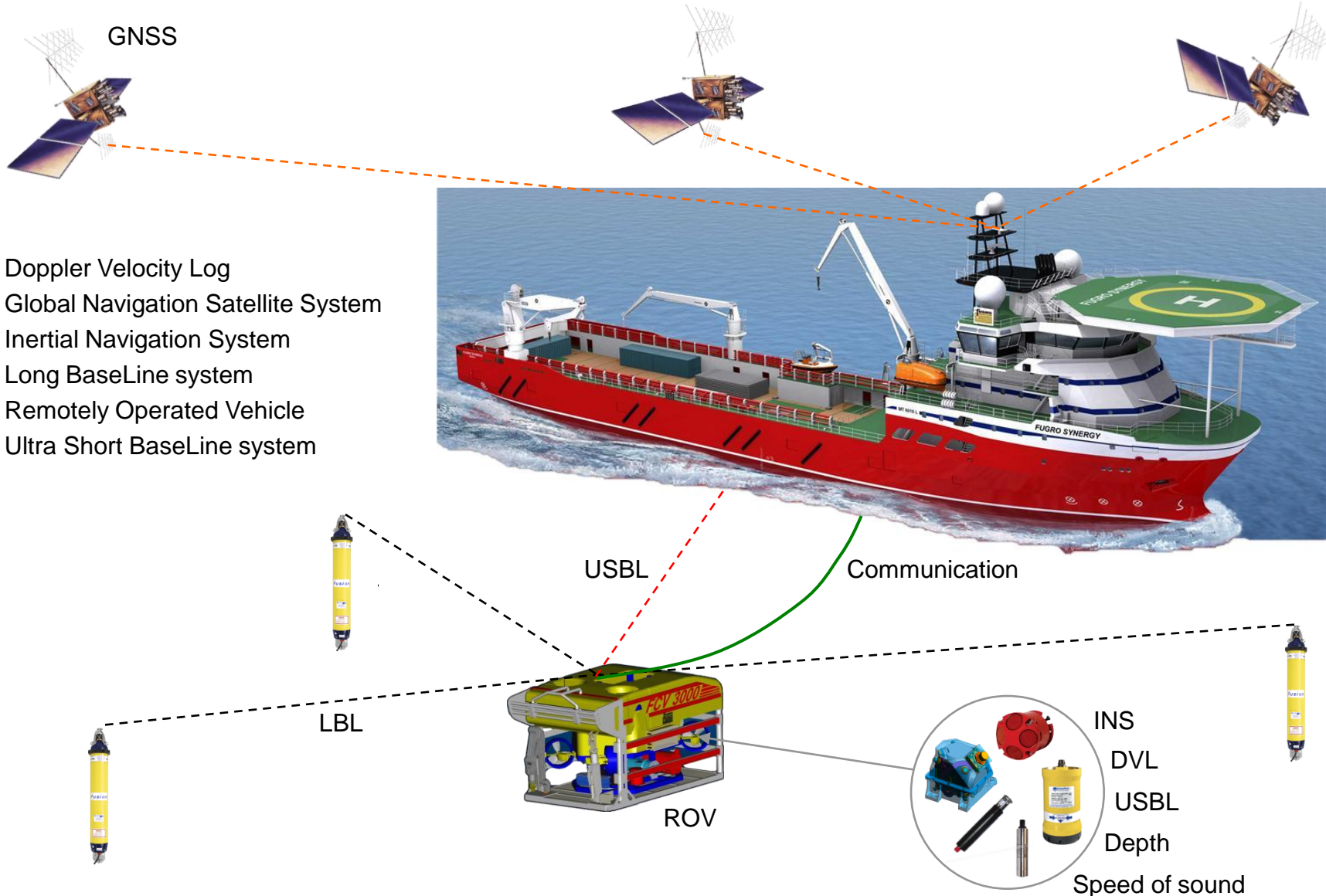
## Race for the Arctic's remaining oil and gas

Climate change and soaring energy prices open up frozen frontier of the Chukchi Sea



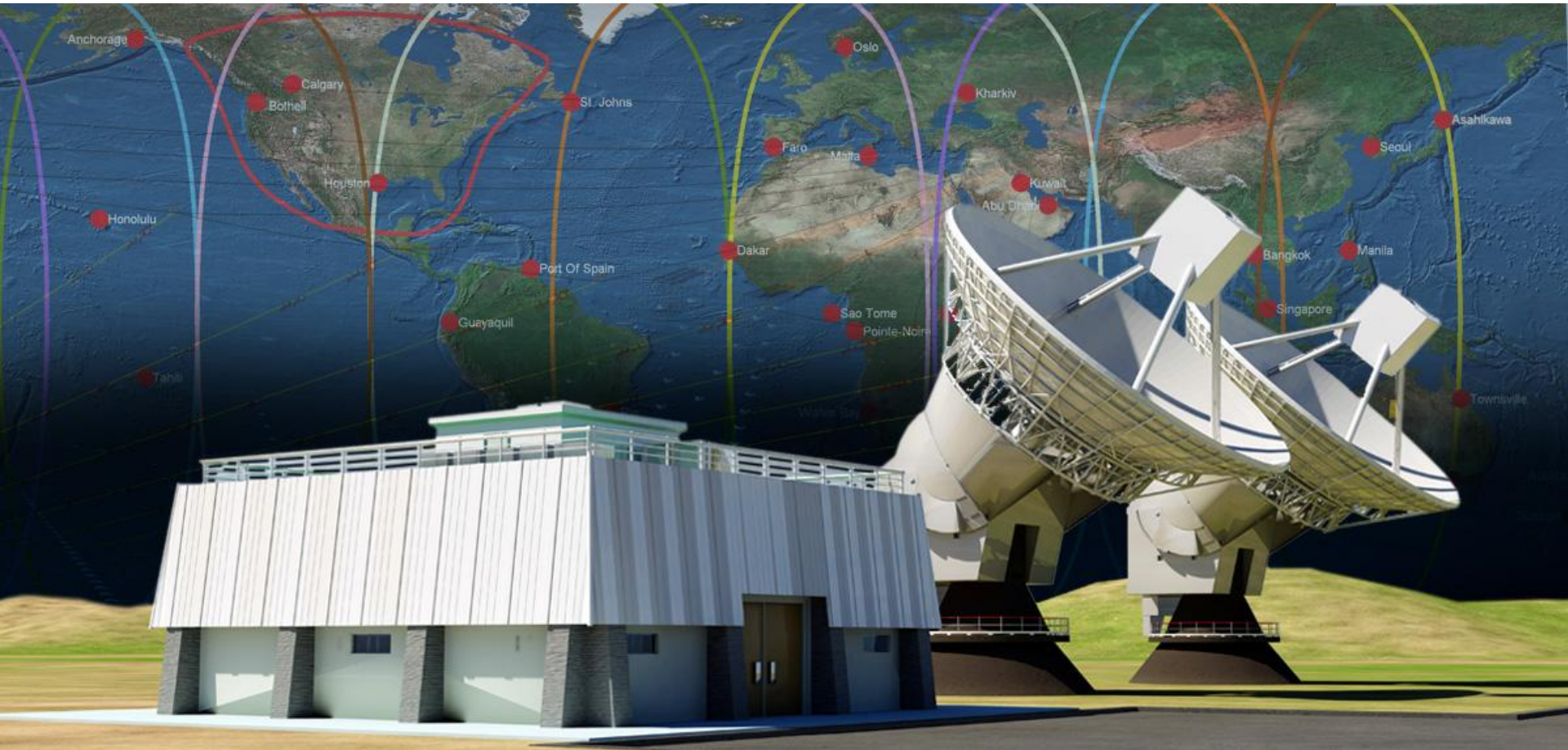


# Integrated surface and subsea positioning



- DVL – Doppler Velocity Log
- GNSS – Global Navigation Satellite System
- INS – Inertial Navigation System
- LBL – Long BaseLine system
- ROV – Remotely Operated Vehicle
- USBL – Ultra Short BaseLine system

# Conclusions



Fugro delivers precise positioning services for a wide variety of offshore activities, using a highly redundant infrastructure and in-house developed hard- and software.

Thank you

