

Trimble CenterPoint® RTX Marine and Applanix POS MV

UNLOCK THE DEPTHS WITH TRIMBLE MARINE SOLUTIONS



Anywhere on water,
trust your **position.**

As a global leader in
positioning technologies,
Trimble® offers

ROBUST AND PRECISE SOLUTIONS

tailored for the
marine industry and
hydrographic surveying.

With a focus on resilience, redundancy, and 24/7 support, Trimble Applanix and Trimble Positioning Services provide premium tools that stand at the forefront of accuracy, availability, and integrity. Leveraging advanced GNSS hardware, software, inertial sensor fusion, and GNSS correction services, Trimble delivers centimeter-level accuracy even in the most challenging conditions.

AT A GLANCE

Trimble Positioning Services

Enabling higher accuracy for industries that can benefit from precision and optimized workflows across project lifecycles with purpose-built solutions.

- Decades-long journey as a market leader in the industry.
- Full solutions: hardware, software, and GNSS correction services integration.
- Global coverage and expert support around the clock.

Why Trimble Applanix?

- **Applanix Technology**
Field-tested and proven, Applanix products maximize your ROI in multibeam technology.
- **The Applanix Marine Team**
Experienced, highly qualified team with a wealth of knowledge leveraged into the development of solutions for your marine operations.

TRIMBLE ADVANCED TECHNOLOGIES



IN THE SPOTLIGHT

Trimble ProPoint®

Trimble ProPoint GNSS is the fifth generation high-precision GNSS positioning technology from Trimble. It leverages the latest developments in GNSS signal infrastructure and Trimble's high-precision Maxwell 7 receiver hardware to deliver improved positioning performance in challenging environments. Trimble ProPoint GNSS supports data from all GNSS constellations (GPS, Galileo, GLONASS, BeiDou, QZSS) and all frequencies. Its advanced algorithms enable robust GNSS positioning performance under harsh tracking conditions where satellite line of sight can be impaired, such as under tree canopy and highway overpasses, and in dense urban areas, while its sophisticated signal filtering and error modeling means better protection against jamming, spoofing, and multipath interference. The Trimble ProPoint GNSS is tightly integrated in the Applanix IN-Fusion+ allowing it to achieve extremely robust high-rate Aided-INS position output at the cm level under all types of signal environments.

Trimble IonoGuard

Solar activity peaks every 11 years, with the next maximum peak predicted in 2025. This has a direct impact on delays and stability of GNSS signals and can have a negative effect on precision positioning. Trimble's IonoGuard technology offers a cutting-edge solution to the challenge of ionospheric interference, a common issue that can degrade the accuracy of GNSS signals. This technology utilizes advanced algorithms to mitigate the effects of all types of ionospheric disturbances on satellite signals, ensuring higher reliability and precision in GNSS positioning.

Through the use of Trimble GNSS receivers with Trimble ProPoint—which features IonoGuard technology—survey tasks can be completed even when there are unfavourable conditions present. With this innovation, Trimble strives to provide robust, accurate positioning solutions to meet the demands of modern GNSS users in 2025 and beyond.

Trimble Applanix IN-Fusion+

The Trimble Applanix IN-Fusion+ technology is an advanced version of an 'aided-inertial' navigation system, whereby the INS is aided by other sensors, such as GNSS, to ensure INS errors do not grow unbounded. The Trimble Applanix IN-Fusion+ technology provides the highest level of navigation sensor integration providing direct georeferencing of your data with unrivaled accuracy and robustness. Incorporating advanced technology such as Trimble ProPoint, Trimble CenterPoint RTX and PP-RTX, centimeter level data can be acquired globally without a base station.

Trimble RTX technology

The Trimble RTX® correction service is a real-time Precise Point Positioning (PPP) technology that uses Trimble's global network of reference stations to accurately generate space state representation models of the ionosphere and troposphere to mitigate atmospheric biases, as well as accurate GNSS satellite ephemeris data to mitigate clock and orbit biases.

By effectively mitigating clock, orbit and atmospheric biases, Trimble RTX enables GNSS receivers to calculate highly accurate positions. Furthermore, Trimble RTX atmospheric models are known to provide additional resilience to solar activity, allowing productivity during periods that may be impossible for traditional differential solutions.

This technology combines GNSS data with advanced algorithms with Trimble Applanix IN-Fusion+ technology to deliver reliable, high-accuracy results in diverse environments. Delivered via Satellite or the internet, Trimble RTX enhances productivity and operational efficiency by enabling precise and consistent positioning performance globally.

HYDROGRAPHIC SURVEYING

Hydrographic surveying is crucial for understanding and managing the marine environment, ensuring safe navigation, safe and efficient marine construction, and environmental conservation.

It entails the precise mapping of underwater terrains, which requires advanced technology to overcome challenges posed by waves, currents, and vessel movement.

The technical difficulties include working on unstable platforms and vessels in constant motion, as well as dealing with harsh environmental factors such as water, salt, wind, tides, and weather. These conditions complicate data collection, necessitating the use of durable equipment and adaptive strategies to maintain accuracy. Additionally, the physical dangers in this environment demand innovative approaches to enhance the speed and safety of operations for professionals in the field.

For hydrographic surveyors, prioritizing both safety and precision is essential, as errors can result in costly or dangerous consequences.

As the industry evolves and surveys are carried out remotely, the requirements for accuracy and reliability are heightened and the technology is pushed further than ever as users strive for efficiency.

WHAT'S ON YOUR VESSEL?

Hydrographic surveying is a sophisticated process that requires a range of advanced sensors and equipment to gather accurate and comprehensive data about the underwater environment. Onboard your vessel, you might find a range of acoustic equipment for detecting above and below the seafloor. These devices are all typically tied together with a primary source of position and orientation.

POS MV (Position and Orientation System): Accurately georeferenced hydrographic survey data is essential for maritime navigation, marine construction, dredging, offshore oil exploration and many more activities.

The Applanix POS MV (Position and Orientation System for Marine Vehicles) blends GNSS data with angular rate and acceleration data from an IMU and heading from GNSS Azimuth Measurement System (GAMS) to produce a robust and accurate full six degrees of freedom position and orientation solution to multiple onboard sensors.

CenterPoint® RTX Marine is a real-time GNSS correction service using an absolute positioning technique to model and correct GNSS error sources and deliver centimeter-level accuracy via Satellite or the Internet. CenterPoint RTX Marine significantly enhances the positioning accuracy of the vessel and ensures seamless and reliable performance even in the most challenging marine environments.

With the ProPoint engine and Trimble RTX, POS MV delivers significant advantages in real-time, resulting in better productivity, faster, and more efficient operations.

Multibeam Echo Sounder (MBES)—Captures detailed bathymetric data by emitting multiple high frequency sound beams across a wide swath of the seabed. Often vessel or pole mounted and requiring the highest of accuracy. The most commonly used sonar in the hydrographic industry.

Single-Beam Echo Sounder—Provides depth measurements directly below the vessel, often used in mobile seabed areas or as a budget alternative to MBES.

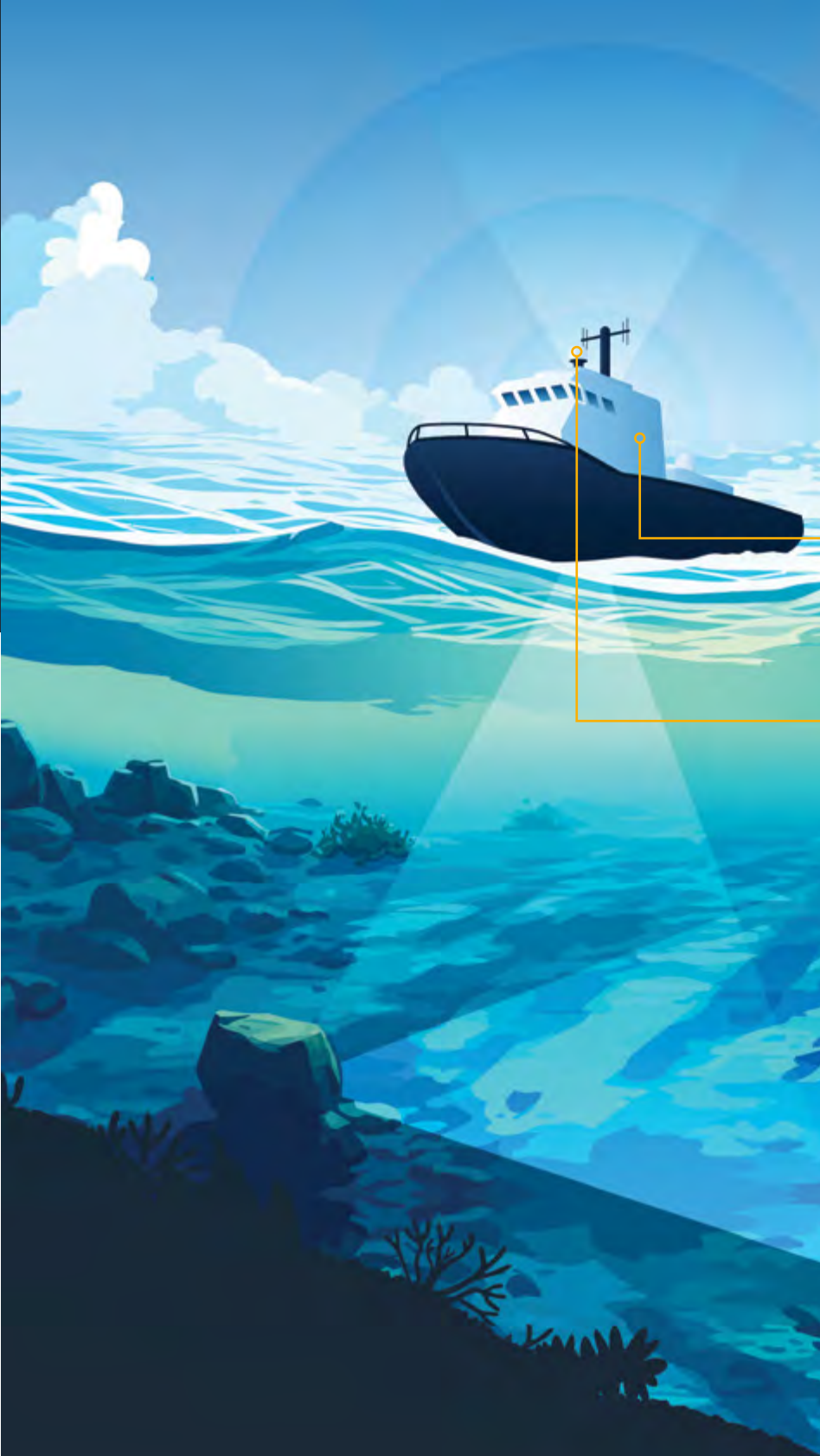
Side-Scan Sonar—A towed system used for mapping large areas quickly and identifying features and obstructions with high-resolution imagery.

Sub Bottom Profiler—A geophysical survey tool used for mapping below the seabed with low-frequency pulses of sound penetrating the seafloor and reflecting with varying intensity from different sediment layers. Often used for oil and gas exploration or detecting hazards.

Magnetometer—A towed system capable of detecting magnetic anomalies from ferrous objects. Typically used for detecting unexploded ordnance on the seabed. Vital when assessing cable or pipeline routes.

By integrating with these sensors and equipment, Trimble's hydrographic surveying solutions provide a comprehensive toolkit for the most accurate and efficient underwater mapping.

Whether you're conducting small-scale surveys with SBES or large-scale, detailed mapping with MBES, Trimble's technology ensures your vessel is equipped to handle the most challenging survey conditions with precision and reliability.



HYDROGRAPHIC SURVEY VESSEL EQUIPMENT

- 1 Multibeam Echo Sounder (MBES)
- 2 Single-Beam Echo Sounder
- 3 Side-Scan Sonar
- 4 Applanix POS MV System
- 5 GNSS Antenna
CenterPoint RTX Marine Correction Service
- 6 LIDAR (Light Detection and Ranging)
- 7 Sub-Bottom Profiler
- 8 Data Acquisition Computers and Processing software
- 9 A-Frame or Crane
- 10 Ultra-Short Baseline (USBL) Positioning System
- 11 Satellite Communication System

TRIMBLE APPLANIX POS MV

Field-tested and proven, Trimble Applanix POS MV maximizes your ROI in multibeam technology.

The Applanix POS MV is a user-friendly, turnkey system designed and built to provide accurate position, heading, attitude, heave, and velocity data of your marine vessel and remote sensing equipment. With many thousands deployed worldwide, POS MV is field-tested and proven in all conditions.

Applanix POS MV blends GNSS data with angular rate and acceleration data from an IMU and heading from GNSS Azimuth Measurement System (GAMS) to produce a robust and accurate full six degrees of freedom Position and Orientation solution.

Applanix brings a quality product to the table while we bring the experience and ability to integrate with other systems.

Lou Nash, President of Measutronics

APPLANIX
POS MV
SURFMASTER
DELIVERS ROLL
AND PITCH
ACCURACY TO

0.10.0

Performance you can rely on:

- Accurate under all dynamic conditions
- Heading accuracy maintained in high multipath environments and in areas of poor GNSS availability
- More robust georeferencing in the most difficult GNSS environments
- Continuous sensor monitoring to ensure optimum performance
- Almost instantaneous reacquisition of RTK following any GNSS signal loss
- Automatic initialization upon power-up following a one-time calibration
- Very low noise L1 and L2 carrier phase measurements
- Superior low-elevation tracking performance regardless of latitude

Applanix POS MV comes in 4 models:

- Applanix POS MV SurfMaster / SurfMaster One
- Applanix POS MV WaveMaster II
- Applanix POS MV OceanMaster
- Applanix POS MV Elite

All POS MV models are designed for use with multibeam sonar systems, enabling adherence to IHO (International Hydrographic Survey) standards on sonar swath widths of greater than ± 75 degrees under all dynamic conditions. At the entry level is the POS MV SurfMaster, which delivers robust georeferencing for small platforms, both manned and unmanned. SurfMaster is available both with a remote IMU and in a single-enclosure form factor. Fully supported by Applanix's industry-leading post-processing software, POSpac MMS, SurfMaster delivers roll and pitch accuracy to 0.03 degrees. WaveMaster II and OceanMaster are designed for increasingly difficult conditions and performance requirements. The POS MV Elite is for users seeking the very highest level of performance available to the industry.

FEATURES:

- IN-Fusion+ ensures optimal GNSS aiding tracking all available constellations and frequencies for any given conditions
- TrueHeave™—no requirement to tune filter for specific conditions, no settling time so no run in time
- High Accuracy inertial measurement units featuring SmartCal™
- Data time tagged to microsecond accuracy

BENEFITS:

- Applanix TrueHeave software improves productivity and accuracy
- Optimally aided architecture ensures a high-quality solution if GNSS outages occur
- Full GNSS Support—ensures robust solution in any environment
- Centimeter positioning anywhere with Trimble CenterPoint RTX Marine
- Applanix' Inertially Aided RTK ensures more robust solution than standalone RTK
- Upgradeability



TRIMBLE APPLANIX POSPac MMS

Applanix POSPac™ MMS for marine applications is your key to powerful, consistent, reliable, and accurate data...every time.

Applanix POSPac MMS for marine is powerful post-mission software for processing sensor data from your POS MV for highly accurate and robust direct georeferencing. Optimised for the marine environment and compatible with a wide variety of hydrographic processing packages, this software solution achieves both maximum accuracy and maximum efficiency for direct georeferencing survey data.

The complete post-processing toolbox delivers a streamlined field-to-office workflow for the best results possible.

Performance you can rely on:

- **Accuracy**—Post-processed kinematic processing and an advanced smoothing algorithm drastically improves position and orientation accuracy.
- **Reliability**—Installation errors can be corrected in post-processing. In addition, alternative differential GNSS sources can be found if the primary source proves unreliable.
- **Robustness**—IN-Fusion+ processing modes use all available GNSS constellations and frequencies for improved performance in harsh GNSS environments.

Specifications:

- Produce highly accurate position and orientation solutions from the GNSS and Inertial data logged by your POS MV system.
- Obtain maximum immunity to GNSS outages in difficult environments—under bridges, cranes and other structures.
- Achieve stable, reliable, repeatable, and more accurate results
- Import, manage and assess the data from your POS MV system and GNSS reference stations.
- Perform installation and data QC.
- Automate data output in a wide variety of industry-standard formats or define your own.
- Built-in database of GNSS reference stations enables POSPac MMS to find the most suitable reference station.
- PP-RTX (Post-Processed RTX): Achieve centimeter level data without a base station, globally, just minutes after your survey.

WHAT IS APPLANIX POSPac IN-Fusion+ PP-RTX2.0?

Applanix PosPac PP-RTX is a cloud-based, global, GNSS correction service that utilizes Trimble's RTX technology to provide cm-level post-processed positioning accuracy without base stations. The Trimble RTX technology utilizes data from a dedicated global network of tracking stations to compute corrections to satellite orbit and clock information as well as atmospheric delay models. Applanix POSPac uses this data through a download only process, to post-process the GNSS-inertial trajectory.

As of POSPac MMS v9.0, IN-Fusion+ PP-RTX2.0 is available utilizing multi satellite and multi-frequency GNSS constellations. The new BDS-III signals from the Beidou satellite navigation system aid significantly in reducing convergence times to <3 minutes and enhancing performance globally.

* Multibeam and laser scan data of Tower Bridge. Image courtesy of NORBIT.

CenterPoint RTX MARINE

Opening oceans of opportunities



TRIMBLE PRECISE POSITIONING: REAL-TIME GNSS CORRECTION SERVICE

For more than four decades, Trimble has been positioning you for success—whether on land, in the field, or now, on the water.

Our Precise Point Positioning (PPP) solutions are available worldwide, backed by the largest network footprint in the industry. No matter the challenge, our correction services are designed to simplify your work by delivering reliable and accurate data. Trimble GNSS correction services support a wide range of marine applications, including coastal construction, hydraulic dredging, hydrographic surveying, seafloor mapping, navigation, exploration, monitoring, and more.

Trimble precise positioning for everything: keeping industries on point, on line, in lane and on time.

Performance you can rely on:

- **Accuracy in real-time¹**
2 cm horizontal and 5 cm vertical real-time accuracy for informed decision-making on the water.
- **Efficient**
Available via Satellite or the Internet, making it easy and efficient to use—reducing the need for costly rework, extra gear, or things to consider in a typical workflow.
- **Integrated full solution**
Allowing seamless operations and minimal downtime even in challenging conditions.
- **Coverage:**
 - ▶ Coastal: Available up to 11 Nautical Miles / 20 kms from shore
 - ▶ Regional: Available up to 100 Nautical Miles / ~200 kms from shore
 - ▶ Global: Worldwide
- **Constellations²**
 - ▶ GPS: L21C/A, L2E, L5
 - ▶ Galileo: E1, E5 (E5AltBOC, E5A, E5B)
 - ▶ GLONASS: L1C/A, L2C/A E6
 - ▶ BeiDou-II: B1I, B2I, B3
 - ▶ BeiDou-III: B1C, B2A, B3, B1I
 - ▶ QZSS: L1C/A, L2C, L5
- **Compatible devices**
 - ▶ Trimble Modular Receivers:
R750, R780, R980, R580, R12i, MPS865, SPS855, BX992, MPS566
 - ▶ Trimble Applanix POS MV (BD992 / BD982)
 - ▶ Recommended Antennas for modular receiver:
Rugged Zephyr 3, 540 AP, GA830
 - ▶ Software
 - Trimble Marine Construction
 - Applanix PosPac MMS

HIGHEST STANDARD OF ACCURACY, AVAILABILITY AND REDUNDANCY

One Trimble solution

CenterPoint RTX Marine is part of the advanced “full solution” technology for marine operations, combining hardware, software, and GNSS corrections to deliver seamless integration and results. Trimble Applanix POS MV hardware has Trimble ProPoint technology in its core, and every aspect of the ProPoint engine is built with Trimble RTX in mind, ensuring superior performance.

Full redundancy

Trimble operates redundant network operations centers with around-the-clock monitoring and maintenance of the Trimble RTX correction service. Additionally, a global network of reference stations uploads real-time GNSS observable data to the operation centers, which process the data, create corrections, and transmit the data through separate upload satellite links to the geostationary Trimble RTX satellites. Throughout the world, many areas have coverage from more than one geostationary Trimble RTX satellite, and backup servers are leveled and available immediately if primary processing servers have any issues.

1. RMS performance based on repeatable in field measurements. Achievable accuracy and initialization time may vary based on type and capability of receiver and antenna, user's geographic location and atmospheric activity, scintillation levels, GNSS constellation health and availability and level of multipath including obstructions. Accuracy may vary in areas beyond 100 Nautical Miles from the coast.

2. GNSS Constellation inclusion in correction dependent on areas and beam selection.

HOW DOES IT WORK?

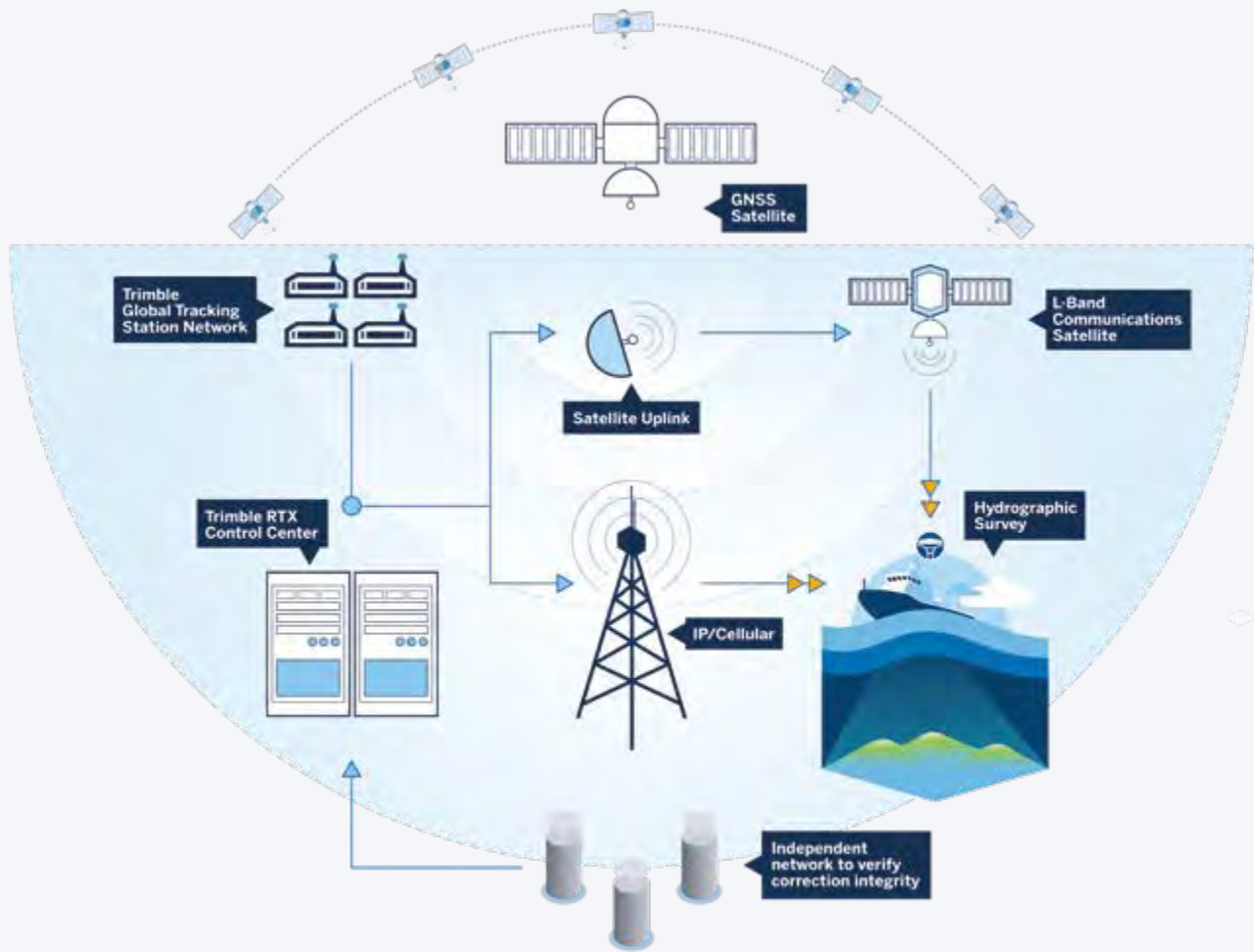
- 1

Global Reference
Station Network:
Observes all satellites in
GNSS constellations.
- 2

Modeling:
Models satellite orbit and
clock errors, as well as
atmospheric delay for all
visible satellites.
- 3

Corrections Delivery:
Corrections data is sent to
the receiver via L-band or
IP network.
- 4

Bias Mitigation:
Mitigated biases result in
better correlation and more
precise positioning.



BENEFITS:

- **Delivering better precision:** Market-leading PPP corrections for the hydrographic survey industry and the fastest global convergence.

• **Accelerating your operations:** Doesn't require local base station or network service coverage—enabling untethered surveying.
- **Easy and cost-effective:** Easy to use and featuring an easy learning curve, the service is available through an annual subscription - a small operating expense which can be included in the cost of the project.

• **Ensuring your productivity:** Utilizing all the modern GNSS constellations and having more available satellites to keep you reliably on point in challenging GNSS environments.

HYDROGRAPHIC SURVEYING APPLICATIONS

Hydrographic surveying has critical applications across various marine environments, from the open sea to coastal waters.

SEAFLOOR, LAKE AND RIVERBED MAPPING

Seafloor, lake and riverbed mapping is a fundamental task that presents unique challenges. Modern hydrographers rely on multibeam sonar technology, combined with precise georeferencing from systems like POS MV, to produce the most accurate seafloor mapping data available. This data is essential for navigation, marine construction, and environmental monitoring.

COASTLINE MAPPING

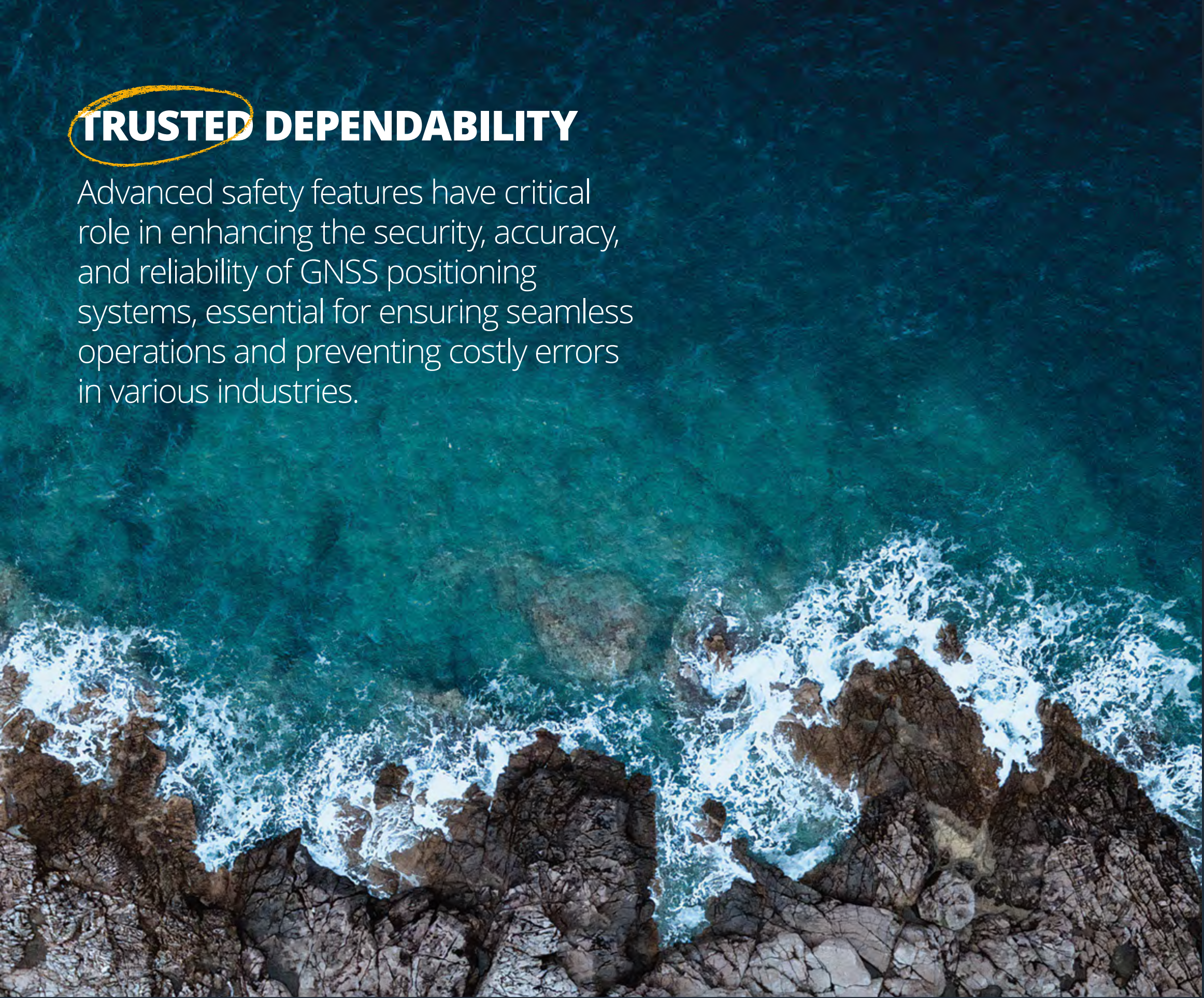
In coastline mapping, hydrographers face the complexity of surveying both above and below the waterline. This involves detailed mapping of the seabed, coastal geography, and man-made structures such as bridges and ports, often in GNSS-challenged environments. Applanix technology offers advanced solutions for capturing accurate data onboard dynamic marine vessels, ensuring that even in difficult conditions, precise mapping is possible.

HARBOR MAPPING

Harbor mapping presents another demanding scenario, requiring surveyors to conduct detailed mapping in shallow, narrow, and often turbulent waters. Whether the goal is port and harbor asset inventory, marine hazard mapping, or coastal zone management, Applanix mobile mapping solutions provide cost-effective, high-quality GIS data to support regulatory compliance and infrastructure management.

For all these applications, having an integrated solution that combines trusted hardware and software, and reliable GNSS correction technologies is a significant advantage. Achieving centimeter-level accuracy in real time lets hydrographic surveyors take control over their decisions on water and make the right calls, achieving the right decision at the right time. Less gear, less hassle, more control on water.

With streamlined operations, fewer components, and reduced complexity, surveyors gain greater control over their projects. Applanix POS MV, advanced antennas, and Trimble’s CenterPoint RTX work together to optimize efficiency and ensure the success of hydrographic surveying operations.



TRUSTED DEPENDABILITY

Advanced safety features have critical role in enhancing the security, accuracy, and reliability of GNSS positioning systems, essential for ensuring seamless operations and preventing costly errors in various industries.

INTEGRITY ASSURANCE

The Trimble RTX Integrity™ monitoring system is an innovative, patented solution, built in direct response to client requirements for production-ready applications.

It continuously validates the reliability of correction data processed by the network, which is broadcast to users in the agriculture, geospatial, construction and automotive industries, ensuring positioning data is right the first time.

Through a unique two-step process, the Trimble RTX Integrity system verifies the integrity of GNSS data received from satellites and filters faulty information in the network server before the correction data is generated, encoded, and broadcast. A secondary post-broadcast check is conducted on the correction data at the integrity stations to validate the integrity flag. Should the integrity flag not be validated, the correction data would not be flagged as verified until the ambiguity was resolved. The integrity monitoring system is fully automated and reacts in seconds to detect, isolate and block faulty data to provide even more highly accurate and reliable positioning.

Trimble RTX Integrity is composed of independent monitoring stations strategically positioned across RTX Fast networks in the United States, southern Canada and across Europe. These stations continuously monitor data output during multiple stages of the Trimble RTX positioning process. Any suspicious satellite data is removed during the integrity protection process and positioning is calculated using only validated data.

Trimble Alloy™ GNSS reference receivers power the independent monitoring stations using redundant internet connectivity for added reliability. To date, no other positioning network offers the same level of data integrity validation across such expansive, contiguous geographies.

NAVIGATION MESSAGE AUTHENTICATION (RTX-NMA)

FEATURES FOR IMPROVED SECURITY AGAINST SPOOFING

Trimble's RTX Navigation Message Authentication (RTX-NMA) is engineered to significantly enhance the security and integrity of GNSS positioning systems, which is crucial for the integrity of the hydrographic surveying industry. These applications demand high accuracy and reliability, and reworks are extremely expensive.

Spoofing can involve rebroadcasting authentic but recorded navigation messages or manipulating them to cause incorrect positioning estimates. Detection of large errors in broadcast ephemeris is possible by using plausibility checks with the previous broadcast ephemeris data within a receiver, but local spoofing with counterfeit messages can be difficult to detect.

RTX-NMA ensures that users of Trimble's RTX correction streams receive authentic navigation ephemeris data by using Trimble's global network of reference stations. Unlike other emerging GNSS authentication methods that are limited or years away from widespread implementation, RTX-NMA provides immediate protection across multiple

satellite systems, on the legacy signals users depend on today, like GPS L1C/A. RTX-NMA uses multiple reference stations to provide the same broadcast ephemeris data (to rule out a local spoofer). Once there is a match, the broadcast ephemeris is checked for ranging errors, and flagged with a quality indicator. Good satellites are processed by the RTX Server correction data generator, and encoded for broadcast. Faulty satellites are excluded from the solution. The quality indicator flag is then used by the receiver to weight the satellite in the solution appropriately. This solution addresses both immediate and future security needs, enhancing the overall safety and reliability of hydrographic surveying operations.

ANTI-JAMMING

Dependence on a single base station in a differential RTK solution makes you quite vulnerable to the impacts of jamming and interference.

Trimble RTX reference stations are located all around the world and are continually monitored by our team of Network Operation Engineers and the RTX Server software. When jamming occurs at a reference station, it can be detected by code and carrier phase analysis to compare range calculations with the broadcast ephemeris. Residuals in the differences can indicate a local source of jamming, allowing the RTX Server software to remove the reference station from the solution. Network Engineers can then work with the station host to identify and resolve sources of jamming.

Additionally, given the global distribution of Trimble RTX reference stations, it would be highly unlikely that a jammer could impact enough reference stations to impact modelling. When one reference station is removed from the solution, nearby redundant stations can fill in, ensuring continuous availability of the correction data.

FOR MORE INFORMATION VISIT:

positioningservices.trimble.com/marine
applanix.com