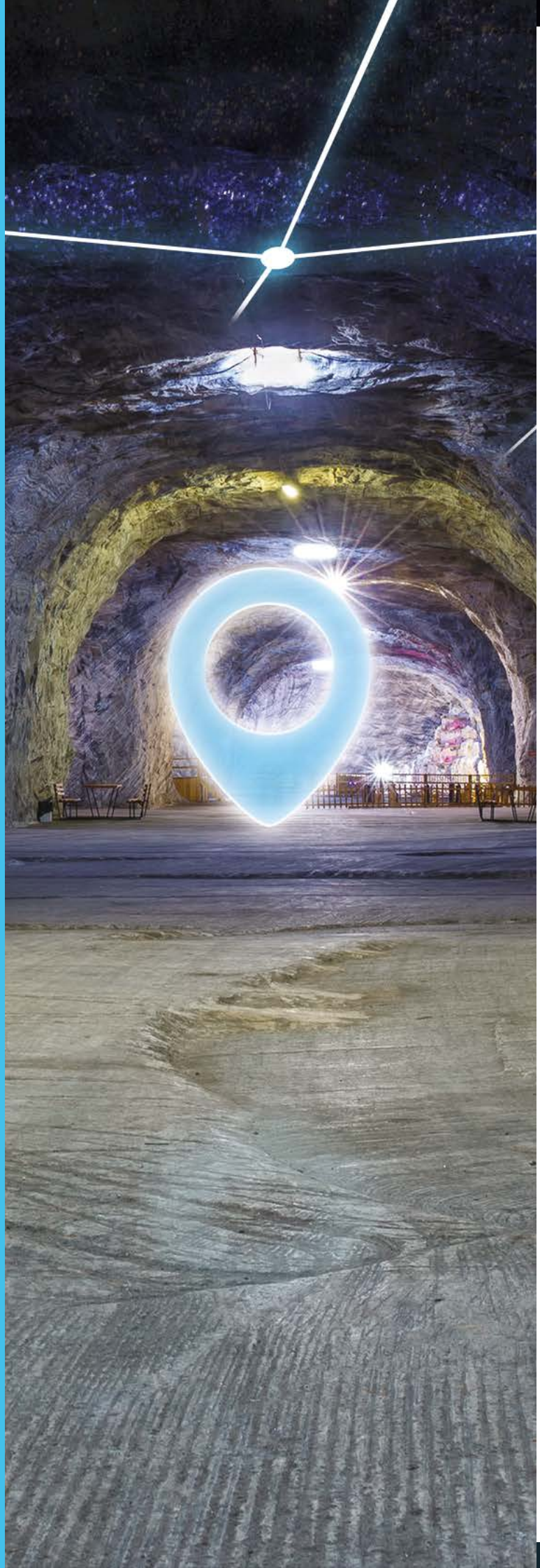


Seamless and Universal

GPS Coverage Extension

SubWAVE™

for Mines

SYNTONY GNSS

GPS Coverage Extension to support underground operations

Mining operations come with a set of dangers and threats, especially in inhospitable underground environment.

To ensure workers safe and healthy work conditions, technology is of great help, particularly when it comes to locating the assets in this galleries maze.

But since those technologies have been designed to address specific use cases, multiple costly deployments complexify the monitoring and miss the point.

To keep mining operators from investing in costly new equipment, Syntony designed a solution to extend GPS coverage to underground mines: SubWAVE™. Fully compatible with already deployed GPS receivers in open pits, SubWAVE™ addresses all the underground location use cases at once.

Available with several modes of accuracy dedicated to specific usage, the solution provides a seamless extension of the natural GPS coverage, enabling homogenic outdoor/indoor monitoring, at optimized cost.

As the standard for worldwide geolocation,
GPS positioning is used everyday
in open pits with efficency,
but cannot reach underground exploitations.

With SubWAVE™, it has become available everywhere.

Mining automation

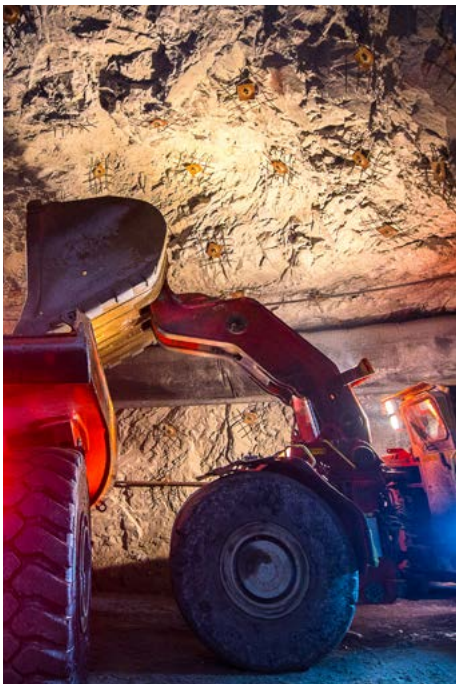
The mining sector is covered by multiple challenges where tele-remote operations is consistently promoted.

In order to optimize operational matters, Syntony GNSS helps to increase very consequently the accuracy that the operator needs in any situation with distant machines.

From collision avoidance to accurate control for day-to-day activities, the SubWAVE™ technology enhances the precision of each operation.

Its compatibility with existing systems and infrastructure is optimal and makes its integrity possible with any of your current machines and devices.

Furthermore, no blind zone appears anymore thanks to the full coverage of its GPS signal through all equipped galleries.



Haulage & workforce tracking indoor/outdoor

The SubWAVE™ technology spreads the GPS signal all along the indoor environment of the mine and in perfect synchronization with the outdoor GPS signal.

This seamless feature without any delay, makes then possible the tracking of all employees or machines located either inside or outside the mine.

Moreover, this technology leads to embrace several use cases: asset tracking, ore tracking, dump tracking, global productivity.

The full compatibility of SubWAVE™ with all your current infrastructure and machines makes its installation fast and efficient.

Choose the SubWAVE™ system in order to get control of all your operations, both inside and outside the mine.

Ventilation-on-demand

Ventilation systems in mines are crucial for the workers' safety. But since they cannot be located with accuracy within mines, those systems run 24 hours a day, just in case there is someone in the area.

This default mode of operations generates extra costs that can be optimized. With SubWAVE™ GPS Coverage Extension and the ability to locate workers in the mine, venting systems can be activated only on demand, offering up to 25% operating costs saving.

Besides, if any malfunction of the ventilation is spotted, workers in the area can be immediately identified and informed. With GPS-enabled location, maintenance workers can be guided to malfunctioning vents, enhancing the response time and shortening the shutdown of operations.

Indoor RTK for people and machines positioning

Similar to what is available outside to enhance standard GPS positioning precision, Syntony GNSS developed a specific augmentation software narrowing down accuracy to meter-level.

The error budget encountered underground is very specific to the environment and antennas, and therefore we need to take into account these specificities to achieve high accuracy.

This feature can be deployed directly on the receivers, or on the centralized positioning server, to optimize costs.

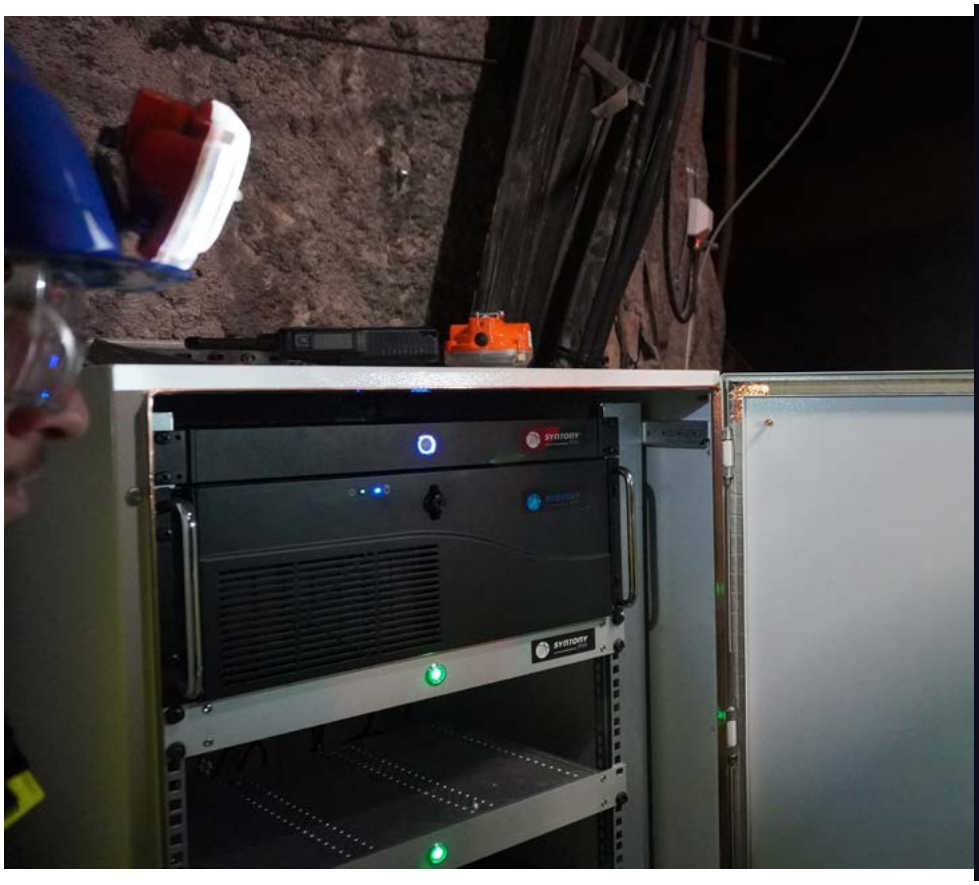
Once installed on the server-side, Syntony's Augmentation Software is provided with raw GPS data from receivers and computes their positions.

Management systems can monitor every asset in the mine with a meter-level precision, with the same receivers they already use.

	SubWAVE™	**SubWAVE™** *with Augmentation Software on Centralized Server*
Compatibility with standard GPS chipsets	✓	✓
Precision level	Decameter CEP*	Submeter CEP*
Typical Use cases	- Emergency calls location - Ventilation-on-demand - Flow monitoring	- Vehicles & machines guidance - Autonomous driving
		

**CEP: Circular Error Probable*

SubWAVE™ Main Benefits



SubWAVE™ is a real-time GPS* emulator providing signal in facilities out-of-range from natural GPS.

Using telecom network to broadcast, SubWAVE™ emulates GPS* signal matching real coordinates, computable by standard chipsets.

Since almost every portable device has a GPS positioning feature, SubWAVE™ allows majority of trackers to keep working underground.

Zone-based or continuous along a path, SubWAVE™ enables efficient positioning, everywhere.

Extension of Universal technology

- Real-time GPS* emulation
  allowing continuity of GPS service where it cannot naturally get
- Seamless transition between outdoor and underground
  Receivers will not even notice they switched to Synthetic GPS

Easy implementation

- Use of existing telecom infrastructure
  GPS signal is broadcast through leaky feeders used for coms, or antennas
- Compatible with existing equipment
  P25, TETRA equipment, or even smartphones equipped with standard GPS chipset

Built to evolve with your requirements

- Software-defined-radio architecture allowing remote updates
  New GNSS constellations, algorithms enhancing precision, etc.

** SubWAVE™ is available with all other GNSS Constellations: Galileo, BeiDou, IRNSS NavIC, GLONASS, QZSS*

They trust us

Enhanced Asset Tracking with Indoor RTK Integration with Mobilaris

Boliden incorporated SUbWAVE's Indoor RTK solution into their existing supervision system, Mobilaris.

This integration enables them to accurately track their assets in real-time, using the same GNSS technology employed in surface operations.

SubWAVE solution has extended GNSS coverage underground seamlessly, maintaining consistent performance and precision.

Asset locations are pinpointed within a few meters, enhancing operational efficiency and safety. This technology adaptation ensures continuous, reliable asset monitoring across all environmental conditions, both above and below ground.

Optimized GeoFencing for Safer, More Efficient Mining with Optimine

Sandvik uses SubWAVE within Optimine to implement GeoFencing capabilities, crucial for mine safety and operational efficiency.

This technology defines no-go zones at the supervision level, instantly alerting when personnel or vehicles breach these areas. It is instrumental in mines with active, hazardous operations and aids in managing truck flows and asset locations.

By preventing asset misplacement, Sandvik will be able to minimize potential ore loss and reduce downtime, thereby optimizing resource allocation and enhancing overall site management.

This strategic integration underpins a proactive approach to safety and operational management.

SYNTONY GNSS

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