THE STRENGTH TO DEAL WITH DISASTER

IN A WORLD FRAUGHT WITH DISASTERS, A GEOGRAPHIC APPROACH CAN MAKE COMMUNITIES MORE RESILIENT, SAYS **RYAN LANCLOS**

Respond, recover, repeat. Communities can no longer sustain this cycle in the face of intensifying risks – from violent weather events to social unrest to health crises. Instead, we need to be proactive, designing mitigation strategies that reduce risk and protect our most vulnerable populations.

Many are taking a geographic approach by looking at where the social, economic, and natural systems collide and present the greatest risk, then inviting those most at risk to help highlight potential solutions. The approach uses location intelligence – combining social, economic and environmental data centred on precise locations, delivered by a geographic information system. Leaders use GIS as a tool to share key information among partner agencies; they also use the technology to identify vulnerable communities and to reach out to residents with relevant surveys, dashboards, and online maps. They use these maps to provide the context that is required to drive lasting change for a more resilient future.

With this understanding, anticipating actions before a threat emerges can mitigate the worst-case scenarios and keep an emergency from turning into a disaster. For instance, firefighters are ensuring they won't be caught without a source of water by readily sharing data about recent hydrant inspections and locations. Municipal leaders are seeing patterns where devastating flooding is occurring most often and then buying and demolishing structures so rising waters no longer pose a flood risk.

Assessing vulnerabilities to protect the public

A geographic approach empowers leaders to focus on the most vulnerable people and areas. Maps can help planners pinpoint those who lack the financial means to evacuate, need access to transport or simply have nowhere else to go, in an effort to provide more equitable resourcing across the community. Responders can quickly see areas where people rely on a power source that may go out.

In this way, agencies avoid spreading limited resources too thinly or deploying them in the wrong places. Instead, they invest where they can have the greatest impact – to support those who need it the most – to truly change future outcomes.

Ahead of Hurricane Sandy, emergency officials in the US updated storm surge maps, helping to evacuate hundreds of thousands of residents on the East Coast and rescue hundreds in Long Island, New York. The maps directed responders to where the biggest needs would likely be.

Planners can also get ahead of events by using GIS to conduct disaster simulations. With 3D modelling, they can run weather scenarios and calculate possible outcomes, providing an early view of what a future disaster could look like. They can augment digital terrain models to show an area's population and emergency shelters and determine whether any vulnerable residents would need to be rescued. With this deeper insight and understanding, exercises can test real-world scenarios and ensure response plans are adjusted accordingly to deliver the resilience required in today's world.

Designing a strategy, then putting it into action

When Hurricane Florence materialised off the coast of North Carolina in the US in 2018, geographic specialists redoubled their preparations. They tested online damage assessment tools used during the previous hurricane. They studied elevation data on maps showing where residents were vulnerable to rising water. Then they planned routes to reach people, if necessary. This geographic approach allowed them to keep watch on water levels in real time.

As rivers swelled, responders were ready. The City of New Bern, North Carolina, dispatched crews to more than 300 water rescues in two days, including in a neighbouring town, avoiding any fatalities. In just seven days, the city knew the cost to rebuild – $100 million.

Staff quickly completed a damage assessment using an online tool that answered the Federal Emergency Management Agency's questions at the onset. The same assessment was shared and updated in the hurricane aftermath. Without it, they would have had to fill out forms and input information by hand, delaying needed relief. Mere days after a devastating hurricane, the city had gotten back on its feet.

In nearby coastal Florida, cities are taking long-range forecasts and community needs into account as they work to proactively design and fix infrastructure. The effort prioritises challenges at a neighbourhood level for areas with tidal flooding. Leaders now take a holistic, geographic approach to projects such as raising roads, installing riparian landscapes and making stormwater improvements.

Mapping existing utilities, roads and natural features also goes hand in hand with identifying vulnerable populations. In the US state of Indiana's recent update to its multi-hazard mitigation plan, personnel identified five particularly at-risk groups and the top five counties in jeopardy, ranked by percentage. The groups included low-income earners, older adults, non-English speakers, those who didn't graduate from high school and those with a disability.

By mapping vulnerable populations, planners can see where people may have difficulty escaping from a disaster or recovering financially and physically.

Communicating risks and resources

In the Philippines, a nation prone to earthquakes, volcano eruptions and typhoons, a major relief agency sought and trained volunteers who lived in or near each of the country's 42,000 local governments. The agency relied on locals rather than outsiders to document risks that may have otherwise gone unseen. The volunteers saw physical features that might wash away in a flood and knew how many residents may be medically at risk during a hazardous event, collecting this data on mobile devices and sharing the information via smart maps. The relief group could add the locations of community assets such as schools and hospitals, including where doctors and nurses may reside, in case they might be needed. This inclusive process, locally led, created a framework for better community engagement and, ultimately, resilience.

Relief organisations around the world have also worked with residents to help in crafting their own mitigation efforts, including building flood walls or irrigation canals to control rising waters or mapping city-sized refugee settlements so those inhabiting them know where to find resources.

When community members have access to shared authoritative, accurate information in the context of a map that they can relate to, they gain awareness of impending threats and can make better decisions about how to react. Knowing which evacuation zone they're in or understanding infection rates in their communities amid a pandemic, people can visualise their own risk and choose what to do based on their ability to adapt or cope in the midst of a crisis. They can find relief or shelters through online dashboards and maps and then document their experiences through online surveys that make their voice heard.

There are ways to stay ahead of increasingly complex natural and human-caused catastrophes by understanding the systemic nature of risk and its geographic and social context. GIS can help us better understand, design and proactively build communities that are better prepared for the dangers to come and more resilient in the aftermath of life-threatening events.

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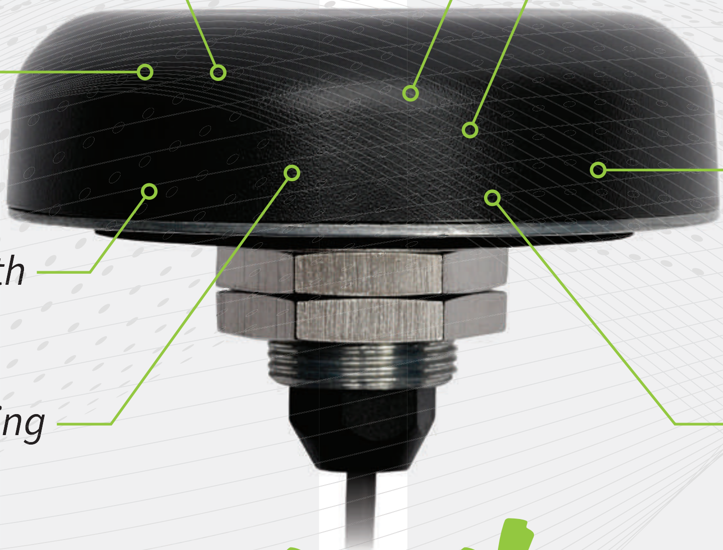

WOW!

Tallymatics integrates Tallysman antennas, a u-blox F9x GNSS receiver and the PointPerfect augmentation service into the **TW5390** multi-constellation and multi-band smart GNSS antenna.

- ***Precise triple-band Tallysman GNSS antenna combined with u-blox F9x receiver family***
- ***Supports u-blox PointPerfect augmentation service:***
  - *3-6 cm accuracy and fast convergence*
  - *SPARTN messages over IP and/or integrated L-Band*
- ***Optional integrated IMU bridges GNSS outages and improves positioning in challenging environments***
- ***Exceptional accuracy and value in a field-ready package***

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Smart Global Navigation Satellite System Antenna **with out-of-the-box PPP-RTK Augmentation Technology**

GNSS augmentation technology has continuously evolved over the years. Today, high-precision augmented GNSS positioning is available to the mass market. The latest generation of precision augmented GNSS receiver systems will allow millions of devices to derive centimeter-level position accuracy, out-of-the-box. TALLYMATICS has developed a multi-band, multi-constellation augmented smart GNSS antenna which integrates the u-blox F9x module family and their PointPerfect augmentation service.

Augmentation Services

Real-Time Kinematic (RTK) augmentation was the first widely used augmentation technique. RTK is a relative positioning technique that utilizes an Observation Space Representation (OSR) method in a configuration consisting of a base station with known coordinates and a rover. The base station coordinates and GNSS observations are communicated to the rover (over radio or cell network) to enable the rover to compute the vector between the base and the rover. Since the base station coordinates are known, and the vector (base to rover) is derived, a precise rover coordinate can be computed. The RTK technique has some limitations. For example, for RTK to derive accurate and precise coordinates, the distance from the base station to the rover must be short (≤ 30 km). When the RTK baseline is short, satellite and atmospheric errors are mitigated/cancelled, common to both the base and the rover. Also, RTK system deployment is costly as two GNSS receivers and a dedicated communication link is required. The RTK method typically produces 1 cm accuracy and has a convergence time of 10 seconds.

Precise Point Positioning (PPP) on the other hand is an absolute positioning technique that relies on a sparse global network of reference stations that collect GNSS observations. The station data is sent to a data center, and the satellite and atmospheric errors are estimated. This method derives a State Space Representation (SSR) correction format. SSR corrections are applicable over a large geographic area and can be broadcast over a communication satellite or a cellular network. The downside of traditional PPP is that the accuracy is <10cm with convergence times in the order of 3-10 minutes.

The most recent evolution of the PPP technique is based on more densely populated Continuously Operating Reference Stations (CORS) in continental/global networks to provide better atmospheric corrections. The u-blox (PPP-RTK) service delivers near RTK precision (3-6cm) with fast convergence times (<45sec) over a broad geographic footprint (continental). The service employs modern bandwidth-optimized protocols to deliver high accuracy and high availability augmentation direct to compatible receivers such as u-blox F9x series via satellite (L-Band) or cellular (IP) broadcast. This technology brings affordable, precise positioning to a wide range of pro-sumer and professional applications.

Building Blocks

The TALLYMATICS TW5390 smart antenna integrates the u-blox F9x GNSS receiver and DS9 L-band receiver modules in a compact multi-band, multi-constellation receiver that supports the PointPerfect (PPP-RTK) augmentation service over geostationary satellites and/or IP messaging. Standard RTK augmentation is also supported via a serial interface. The u-blox receiver technology is coupled with a Tallysman multi-band GNSS Accutenna to receive L-band corrections and GNSS signals with the clarity required for precise positioning.

Successful integration of analog receiver elements (wide-band antenna, signal splitters, Low noise amplifiers, tight multi-band/multi-stage filtering) with the digital receivers, powered by noisy switching regulators, is a tricky business with many bear traps. This is exacerbated in a compact implementation, posing mechanical challenges related to enhanced signal reception and the IP69 rating. That being behind us, TALLYMATICS, in cooperation with u-blox, is pleased to offer a "commercial, off-the-shelf" solution for PointPerfect augmented precise positioning, out-of-the-box.

TALLYMATICS TW5390 GNSS + L-Band High-Precision Integrated Antenna Receiver

The TALLYMATICS TW5390 'GNSS + L-Band' High-Precision Integrated Antenna Receiver

We recognize that the TALLYMATICS TW5390 product format may not be appropriate for all applications. For those users who wish to develop OEM implementations, the TW5390 provides an instant solution and a demonstration device, allowing evaluation of the achievable performance with u-blox receiver technology, PointPerfect augmentation and Tallysman Antennas.

OEM usage requirements commonly relate to product format limitations (particularly for the antenna), antenna E-M environment issues, weight, and integration with other systems. When going down this path, it is important to know what factors are key to realizing the full potential performance of the overall system. In particular, the antenna element is more critical than might be initially appreciated. To realize this system's achievable accuracy, the antenna must provide sufficient signal clarity for the receiver to determine the distance, antenna-to-GNSS-satellite (in a MEO orbit), to within a centimeter or better, no matter the point angle. A metaphorical tape measure; awesome, eh?

Key Antenna Features:

- GNSS upper and lower band coverage for the four primary GNSS constellations (GPS, Galileo, GLONASS, BeiDou)
- Broad bandwidth, right-hand circular polarization with dual- or quad-feed elements with superior multi-path rejection, such as Tallysman Accutenna technology
- A super Low Noise Amplifier
- GNSS Sharp pre-filters and multi-inline filters to mitigate saturation and cross modulation (especially from Ligado and LTE signals)
- Tight Measured phase center offset, low axial ratio, low overall noise figure.

Clearly, something to be left to experts in the field.

Then other factors include switching noise from proximate digital systems, USB3 interfaces, and switching power supplies, particularly with closely co-located antennas. Lots of bear traps for sure, but amenable to careful engineering as proved by the TW5390.

The TW5390 employs the latest generation of u-Blox multi-band GNSS and L-Band receiver modules. The u-blox modules allow direct decoding of the PointPerfect, SPARTN formatted augmentation packets. A super careful layout, tight filtering and a very low noise architecture allow both receiver modules to coexist with other noisy circuits within a compact footprint. With the PointPerfect SPARTN augmentation packets active, the TW5390 performance dramatically improves to offer sub-6cm performance, while the dual-band multi-constellation capability of the GNSS receiver enables fast convergence time.

The TW5390 supports two PointPerfect PPP augmentation delivery methods. Direct over-the-air L-Band message delivery is suitable for unobstructed and rural applications, and IP network delivery is ideal for urban areas where cellular data coverage is strong and the L-Band satellite signals may be blocked.

The TW5390 supports untethered dead reckoning via the integrated Inertial Measurement Unit (IMU) sensors. When operating the device in the most challenging environments such as a deep urban canyon where GNSS signals may be partially obstructed and subject to strong multi-path or when fully obstructed such as under a bridge, the IMU sensor data supplements the position solution algorithm to maintain the most probable accurate position solution.

The TALLYMATICS TW5390 integrates Tallysman antenna technology with u-Blox receiver technology in a compact IP69K-rated enclosure. The communication link is supported by robust integrated RS-485 differential transceivers for superior noise immunity and extended cable length applications. Several radome and cable options are available, with custom factory device configuration available upon request.

TW5390 SDK

To enable rapid development, TALLYMATICS offers an easy-to-use MS Windows software development kit that includes:

- the TW5390 Smart Antenna
- a configuration adaptor that converts the RS485 serial link to a USB interface with 2 Virtual COM ports (one for receiving corrected GNSS signals and the other for sending correction information to the TW5390)
- Windows-based TruPrecision application which facilitates TW5390 configuration, as well as easy connection to the u-blox PointPerfect augmentation service delivered over u-blox's ThingStream IoT service using MQTT protocol
- 60 days of free access to the PointPerfect Service

Conclusion

Incredible GNSS accuracy is becoming much more accessible and affordable with enhanced/integrated systems such as the TALLYMATICS TW5390 smart antenna. The TW5390 integrates u-blox receivers, PointPerfect augmentation technology and Tallysman GNSS antennas to deliver unprecedented accuracy and value in a small package. This high level of integration, delivered in an "all-in-one, off-the-shelf" cost-effective smart antenna, ensures a successful deployment. Trust TALLYMATICS to deliver "state-of-the-art" smart antenna solutions.

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