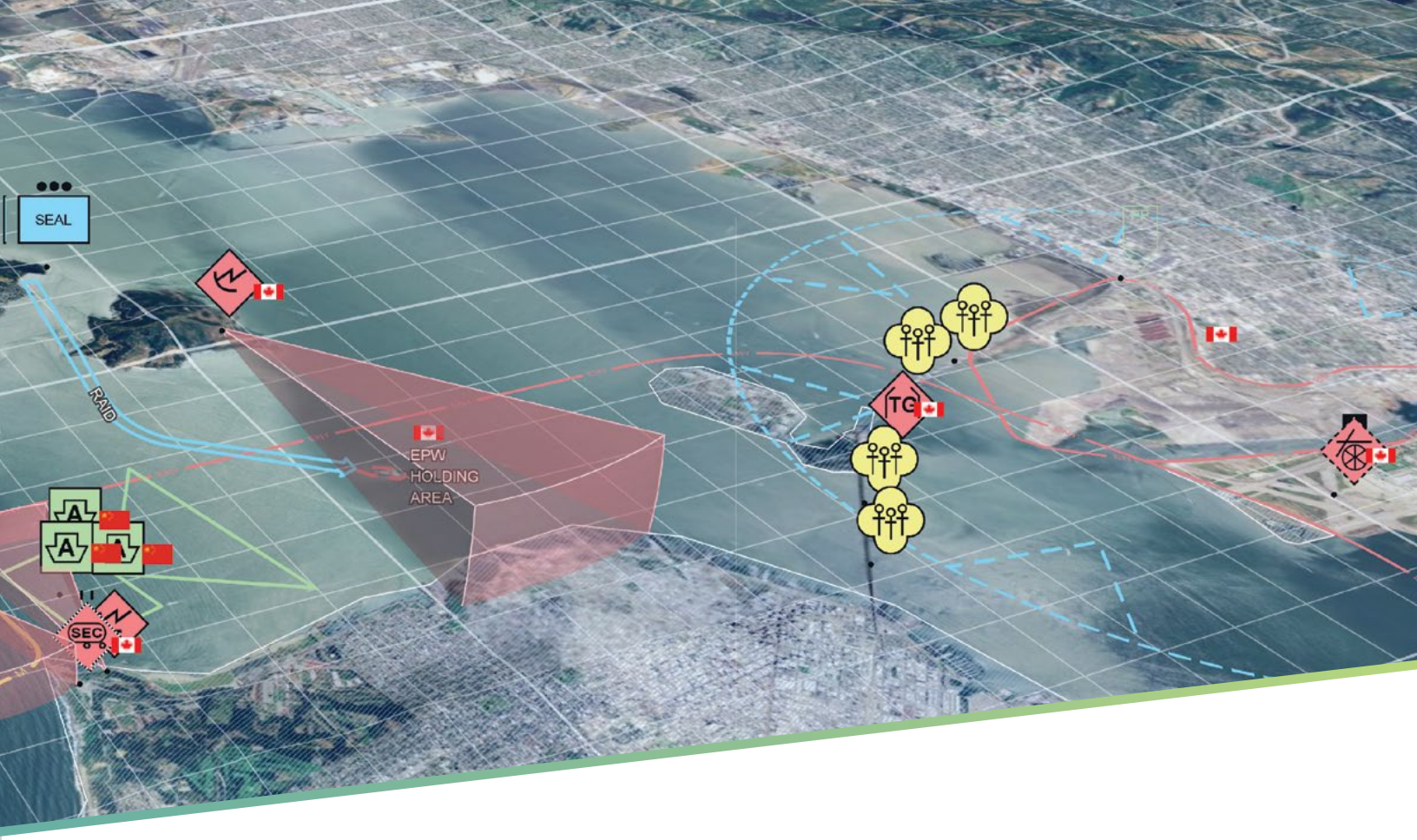
How to Differentiate Your Radar/Sonar System with Real-time Information and High-Performance Visualization and Analytics

By Germán Barba and Ignacio Hernández

Radar and sonar technologies are everywhere. Radars are used to monitor civilian air traffic, busy tarmacs at airports, and the weather, as well as protect our airspace from intruders and enemy attacks. Sonar technology is used to explore and monitor the vast oceans and seas that cover the planet.

Within the radar and sonar domain, there is a large and diverse number of users with unique requirements and objectives, from manufacturers to system integrators to end-user organizations.



Stakeholder Requirement

While track display and analysis are not essential to radar and sonar manufacturers' sensing hardware, their products will also be judged by the quality of the user experience. Therefore, it makes sense for manufacturers to equip their hardware with out-of-the-box visualization capabilities that are on par with the high quality of their products.

Systems integrators are continuously faced with different projects in different parts of the world, where constraints like operating systems, symbology standards, data feeds, and more may vary each time. And yet, despite these differences in requirements, every radar or sonar integration project has commonalities. There is a kind of lowest common denominator of functionality and technical capability that needs to be developed each time.

Systems integrators, therefore, typically want the best of two worlds: a solid base capability to avoid reinventing the wheel on every project and flexible and extensible technology to adapt to the needs of each project.

End-user organizations want easy-to-use technology that is fast, intuitive, and delivers the capabilities they expect. They want to see on their screens more than the traditional bleep; they want to be able to introduce data fusion and advanced analytics without performance lags. And their IT departments want systems that have low costs and are easy to maintain.

In summary: End users want to have powerful systems that deliver a smooth user experience and a low total cost of ownership. System integrators want to create systems tailored to their customers' needs without having to reinvent the wheel each time. And manufacturers want to see their software reflect the quality of their hardware.

The Geo-Ops Challenge

Ultimately both the manufacturer and the system integrator are focused on the end user. End users of radar and sonar feeds typically want to combine real-time sensory feeds with other data like maps (2D or 3D), historic track data, and more. This is a typical example of how map data or geospatial information no longer lives in separate stovepipe systems but needs to be combined with real-time domain data. We call this the "Geo-Ops Challenge" – a challenge that is very much alive in the radar/sonar industry. Here is where the importance of flexible, fast, and powerful solutions becomes relevant. Ideally you want, with one system, to provide a variety of information to all the users, from operators to high-level decision-makers.

From the Traditional "Bleep" to Dynamic Information Systems

Meeting these complex requirements and equipping organizations with the tools to address the Geo-Ops challenge is difficult for traditional technologies. We'll look at two common approaches: dedicated radar displays and conventional GIS.

Dedicated radar displays

If you have difficulty imagining what a dedicated radar display is, just think of an old James Bond action movie. Picture a green dot on a black screen that gets refreshed every few seconds or milliseconds, and a characteristic *"bleep"* sound.
These systems have the benefit and strength that they are able to present real-time track data very fast, with very fast update rates. But they are far from intuitive and do not show any other data. They merely show the radar is working with simple information. There is no possibility to engage in data analysis or to fuse different datasets. And often the software system is limited by specific hardware and not designed to work in larger "systems of systems."

In other words: "Performance and accuracy: yes. Data fusion and user experience: no."

Conventional GIS

Another possibility is to try to base your system on conventional GIS. But these present a plethora of problems. Conventional GIS typically needs data to be pre-processed and stored in a built-in geodatabase before being analyzed and displayed. And more often than not, in order to pre-process the data, it needs to be transformed into another format. We also refer to this as ETL or extract, transform, and load. This has two main consequences. The first one is time. It's a longer process that delays the result, making it unusable for real-time data handling. The second consequence is accuracy. You may lose some level of detail with each one of the processing steps. The below schema shows intuitively how the different processing steps delay fast and performant data handling and visualization.

$Data^1$ -> $Data^2$ -> $Data^3$ -> Map

In other words: "Data fusion and user experience: yes. Performance and accuracy: no."

Bridging the Divide: Bringing Both Worlds Together with the Luciad Portfolio

What if you want to combine the real-time performance of the blip on the screen with comprehensive data and a better user experience (and more capabilities)? In that case, you need a tool that will not be delayed by ETL steps in the system, and that can also display the information in beautiful 2D/3D maps at the same time. The solution is the Luciad Portfolio. Luciad is a truly unique location intelligence technology, which has the ability to ingest data as it comes without any extra steps that would strain your system. Luciad makes it possible to display information in real time.

Data[1] -> Map

Furthermore, Luciad is created with a modular approach, perfect for enhancing your current system. Think of it like modular blocks that allow you to build anything you want – and to extend what you built in a later stage. It is structured with different libraries. These libraries add different functionalities to your system. Do you want to add military symbology? One library. Add weather data? One library. Add line of sight to your 3D map? One library. This means that you do not have to add to your cart things you do not need. It also means that your system will be efficient and light no matter the use case.

One example is our PTD (Planning Controlling Tool) project in NATO, which combines line-of-sight functionalities with terrain data to visualize the optimal location to install radar antennas. Another example is the CAPT (Coverage and Planning Tool) project with Eurocontrol, the European agency that controls aerospace and flight protocols. Eurocontrol needed an easy way to find the best location for radars for optimal aerospace coverage as well as simulate landing and takeoff scenarios with the current rules, restrictions, and regulations in place.

CAPT can easily simulate scenarios and visualize interactive simulation results

Another NATO related example is the MASE (Multi-AEGIS Site Emulator) project. NATO needed a system capable of handling thousands of dynamic points of data in real time. This task had an extra degree of complexity because it had to run in low-end hardware at 60 FPS. Only if your system is perfectly optimized can you create such tools.

The MASE project can cope with millions of dynamic units, updated per second, running on rugged tablet with only 4GB of RAM memory and no dedicated graphics card

Real Time Is the Nature of Radars

Whether it's the position of an enemy ship or the location of the next incoming plane, radars were created to display real-time information. But we have come a long way from the bleep in the map. Now you can fuse that data with other relevant information and visualize it in its context. It is no longer a dot in a map, but a plane, a ship, or a UAV moving across your screen with details about the terrain, position, and situation.

With the Luciad portfolio, you can either create or enhance your current system without reinventing the wheel and provide a great experience for your end users. It is possible to have a performant and reusable solution, just by adding the right pieces to your system.

Germán Barba *is responsible for strategic relations and projects at Hexagon's Geospatial division. One of his projects is to evangelize the radar/sonar community on the importance of in-memory data modeling and promoting Hexagon's real-time situation awareness capabilities.*

Ignacio Hernández *is a software engineer and head of Presales for Americas at Hexagon's Geospatial division. He has extensive experience in the radar/sonar domain, having worked for the Spanish Armed Forces and consulted with numerous systems integrators.*

Hexagon is a global leader in sensor, software and autonomous solutions. We are putting data to work to boost efficiency, productivity, and quality across industrial, manufacturing, infrastructure, safety, and mobility applications. Our technologies are shaping urban and production ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

Hexagon's Geospatial division creates solutions that deliver a 5D smart digital reality with insight into what was, what is, what could be, what should be, and ultimately, what will be.

Hexagon is a global leader in sensors, software and autonomous solutions. Learn more about Hexagon (Nasdaq Stockholm: HEXA B) at hexagon.com and follow us @HexagonAB.