White Paper :

Sea Tel

Multi-Axis Stabilized Antenna Architecture

Sea Tel
COBHAM

Multi-Axis Stabilized Antenna Architecture

There is a debate brewing in the maritime VSAT communications industry as to what constitutes an axis and how to count these axes in a given antenna model. This debate entirely misses the point of why these axes are important. New entrants into the industry are trying to confuse the market place with claims of 4-axis systems as if it is an exclusive feature of their product. To make matters more confusing, there are video animations circulating on the Internet that mislead the user by comparing the motion of a 2-axis system with a 3-axis system. The so called 4-Axis systems refer to polarization as the fourth axis; this feature was incorporated in Sea Tel's antenna architecture in the 1990s and has been available as standard since that time. Here is a summary of Sea Tel's 2-axis and 3-axis antenna architecture.

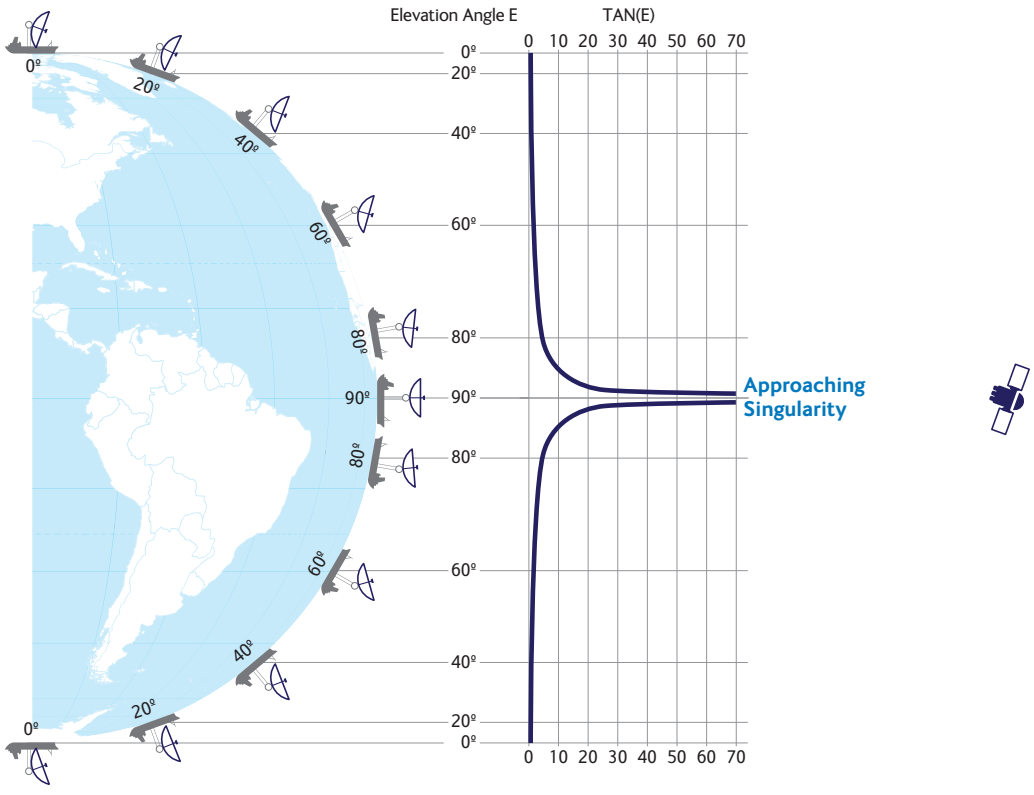
Having 4 axes in total is a good idea. That's why Sea Tel implemented this technology in the 1990s.

- 2-Axis antenna system from Sea Tel: 2 axes of pointing and 1 axis of polarization
- 3-Axis antenna system from Sea Tel: 3 axes of pointing and 1 axis of polarization.

Sea Tel systems take into account only the pointing axes when categorizing the systems as 2-axis or 3-axis. This is because polarization axis is only needed when the satellite signal is linear. For circular polarization, there is no 4th axis even in the so called 4-axis systems.

In a 2-Axis system, the EL and AZ axis are the pointing axes while the polarization axis orients the feed/LNB to ensure proper communication with the satellite. However, as the ship moves closer to the equator and the elevation angle approaches 90 degrees, the effort required to keep the antenna pointed and aligned to communicate a linearly polarized signal is directly

Chart 1:
Effort needed to keep a 2-axis antenna pointed accelerates and approaches infinity very fast after 80º as seen in this diagram. At 90º elevation, it is in fact infinitely large.

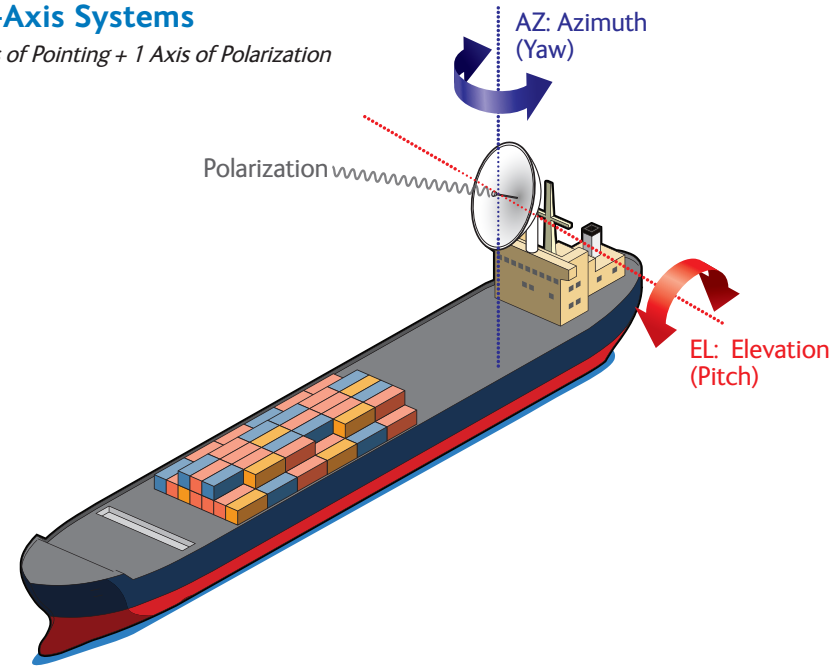


proportional to tangent of the elevation angle. At some point, this effort is infinitely large even for the smallest movement of the ship. This point is known as singularity as shown in chart 1. This is an inherent limitation of a system with two pointing axes, aka 2-axis systems.

The 3-Axis system from Sea Tel does not have this limitation because our state-of-the-art Fast Response Cross Level beam points the antenna in the right direction even when the elevation angle approaches ±90 degrees.

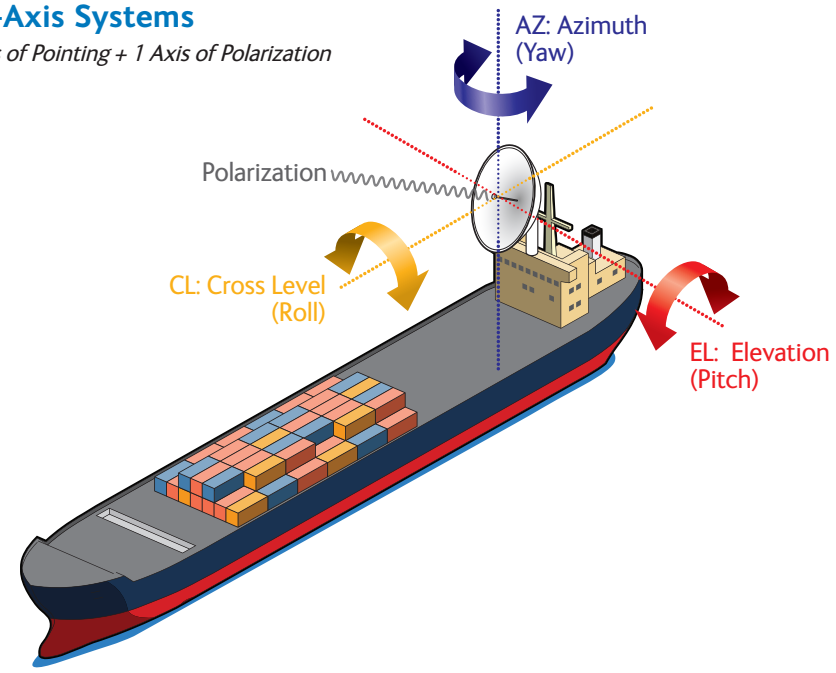
Sea Tel's 2-Axis Systems

Figure 1: 2 Axes of Pointing + 1 Axis of Polarization



Sea Tel's 3-Axis Systems

Figure 2: 3 Axes of Pointing + 1 Axis of Polarization



Beyond Axes

The number of axes does not ensure that the antenna system will operate at the optimal performance level in a given scenario. After all, assembling many types of different instruments in an orchestra to play together does not ensure that the sound produced will be symphonic. The antenna must also have a high-level, closed-loop control system algorithm that takes into account every possible operational scenario and components that have passed some of the most stringent quality systems to perform at its peak level.

Jet Airliner technology incorporated in Sea Tel Antennas

Sea Tel antenna systems currently use components of the inertial navigational system (INS) that is deployed in jet liners and missiles. These components include a computer, accelerometers and rate sensors to continuously calculate the position, orientation and velocity vector of a moving object without the need for external references. It is also known as an inertial reference platform or inertial guidance system.

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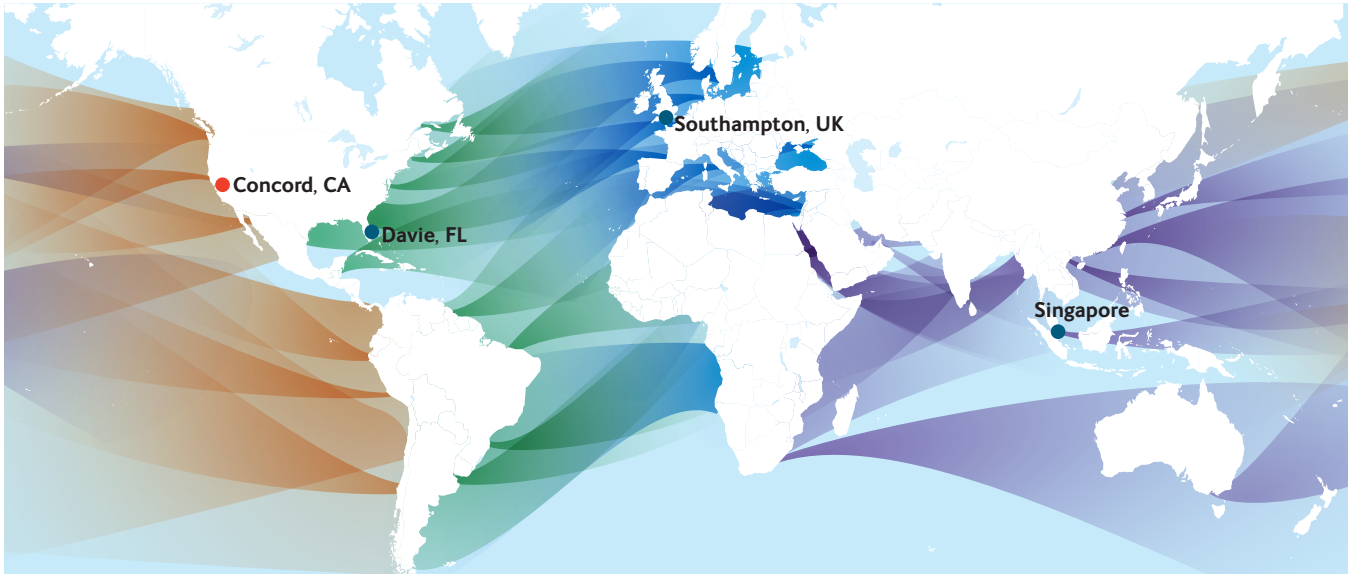
Sea Tel Generation II electronics that is currently incorporated in all XX09 Mk2 and XX10 antennas have a full inertial reference system defined by six sensors. There are three sensors for rate and three for acceleration (tilt). This makes the system equivalent to the inertial reference systems used in jet airliners and missiles.

The micro-electromechanical (MEM) sensors used in Sea Tel's antennas are based on the same technology currently being used in missile and aerospace technology around the world. Moreover, mounting these sensors so they remain fully operational all the time is also very similar to what is used in the missile technology, perhaps one of the most aggressive environments these sensors can face.

Sea Tel 4009 3-axis antenna

Working in harmony: Inertial Navigational System, antenna weight & antenna balance

Proper mass of the system and how to balance it for robust field performance is a matter of fine tuning. Sea Tel system architecture has achieved this perfect balance by exploiting the six sensor axes and designing the inertial reference system for it. This enables the system to be balanced in all conditions. Sea Tel's 3-Axis antenna systems are refined to a point and balanced for robustness. The systems are designed for light weight, long life and lowest total cost of ownership. Unlike competitive systems that incorporate large servo motors to stay balanced, Sea Tel systems have minimal weight for peak performance. Our proprietary algorithms ensure that the system does not go out of balance during operation. Yet, it is easy to rebalance when repairs are needed in the field. By eliminating the need for large servo motors for balancing, Sea Tel systems have heavier performance and much lighter in weight than competitive systems.



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The most important thing we build is trust

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