



Advanced VTS and Coastal Surveillance Radar Technology

INFORMATION DOCUMENT

Mark Bown – Group Marketing Manager at Kelvin Hughes discusses the potential benefits of a dual X-Band and S-Band VTS or coastal surveillance radar.

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Choosing a Vessel Traffic Service (VTS) or Coastal Surveillance solution is often a difficult process. Deciding which radar sensor is right for your application can be a challenging task. Having chosen the right technology it is also necessary to ensure there are adequate sensors in place to achieve the system objectives. With high expectations and, in many cases tight budgets, the decision process to get the best value for money can be a complicated business.

For systems requiring 'standard' and 'advanced' IALA compliance, single and dual redundant systems are available however the latter comes with increased cost and in some cases can be prohibitive. If the system is in a region that experiences high humidity and/or heavy rainfall, the need to cover the area with both 'X and S' Band radars can further increase complexity and cost.

Kelvin Hughes have addressed this issue through the development of their SBS-900-4 SharpEye™ system.

The SBS-900-4 is a unique in shore-located dual radar sensor system that co-locates an 'X and S' Band transceiver with a combined 'X' and 'S' Band antenna.

SBS-900-4 System



Figure 1 - Kelvin Hughes SBS-900-4 installation

Choosing the correct frequency band for your system is largely a question of compromise.

For example, while the X-Band frequency is best suited to providing an acceptable level of range and bearing discrimination, its performance in rain cannot match the S-Band. This is not because X-Band is technically inferior but simply the physical properties of rain i.e. the reflection and attenuation coefficients of the droplets of water with respect to the X-Band frequency have a degrading effect. The effect experienced is the same for any X-Band radar.

In areas experiencing high rainfall, the only option previously was to invest in two separate radar systems including the tower and infrastructure. This enabled the X-Band to provide excellent range and bearing discrimination in good weather while providing the option to switch to the S-Band when prevailing conditions seriously degraded the X-Band performance.

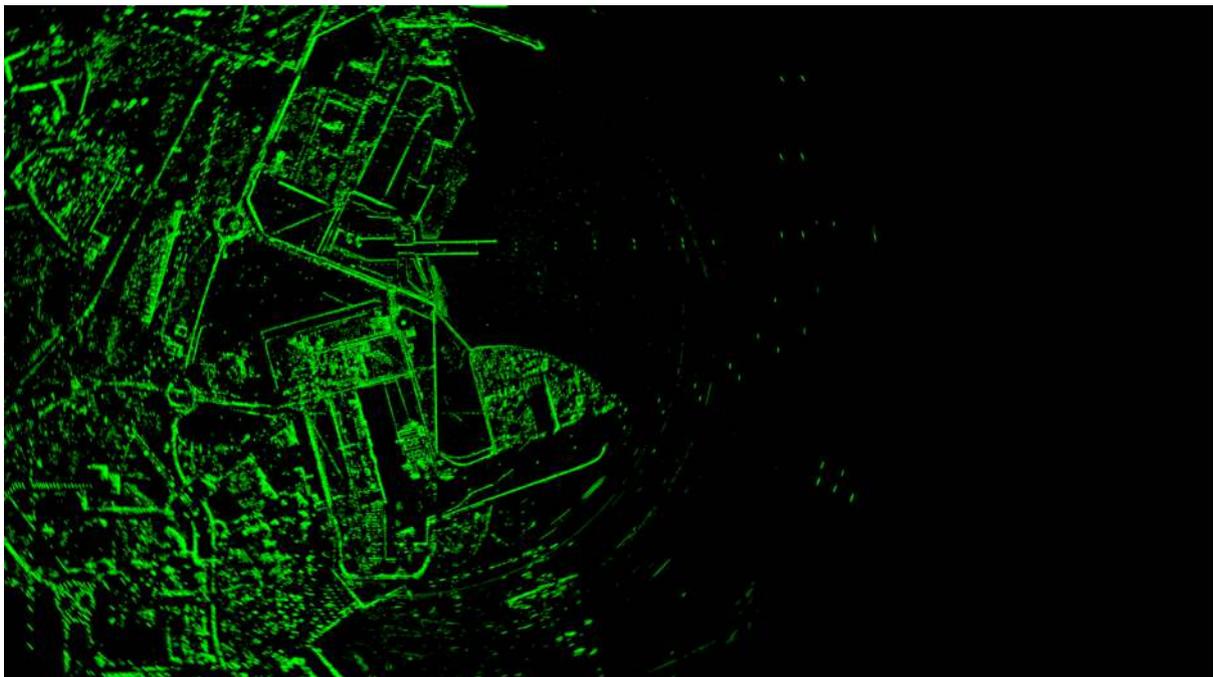


Figure 2 - SBS-900-4 X-Band 6NM range scale radar picture - Middle East

[Click here for radar video of SBS-900-4 in operation.](#)



Another advantage of having the two radar frequencies available is to alleviate the problems of ducting which is prevalent in many parts of the world but especially in the Middle East. A tendency to mount antennas above 50m or so to increase the radar horizon also increases the opportunity for the transceiver to be radiating above the duct. While not a guaranteed

cure, the wide frequency diversity of the two bands offer an increased chance of combatting the problem.

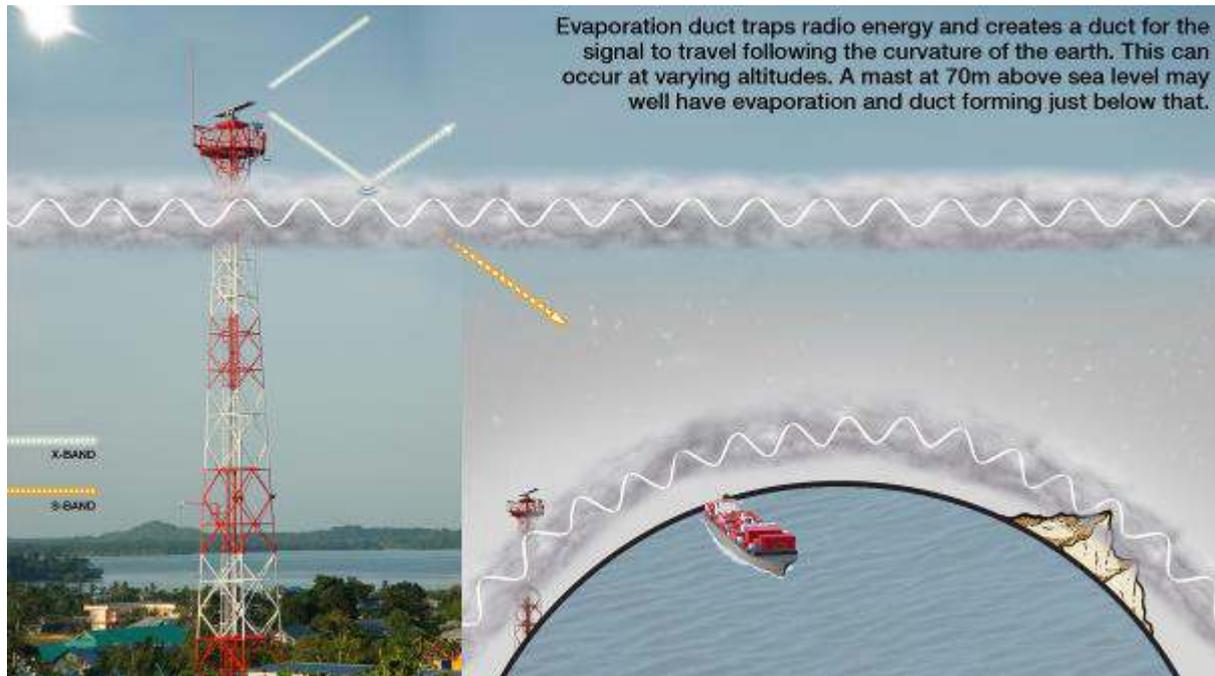


Figure 3 - Ducting infographic

Just about any coastline radar project within the tropics will be subject to either frequent heavy rain or ducting or both. Often an X-Band radar is chosen as this will be the best compromise for the majority of the time but it is likely to be almost blind for extended periods.

If the operational requirement cannot accept these periods of poor performance then both X-Band and S-Band frequencies are required which results in the need for two antennas and either separate towers or a much larger heavier tower that can accommodate the turning circle of both 'X and S' Band antennas, not to mention the additional weight. This all adds cost to the mast design and as a result, the tendency is for one of the radar frequencies (normally the S-Band) to be omitted.



Figure 4 - Transceiver enclosure for mast / tower mounting

The SBS-900-4 system is a mast-mountable transceiver housing with a difference.

It offers dual band, both an 'X and S' Band radar sensor, using a co-located antenna and turning mechanism. This in turn significantly reduces the upmast weight and the space required to accommodate the aerial turning circles.

The outcome is an optimised combination of transceivers but without all the additional cost of a stronger and wider mast that two separate systems would demand.

The SBS 900-4 has a 5.5m X-Band antenna combined with a 3.9m S-Band antenna. The SharpEye™ X-Band deploys Doppler processing, Frequency Diversity (FD) and high resolution pulse compression techniques. The SharpEye™ S-Band also features Doppler processing and high resolution pulse compression techniques. The overall performance is enhanced further by the co-located 'X and S' band antennas simultaneously transmitting both frequencies.

This combination maximises the benefits of X-Band resolution and detection performance in clutter with the additional S-Band advantages of longer range detection in heavy rain conditions. For sites which may be susceptible to anomalous propagation (i.e. the evaporation ducting), this dual band solution introduces significant additional frequency diversity to improve the probability of target detection despite the unwanted effects of ducting.



Figure 5 - SBS-900-4 Antenna opposing antennas diagram

Both sensors are mounted on the same mast or tower, with the X-Band mounted on top of the S-Band antenna at 180 degrees to one another. The 'X and S' Band radars transmit simultaneously.

SharpEye™ Technology

Kelvin Hughes' SharpEye™ technology has been attracting lots of attention for all the right reasons. SharpEye™ is ideal for VTS and coastal surveillance systems, not only because of its performance but also because of its inherent reliability and low maintenance requirements.

Radars are often located along the coastline on high and remote locations typically difficult to access for servicing and repair.

SharpEye™ uses solid state components that easily exceed the life of a conventional radar.



Figure 6 - SharpEye™ X-Band Transceiver

SharpEye™ uses solid state components that easily exceed the life of a conventional radar. Not only is the need for routine maintenance removed, such as changing the magnetron every year, but the transceiver reliability of at least 150,000 hours between failures (17 years) results in a reduced through life cost of ownership and reduced downtime.

SharpEye™ uses a patented sequence of coded and varying length pulses to help ensure target fidelity at all ranges. The sequence comprises of a 0.1µs gated continuous wave (short pulse),

and two pulses (medium and long pulse) containing a non-linear frequency modulated chirp with a swept bandwidth of approximately 40MHz. This is to provide excellent range resolution out to the maximum instrumented range whilst maintaining the ability to see small targets at longer ranges.

SharpEye™ incorporates Doppler - Moving Target Detection (MTD) techniques. This places the received radar returns in a bank of narrowband coherently integrated filters to resolve targets from the clutter. This delivers a significant performance advantage in detecting small targets. This also removes the requirement for operators to continuously adjust radar settings to meet changing environments – such as sea and rain clutter settings – a necessity with conventional radar systems.

SharpEye™ can also be tailored for optimum performance in a specific location and environment. For example, a SharpEye™ VTS radar sited on a river estuary only needs to detect targets at a relatively short range when the radar antenna is being directed across the river, but with a high degree of discrimination. On the other hand, when the antenna is directed down river and out to sea, it needs to detect targets at a much greater range.

SharpEye™ can be configured to deliver different transmission modes in different scan sectors, to produce the most effective and efficient target detection.

Summary

The Kelvin Hughes Shore Based Sensors (SBS) portfolio offers an array of options to suit the needs of port authorities and coastal surveillance requirements. Providing a combined approach the SBS-900-4 system is a cost effective combined 'X and S' Band sensor on one platform.

For technical specifications and more information please visit the Kelvin Hughes website:

<https://www.kelvinhughes.com/maritime/vts-radar>

<https://www.kelvinhughes.com/maritime/coastal-surveillance-radar>



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