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Optimizing military shipboard communications ● ●

Mobility is one of the fastest growing segments of the satellite sector right now, as demand grows, and applications increase. However, delivering connectivity on board military vessels at sea is far from easy. Jim Chambers, Vice President Engineering at XTAR, explains the challenges and solutions.

Like many other scenarios, when it comes to shipboard communications in the military, no one solution fits every need. There is a growing number of proposed solutions for today's fleet, but for each frequency band in every application, there are distinct advantages and disadvantages. Users must be clear as to their requirements and well-informed as to the potential from each frequency band.

In the past, large sea vessels tended to use two frequencies, commercial C-band and military X-band, while smaller vessels used L-band services. Today, there are a wide variety of choices with more on the way. With the rise of newer technologies and approaches, what factors should be considered when selecting the right type of communications at sea?

The challenges of sea-based communications have remained the same over the years, namely adequate coverage, weather conditions, customizability and terminal size. This article seeks to examine each challenge and compare solutions available today; both the traditional frequencies as well as newer technologies.

Challenge #1: Coverage

The ability to keep communications while moving quickly and seamlessly across wide geographical areas is a must for any

seaborne vessel. Wide global beam coverage is essential for communications at sea and this is a large reason why C-, L- and X-band have all traditionally been popular choices – of all the solutions available today, they currently provide the best coverage. A recent entry with near global coverage is Inmarsat's Global Express (HTS) system. While Ku-band has increased a bit in popularity for sea communications, it lacks global beams and therefore faces a challenge when travelling through open water outside normal shipping lanes.

High Throughput Satellites (HTS) face the same challenge with even smaller beams. While the beam-to-beam transition issue has been solved to some degree, the process is not seamless and locks the user in to one provider. In addition, for some providers, only a certain number of spot beams can be used at one particular time.

A large coverage area under one beam can certainly be an asset. As an example, XTAR provided frequency for the *Hesperides*, a Spanish research vessel. The *Hesperides* benefited greatly from global beam coverage as it was required to travel in areas not covered by other beams, such as Antarctica.

Challenge #2: Weather

Rainy and humid conditions at sea mean that other frequencies will suffer from rain attenuation. Here again, C-band and X-band remain solid choices for reliable communications in most weather conditions, due to their position on the RF spectrum (less than 10 GHz). While more and more users are exploring Ku and Ka-band for shipboard communications, it's important to keep in mind the high potential for both options to suffer from rain attenuation. Techniques such as uplink power control (requires more terminal power) and ACM (reduces data rate) help increase availability but at a cost and still at lower availability than C and X-band.



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Challenge #3 Customizability

The military user has a different set of requirements than commercial users; therefore, managed services built for a primarily commercial user base may not serve the military user best. Military users often have applications such as ISR that differ from commercial user requirements. This may lead to unique requirements in data rates and data rate direction and service level requirements such as availability. Also, military users may have legacy equipment that they want to continue to use. Wideband Ku, C-band, and X-band space segment allow government users options for designing purpose-built networks for coverage, data rates, equipment, service level agreements, and gateways.

Challenge #4: Terminal Size

Any vessel at sea faces the challenge of real estate. Terminals must be as small as possible yet be able to handle all of the communication needs, including large amounts of data, video and imagery plus all of the regular communications such as phone and internet for morale, welfare and recreation (MWR). In general, small antennas are used in spot beam coverage



● ● Photo courtesy of Pexels

and larger antennas are required for global beam coverage.

While more and more Ku-band and HTS terminals are being examined because of their size, the other factors mentioned above such as coverage, ability to provide service in inclement weather, and ability to meet service requirements must be taken into consideration. These trade-offs are important to recognize in the decision-making process.

Other considerations

Adjacent satellite interference (ASI): Systems that utilize smaller antennas are more susceptible to ASI. This includes Ku- and Ka-band systems that use small sub-meter antennas. To avoid transmitting ASI, spread spectrum techniques are often required, spreading the power over a larger bandwidth. This, of course will significantly increase the costs for the user. X-band satellites have four-degree spacing and rarely face this challenge.

Global beam services have a limited amount of capacity available overall. There is potentially more capacity available in Ku-and Ka-band if the coverage is available.

The potential use of low orbit satellites for shipboard communications is somewhat unknown at this point. There are currently not enough details known about these satellites such as terminal size, equipment cost, and service provider flexibility. All these factors must be taken into consideration.

Medium Earth orbit satellites (MEO) have limited coverage in terms of spot beams and no coverage above/below 45 degrees latitude. This results in multiple satellites required to cover a region. In moving military ships where large areas are typically covered, this may be an obstacle.

No one size fits all

Whether a user seeks communications for a slow-moving vessel, or a high-speed intercept boat, as more and more solutions are presented for communications at sea, it is imperative that users sharply define requirements, and then take the time to understand the solutions available. There simply is no one-size-fits all when it comes to SATCOM, particularly for the missions of military naval fleets. There is only the best solution for a particular application and situation.

It is for this reason that many multi-band terminals are being added to vessels. It is also for this reason that the more traditional solutions which have been used for decades, continue to be used with good results.

Newer technologies are attempting to address some of the challenges at sea and time will tell to what degree they can meet user need.

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