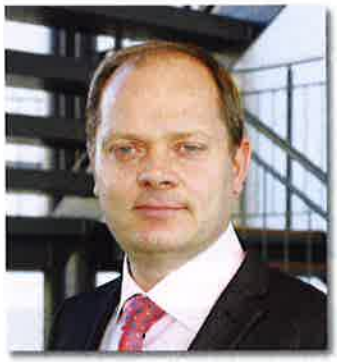
Part 1:

VSAT

A vital and expanding communications link

In the May/June issue of *MEJ* the three major manufacturers in the marine satellite TV industry talked about the issues and potential of that market. This time we're focusing on a satellite communications technology that is growing quickly—VSAT—Very Small Aperture Terminals. Part 2 of the VSAT story will appear in the November/December issue.

We're grateful to the VSAT experts below and the companies they represent— Intellian, Cobham, and KVH Industries—for responding to our questions in detail.



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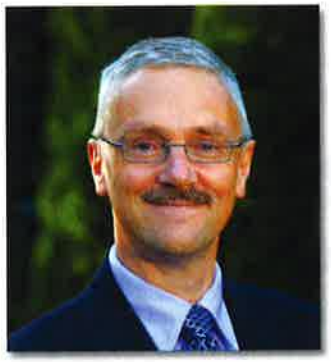

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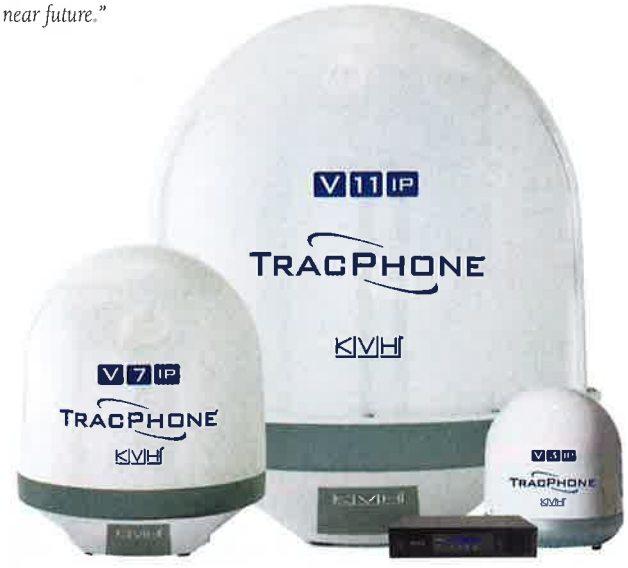
"Additional satellite capacity and evolving technologies will continue to create opportunities for faster data speeds for maritime customers in the near future."



Q:1

Please describe the current health of the VSAT business in the recreational market as well as in the various commercial maritime sectors, such as passenger vessels, energy, cargo, fishing, etc.

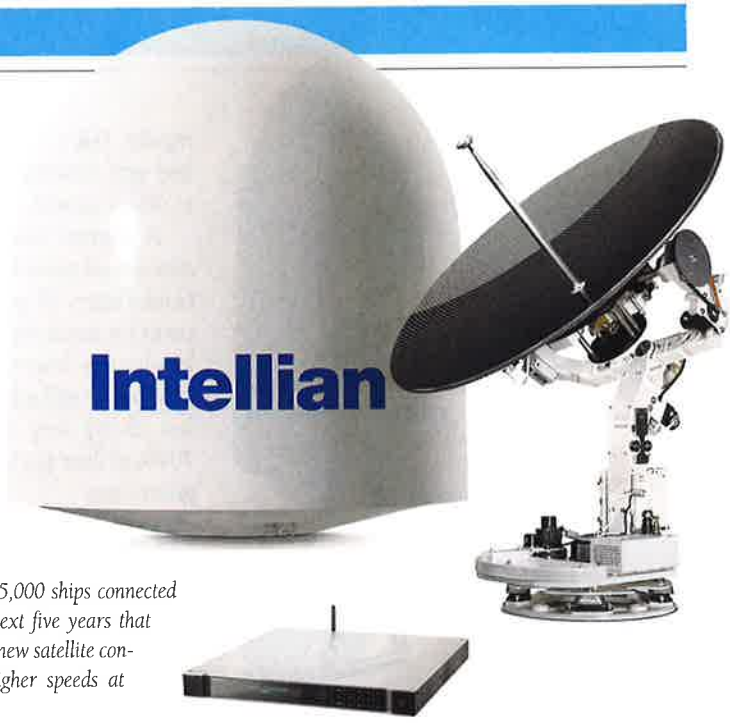
KVH: The VSAT business in both the leisure marine and commercial maritime markets is extremely active, driven by the increasing reliance on broadband connectivity for everything from email to remote engine monitoring. Industry research suggests the maritime VSAT market will grow 15% annually for the next few years.

Recreational boaters are seeing the advantage of having broadband connectivity onboard, as it enables them to spend more time on the water and still stay in touch with family, friends, or work. One KVH customer is working from his boat while on a round-the-world voyage, thanks to connectivity with KVH's TracPhone satellite communications antenna systems and mini-VSAT Broadband network.

Commercial vessels are installing and updating VSAT systems knowing they provide the means for operational efficiencies (better voyage planning, equipment monitoring and repair, filing port documentation by email, etc). Broadband connectivity from a provider such as KVH, with fast data speeds, also provides an important form of crew welfare, namely Internet access for the crew members on the vessels, which is necessary if vessels want to attract and retain the most highly skilled crewmembers.

VSAT activity varies among specific markets:

- **Leisure Marine**: Very active market for VSAT as boaters—from small boats to megayachts—want to stay connected while on their boats. For keen sportfishermen, Internet access lets them use fishfinding or water temperature apps, or simply communicate with other boaters.
- **Fishing:** Commercial fishing fleets are a strong VSAT market; they rely on Internet access to communicate between vessels and to upload data about the day's catch; also important for crew welfare.
- **Energy:** Very slow market currently due to the drop in the price of oil.
- **Cargo**: Merchant ships as a whole are a huge market for VSAT adoption, with industry reports putting the number of addressable vessels (those needing broadband services) at close to 100,000.



"From an overall maritime industry perspective, the average number thrown around in terms of estimates is close to 25,000 ships connected at sea through VSAT. In the next five years that number could likely double, as new satellite constellations launch, enabling higher speeds at lower costs."

Intellian: From an overall maritime industry perspective, the average number thrown around in terms of estimates is close to 25,000 ships connected at sea through VSAT. In the next five years that number could likely double, as new satellite constellations launch, enabling higher speeds at lower costs. Furthermore, developments in antenna technology will help drive adoption by simplifying what is today still a rather specialized and complex technology.

For scale to occur in satellite connectivity as a whole, whether it's Ku-band, Ka-band, FleetBroadband, Iridium, or other, the hardware that drives these solutions must become smaller, less expensive and easier to install. Many interesting new initiatives are underway throughout the industry that will see this challenge met in the coming months and years. It is indeed an exciting time in the industry with wide scale change for the better just over the horizon.

Cobham: There is significant growth in the use of VSAT services in the commercial and recreational sectors, though the drivers for this are slightly different. For merchant and offshore vessels, trawlers, cruise ships, etc. the rationale for installing maritime broadband is normally going to be increasing vessel efficiency or improving crew and passenger welfare. In the large yacht/superyacht world though, it's more a case of ensuring good connectivity is available for the owner and their guests or, indeed, charter guests. The only way to achieve consistently reliable, high-throughput connectivity effectively is through VSAT of some form. Of course, with superyachts the technology and equipment onboard is often the same as that on larger commercial ships, so VSAT is also being used to support vessel operations and provide a link to home for crew members.

We expect VSAT services to penetrate the recreational market even further in the coming years due to the advent of new narrow-beam (also known as spot-beam) Ka-band VSAT services, which can accommodate much smaller, lighter and easier-to-install antennas. It's important for the market to understand, though, that Ka-band doesn't instantly mean you can use any small antenna. It still has to provide very strong radio frequency (RF) performance, otherwise the link to the satellite will become degraded on the edges of the spot-beam, potentially resulting in loss of service. We have invested heavily into optimizing the RF performance in our new range of small Ka-band antennas, in parallel to focusing on weight, in order to provide a state-of-the-art package for the lower end of the maritime segment, like smaller yachts, fishing and wind turbine support vessels. The new range currently includes the SAILOR 60 GX for Inmarsat's new Fleet Xpress service and SAILOR 600 VSAT Ka for Telenor's Thor 7, a new Europe-only Ka-band service.

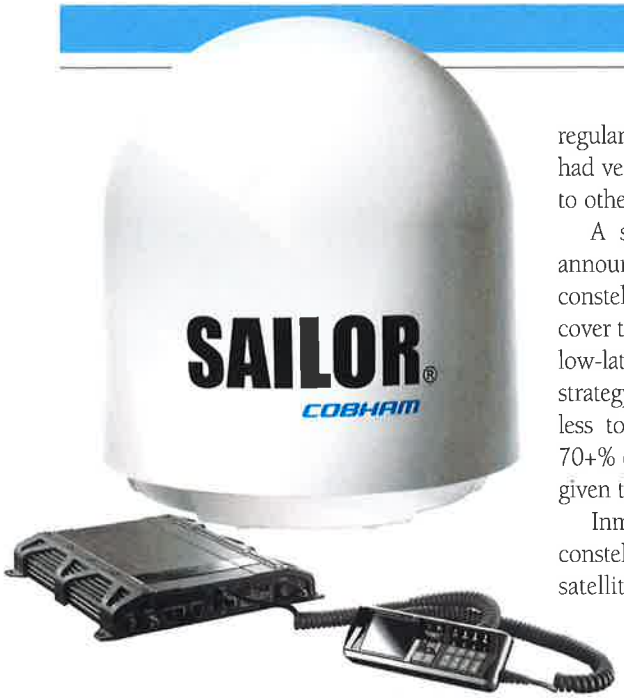
Q:2 It's common for boat owners to expect the same fast Internet service that they get at home, but that often isn't the case at sea. Apparently the problem is worse in some areas than others where speeds are reduced because of a lack of bandwidth. Is there a fix on the horizon for contention issues either through VSAT technology or the launch of additional satellites?

Intellian: The short answer is yes. High Throughput Satellites (HTS) are only just coming online, having now been talked about for the last three to five years. Inmarsat's Global Xpress constellation is the first example of a truly global high throughput network and service offering.

While average plans on GX are not all that different from what is generally seen on traditional Ku-band networks, contention is much better, as the spot beams are much smaller and more focused, meaning less sharing of each individual beam. Some popular Ku-band services today advertise up to 2Mbps of download speed, but a good portion of the time users cannot even load a webpage due to network contention bringing things down to a snail's pace.

GX should alleviate some of that problem, while also offering those who are willing to spend a bit more for faster service the ability to really crank up the volume, so to speak, with speeds well into the Mbps range.

Other players are making their HTS plays



"We expect VSAT services to penetrate the recreational market even further in the coming years due to the advent of new narrow-beam (also known as spot-beam) Ka-band VSAT services, which can accommodate much smaller, lighter and easier-to-install antennas."

as well. Intelsat, one of the world's largest satellite operators has recently launched the first of its EPIC constellation. EPIC is actually a Ku-band HTS offering that will add a significant amount of capability. Unlike Inmarsat, which is both a satellite operator and a service provider in the maritime space, Intelsat is only an operator, so they lease space segment onboard satellites like the one just launched to other service providers, such as Marlink and others.

These organizations then create service offerings based on the capacity they have purchased. This is worth mentioning so that people who are not as familiar with the aerospace industry can better understand where and how to access these new offerings. The answer is that many of the existing major players in traditional Ku-band VSAT will most likely fold some new capacity offered by EPIC into their existing offerings.

Other interesting things on the horizon are a bit further out, but are potentially even more game changing. Iridium is launching its NEXT constellation starting this year. By 2019 all of the new satellites will be in orbit, offering speeds up to 1.5Mbps with extremely low latency. Low latency is important as it delivers a user experience at the keyboard that feels much more similar to working over regular WiFi. Traditionally, Iridium has also had very reasonable airtime pricing compared to others as well.

A startup company called OneWeb has announced plans to launch a Low Earth Orbit constellation of over 800 satellites that will cover the entire world in constant, high speed, low-latency Internet. Plans for their maritime strategy are still relatively undefined, but needless to say they will want to monetize the 70+% of their payload that is over water at any given time.

Inmarsat itself will begin launching its I-6 constellation in roughly 2018. These new satellites will significantly increase the throughput capability of the GX network, enabling speeds into the 10s of Mbps per user. Additionally, the I-6 constellation will serve as the next generation of Inmarsat's FleetBroadband service. Less is known about what is planned here, but Inmarsat is currently engaged deeply with its entire ecosystem from manufacturers to applications developers to end users in an attempt to find the sweet spots in terms of price, performance and form factor.

The "small boat" segment, which in Inmarsat language includes more or less the entire leisure and commercial fishing markets, is a major area of focus as part of this effort, so in all likelihood some interesting things will be coming from this direction soon.

Cobham: VSAT is regional as services are only available within the footprint of a particular satellite. Many VSAT service providers have built near seamless networks of satellite footprints though, so in some cases VSAT can be seen as near global. But there are still some areas where service isn't available or the bandwidth available is low. These would normally be areas with low maritime activity, though. There is indeed a fix, or at least a boost for maritime VSAT services coverage coming very soon. Inmarsat Fleet Xpress is a new global maritime broadband solution that combines Ka-band VSAT with its existing L-band FleetBroadband service. Inmarsat has three new satellites in place, giving near global VSAT coverage, while FleetBroadband (which is basically fully global) is used for back-up and to fill in any holes in the Ka-band coverage (when going closer to the poles for instance).

Cobham SATCOM has antennas ready for Fleet Xpress services. In addition to the new 60 cm antenna system already mentioned, we also have a 1m system, the SAILOR 100 GX. In addition, any SAILOR 900 VSAT (Ku-band) sold in the past 24 months will be configured for easy migration to Fleet Xpress (Ka-band) with an easy to use field migration kit. This means that vessels with SAILOR 900 VSAT already onboard have a more cost effective way to benefit from the large amount of extra bandwidth that the Global Xpress network will unleash on the maritime world. All Fleet Xpress users will need a FleetBroadband system integrated, though. SAILOR FleetBroadband has dominated the market since its launch in 2007 (selling over 45,000 terminals) due to a strong balance between prove and performance. These qualities still stand, as FleetBroadband gets a new lease on life thanks to Global Xpress.

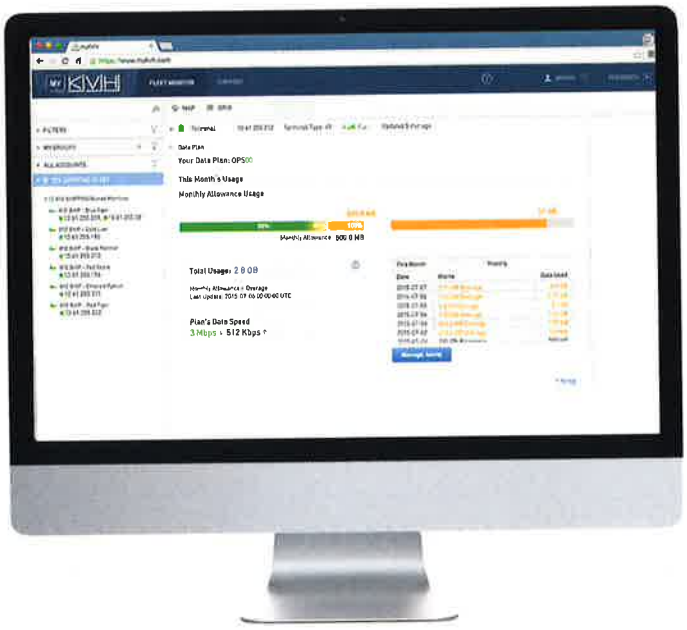
More Ka-band VSAT bandwidth is also set to be introduced for European users this year, on Telenor's Thor 7 service. We have been an early antenna development partner and the first with an approved antenna for this new service, which will provide significant levels of bandwidth from the North Sea down to the Mediterranean. We have 60cm and 1m antennas ready for Thor 7.

KVH: Additional satellite capacity and evolving technologies will continue to create opportunities for faster data speeds for maritime customers in the near future. KVH has been a leader in providing fast and reliable service from the very start. When KVH entered the maritime VSAT broadband market in 2007, our mini-VSAT Broadband network and TracPhone V-series satellite communications antenna systems utilized innovative antenna technology and advanced engineering to provide data speeds to our customers that were 10 times as fast and 1/10th the price of competing VSAT systems—and that is still the case today. Today, our TracPhone V-IP series systems' top data speeds (4Mbps for TracPhone V11-IP, 3Mbps for V7-IP, and 2Mbps for V3-IP) are made possible by KVH technology that minimizes contention and ensures lower latency—two key factors in optimizing a satellite Internet connection at sea.

Some boat owners may experience unsatisfying Internet service onboard if they are using a regional satellite service provider, which may be more likely to have limited satellite capacity. A global satellite service provider, such as KVH, can provide a much more reliable and comprehensive service than the numerous regional satellite providers that exist in the VSAT market today. With seamless

coverage, KVH's network ensures that a vessel will have continuous access as it transits the oceans and shipping routes of the world. KVH is continually monitoring and improving the mini-VSAT Broadband network to ensure our customers have the critical connectivity they need at all times onboard their vessels; in addition, KVH can add satellite capacity to meet increasing demand from our customers everywhere around the world.

Another source of dissatisfaction among boat owners may be due to the fact that they are not using an end-to-end solution for their Internet service onboard, and so it is more difficult to trouble-shoot problems should they arise. KVH is unique among maritime VSAT providers in that we design and manufacture the antenna system hardware and also operate the satellite network; other service providers only do one or the other part of the equation.



KVH's mini-VSAT Broadband customers can use the myKVH web portal to monitor data usage and other functions, such as online/offline status, signal strength and vessel location.

Q:3 The market is seeing new air time packages, such as Fleet One, which seems to be gaining popularity among owners of small boats operating along the coasts. What can boat owners and dealers expect to see in the way of trends in air time packages over the next 12 months or so?

Cobham: Cobham SATCOM was delighted to be such an integral part of Fleet One, and feels that it offered a very cost-effective communication solution for smaller boat owners, In terms of new airtime packages, the trend from service providers has been reducing the cost to the end-user, but that can only go so far. It's possible that rather than costing less in years to come, the service provider industry will try to provide more for your money, i.e. higher speeds or larger data allowances. As an antenna manufacturer, it is part of our strategy to support cost management for service providers working with end-users.

One benefit of our new 60cm Ka-band VSAT antennas is that because they are so low weight, they are much easier and lower cost to install. This may help service providers to operate more cost effectively, i.e. they don't need to pay for a crane to install the antenna. Ultimately, some of these savings may be passed to the customer either in the form of lower costs or by enabling more margin to provide more throughput for the same cost.

KVH: Affordable airtime packages have been part of KVH's offering for years now; our TracPhone V3-IP has had a $49 per month for 50 MB data airtime package from the day it was introduced, in 2011, for a per megabyte price of $1, at speeds as fast as 2Mbps downlink and 128Kbps uplink. The Fleet One packages are $49 per month for 10MB data, so much more expensive per megabyte plus slower speed (max 100Kbps up and down).

KVH is leading the maritime VSAT industry in terms of affordable airtime coupled with fast data speeds. For example, last October we introduced new airtime packages that provide the fastest data speed available across all packages. In other words, whereas some Internet service providers give the fastest data speeds only to customers buying the largest monthly packages, KVH gives the fastest data speeds no matter how small or large the monthly airtime package is.

As satellite capacity becomes more available—as is expected in the industry—airtime prices may continue to become even more affordable, which will peak the interest among recreational boaters. Large commercial vessels have greater needs in terms of gigabytes per month per vessel to accommodate operational use and crew use, and packages for those customers are tailored to their needs.

It's important to note that faster data speeds are important if a vessel wants to make use of new cloud-based applications for improving operational efficiency. KVH provides maritime customers with affordable, usage-based plans at the data speeds they need to take advantage of new cloud-based applications. We give them the tools they need for bandwidth management by user and vessel.

Intellian: Service providers are finally starting to understand that for most small-boat owners who are willing to make the investment in satellite communications, the issue is not really the hardware cost, but the ongoing service cost. People understand that vessel systems cost money, especially when they have to talk to a satellite. Of course a reduction in hardware cost is helpful, but reduction in service cost is going to do more to drive adoption.

Inmarsat's FleetOne plans are a good example of a service provider that has finally created an offering which is in some way market enabling. Less than $4000 for the terminal, and anywhere from $100-$350 per month in airtime gets the average boater what they need: basic phone, email and a very small amount of Googling.

That's ok for today. Most of the time, pleasure boaters have 4G or WiFi, so the need for the satellite terminal is only in rare cases when the urgent email must be sent out

between harbors, or the urgent call you've been waiting on at the office must be forwarded to you.

Other things to look out for are the IridiumNEXT pricing plans. They will likely be a good value.

Q:4 Many VSAT plans are based on a monthly data allotment; what tools are important in order for customers to keep track of onboard data usage and not incur overage charges?

KVH: To manage and monitor onboard data usage, KVH provides mini-VSAT Broadband customers with the myKVH web portal. The myKVH portal displays vessel location, online/offline status, and signal strength, and makes it easy to manage data access by providing:

- Month-to-Date data usage display
- Ability to create and manage automated data usage alerts sent via email & text/SMS
- Self-service MB-based user allocations
- Ability to create and manage per month MB allocation profiles
- Ability to create and manage onboard users assigned to a profile
- Network Configuration
- Ability to set LAN configuration via templates
- Ability to configure WiFi settings

Intellian: This is actually not accurate. The vast majority of VSAT plans are based on a fixed cost, always on model. KVH is an exception to this, since they are a VSAT provider that prices their service much like an L-band product, such as FBB where you pay by what is used.

FBB users, though, are the ones who really should be careful not to overuse their data plans. A key part of that is shutting down all background services running on your onboard network that may reach out automatically and try to download something.

Examples are Windows Updates, or these days updates of any kind. Smart phones are constantly updating, so unless you are actively trying to send an email, text, or use the Internet, a good idea is to keep your phone in airplane mode when onboard a pleasure boat with a live satellite connection.

The good news here is that providers are now well aware of the kinds of accidents that can happen and have the ability to lock down terminals to only do certain things. Owners and captains should work with their provider to help define those parameters and get the experience they want.

Another interesting trend is the development of applications specifically designed for use on satellite networks. For example, a number of chat applications exist that dramatically reduce data usage while still providing the ability to chat from your smartphone over the satellite terminal.

Inmarsat has taken this a step further, initiating the "Certified Application Partner" program to foster development of applications that are designed for low data usage.

Cobham: Some service providers will provide an online portal to keep track of usage, or the usage allowed under subscription is set within predefined parameters. **MEJ**