

A dramatic seascape with a stormy sky and a bright horizon over the ocean. The sky is filled with dark, heavy clouds, with a bright light source breaking through near the horizon, creating a shimmering path of light across the water. The water is dark blue with white foam from a boat's wake in the foreground.

CONNECTIVITY AT SEA:
A Guide to Advances in Maritime VSAT

ABOUT THE AUTHOR

KVH Industries is the world's leading provider of mobile satellite communications and television antenna systems. Serving maritime and military customers since 1982, KVH's onboard terminals offer unmatched performance in all sea and weather conditions. KVH provides 24/7/365 global support for its mini-VSAT Broadband products, and is a publicly traded company (NASDAQ: KVHI) with U.S.-based sales, support, manufacturing, and design facilities in Rhode Island and Illinois and offices in Denmark, Norway, and Singapore.

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The Need for Broadband

The Benefits of Offshore Connectivity for Commercial Maritime Operations



Seafarers know the importance of responding quickly and appropriately to changing conditions at sea. Likewise, premier commercial maritime operators know the importance of adapting to changes to keep an enterprise competitive. Today, the biggest change the shipping industry faces is in the realm of technology. Where once it was enough to have an onboard communications system for occasional calls or e-mail and emergency use, today it's a business necessity to have 24/7 broadband connectivity to operate a vessel efficiently and effectively. Indeed, affordable broadband connectivity linking ship at sea to shore provides the ability to leverage the efficiency of a globally networked workforce.

"The flood of information coming at the average mariner these days – especially the senior officers – can be overwhelming. It has been heard on ships over and over that it is not necessary to know all of the information, but that it is imperative to know where to find it," a maritime consultant recently noted¹. There's no question that the optimal way to access and process information on a ship today is via fast, reliable broadband connectivity.

The Benefits of Broadband Connectivity

- **Increases vessel operational efficiency** – enhanced navigation, voyage planning, onboard logistics, and increased collaboration between ship and shore
- **Optimizes engineering & IT functions** – enables remote systems monitoring, and diagnostics, software updates, and electronic access to e-documentation; minimizes costly travel and labor charges for repairs
- **Facilitates safety & security requirements** – vessel tracking to avoid piracy attacks, documentation of onboard events, and a liaison with maritime security organizations; meets increased regulatory requirements
- **Enhances crew management & morale** – access to e-learning programs, e-mail, phone, and Internet enabling communications with shore-based family and friends
- **Improves customer service** – real-time status reports that aid in logistics, supply chain management, and customer inventory control



Broadband in the Spotlight

Maritime Labour Convention 2006

The International Labour Organization's Maritime Labour Convention (MLC) 2006, sometimes called the "Seafarers' Bill of Rights," covers working hours, accommodations, and other aspects of working at sea, and is groundbreaking in that it combines 70 separate existing maritime labour documents into a single global standard. Broadband connectivity helps vessels comply with MLC 2006 by ensuring that crew members have easy access to e-learning and training, and also provides contact with friends and families via e-mail, Internet, and social media. *For more information, visit the Maritime Labour Convention page at www.ilo.org.*



Broadband on the Chart

Electronic Charting & Maritime Safety

In efforts to ensure the safe operation of vessels worldwide, the International Maritime Organization (IMO) supports the use of many navigational tools that are optimized by broadband connectivity. A primary example is the Electronic Chart Display & Information System (ECDIS), a mandatory system for providing precise chart and position information to a ship, including automatic chart updating. *For more information, visit www.ecdis.com.*

Vessel Operational Benefits

Broadband connectivity brings detailed, accurate, real-time data right into the bridge, adding a level of operational efficiency unlike anything possible in the past. For example, given that the route selection is of utmost importance to everything from schedule to profitability, broadband connectivity increases operational efficiency by improving the tools for navigation and voyage planning. With broadband, the onboard crew and onshore support staff have real-time access to weather, currents, and wave height data, electronic delivery of ECDIS charts, and updates on port scheduling and route congestion. Supply chain management, key for the success of any enterprise, is improved with accurate vessel tracking and reporting, providing real-time updates for customers.

Collaboration between employees on and off shore is improved by broadband connectivity, which provides Voice over IP (VoIP), instant messaging, and real-time e-mail exchanges. Broadband also helps eliminate redundancy in data entry, and simplifies the process of routine activities like ordering parts and supplies.

Engineering Benefits

The complex systems of a seaborne maritime platform – be it a tanker, containership, bulk carrier, rig, or other – demand attention from skilled engineers and technicians, both on board the vessel and on shore. Broadband connectivity facilitates the mandatory Planned Maintenance System on ships, resulting in fewer repairs required due to improved preventative maintenance. Less travel time is needed sending experts to the vessel and less time is spent in port for repairs as centralized experts

assist onboard engineers by monitoring equipment in real time while the vessel is at sea. With costs starting at \$2,500 (USD) to send an engineer to a vessel for a repair, reducing those trips translates to immediate and substantial savings.

Broadband connectivity also improves access to engineering manuals and other documents relevant to the vessel's systems without the need to make space for paper documentation, which can weigh as much as a ton and require a dedicated onboard administrator to maintain. Digital versions of operating and troubleshooting instructions, maintenance procedures, parts data, and service bulletins can be electronically conveyed, searched, and accessed. With broadband connectivity, onboard engineers also have access to manuals and data directly from a supplier or manufacturer, at any hour from any time zone.

Safety and Security Benefits

Broadband connectivity helps maintain the safety and security of the vessel and crew, including safe route planning, vessel tracking for piracy alerts, status updates from the crew, biometrics for drug and alcohol testing, security training, and disaster preparedness. In addition, closed circuit television (CCTV) is used to monitor vessel status, onboard events, and accident reconstruction, and plays a key role in telemedicine as well as remote consultation for vessel repairs.

Certification and compliance confirmation of both the vessel and the crew is aided by broadband connectivity, which provides access to online documentation, and facilitates liaisons with maritime security organizations. (see Resources on page 30)

Crew Management Benefits

As broadband use has increased on land for everything from e-mailing friends and family, to sharing videos, photos, and messages on social media, so too has the demand for similar contact while at sea. Broadband connectivity helps vessels reduce turnover, enhance recruitment, reduce training costs, enhance medical treatment, and meet new maritime labor requirements.

Crew morale gets a boost from voice communications (affordable calls using VoIP over VSAT), onboard cell phone access, SMS text messaging, and Internet. Training and career development is possible through e-learning and computer-based courses in a wide variety of disciplines and languages. The higher the crew satisfaction and crew retention, the lower the costs for recruitment and new-employee training and the more smoothly the ship runs while at sea.

Customer Service Benefits

Accurate information and excellent service are key components of customer satisfaction. With broadband connectivity, a commercial maritime operation can offer customers such value-added shipping services as real-time tracking and reporting of cargo position and status, ensuring just-in-time deliveries, and thereby reducing customers' need to hold inventory to cover shipping delays. These services help these operations differentiate themselves from their competition, providing a more valuable solution to their customers that can be sold for a premium and increase revenues and margins.

With so many benefits to broadband connectivity, commercial maritime operators realize that to be competitive, they must be connected.



Broadband on the Docket

Port & Vessel Documentation

In an increasing number of countries and ports around the world, notices of arrival and departure, as well as passenger and cargo information, and ships' certificates must be submitted electronically. For example, the U.S. Coast Guard requires all cargo vessels to submit Notice of Arrival (NOA), Notice of Departure (NOD), and Advance Passenger Information System (APIS) documents electronically. International classification society Bureau Veritas recently replaced paper dossiers with electronic updates for ship documentation accessed by owners, charterers, and port authorities. For more information, visit www.nvmc.uscg.gov.



Broadband in the "Lime" Light

Greenhouse Gas Emissions

Concern about greenhouse gases has prompted governing bodies to mandate that large vessels (tankers, containerships, and freighters) reduce their greenhouse gas emissions by increasing fuel efficiency 30% over the next few years. Currently, about 3% of global carbon dioxide emissions are said to come from large ships. Broadband connectivity plays a role in increasing a vessel's fuel efficiency and thereby reducing CO₂ emissions by delivering real-time weather and sea current forecasts to the ship and automatically sending ship operation data back to shore for ongoing analysis and optimization. For more information, visit the Marine Environment pages of the International Maritime Organization at www.imo.org.

The Challenge

Difficulties in Fielding Fast, Affordable Broadband on Vessels



A look at how maritime satellite communications technology has evolved points to the significant challenges inherent in bringing broadband connectivity to vessels transiting the globe within parameters that meet the seagoing constraints of ships large and small.

The oldest versions of global maritime satellite communications – big, slow, and prohibitively expensive – were first offered by Inmarsat in the early 1980s. They consisted of low-frequency L-band service delivered by special MSS (mobile satellite service) satellites. Even though it was designed for mobile use, L-band service initially required huge antennas to receive signals from early power-starved satellites. Over time, as new generations of satellites were launched, the size of the equipment was reduced, but the high cost of L-band service was not.

In an effort to make data use affordable for mariners, satellite service providers began adapting terrestrial VSAT (very small aperture terminal) satellite technology delivered by FSS (fixed satellite service) for the maritime market. Thus evolved the first generation of standard maritime VSAT products, characterized by faster speeds and lower airtime costs than L-band solutions, but with the disadvantage of larger antennas and regional service. Indeed, the size and cost of standard VSAT antennas coupled with spotty regional service limited the adoption of this technology to oil and gas rigs and very large ships.

Another problem with older maritime L-band and standard VSAT services is the capacity constraints inherent in the time division multiple access (TDMA) technology they use. TDMA technology separates bandwidth into specific frequency bands and

then divides these bands into small time slots, with the result that only one user at a time can send or receive data. Sharing of satellite capacity on TDMA systems introduces contention – competition between users assigned to a specific channel for the available capacity. (see page 12 for TDMA details)

Spread spectrum technology, used by modern satellite and cell phone service networks, is a more advanced approach to satellite communications technology. It allows simultaneous transmission of data, and ensures that every user on the system enjoys the fastest data rate available even when multiple users are transmitting simultaneously. One result of the advanced technology is low latency, which makes for better quality VoIP calls. Latency, measured in milliseconds, describes the delay that is caused by the physical distance a data transmission signal must travel into space to the satellite and back, and the time used by the satellite network in receiving and transmitting the data. The higher the latency, the

worse the delay, which becomes annoying while making VoIP calls, and which can make it very difficult to run modern cloud-based ship-to-shore applications. Unlike TDMA networks that require time delays for sequencing transmissions, modern spread spectrum networks offer low and consistent latency (≈ 600 ms) reflecting the time it takes for a transmission to travel to the satellite and back to earth.

A new category of satellite communications was created by mobile technology innovator KVH Industries in 2007, and given the name “mini-VSAT Broadband” to reflect both the compact size of the antenna hardware fielded on a vessel, plus the system’s spread spectrum VSAT technology, which makes maritime broadband a reality. KVH’s mini-VSAT Broadband is the only maritime satellite communications network utilizing patented spread spectrum ArcLight® technology invented by KVH’s satellite communications technology partner, ViaSat.



Maritime Satellite Communications: Vessels Getting the Word Out

Phone/Fax Era:

Starting in the early 1980’s, Inmarsat was created as an NGO by the UN to provide emergency communications, phone and fax services to vessels at sea

E-mail Era:

In the early 1990’s, Inmarsat began offering data services to complement phone and fax, but at speeds and costs that limited use primarily to text-based e-mail

Data Era:

In the early 2000’s, Inmarsat launched a new generation of higher speed L-band services for data communications, but the service was so expensive that vessels began to use TDMA VSAT technology in addition to Inmarsat to provide affordable Internet access

Broadband Era:

In 2007, new spread spectrum technology enables small, affordable onboard terminals to deliver fast, affordable maritime broadband VSAT service to ships. Today this service is available on a global basis

The Solution

A New Kind of Maritime VSAT Service
Designed for Maritime Use



A breakthrough in maritime satellite technology, mini-VSAT Broadband was introduced by KVH in 2007, and has grown in just five years to be the leading maritime VSAT service.²

Designed specifically for mobile maritime applications, mini-VSAT Broadband is a robust, dual-band service covering the globe. Of particular importance is the fact that all aspects of the satellite communications system are designed, manufactured, managed, and supported by KVH, providing a complete end-to-end solution simplifying the user experience and creating the opportunity for refinement, innovation, and flexibility at every stage.

The five major characteristics of mini-VSAT Broadband – *affordable*, *reliable*, *fast*, *global*, and *small* – are the compelling advantages that have contributed to its growth.

Affordable

Airtime costs must be manageable if commercial maritime operations are to reduce and optimize their satellite communications budgets, especially as they enter an era of increased bandwidth demand. The mini-VSAT Broadband service has versatile airtime options including metered rate plans starting at \$0.99/MB for data and \$0.49 per minute for voice, with low-commitment metered plans starting at \$49 per month. These airtime rates are 1/10th the cost of conventional L-band MSS services. Fixed-rate, speed-based plans are also available, for a SATCOM budget with no surprises.

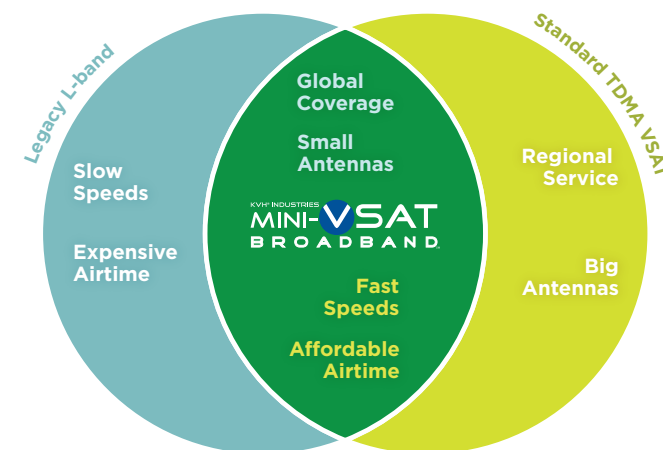
Another aspect of affordability with mini-VSAT Broadband revolves around the installed cost of the compact TracPhone[®] onboard antenna hardware designed specifically for the service (*see more on pages 22-25*). The terminals' small sizes make them less costly and easier to install, a savings over the labor costs involved with multiple days of installation for large C- or Ku-band TDMA VSAT terminals, not to mention lost revenue from days in port.

Reliable

With so many elements making up a maritime satellite communications system – satellite network and hubs, onboard terminal (antenna, antenna control unit, modem, network management hardware), airtime service, and technical support – reliability must cover all of the variables.

The mini-VSAT Broadband solution is the only maritime broadband service where one company does it all. KVH operates the satellite network, manufactures both the antenna and belowdecks hardware, manages the airtime service, and provides 24/7/365 support. This end-to-end approach helps the vessel's crew more easily manage the satellite communications system and enables KVH to remotely monitor and diagnose any hardware issues, remotely update software in the terminal, dynamically monitor and reconfigure the network, and make adjustments in real time, including adding capacity, to support its customers. Further, reliability is built into the mini-VSAT Broadband network with redundant coverage in many parts of the world.

The best of both worlds!





That Was Fast!

Market Share Leader in Maritime VSAT in Just Five Years

The mini-VSAT Broadband service, which KVH launched in 2007, has quickly grown to become the world's leading maritime VSAT network. In two independent industry research reports, mini-VSAT Broadband is noted as having the largest market share of any maritime VSAT network. Specifically, at the end of 2011, KVH's mini-VSAT Broadband service accounted for 16% of an estimated market of just under 9,000 activated maritime VSAT terminals, a market share that is 20% higher than the next closest competitor.²



Network Attributes of mini-VSAT Broadband

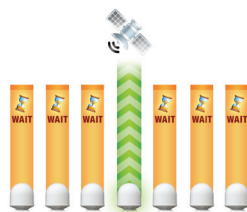
- 14 Ku-band transponders and 3 C-band transponders blanket the globe with multimegabit service
- Secure teleports in 10 different locations house 17 interlinked network hubs
- Network management servers ensure high level of service with advanced traffic prioritization and QOS
- CommBox™ technology (integrated into the TracPhone V7IP and V11) delivers enterprise network extension, optimized data delivery, and onboard network security
- One-call global 24/7/365 after-sale support provide automated care-ticket management directing on-call technical support in 170 ports worldwide

Fast

Consistently fast transmission speeds, low latency, and the ability to prioritize important traffic are key factors in delivering high quality broadband service to vessels. The innovative technology of the mini-VSAT Broadband service translates to data speeds as fast as 4 Mbps down/1 Mbps up, fast average data speeds, and low latency creating a superior network for running applications and delivering files.³

The Science Behind the Speed

KVH mini-VSAT Broadband uses advanced ArcLight spread spectrum technology from ViaSat, KVH's technology partner. ArcLight's unique Code Reuse Multiple Access (CRMA) technology allows simultaneous data transmissions, which are immediately burst onto the network across the entire available satellite capacity. The result is extremely low and consistent network latency of typically less than 600 ms for quality VoIP calls, data service with more consistent speeds, and shorter ping times resulting in faster web page loads.



Fixed-assignment TDMA VSAT systems divide bandwidth into time slots, forcing users to wait their turn.



KVH mini-VSAT Broadband systems employ advanced CRMA technology, allowing simultaneous transmission for all users for faster, consistent data speed.

Global

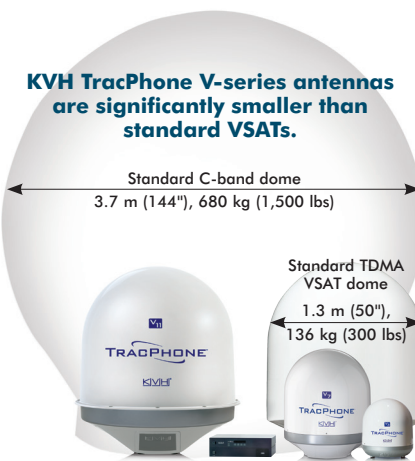
Commercial maritime operations, global by nature, demand a global solution for satellite communications. The world's first global integrated C/Ku-band VSAT network, mini-VSAT Broadband, provides connectivity while transiting all world shipping lanes, creating a robust, fault-tolerant solution for a ship's business operations. Delivered by 14 satellite transponders, the core Ku-band coverage areas include the northern hemisphere, Southeast Asia, the Indian Ocean region, South America, Australia, and New Zealand. The C-band overlay, delivered by three high-powered global transponders, covers the globe except extreme polar regions. Beyond extending the footprint, the C-band coverage also offers the benefits of robust, rain-resistant C-band signals and redundant global coverage in virtually all of the Ku-band regions.

The mini-VSAT Broadband network also has worldwide regulatory authority to operate offshore and in port in more than 125 countries. In coastal regions within 200 km of shore where C-band communications are often prohibited, the network uses Ku-band coverage. When moving among regions, the network's consistent configuration means no changes are required in hardware, modem, or software for truly seamless roaming. This next-generation solution – mini-VSAT Broadband – covers 95% of the Earth's surface with proven 99.5% network uptime.

Small

Space is always at a premium on vessels, but for years they have had to accommodate huge satellite antennas to receive global coverage and fast transmission speeds. The spread spectrum technology of mini-VSAT Broadband enables a breakthrough design in antenna hardware: compact onboard terminals with no compromise in speed or coverage.

KVH's TracPhone V-series antenna units – developed specifically for the mini-VSAT Broadband service – are compact, ranging in size from just 39 cm to 1.2 m in radome diameter. These small antennas are easier to install in locations with a clear line of sight to the satellite for better reception. Without compromise, the small radomes of the TracPhone V-series translate to big performance, with download speeds as fast as 4 Mbps and upload speeds as fast as 1 Mbps, and seamless global coverage.³



KVH TracPhone V-series antennas are significantly smaller than standard VSATs.

Standard C-band dome
3.7 m (144"), 680 kg (1,500 lbs)

Standard TDMA VSAT dome
1.3 m (50"),
136 kg (300 lbs)

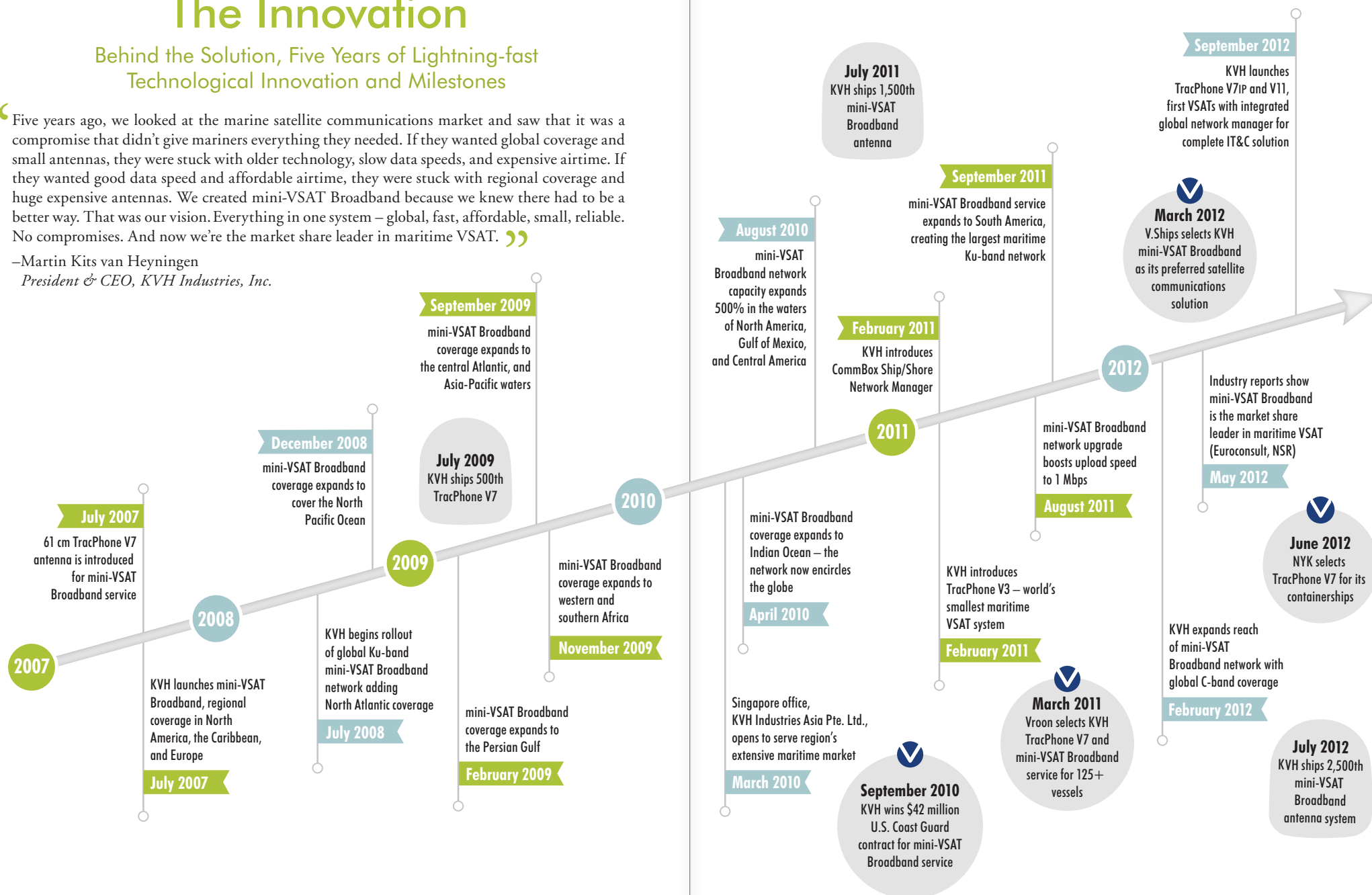
TracPhone V11	C/Ku	1.2 m (48.8"); 102 kg (225 lbs)
TracPhone V7IP	Ku	66.3 cm (26.1"); 26.1 kg (57.6 lbs)
TracPhone V3	Ku	39.4 cm (15.5"); 11.3 kg (25 lbs)

The Innovation

Behind the Solution, Five Years of Lightning-fast Technological Innovation and Milestones

“Five years ago, we looked at the marine satellite communications market and saw that it was a compromise that didn’t give mariners everything they needed. If they wanted global coverage and small antennas, they were stuck with older technology, slow data speeds, and expensive airtime. If they wanted good data speed and affordable airtime, they were stuck with regional coverage and huge expensive antennas. We created mini-VSAT Broadband because we knew there had to be a better way. That was our vision. Everything in one system – global, fast, affordable, small, reliable. No compromises. And now we’re the market share leader in maritime VSAT.”

–Martin Kits van Heyningen
President & CEO, KVH Industries, Inc.



The Trend: IT is it

Information Technology (IT) is Taking its Place on Vessels;
Satellite Communications Solutions Must Meet
Onboard Networking Needs



The maritime industry has long understood the importance of managing resources on board a ship as a key to ensuring successful voyages. The resource of bandwidth is no exception. As every segment of a ship's crew becomes increasingly reliant on broadband connectivity, the role of onboard network management becomes ever more important.

Commercial fleets require secure, integrated tools to support business efficiency, crew morale, regulatory compliance, and safety needs, even if there are limited IT skills on the vessel. Onboard networking ensures that the wide range of uses for broadband on the ship – everything from integrating the vessel with corporate networks on land to providing Internet access for the onboard crew – can be managed effectively.

The benefits of onboard network management include enhancing the efficiency of onboard users, reducing travel and support costs, enabling online applications, and managing connectivity costs. Remote software and virus updates are delivered and loaded electronically rather than using a cumbersome physical medium like CD-ROMs, and applications can be installed and re-installed over the air as well.

A reliable IT solution ensures that unique secure networks for operations, crews, vendors, and customers can be established and supported. Onboard networking also enables more efficient communications with crews using VoIP, GSM, SMS, and more efficient online applications with high-quality, low-latency connections.

For safety and security purposes, onboard networking optimizes CCTV and mobile video for such applications as monitoring vessel security, teleconferencing, and telemedicine.

Onboard networking facilitates remote monitoring of the vessel's condition and performance, critical particularly for segments of the shipping industry where hazardous cargo requires strict ship monitoring, or refrigerated cargo vessels where customers

require verification of cargo temperature and status. Remote maintenance of onboard networks and computers can be conducted as well.

Full onboard IT & Communications Solution with CommBox Network Manager

Providing high quality connectivity to vessels requires the ability to remotely manage onboard networks in addition to providing a fast, reliable data link. With modern systems, like KVH's mini-VSAT Broadband network and exclusive CommBox technology, best-of-breed network management technology is fully integrated into the network offering a complete onboard IT & Communications (IT&C) solution.

The advantage of a fully integrated IT&C solution is that data traffic is managed both at the satellite network level using sophisticated hub technology and at the enterprise and vessel level using KVH's exclusive CommBox technology ensuring a consistently high level of broadband service. Web and data transmissions are compressed and optimized. Important operational data is given priority on the network. SPAM and malicious files are kept out. Secure file delivery is automatically monitored and confirmed. For busy IT departments, remote PC management, automated software updates, virus protection, and firewalls are all available.

Simplifying onboard networking even more, CommBox is now built into the TracPhone V7IP and TracPhone V11, and may be easily added to the TracPhone V3 and virtually any other communications system.



CommBox Offers:

- Fully unified onboard networking for a complete IT & Communications solution (IT&C)
- Optimized to work with the mini-VSAT Broadband network
- Best-of-breed network manager
- Data transfer optimization
- Secure assured file delivery
- Firewall and e-mail virus protection
- Unique onboard networks with prioritized service for operations, charters, vendors, and/or crew members
- Complete Internet café and VoIP calling solutions with prepaid calling cards for passengers or crew



KVH's End-to-End Solution

Maritime SATCOM is no longer just about communicating with shore, it's also about onboard networking.

On Board

Fully integrated solution manufactured and backed by KVH

- Antenna
- Modem
- Antenna Control Unit
- Network Manager

In Space

17 FSS satellite transponders deliver KVH's mini-VSAT Broadband service globally, covering all shipping routes, offshore oil fields, and fishing grounds

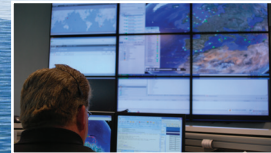
Corporate Offices

Secure connections from onboard network to onshore hubs for vessel-critical operations

Any Time, Any Place

KVH 24/7/365 Call Center

One-call resolution for any hardware or service issue, with remote diagnostics and local technical support at every major port on Earth



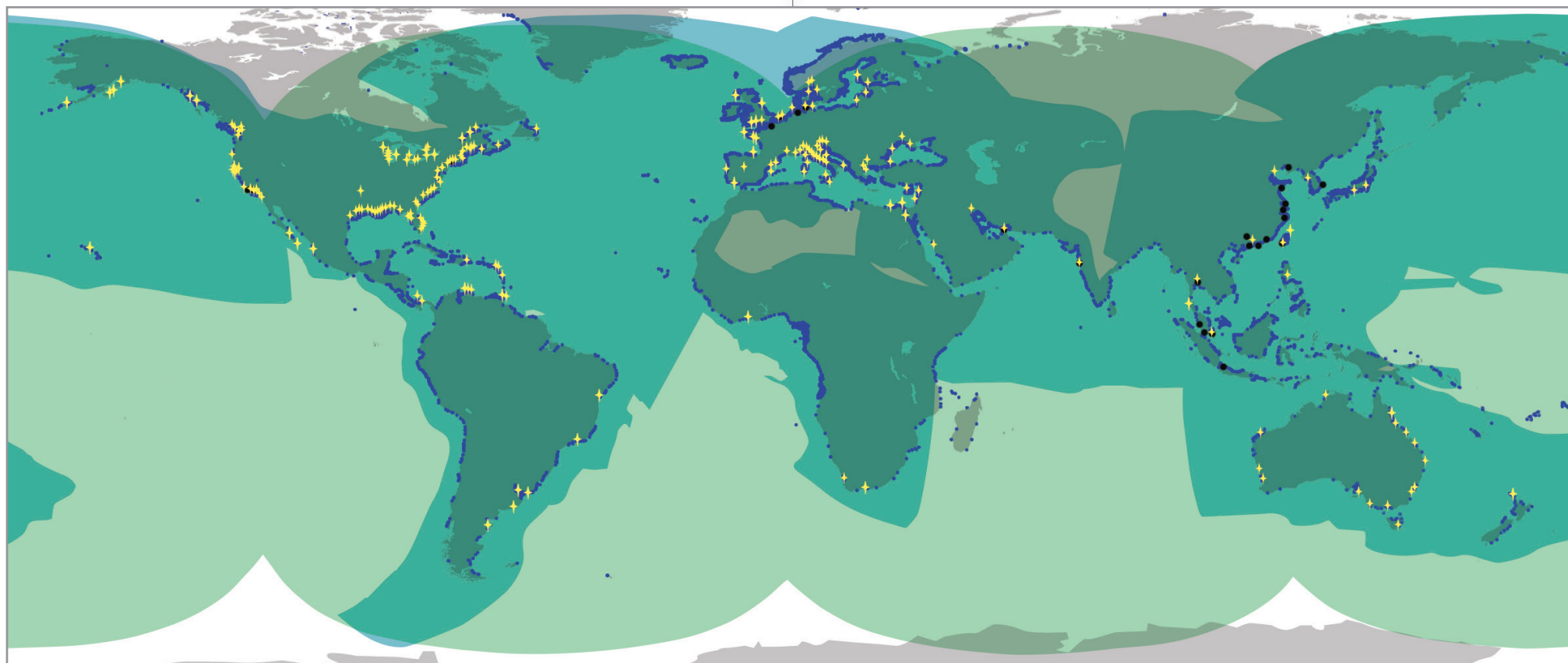
On Land

Secure, regional teleport hubs equipped with advanced network management servers monitor the network

Covering the World

mini-VSAT Broadband Covers the World,
and so does KVH's Customer Support Network

Fully global coverage and KVH GlobalCare –
a premium support program designed
to provide 24/7/365 support at
all major ports around the globe



- Ku-band Coverage Only
- Ku-band Coverage with C-band Overlay Coverage
- C-band Coverage Only

- ★ GlobalCare In-port Service Providers
- World Ports Supported by KVH GlobalCare Tiered Service Support System
- Major Shipping Ports

Flexible Onboard Terminals

Three Antenna Hardware Choices Provide
an Ideal Fit for Every Vessel



Not only did KVH create the mini-VSAT Broadband network from the ground up to be the first next-generation maritime satellite communications service, they also created a new generation of onboard terminal with advanced antenna technology and fully integrated below deck units that have better features and are more reliable and easier to install than anything else in their class. The result? TracPhone V3, V7IP, and V11 – three antennas with breakthrough design and performance.

Patented ArcLight spread spectrum technology enables the TracPhone antennas to be extremely compact (from 39 cm to 1.2 m) and still offering outstanding coverage and speed. KVH's high-efficiency RingFire™ antenna design and dielectric feed rod technology ensure the TracPhone antennas have great performance even in poor weather. The TracPhone antennas are fully stabilized, and the systems include powerful spread spectrum modems and sleek belowdecks antenna control units fully integrated and configured for easy installation.

TracPhone V3

World's Smallest Ku-band Maritime VSAT Terminal

A game changer for meeting data needs with a small antenna, the ultra-compact TracPhone V3 provides always-on broadband data connections, an integrated voice line, worldwide coverage from the mini-VSAT Broadband network, and dramatically reduced airtime costs. TracPhone V3's outstanding attributes:

- Spread spectrum technology enables breakthrough ultra-compact design without compromise in performance
- Affordable airtime costs, starting at \$0.99 per MB for data, \$0.49 per minute worldwide for voice, to land *or* cell
- 95% smaller in volume than standard Ku-band VSAT systems, for far less costly installation
- Excellent, ultra-compact option for vessels needing an affordable replacement for FleetBroadband systems
- Rugged, high-performance design with superior tracking and stabilization
- One integrated voice line optimized for use with satellite services
- Affordable metered airtime packages with fastest activation in the industry



TracPhone V3 Stats

Antenna Dish: Dia. 36.8 cm (14.5")
Antenna Dome: Dia. x Height
 39.4 cm x 44.7 cm (15.5" x 17.6")
Weight: 11.3 kg (25 lbs)
Antenna Type: Ku-band
Download Speed:³ Up to 2 Mbps
Upload Speed:³ Up to 128 Kbps

TracPhone V7IP

Enterprise-grade, Feature-packed Ku-band Maritime VSAT Terminal

The new TracPhone V7IP is a breakthrough maritime satellite communications product designed for the broadband era and its requirements for onboard networking. A 3-axis gyro-stabilized, 61 cm-diameter VSAT antenna, TracPhone V7IP provides always-on connectivity and worldwide coverage using the industry-leading VSAT network – mini-VSAT Broadband. It offers:

- Streamlined belowdecks unit includes ArcLight spread spectrum modem integrated with KVH's breakthrough IP-enabled antenna control unit – the CommBox-ACU – featuring built-in CommBox Network Manager, VoIP adaptor, Ethernet switch, and WiFi for reliability and simple installation and use
- Compact, high-performance antenna solution in an affordable, yet rugged hardware package similar in size to FleetBroadband FB500, but with the speeds of VSATs over six times its size
- Modern, web browser-based user interface with iPhone® app
- Two integrated voice lines optimized for use with satellite services, can expand to up to nine concurrent voice lines for crew calling, etc.
- Affordable airtime rates and flexible packages with fastest activation in the industry

TracPhone V7IP Stats

Antenna Dish: Dia. 61 cm (24")
Antenna Dome: Dia. x Height
 66.3 cm x 79.2 cm (26.1" x 31.2")
Weight: 26.1 kg (57.6 lbs)
Antenna Type: Ku-band
Download Speed:³ Up to 2 Mbps
Upload Speed:³ Up to 1 Mbps



TracPhone V11

World's First Dual-mode C/Ku-band Truly Global Maritime VSAT Terminal

The revolutionary new TracPhone V11 dual-mode onboard terminal uses a single, small, 1.1 meter antenna to seamlessly access both the C- and Ku-band satellites of the mini-VSAT Broadband network for truly global coverage. Unlike competing L-band and Ku-band solutions that require two terminals joined with a router, the TracPhone V11 is a unified solution: one antenna seamlessly providing both C- and Ku-band services and integrated to one streamlined belowdecks unit. It offers:

- Breakthrough antenna design offering C- and Ku-band services in one, ultra-compact antenna unit 85% smaller by volume and lighter than C-band VSATs for less costly installations and streamlined operations
- Streamlined belowdecks unit includes ArcLight spread spectrum modem integrated with KVH's breakthrough IP-enabled antenna control unit – the CommBox-ACU – featuring built-in CommBox Network Manager, VoIP adaptor, Ethernet switch, and WiFi for reliability and simple installation and use
- Modern, web browser-based user interface with iPhone app
- Two integrated voice lines optimized for use with satellite services, can expand to up to nine concurrent voice lines for crew calling, etc.
- Affordable airtime rates and flexible packages with fastest activation in the industry

TracPhone V11 Stats

Antenna Dish: Dia. 1.1 m (42.5")
Antenna Dome: Dia. x Height
 1.2 m x 1.4 m (48.8" x 57.3")
Weight: 102 kg (225 lbs)
Antenna Type: C/Ku-band
Download Speed:³ Up to 4 Mbps
Upload Speed:³ Up to 1 Mbps

Innovative Pedestal Design for Better Operation and Reliability

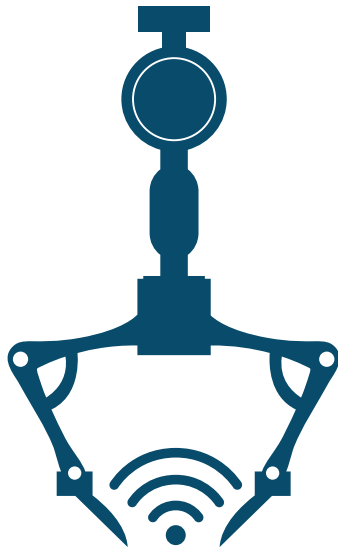
TracPhone V7IP and V11 antennas feature a pedestal design that is both innovative and simple: a motion-optimized tubular configuration creates a 3-axis mechanism that allows the antenna to move through elevation, cross-azimuth, and azimuth tracking motions while occupying the least amount of space within the unit's radome housing. As a result, both boast an extended elevation range of -24° to 119°, ensuring that the antennas track mini-VSAT Broadband satellites directly overhead at the equator and low on the horizon at polar latitudes. This unique 3-axis gyro-stabilized pedestal with a 4th axis of automatic skew adjustment seeks the optimum satellite within the mini-VSAT Broadband network and tracks it through the full dynamic specifications required for commercial ships. The space-efficient pedestal design is one more reason why KVH's antennas continue to lead the market in compact size and advanced technology.

Top Onboard Terminals for Offshore Networking

TracPhone V7IP and V11 feature KVH's new CommBox-ACU, an Internet Protocol-enabled antenna control unit with a built-in CommBox Network Manager – the optimal choice for today's digital vessel. The CommBox-ACU also provides a convenient, web browser-based system interface; over-the-air software updates, configuration, and troubleshooting; integrated Ethernet switch, and VoIP adaptor for simpler installation, control, and support. The CommBox-ACU's network management capabilities are based on the KVH CommBox Ship/Shore Network Manager, and include such features as web/DNS caching, least-cost routing, bandwidth management, transmission optimization, firewalls, e-mail virus protection, VLAN configuration, VPN, automated file transfers with differential synchronization, and crew e-mail. For more information, visit kvh.com/V7IP or kvh.com/V11.

KVH Quality

Producing Maritime Satellite Terminals to the Highest Standards



The mini-VSAT Broadband network was created by KVH as a fully integrated hardware and service solution for maritime satellite communications. At every step, quality guides the process.

Satellite Antenna Design & Testing

KVH develops its satellite antenna products in its research and development center located at its world headquarters in Rhode Island. To ensure that antennas receive rigorous testing approximating real-life extreme conditions, KVH uses a dedicated testing facility, equipped with a custom-made hexapod motion simulator. Satellite antennas mounted on top of the hexapod are moved violently through lateral, longitudinal, and vertical movements, and through pitch, roll, and yaw rotations. This testing is an important step in the process of ensuring maximum performance of the satellite antenna systems, and great tracking for commercial vessels at sea. Further, the Highly Accelerated Life Test (HALT) chambers help eliminate design defects early in development.

Product Manufacturing

KVH produces the TracPhone V-series antenna systems in a new state-of-the-art manufacturing facility, located across the street from its headquarters. The 75,000-square-foot facility houses the production floor as well as the warehouse, shipping, and receiving areas. KVH is an ISO 9001:2008-certified manufacturer, as well as an approved military contractor meeting stringent quality standards that are recognized worldwide.

Satellite Network Operations

KVH continually monitors, manages, and improves the mini-VSAT Broadband network, which was built from the ground up to become, in just five years, the world's most extensive Ku-band network, and the world's only unified global C/Ku-band VSAT service. The mini-VSAT Broadband network is future proof as well: KVH leverages abundant commercial satellites so new capacity can be added, exactly where it is needed. This flexibility means the network can grow quickly to meet user demands without multiple-year delays and pass-along capital costs for new satellites.

Global Support

With customer satisfaction the most important goal, KVH's airtime service department will ensure systems are activated fast and customers have the airtime package that best fits their needs. Plus, unlike other solutions where each element in the SATCOM system is produced by a different vendor, KVH's end-to-end approach means one central 24/7/365 global support center will handle any issues that may arise.



KVH World Headquarters, RI USA
(with offices worldwide)



KVH Manufacturing Center



KVH Testing Facility with
Hexapod Motion Table



KVH Global Support Center

Comparing the leading maritime satellite communications services

	Legacy Solution: L-band (Inmarsat FleetBroadband)	KVH mini-VSAT Broadband (TracPhone V-series)	Legacy Solution: Standard TDMA VSAT (various)	
Data Speed (up/down)³	FB150: 150 Kbps/150 Kbps	V3: 128 Kbps/2 Mbps	Ku-band: 512 Kbps/1 Mbps	
	FB250: 284 Kbps/284 Kbps	V7IP: 1 Mbps/2 Mbps		
	FB500: 432 Kbps/432 Kbps	V11: 1 Mbps/4 Mbps	C-band: 512 Kbps/1 Mbps	
Antenna Hardware Diameter (Antenna Unit)	FB150: 27 cm (11")	V3: 39.4 cm (15.5")	Ku-band: 127 cm (50")	
	FB250: 27 cm (11")	V7IP: 66.3 cm (26.1")		
	FB500: 69 cm (27")	V11: 1.2 m (48.8")	C-band: 3.6 m (144")	
Weight (Antenna Unit)	FB150: 5 kg (11 lbs)	V3: 11.3 kg (25 lbs)	Ku-band: 136 kg (300 lbs)	
	FB250: 5 kg (11 lbs)	V7IP: 26.1 kg (57.6 lbs)		
	FB500: 23 kg (51 lbs)	V11: 102 kg (225 lbs)	C-band: 680 kg (1,500 lbs)	
Installation	FB150: 1 day	V3: 1 day	Ku-band: 2 days	
	FB250: 1 day	V7IP: 1 day		
	FB500: 1 day	V11: 1 day	C-band: 5 days	
Coverage	FB150: Global except arctic regions	V3: Seamless worldwide regions	Ku-band: Seamless worldwide regions	
	FB250: Global except arctic regions	V7IP: Seamless worldwide regions		
	FB500: Global except arctic regions	V11: Global except arctic regions	C-band: Global except arctic regions	
Reliability	Service supplier	Inmarsat	KVH	Virtual network operator
	Antenna supplier	Thrane, Addvalue, Furuno, JRC, Sea Tel	KVH	Sea Tel, Orbit, Thrane, KNS, Intellian
	Modem supplier	Thrane, Addvalue, Furuno, JRC	KVH	iDirect, Comtech, HNS, Globecom
	Network Manager supplier	Vizada, Dualog, Livewire	KVH	Vizada, Dualog, Livewire
	After-sale support	Customer needs to figure out	KVH	Customer needs to figure out

Things to consider when selecting an offshore connectivity solution

The Network

- Satellite coverage fulfills business need and has proven network reliability
- Capacity easily added to network to support growth
- Modern transmission technology designed for mobile use
- Data transmission speeds
- Latency of transmissions
- Prioritization of mission critical applications

Onboard Terminals

- Flexibility of onboard equipment for different size vessels/networking requirements
- Experience of vendor in supporting onboard hardware (manufacture and support own hardware versus using third party equipment)
- Antenna, modem, network manager designed by one manufacturer as integrated solution
- Cost of onboard terminals
- Size and number of antennas required
- Time & cost of antenna installation/integrating components/activation
- Ability to mount antennas with clear line of sight to the satellites on all headings

Onboard Networking & Data Transmission

- Automated file transfers with differential synchronization
- Built-in firewall
- VPN capability for enterprise network extension
- Ability to set up multiple networks for operations, crew, and vessel charters/visitors/passengers
- Web-caching
- Data compression for enhanced efficiency
- Data transfer and optimization
- URL and content filtering
- E-mail management system with roaming crew accounts
- Internet café options for crew
- Crew calling card options
- Least cost routing
- Anti-spam and e-mail anti-virus filters
- Streaming supported

After-sale Support

- 24/7/365 support
- On-call problem resolution
- Ability of support center to diagnose both hardware and service issues
- Global local technical support network in all major ports

Footnotes

1. *Captain Richard Madden, "Maritime Continuing Education... What Have You Done Today?"* gcaptain.com, July 14, 2012
2. *Euroconsult, March 2012; NSR, May 2012*
3. *Published data rates are rate plan maximums and may vary in different regions and under different conditions.*

Additional Resources

Report: *Comparing KVH mini-VSAT Broadband to Legacy Solutions*
www.minivsat.com/one

Extreme Testing: *KVH Satellite Antennas Take a Wild Ride*
www.kvh.com/hexapod

Standards of Training, Certification & Watchkeeping (STCW) Convention
www.stcw.org

Electronic Chart Display and Information System (ECDIS) www.ecdis.com

ILO Maritime Labour Convention, 2006 (MLC, 2006) www.ilo.org

International Convention for the Prevention of Pollution from Ships (MARPOL)
www.imo.org/OurWork/Environment

International Maritime Organization (IMO) www.imo.org

Maritime Liaison Office (MARLO) <http://www.cusnc.navy.mil/marlo/>

Maritime Security Centre – Horn of Africa (MSCHOA) <http://www.mschoa.eu/>

Regional Cooperation Agreement on Combating Piracy and Armed Robbery
against Ships in Asia (RECAAP) www.recaap.org

United Nations Oceans and Law of the Sea
www.un.org/Depts/los

www.minivsat.com



KVH Industries, Inc.
World Headquarters
Middletown, RI U.S.A.

Tel: +1 401 847 3327 Fax: +1 401 849 0045
E-mail: info@kvh.com

KVH Industries A/S
EMEA Headquarters
Kokkedal, Denmark

Tel: +45 45 160 180 Fax: +45 45 160 181
E-mail: info@emea.kvh.com

KVH Industries Pte Ltd.
Asia-Pacific Headquarters
Singapore

Tel: +65 6513 0290 Fax: +65 6472 3469
E-mail: info@apac.kvh.com

KVH Industries Norway AS
Regional Office
Horten, Norway

Tel: +47 33 03 05 30 Fax: +47 33 03 05 31
E-mail: info@no.kvh.com