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# Developing a Maritime Internet of Things Service

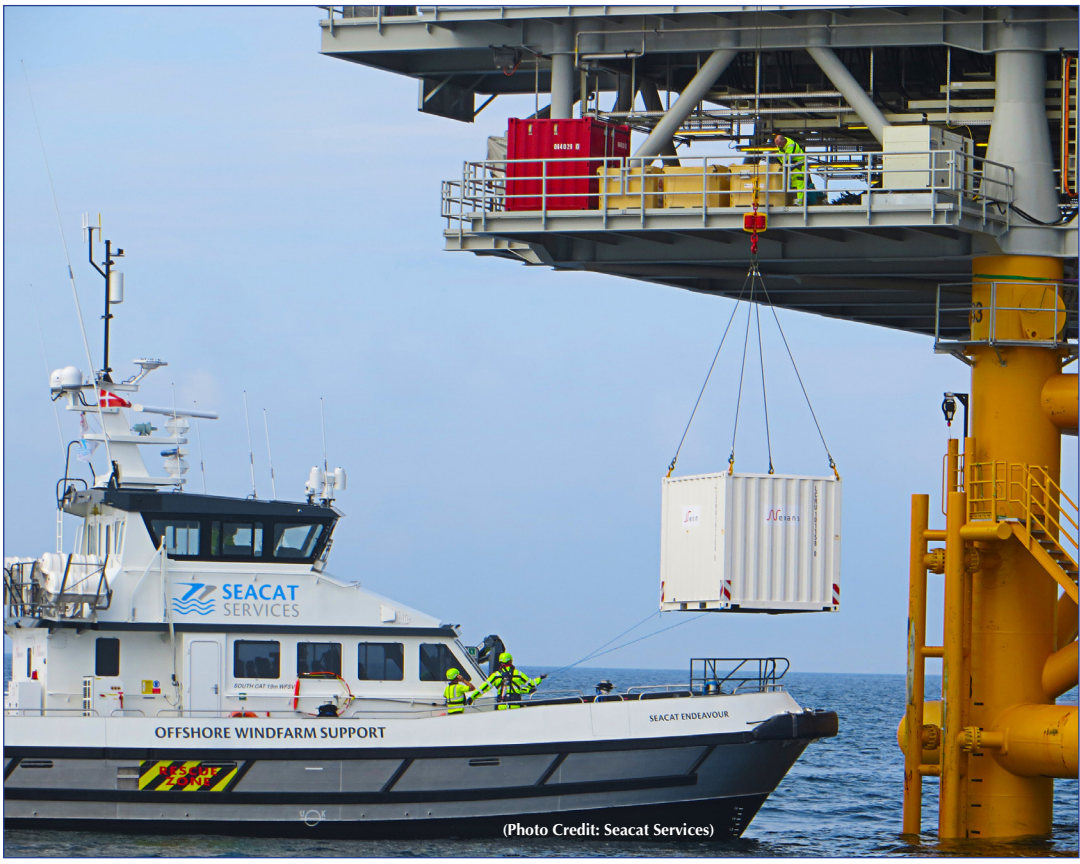
## *Big Data Analytics for Remote Vessel Monitoring, Operations*

**By Bob Balog • Robert Hopkins • John Croy**

There's a lot of discussion in the maritime industry about the Internet of Things (IoT), but we often hear an undercurrent of skepticism about what big data can really do for a vessel. Here's one scenario: Imagine you are the shore-based fleet operator for a dozen world-voyaging commercial vessels. One of your 1,000-ft. freighters is pulling away from the coast of Norway at the start of a journey to Newfoundland, which is to say it will soon be in a vast ocean thousands of miles from port. An alarm pops up on your computer showing erratic accelerometer data on one of the vessel's systems, consistent with excessive vibration on a propeller. You immediately run a data analysis program, determine that the propeller is indeed within a few hundred rotations of failure, and put in a call to the vessel captain to return to port, just 50 nautical miles away, for a repair. Had the propeller failed on its own time, the vessel would have been crippled in the middle of the north Atlantic, prompting several hundred thousand dollars in emergency services, not to mention the cost of lost voyaging time.

For exploration or research vessels, a similar dilemma could interrupt work at a crucial juncture, sacrificing valuable time and dollars, and potentially forcing an expedition to be cancelled.

What will it take to ensure that timely monitoring and alerts become part of a seagoing operation's everyday reality, no matter the size of the fleet or sophistication of the vessels? To make this type of service truly groundbreaking, it



(Photo Credit: Seacat Services)

*A pair of KVH satellite antenna domes is installed high up on a Seacat Services vessel that provides support for wind farms located off the coast of European countries, including England, Denmark and Germany. The two KVH systems used on this vessel are the TracPhone V3-IP, providing satellite Internet connectivity, and the TracVision M3, providing satellite television programming. This type of vessel can benefit from sensor-based analytics that alert ship operators and support technicians to potential issues with the vessel systems so equipment can be kept in optimal condition for maximum vessel availability.*


*(Top and Bottom) Included under the dome of a KVH TracPhone V7-IP satellite communications antenna are sensors providing data to .log files; the team developing KVH's Internet of Things product used the .log files as part of their research process. KVH's Integrated CommBox Modem (ICM) is the belowdecks unit on board vessels using KVH's TracPhone V-IP series satellite communications antenna systems. For KVH's IoT product, the ICM's computing power is used to run code of any complexity and sampling rate on a vessel without overloading the satellite network.*

should address as many systems on a vessel as possible—rather than the current trend for each equipment manufacturer to develop a one-off monitoring system just for their product. What would that take?

The hurdles involve not merely collecting and processing the amount of data the ship's many systems generate, but also getting that data to a shore-side analyst and facilitating a warning system to trigger a rapid response to the data.

### Starting Point: KVH's Fielded Antennas

As a provider of maritime VSAT systems, we knew we were uniquely positioned to tackle these hurdles. Early last year, we set out to develop a maritime IoT service using what we had at our fingertips—our own fielded satellite antennas. We established a "fleet" of vessels with active KVH antennas but inactive commercial activity, amenable to being part of a test; the vessels are located all around the world, and testing is ongoing.

We had a lot going for us right from the start: Our satellite products already save performance data in .log files on board. This .log file shows things such as temperature inside the dome, blockage events, activity of the stabilized antenna's tracking mechanism, percentage of time online or offline, and number of times someone logs into and out of the system. Our engineers and service technicians use these .log files to do fault analysis after a problem has occurred. But we wanted to take that manual process and make it preemptive and automatic.

### Challenge: Vessel Sensors Generate Large Data Files

Knowing that the raw .log files, solely for the antenna data, are large, generally 9 to 10 MB every 24 hours, we knew that additional data from other equipment would create an extremely large data file every day. A Futurenautics research report in 2016 noted, for example, that a well-instrumented ship can generate up to 60 GB of data per day. Moving all 60 GB would cost more than $250,000 per month per ship; a huge sum.

To enable vessel operators to make use of sensor-based analytics (SBA), we had to figure out how to get all the data off the ship in real time without crippling anyone's budget and without crippling our satellite network. We have thousands of vessels using the KVH mini-VSAT Broadband network.

The goal was to analyze the antenna .log file on the ship, and send just the summary report to shore. By doing so, we could reduce the size of the file delivered to shore by a factor of 1,000. The strategy was to use the server on our ICM belowdecks antenna unit to host the analytics code—the same code that we normally run at our networks operations center on the .log files of troublesome units. Our workflow changed dramatically. Rather than learn of an antenna failure, download the .log over the space link and analyze it onshore after the fact, we are now on track to analyzing the .logs of every antenna once per day to search for latent problems and resolve them. The ICM's computing power allows us to run code of any complexity and sampling rate on the ship without overloading the satellite network.

### Making Sense of Raw Data

Using proprietary software, we have been monitoring our test fleet of VSAT equipment in the field, identifying potential failures. We are taking the raw data we are receiving and working on generating statistics automatically from the data report. For example, in one recent two-day period, we had 181 vessels reporting such information as: percentage of time online, number of satellite changes per day, and number of blockage events per day.

***"Rather than learn of an antenna failure, download the .log over the space link and analyze it onshore after the fact, we are now on track to analyzing the .logs of every antenna once per day to search for latent problems and resolve them."***

We specified certain parameters so that tickets for tech support are triggered automatically—and emergencies are prevented. This puts us clearly in the world of active customer service management. We know our value will be in providing a way of collecting the data, preprocessing it, compressing it, and transmitting it back to shore. We also know the value to the fleet operator in preventing failures at sea could be hundreds of thousands of dollars.

### Benefits to Vessels, Operators

On a typical commercial vessel, prime candidates for operational optimization utilizing real-time data include fuel savings, route planning and optimization, risk mitigation, and maintenance and repair programs. For example, Maersk demonstrated a 13 percent reduction in fuel consumption from 2012 to 2014 while increasing container count by 11 percent, by utilizing real-time data for route planning and optimization. In addition, maintenance and repair costs can be reduced if performance data from vessel systems are proactively monitored. Some $30 billion per year is spent on repairs and maintenance in the shipping industry, with a typical ship spending $650,000 to $700,000 annually. Approximately 36 percent of all P&I claims are related to hull and machinery damage.

Add to those possibilities the fact that operational big data includes not only remote condition monitoring and analytics, but it can also mean figuring out an efficient way to send a 1-GB maintenance manual from shore to vessel; sending company communications or videos; providing training materials; performing file/software/virus updates; and ensuring the vessel has the highest resolution, most accurate weather and map data at all times.

A complementary use of much of the same data is for fleet management, by the onshore operators and superintendents that see to the operational readiness and overall performance of their vessels. In fact, there are many stakeholders watching each ship from shore during its voyage. They could all use real-time data to be more effective in their jobs.

As KVH prepares to offer remote condition monitoring and analytics, we are excited by the benefits for fleet operators: lower cost and higher quality service by maritime equipment manufacturers, and lower maintenance costs with fewer off-charter interruptions. We are applying what we're learning internally to the full range of big data initiatives that can help our customers increase their operational efficiency. **ST**

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