How to entice ship owners to support e-Navigation

Making e-Navigation work in an industry with a range of different proprietary technologies could prove extremely difficult and very costly for shipping companies – what is really required is a common architecture that will allow different systems to work together as required, *writes Fred Pot, Marine Management Consulting*

In 2006, at its 81st session, the International Maritime Organisation's Maritime Safety Committee (MSC) decided to include in the work programmes of the NAV and Radiocommunications and Search and Rescue (COMSAR) Sub-Committees a high priority item on 'Development of an e-Navigation strategy'.

The stated aim of the IMO in this regard is to develop a strategic vision for e-Navigation, to integrate existing and new navigational tools, in particular electronic tools, in an all-embracing system that will contribute to enhanced navigational safety while simultaneously reducing the burden on the navigator.

E-Navigation has been defined during this process as "the harmonised collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment."

In the intervening years since this initiative was first mooted IMO's Correspondence Group on e-Navigation (CG) and IALA's e-Navigation Committee have almost exclusively focused their efforts on developing requirements for the shore-side part of the system architecture.

For example, Annex 2 of the CG's report to IMO's NAV sub-committee (NAV 59) focused on the requirements for the system architecture of the "Maritime Cloud" and how shore-based authorities could use it, while IALA's e-Navigation Committee seems to focus mostly on the shore-based authorities' systems architecture.

So far ship owners have not proposed, let alone accepted a common ship board system architecture that will accommodate e-Navigation solutions.

Yet, ship owners will likely be expected to foot the bill for shipboard implementation of e-Navigation solutions. This will likely require them to acquire, install, maintain and train users of significantly more complex systems and it will likely increase the volume of wireless communications between ship and shore.

Primarily because of the additional cost of implementing e-Navigation solutions on new ships, most ship owners oppose or even attempt to block adoption of e-Navigation solution carriage requirements at the IMO level. They are using their Flag States and their associations (International Chamber of Shipping, BIMCO, Cruise Line International Association, Intertanko, etc) to resist new carriage requirements.

In response, Port and Coastal Authorities may well elect to start enforcing such carriage requirements in their regions rather than wait for IMO to mandate them.

What can we do to prevent local authorities from enforcing regional, possibly incompatible carriage requirements? What can we do to gain ship owners' support for e-Navigation? Can we quantify the cost savings that e-Navigation will bring them? If we can't do that, can we address other needs/issues/problems that ship owners face? What are these needs/issues/problems?

e-Nav issues

To stay competitive, ship owners must reduce crew size to the minimum level required by their Flag State, recruiting crews from a variety of countries each with their own language and culture and with varying levels of training and (system) competency.

Another issue is the increasing cost of maintenance and repair of on board systems. Their number, cost and complexity continue to grow. e-Navigation carriage requirements will undoubtedly add to this growth.

Systems invariably come with their own, often embedded, proprietary computer that is typically not able to communicate with the outside world because it is proprietary and closed. Many of these systems require traveling specialist service engineers to remote ports for maintenance, repairs and upgrades.

A related issue is vendor lock-in. Electronic equipment and systems are typically selected by the shipyard and offered with the ship as a package that can be changed, but the change order fees tend to be significant.

The result is that ship owners typically are prevented from using their own criteria (cost, maintainability, features, intuitiveness, quality, reliability, etc) to select on board systems. Also, the lack of inter-vendor compatibility prevents ship owners from 'Mixing-and-Matching' systems from different suppliers.

The result is that ship owners are typically locked into a single vendor's support and service for each system. That suits vendors because they can, and often do, charge a premium for their support and services.

The changes in crew characteristics in conjunction with the increasing maintenance cost of a growing number of complex proprietary on board systems make remote monitoring, trouble shooting, repairing and upgrading systems a must rather than a nice to have.

Plug-n-play

To gain ship owner support for e-Navigation, I propose that we develop a proposal for an on board system architecture that addresses e-Navigation infrastructure requirements but also addresses ship owners' issues:

- Cost of maintaining a growing number of ever more complex systems
- Vendor Lock-in
- Lack of Inter-Vendor Compatibility and resulting inability to Mix-n-Match systems
- Increasing volume and cost of wireless communications between ship and shore

Specifically, I believe that we should propose a ship board system architecture that is based on a secure Local Area Network (LAN) with a 'Maritime' version of Universal Plug-n-Play (UPnP) and add remote servicing capabilities for each system on the ship board network.

We all have experienced Plug-n-play in action, for instance when we add a printer to the router on our home network.

As soon as the printer's network cable is plugged into the router, the printer uses its DHCP client to obtain an IP Address from the router's DHCP host. You can then connect your computer to the printer, get status information (ink-levels, out of paper warnings, etc.) and start using it.

To do that your computer needs information from the printer. The printer publishes that information on its internal web server or lets you download its proprietary application to your computer that interacts with the printer.

The international standard for UPnP (IEC 29341-x) doesn't require that a system that wants to use UPnP to connect itself to a network first identifies itself with a security certificate that proves that it is trustworthy and not malicious.

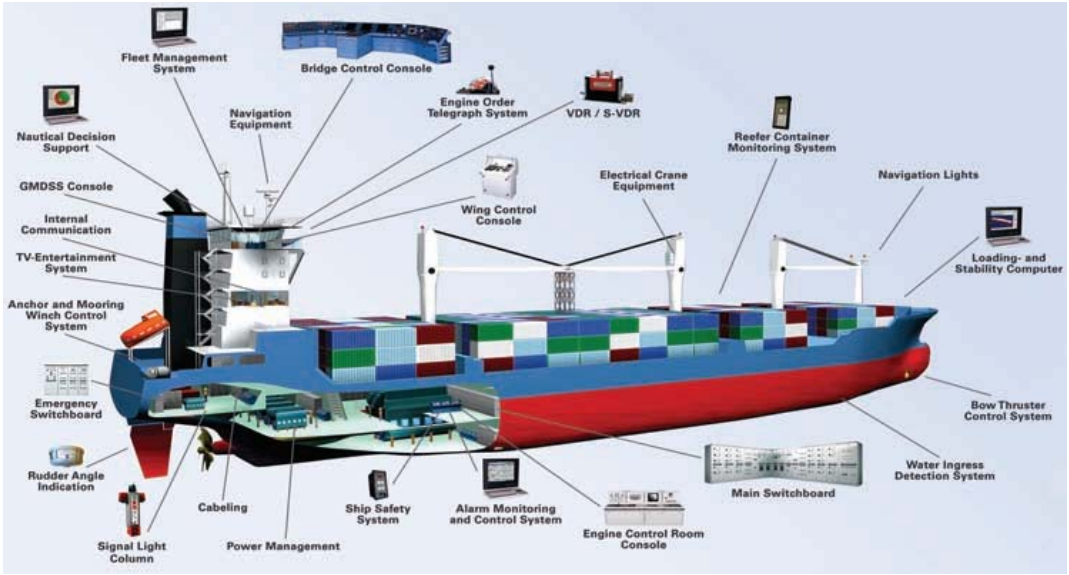
Such 'authentication' would need to be added to the maritime standard so that it requires that only systems whose security certificate is on a 'White List' are allowed to use 'zero configuration' UPnP to be added to the network.

This white list of systems that have a trusted security certificate would be created by the shipyard and maintained by the ship owner or his system integrator. A system's security certificate would be issued by the vendor and IMO would authorise vendors to issue certificates for the systems they sell.

The 'White List' would include security certificates of trusted systems/nodes/services that are offered in the Maritime Cloud (See Annex 2 of the CG's report to NAV 59).

The Universal Plug-n-Play standard would further need to be amended to require that all systems advertise on their webserver:

- A detailed description of the system's functions and controls
- Vendor details including the Vendor's IMO authorisation to issue security certificates
- The system's model number and, if applicable, its certificate of compliance with the IMO performance standard for such systems (i.e. Radar, ECDIS, etc.)
- Serial Number



A huge range of systems across the ship are required to communicate. Photo: Interschalt

- System Software Version and a link to the file on its webserver that contains a history of version upgrades
- Warranty Status
- Service Subscription details (expiration date, payments, etc.)
- A link to the System's Manuals

This would also need to include a link to the system's Maintenance & Settings Web Page on its webserver that lists the current configuration, details of subscriptions to software updates, and, if the system is a sensor, then a measure of its accuracy and an indication of the system's health (perhaps marking the time of the system's last 'Heartbeat' and any alarms generated by the system).

Maritime Plug-n-Play should not be limited to adding local systems to the ship board network. Systems on the ship board network should also be able to use Maritime Plug-n-Play to subscribe to trusted services that are available in the Maritime Cloud:

- Electronic Chart Updates
- Weather Information
- Maritime Safety Information
- Remote monitoring of on board systems
- Etc.

Connection

When a new system uses (Maritime) UPnP to connect itself to the on board network, then all other systems that are already on the network can be set up to connect with (to 'discover') the new system, just like any computer on your home network can be connected to (discover) your printer. Such Machine-to-Machine (M2M) connections are called subscriptions.

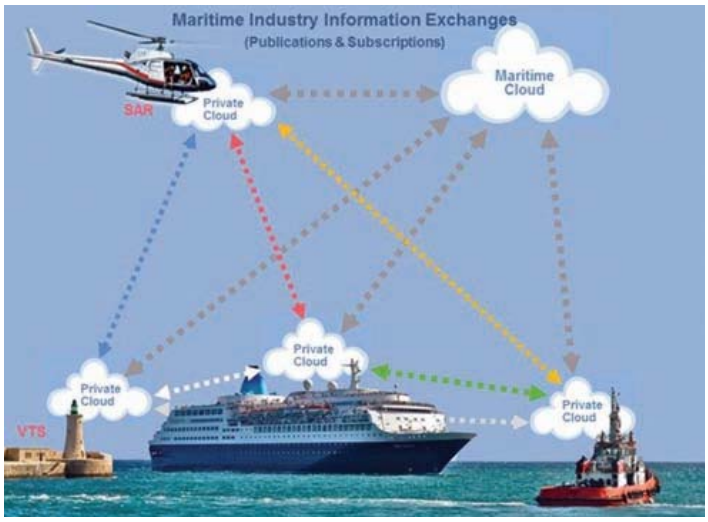
M2M subscriptions of systems (subscribers) to other systems (publishers) on the ship's network or in the Maritime Cloud will need to be managed. Only those subscribers whose system's security certificate is on the White List should be allowed to subscribe to another (publishing) system.

Ship owners will want to add to their White List the security certificates of (shore-based) subscribing systems that they and their vendors use to remotely monitor, trouble shoot, repair and upgrade on board systems.

Furthermore, to ensure availability of mission critical systems the master will want to have the option to limit maintenance access to such systems to periods when they are not needed for controlling the ship.

'Subscriber Pays' functionality should be one of requirements of the communications system infrastructure. This will require establishment of an invoicing system that bills subscribers for the cost of their subscription message traffic for each communications channel that is used to carry the traffic.

Shipboard and shore-based subscribers will want to use a sophisticated least cost message router that prioritises subscription message traffic and either routes it via a communications channel that is currently available or use a 'Store-and-Forward' system by putting it in a message queue to be transmitted via a lower cost channel that will become available later during the voyage (i.e. Cellular, WiMAX, VHF Data Exchange, WiFi and future technologies).



The Maritime Cloud would hold White Lists for trusted systems and data on connected ships

The ship board router will need to base its predictions of availability of lower cost communications channels on:

- The communications equipment that is available on board
- The ship owners' cost to use each channel
- Communications channel coverage maps
- The voyage plan

The ship's router will need to share its channel address and availability predictions with shore-based subscribers' message routers by publishing this 'channel connection' information on the Maritime Cloud.

For communications billing purposes and to enable least cost routing, subscription messages that use a wireless digital communications channel between ship and shore will need to indicate the ID of their subscription and specify their maximum acceptable message delivery delay (latency).

Implications

The major implication of this proposal is that all systems, both on board and in the Maritime Cloud, are amended to include Maritime Plug-n-Play functionality.

Vendors are likely to charge a premium for such systems and for remote monitoring and servicing such systems, thus driving up the Total Cost of Ownership (TCO), however, establishing this system architecture for the maritime industry will lay the groundwork for establishing a common (Android-like) ship board platform (cloud) that all applications can use, including the proprietary systems that currently require their own proprietary boxes, each with their own power supply, network cabling, processor, operating system, data storage, user interface, etc.

An example of a common platform such as I am describing is the Open Source project that created the Marine Systems Software Architecture (MARSSA).

Work on MARSSA began in 2008 by a team of marine software engineering experts and mariners at MARSEC-XL (Marine Software Engineering Center of Excellence). On the 14th of February 2011 MARSEC-XL donated the very first version of MARSSA to the Open Source Community and the work on MARSSA has continued as an open source project hosted by MARSEC-XL Foundation since then.

MARSSA sets out to provide a Reference Architecture (RA), which will serve as a base for the development of standards and, at the same time, an architecture to support the integration and interoperability of software-dependent devices and systems on board and on shore.

The RA learns from other domains such as avionics and automotive, however it directly addresses and takes into account the specificity of the maritime domain. It provides an architectural blue print for a set of products / systems based on the pool of previously successfully implemented solutions and combined with a set of new requirements.

Experience in other industries has shown that a common platform significantly reduces the need for proprietary boxes. MARSSA will allow vendors to focus on the quality of their application rather than on the whole stack (i.e. cabling, power supply, processor, operating system, data storage, user interface, etc.).

They can re-use proven software components and the functionality offered by the common onboard platform to develop their proprietary solutions thus significantly reducing their development cost and improving their quality. The cost of network cabling and the cost of building-in system redundancy with automatic failover will also decrease significantly.

Furthermore, developers other than those employed by hardware system vendors will be able to offer their own related innovative solutions. The effect of this increased competition will be to turn the current 'sellers' market' into a 'buyers' market'.

It will decrease the cost and increase the quality and the number of available solutions for ship owners to choose from and allow them to mix-n-match solutions that best fit their selection criteria.

And it will provide a system architecture that fully supports all possible e-Navigation solutions…. DS

About the author
Fred W. Pot *is principal of Marine Management Consulting and can be reached at fpot@enavsolutions.org. For further information on MARSSA visit www.marssa.org*