Lockheed Martin

RTI selected for Sea SLICE — Advance Platform Control System

"RTI provides a scaleable real-time COTS middleware that is easy to integrate and has proven to be very reliable in the field."

Sea SLICE Lead Software Engineer

The display controllers located in the bridge provide the ability to monitor all ship subsystems, as well as the ability to control/tune the APCS Ride Control Algorithm. The fault-tolerant nature of the architecture, supported by RTI middleware, provides dynamic configuration of display systems and alternative ship control in the event of display, processor or monitor failure.

Lockheed Martin Marine System's SLICE™ technology is a patented ship design that enables Small Waterplane Area Twin Hull (SWATH) ships to operate at higher speeds without sacrificing efficiency by retaining a characteristic low motion in a seaway. The key to this innovation is the reduction of wave-making, made possible by four teardrop-shaped, submerged hulls supported by short struts. This configuration allows for speeds well beyond the "hump" on the Froude resistance curve. Combining this increased speed capability with extraordinary stability in high seas, SLICE technology opens up a new set of options for commercial and military applications. Ship operators want small, affordable ships that perform at high speed in high seas. This technology fulfills both of these requirements. The Sea SLICE prototype, which is only 105 feet long and 52 feet wide, is as stable in rough seas as a 350-foot conventional monohull ship.

A significant challenge for naval architects is to design ships of limited size that are capable of handling heavy seas.

The SLICE technology, introduced in 1997, is a fast SWATH variant that slices through the water without making waves. This patented, advanced hull design allows the SLICE hull to reduce wave-making resistance at high speeds by up to 35% compared to a SWATH of the same displacement. The SLICE design produces the same stable ride as a SWATH, but can achieve higher speeds with the same horsepower. Since SLICE is based on SWATH technology, SLICE possesses all of a SWATH's advantages: smaller size, better sea-keeping, cheaper acquisition and operating costs. Adding to these benefits, SLICE has higher speed, reduced wake, better range, endurance and fuel consumption, and is built utilizing conventional shipyard practices.

Advanced Platform Control System

In order for Sea SLICE to achieve optimal stability and performance in up to sea state five conditions, Lockheed Martin Marine Systems designed and implemented the onboard Advanced Platform Control System (APCS). The APCS, written primarily in C++, was designed to monitor the propulsion system, control all auxiliary systems such as fuel, ballast, and diesel generators and drive the control surfaces of the SLICE advanced hull form dynamics. In order to achieve optimal performance and fully maximize the advanced hull design performance, the fins attached to the in-board side of the submerged pods must be monitored in real-time in order to make the necessary runtime adjustments and provide a stable platform in varying sea states. Fin angle deflections and associated rates must be monitored and controlled very carefully to achieve high-speed performance. The architecture of the APCS is distributed and includes both system and display controllers over an Ethernet backbone. The system controllers utilize Wind River's VxWorks® RTOS while the display controllers run under Windows NT®.

RTI Enables Lockheed Martin's Advanced Platform Control System

The Lockheed Martin Sea SLICE development team was confronted with the decision to either expend project resources to design, test, document, and maintain their own real-time custom inter-processor communications (IPC) package, or purchase a Commercial Off The Shelf (COTS) solution. In addition, the software architects had to determine which middleware paradigm best fit their application requirements. After reviewing several COTS middleware solutions, they determined that the data-centric publish/subscribe model was optimal for Sea SLICE. After several product evaluations, Lockheed Martin chose to employ RTI Data Distribution Service (formerly NDDS) middleware product. Lockheed Martin then

leveraged the three-day Quick-Start, provided by RTI's professional services group, to quickly traverse the learning curve. As a result, the design team was able to quickly enable data-centric communication between their Windows and VxWorks onboard computing elements. This helped to reduce the program risk by validating the system and software architecture early in the development cycle.

Advanced Platform Control System

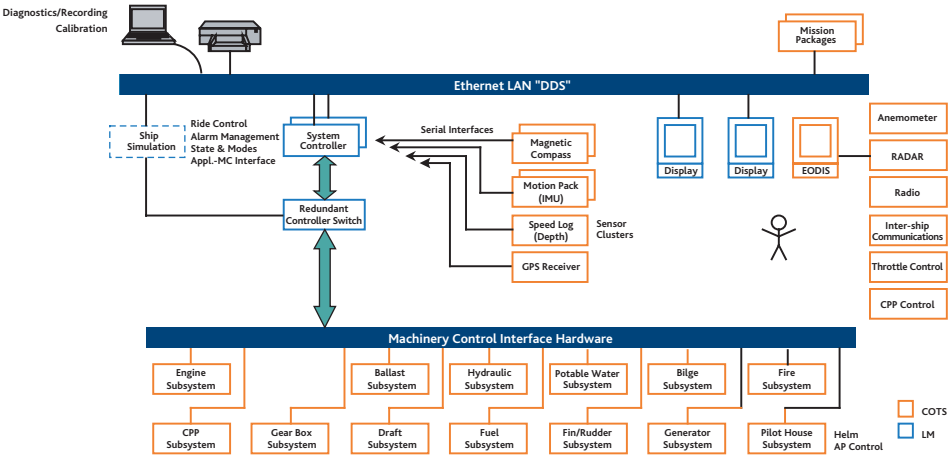
- Easy to learn and apply as compared with other COTS middleware products
- Supports open-scalable architectures
- Real-time support, multi-platform support
- Cost effective
- Supports redundancy and fault tolerance
- Support/Debug tools
- Easily integrated with Wind River's Tornado®/VxWorks and Microsoft Visual Studio®
- On-site Quick-Start training
- Great for rapid prototyping
- Reliable—thousands of hours of fault-free operation at sea

Low Latency, Real-Time Performance

In September 2003, the addition of the two degree-of-freedom rudder system significantly enhanced the control and maneuverability of the vessel. By employing RTI within the APCS, development engineers could painlessly join the network during sea trials via their laptops, subscribe to various published 'topics' of data, and graphically monitor the entire distributed system. In addition, when necessary, these newly joined nodes could publish data topics in order to stimulate the system to induce test conditions and control system behavior. In conjunction with RTI, Lockheed Martin also utilized RTI's graphical runtime tool (StethoScope®) to assist in tuning their distributed system. RTI, in concert with StethoScope, allowed the integration and test team to both monitor and fine-tune, at runtime, their embedded system for optimal performance.

Conclusion

Lockheed Martin's Advanced Hullform SLICE technology has been successfully demonstrated to solve real-world ship design challenges. Lockheed Martin chose RTI for their Distributed Control System inter-processor communications instead of choosing alternative middleware solutions, or designing/writing their own proprietary solution. RTI has provided the ability to quickly communicate, in real-time, between several computing nodes running heterogeneous operating systems. RTI provides a very stable real-time publish-subscribe solution that has provided thousands of hours of fault-free operation. This, coupled with RTI's auto-node-discovery feature, afforded Lockheed Martin engineers the flexibility to efficiently design, test, debug, and enhance their distributed system while at land or sea.



About RTI

RTI supplies middleware and distributed data management solutions for real-time systems. With innovative technology and deep expertise in distributed applications, RTI provides an unequaled competitive advantage to customers developing systems that benefit from high-performance access to time-critical data. RTI solutions have been deployed in a broad range of applications including command and control, intelligence, surveillance, data fusion, simulation, industrial control, air traffic control, railway management, roadway traffic monitoring and multimedia communications. Founded in 1991, RTI is privately held and headquartered in Sunnyvale, California.

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