ALSTOM Schilling Robotics Builds Complex Robotic Systems Using Real-Time Innovations Development Tools

Tools reduce project costs and simplify code management

ALSTOM Schilling Robotics (www.schilling.com) is the world leader in telerobotic technology. Their systems operate in the world's most difficult environments, from the crushing pressure of the ocean floor, to the high radiation of nuclear reactors, and the toxic atmosphere within waste facilities.

Schilling needs a reliable software framework: a critical fault in the software running these systems could result in the loss of very expensive equipment. At the same time, the software must be flexible and able to support rapid development across Schillings many product lines.

That’s why they chose the Real-Time Innovations (RTI) Constellation software platform with the NDDS distributed networking layer.

**CONSTELLATION ENABLES FAST AND RELIABLE CONTROL SYSTEM DEVELOPMENT**

Schilling used the Constellation software platform to develop and integrate the controls and communications for the robotic modules in the Titan 3 and Conan remote manipulator systems and the Quest Remotely Operated Vehicle (ROV). Using Constellation, the software engineers:

- Develop incrementally. Constellation scales well with project complexity. Schilling engineers break down complex systems into a hierarchy of interacting components. Each component is individually designed, developed and tested on a host system (well before the hardware is available). The components are then integrated into higher level components which in turn are tested and combined into even higher level components.

- Share designs and re-use code. Constellation's graphical "drawing board" provides a repository of re-usable modules and visual diagram editor. Engineers build components using graphic data flow and state chart representations and stores them in the repository. Any other engineer can pick up the diagrams, easily figure out what it does, and re-use it or modify it to suit their purposes. Over 60 percent of the code first developed for a sub-sea operations project controlling a dual Titan 3 arm system was reused in a nuclear waste cleanup project controlling boom-mounted dual Conan arms.

- Tailor to each customer's needs. Every customer has special requirements; modifications and re-designs are a fact of life. The engineers make changes at the diagram level. The Constellation framework generates the code and configures the run-time scheduling accordingly, reducing the labor costs from 30%-50%.

**RTI Consulting Services Provide Valuable Expertise Early in Project Cycle**

The RTI Professional Services Organization's worked with Schilling Robotics during critical phases of design, implementation, and new product testing. The PSO experts provide training product training and design analysis to make sure engineers are using the tools efficiently. PSO also provides programming talent. On several occasions, when Schilling needed additional support to meet their stringent delivery deadlines, PSO assisted Schilling in designing and implementing the software control subsystems.

"RTI consultants produce high quality designs and code that works 'right out of the box.' I like to bring them in very early in a project and take advantage of their expertise."
Constellation helped Schilling in other measurable and immeasurable ways:

- Concurrent development: Teams could work on different subsystems in parallel. Constellation manages the relationships between components in each subsystem, reducing the integration phase labor costs by 30%.
- Controls systems framework: Constellation is designed specifically for sensing and control applications.
- Documentation: Constellation automatically generates HTML documentation for all components.
- Debugging: The close integration between the Constellation framework and its debugging tools reduced the labor during test and debug by 50%.

Schilling's latest product is the Quest ROV. An underwater unmanned vehicle used for servicing, installation, exploration, salvage, and recovery operations. It runs from an all-electric propulsion system with an advanced network design to reduce the complexity of the cabling between the ROV and its support ship. Schilling used Constellation to develop its control software. Schilling added the Constellation real-time, publish-subscribe communications middleware, NDDS, to simplify ROV to ship communications in this project.

Schilling continues to use Constellation for upcoming projects. The engineers re-use the components developed for Titan, Conan and Quest, modify existing components to incorporate algorithm and hardware improvements, and add new components, all within Constellation's graphical diagram editor. The Constellation framework integrates new and old components, reducing rework and testing.

**Publish-Subscribe Provides a Flexible Networking Backbone**

The Constellation real-time publish-subscribe (RTPS) networking middleware ties together the distributed computing architectures Schilling uses for many of its advanced products. The middleware provides a common, communications API across a wide variety of processor architectures and operating systems and eliminates the network programming. This gives Schilling's engineers the flexibility to use different processors and operating systems and add new publishers and subscribers without modifying existing components.

Constellation End-to-End Tool Chain

The Constellation software platform provides a framework for the run-time modules and wide variety of ready-to-use components. In addition, it provides tools to help through all phases of application development:

- **Graphical editor**: Use the "drawing board" to build simple components to complete composite object groups combining sampled-data and event-driven processing.
- **Communications**: The WaveWorks middleware and tools simplify network programming and help debug and optimize distributed object communications.
- **ScopeTools**: Real-time, embedded applications make debugging hard; the ScopeTools provide real-time views into the application's operation, memory and process measurement and analysis to help you see what's happening when, and coverage analysis to make sure your tests are thorough.