REAGAN TEST SITE ADOPTS RADAR OPEN SYSTEMS ARCHITECTURE

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Introduction

The Reagan Test Site (RTS) on the Kwajalein Atoll in the Marshall Islands has a suite of high-power precision instrumentation radars spanning the frequency spectrum from very high frequency (VHF) to W-band—about 100 gigahertz. These radars were developed from the ground up using proprietary hardware and software architectures. Because each radar's architecture and technology was unique, these radars proved difficult and costly to maintain and upgrade.

Radar open systems architecture (ROSA) implements the open-systems (OS) model by breaking down a radar into functional building blocks that are constructed using commercial off-the-shelf (COTS) hardware whenever possible. This breakdown provides loosely coupled operational subsystem components that are tied together using well-defined interfaces that form a complete radar-processing and control system. Building blocks can be easily added or modified to allow new technology insertion with minimal impact on the other elements of the radar system. By using common building blocks on all its radars, RTS now realizes a great savings in maintenance labor and minimizes the cost of its radar spares.

OS hardware and software components conform to formal interface specifications that are fully defined, publicly available, and maintained according to group consensus. The OS focus on decomposition and interfaces maximizes flexibility in developing and maintaining a system. A common OS example is the personal computer, which provides standard interfaces for disk drives, graphic cards, and peripherals. Customers can replace or upgrade PC components from a competitive marketplace based on performance and cost, independent of a specific vendor.

COTS

Another important aspect of an OS approach is maximizing the use of COTS technology to benefit from a competitive market and to change quickly to newer, better, and lower-cost components. Developing custom components that adhere to standard open interfaces is perfectly acceptable within an open system where custom components are required. Proprietary COTS components with closed interfaces cannot be part of an open system.

How is the OS approach relevant to large defense systems? For years, DOD was the major driver of electronic components used in weapon systems, allowing DOD to synchronize the modification or fabrication of new systems with new components. In today's market-driven electronic world, DOD has little control over electronic components that evolve every 18 months. It is increasingly difficult to build and maintain DOD systems, which have 8- to 15-year cycle times.

To benefit from new technology and cost reductions, DOD systems must be designed to accommodate the fast evolution of the commercial market. The use of OS components is the solution to bridging DOD with the commercial market and building cost-effective systems that can evolve over a lifetime and adapt to new threats.

ROSA

The ROSA model breaks down a radar's processing and control architecture into individual, loosely coupled subsystems. Each subsystem performs specific radar functions and can run autonomously. When combined, these building-block subsystems form the entire processing and control architecture for a complete radar.

Radar systems have historically employed tightly integrated designs, custom hardware, and proprietary interfaces. ROSA replaces this with intelligent subsystems for each major radar component. These radar peripherals perform all interface functions between the main computer and low-level radar electronics. This configuration provides an important level of abstraction that makes the software within the main computer largely independent of the underlying hardware. The software thus becomes very portable from radar to radar.

Communications The Key

Communication between the subsystem components and the main computer is key to the success of ROSA architecture. Subsystems act as software objects that perform specific functions based on control messages. Specifically, a high-level control message is passed from the main computer to the subsystems using a single commercial network interface.

With every major control cycle, the main computer broadcasts a

The ARPA Long Range Tracking and Instrumentation Radar, or ALTAIR, is one of four highly sophisticated radar systems at the Reagan Test Site being modernized with COTS equipment and software.

control message to all the subsystems, and each subsystem reads the message and performs the requested function. In essence, each subsystem becomes an intelligent peripheral that provides a unique function driven by control messages.

In addition to simplifying design, ROSA systems show benefits in the test and evaluation stage. First, the radar interfaces of each subsystem can often be built using widely available commercial boards that have already been tested by the manufacturer and are supplied along with diagnostic software. As a result, testing can start at the subsystem level instead of the component level, drastically improving the development cycle of the subsystem.

Second, the distributed architecture in a ROSA system provides a clean mechanism for testing individual subsystem components prior to integration. By providing intelligence within the individual subsystems, test and evaluation can be completed using a modular approach. Modular testing is accomplished by allowing each subsystem to generate its own control messages. During radar development and testing, subsystems generate and drive their own control message. This modular testing provides a very efficient use of resources and allows all subsystems to be developed and tested in parallel.

An antenna control subsystem (ACS) is another good example of ROSA's applicability. The ACS receives high-level azimuth and elevation pointing commands from the main radar computer and then does everything else. The main computer need not know the underlying antenna electronics or the details of the servo loops. All required information is passed back and forth between the ACS and the main computer using high-level messages.

ROSA modularity also provides control over specific sections of the radar without requiring the complete system. The autonomous nature of the subsystems also provides distributed fault isolation: subsystems are responsible for isolating faults within their section of the radar. The ACS can move the antenna, for example, while the transmitter control subsystem can transmit pulses into a dummy load while running in "local" mode.

Conclusion

ROSA has been used successfully in modernizing the radars at the Reagan Test Site. Modular open systems architecture leads to improvements in time-to-market, cost, technology refresh, and commonality across radar systems.

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