EGLIN RADAR MODERNIZATION PROJECT

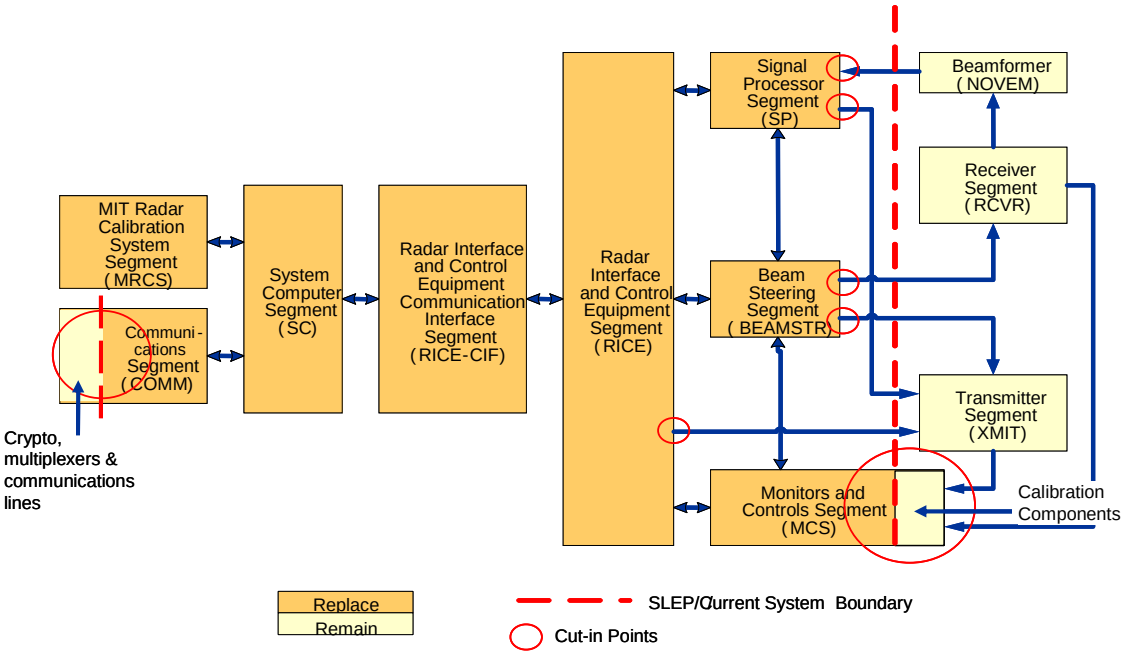
One of ITT Systems Division's trail-blazing and transformational initiatives is the Eglin Radar Modernization Project (known as Eglin SLEP) as part of the System Engineering and Sustainment Integrator (SENSOR) contract. The aim of this project is to design and implement a major modernization of the Eglin radar system and thereby realize a pivotal first-step in modernizing the entire portfolio of Space Control Sensors.

The immediate motivation for conducting this thorough-going modernization of the Eglin radar consists of 2 parts. First, the Eglin radar is an important contributor to Space Situation Awareness. The accuracy, sensitivity, coverage and bulk satellite-handling capacity of this radar make it a unique element of USSTRATCOM's space surveillance network. This dedicated space surveillance sensor collects metric and Space Object Identification data on both near Earth and deep-space objects. Some of the unique features and capabilities of this radar are: (1) by virtue of its sensitivity, this radar collects data on many small objects ; (2) by virtue of its geographic location and south looking face, it tracks numerous low inclination objects; (3) by virtue of its being the largest tracker of objects in the manned space flight regime, it makes important contributions to space shuttle missions and safe manned flight operations; and (4) by virtue of its high capacity it provides tracks on a large number of cataloged objects on a daily basis.

The second reason for modernizing the radar is that numerous mission-critical components will become unsupportable over the next few years. These include the mission critical command and control computers, signal processor, radar beam steering and radar control equipment. All of these problems can be traced to common sources: the age and obsolescence of the equipment, and the lack of sources of repair and spare parts. The magnitude of the sustainment challenges confronting this system are indicated by the fact that the Eglin radar entered service in 1967 and at that time it was the first large phased array radar built.

In order to keep this essential capability on line this project has been initiated and timed to reach fruition prior to the time when the sustainability of these components will impact system operations. The immediate objectives of the modernization project are to: (1) extend the serviceable life of the replaced components through 2028; (2) reduce operations and maintenance costs; and (3) create a system that facilitates future upgrades by incorporation of a modular, open-system architecture. The scope of the initiative includes replacing mission-critical computer resources and other equipment components, and re-engineering the software in a supportable language. Figure 1 shows the current system and its constituent segments, and also shows (via color coding) those legacy system segments that will be replaced in the modernized system as well as those that will be retained. Basically, everything but the transmitter and receiver segments and antenna faces, the beam forming segment, the communications lines, and select front-end communications equipment (e.g., cryptographic devices and multiplexers) will be replaced.

Figure 1. Scope of the Eglin Modernization



The transformative power of the Eglin Modernization project derives from information-age technologies that eschew monolithic architectures and enforce architectural layering. In this fashion, the commonality among sensors is stressed and the differences between sensors are confined to a "thin" layer near the hardware. As a result of this paradigm shift, the Eglin Modernization project will result in a number of artifacts, such as the system architecture, framework and subsystems, that can be reused in modernizing the entire suite of ground-based space control sensors. Such reuse not only reduces the cost, schedule and risk in modernizing other systems but also engenders network-wide life-cycle cost savings in the areas of training, operations, maintenance and sustainment.

The transformative nature of this project is further attested to by its potential effects on the broader SENSOR contract in two important areas. On the one hand, a successful Eglin Modernization will conceivable translate into a second revenue stream (a modernization stream) that will complement the current sustainment revenue steam. It is anticipated that a balanced program with comparable levels and constancy of funding in these two revenue streams will result. On the other hand, it is anticipated that a successful Eglin Modernization and gradual modernization of other sensors in the SENSOR portfolio will result in a transformation of the SENSOR program organization from a sensor-centric focus to a layer-or subsystem-centric focus. When the same subsystems are deployed at multiple sensor sites (even sites which employ disparate phenomenologies (radar & optical), technologies (phased array & mechanically steered) and missions (deep-space/near earth, cued/non-cued)) a single organizational entity will conceivably maintain that common subsystem for all sensors.

The Eglin Modernization Project has its origins in an initial endeavor launched in 2003 to research the methods and techniques for modernizing the aged Eglin radar system. This conceptual investigation and foundational research culminated in the establishment of this project in 2004 as SENSOR's first major acquisition program.

Since that modest start the Eglin Modernization project has grown from a handful of researchers and analysts to a current staff of 60 full time engineers, logisticians, programmers, technicians and testers. Moreover, the project has realized a number of major milestones and conducted highly successful reviews including a System Requirements Review in October 2004; a System Design Review in June 2005; and a recently completed Preliminary Design Review (June 2006). The breadth and depth of SENSOR's preliminary design coupled with an immensely successful software Pilot Program has convinced the entire community that SENSOR is doing all the right things and that this program is on track for success. All systems are "Go" for a Critical Design Review in 2007, followed by the building, testing, installation and provisioning of an operationally accepted system in 2011.

Technologies being pioneered on this project include application of an object-oriented (OO) systems engineering methodology, OO subsystem design and implementation, use of real-time Java as the operating system in the application layer of the architecture, use of a gigabit-Ethernet-based network architecture, blade servers for application software, and a fully programmable digital signal processor. In addition, the layered system architecture (Figure 2) draws inspiration from and improves upon Massachusetts Institute of Technology/ Lincoln Laboratory's (MIT/LL's) Radar Open System Architecture (ROSA) and incorporates best-of-the-breed features from other legacy radars such as the Cobra Dane embedded simulation capability. However, even in this latter instance, SENSOR's architecture ameliorates loading and measurement issues by hosting the simulation on a dedicated processor so that rigorous and realistic testing of subsystem functionality, capacity, timing and throughput margins can be established.

Figure 2 shows the layered Eglin modernized system architecture, the allocation of the 11 subsystems to layers, and the interfaces between layers, subsystems and external entities. The layers partition required functionality based on real-time processing demands, with the non-real-time functionality confined to the Enterprise Layer, modest real-time system functionality assigned to the Mission Layer, and hard-real-time functionality resident in the Control and Signal Processing (C&SP) Layer which interfaces directly with the legacy Eglin radar hardware. Further partitioning of layer functionality into subsystems was driven by the desire to architect a system with subsystems that were modular, open and that exhibited strong cohesion and loose coupling.

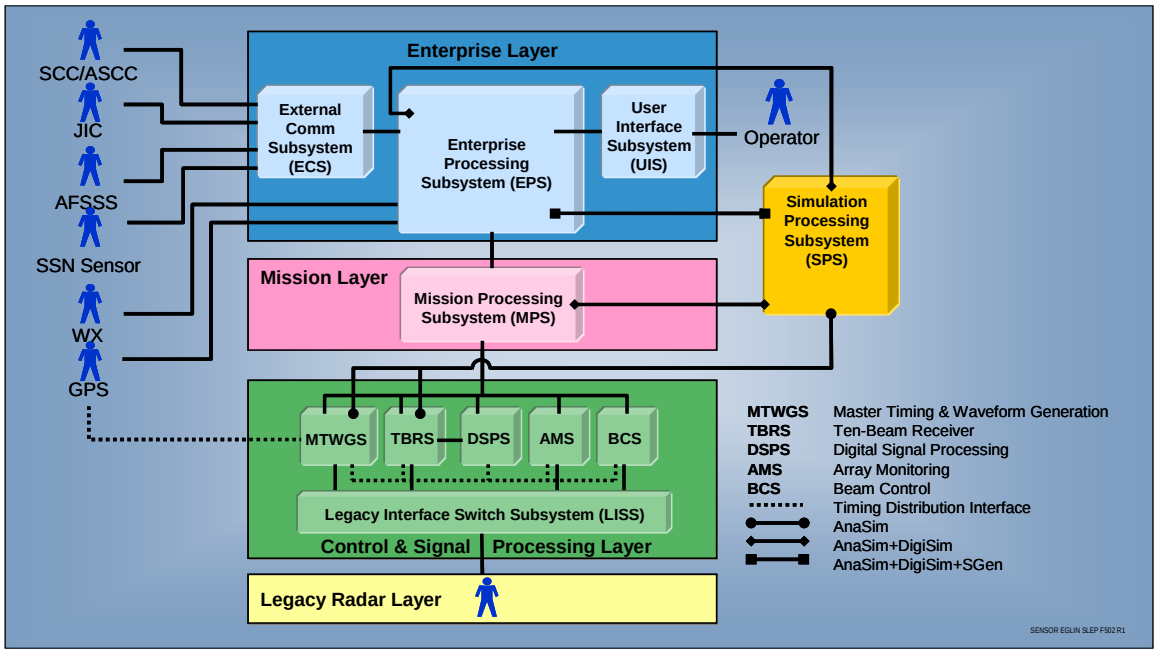


Figure 2. Eglin Modernization Architecture

Several key aspects of SENSOR's overarching approach to building and deploying this system are worthy of mention. First, SENSOR will implement the system in a series of four incremental builds (with sub-builds targeted for each major build) of increasing functionality and complexity. Incremental builds are a proven industry best practice to manage complexity and reduce integration risks. Another best practice that SENSOR has adopted is to deploy and test the system at site in a series of stages. Again, the aim is to reduce integration risk by early and frequent testing with the legacy radar equipment. A third major highlight of SENSOR's approach is to remain vigilant for opportunities to realize system performance improvements. Although the proximate goals of this effort, as previously discussed, are to address near-term sustainability shortfalls, and SENSOR's requirement is to maintain current radar performance, SENSOR is not designing a system to existing capabilities. That is, SENSOR will not reproduce a 50 year-old system on state-of-the-practice equipment, but will field a modernized system that modestly improves upon current system sensitivity, capacity and throughput. Fourth and finally, SENSOR will build and test the modernized system in the System Integration Laboratory residing in the Tenderfoot Facility in Colorado Springs. This facility will allow realistic testing of the system in the laboratory using closed-loop digital and analog simulation prior to deployment to the site. Thus, this laboratory will allow SENSOR to minimize the amount of site downtime required to test the modernized system.

Although a number of programmatic and technical challenges remain before victory can be proclaimed, SENSOR's Eglin Modernization Team is pleased with and proud of the modest victories achieved to date, and they are postured to move smartly forward with confidence and commitment on this trail-blazing and transformative project.

Note: L-3 Engineering and Technical Services provides Acquisition logistics, Type One training, Quality Assurance and development support to the Eglin Modernization Team.