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NEXRAD PRODUCT IMPROVEMENT - STATUS OF WSR-88D OPEN RADAR DATA ACQUISITION (ORDA) PROGRAM

Gregory S. Cate* and Roger W. Hall
Office of Science and Technology
Norman, OK 73069

Marvin L. Terry
RS Information Systems, Inc.
Norman, OK 73069

1. BACKGROUND

The Weather Surveillance Radar-1998 Doppler (WSR-88D) is one of the key underpinnings of the NWS Modernization effort begun more than a decade ago. The NEXRAD tri-agencies established the NEXRAD Product Improvement (NPI) Program shortly after the initial WSR-88D deployment. They recognized the need to update the system hardware and software to take advantage of new technologies (Saffle et al. 2002). The ultimate objective is to achieve performance goals of the user agencies, including those NWS objectives developed in response to the Government Performance Results Act (e.g. increase tornado warning leadtime, reduce false alarm rate and improve detection accuracy).

The Open Radar Product Generator (ORPG) was the first WSR-88D sub-component to be developed and successfully deployed under NPI. Even while the ORPG was still in development, the National Severe Storms Laboratory (NSSL) began efforts on a Proof-of Concept for the Open Radar Data Acquisition (ORDA) subsystem. NSSL demonstrated the Proof-of-Concept in May 2000, clearing the way for the initiation of the NPI ORDA Program. The NEXRAD Program Management Committee (NPMC) authorized a study of possible commercial alternatives in February 2002. In May of 2002, the NPMC accepted the recommendation to modify the ORDA Program approach to use the commercial SIGMET RVP8/RCP8 system. This paper describes the program organization, technical aspects of the SIGMET ORDA, and current program status.

[1]Corresponding author address: Gregory S. Cate, DOC/NOAA/NWS/OST1, 2227 W. Lindsey Street, Suite 1500, Norman, OK 73069; e-mail Gregory.S.Cate @noaa.gov

2. ORDA PROGRAM ORGANIZATION

The three agencies supporting NEXRAD are the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce, the Federal Aviation Administration (FAA) of the U.S. Department of Transportation, and the United States Air Force of the Department of Defense.

To create an orderly WSR-88D system evolution, the three NEXRAD agencies established the NPI Program as a long-term program to plan, manage, and execute major improvements to the WSR-88D system. The NPI Program began in fiscal year (FY) 1993 as part of the NEXRAD JSPO Product Improvement (PI) Program. NPI moved to the NWS Office of System Development (OSD) in FY 1994 and subsequently became the responsibility of the Office of Science and Technology (OS&T) in the NWS restructure.

The contract for ORDA was awarded to RSIS, Inc., a Commerce Information Technology Solutions (COMMITS) Contractor, in July 2001. OS&T Program Management and Project Engineering staff are collocated with RSIS in Norman to provide timely and consistent program and technical direction. Focusing ORDA Program activity in Norman provides the opportunity to team with subject matter experts at the Radar Operations Center (ROC) and NSSL.

3. ORDA TECHNICAL ASPECTS

Earlier conference papers summarized RDA functionality and the components of the RDA subsystem to be replaced by the ORDA Program (Zahrai et al. 2002). Figure 1 illustrates the RDA architecture and those components being replaced. A subtle but important characteristic of the ORDA Project using the SIGMET COTS solution is that the primary focus is on integration; design is performed in the context of the SIGMET system and is constrained by the legacy technical environment.

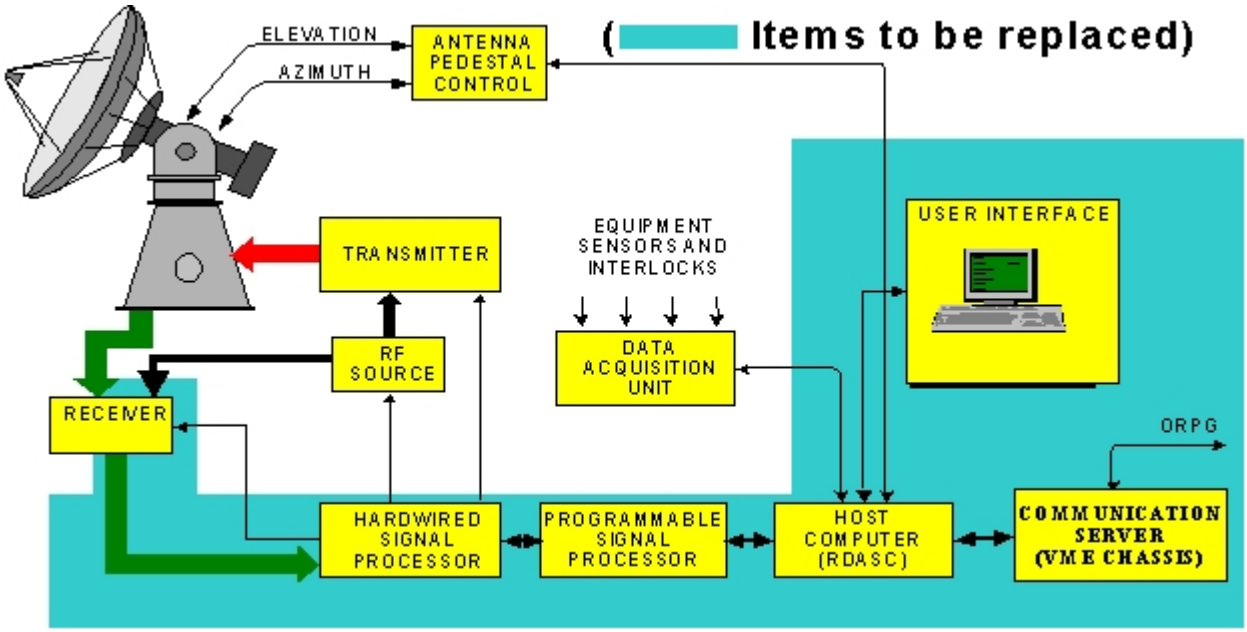

Figure 1 ORDA Component Replacement

The agencies can realize project savings because less design work is required, but some of these savings are offset by the effort to integrate a COTS product into the legacy operational system.

A significant change from the earlier proposed ORDA architecture is the inclusion of a digital receiver. The NPI Program had planned to replace the current analog receiver with a digital receiver as a part of a later integration project in the RDA (Dual Polarization). Supportability issues with the analog receiver, current receiver technology and immediate operations and maintenance cost drove the decision to proceed with a digital receiver. Inclusion of the digital receiver will simplify system calibration and reduce components, resulting in more consistent data quality and improved system reliability.

ORDA is composed of SIGMET's RVP8 Signal Processor/Digital Receiver, RCP8 Antenna/Radar Controller and Intermediate Frequency Digitizer (IFD). Both the Signal Processor and the Control Processor hardware use the same chassis, I/O card, and PCI-based single board computers (SBCs) with dual Pentium processors running the Linux operating system. Commercially-available processor technology make custom signal processor hardware and a real-time operating system unnecessary. RSIS is specifying commercially-available cables and simplified hardware interface panels. These steps will reduce the time required for installation, decrease the complexity of the installation, and make life-cycle support simpler and less expensive. This design also replaces the communications interface to the RPG with a communications server using TCP/IP, allowing the elimination of the outdated X.25 communications interface to the RPG.

The capability to infuse new science is an important requirement for ORDA. The SIGMET approach incorporates the Application Programing Interface (API), a collection of functions that defines an interface between SIGMET applications and user-developed applications. This API structure allows SIGMET to preserve their software baseline integrity and still provide flexibility in software development and maintenance. SIGMET's principal APIs are 1) the Interactive Radar Information System (IRIS) Antenna Driver and Built-In Test Equipment (BITE) API, supporting status, control and offline test customization, and 2) the RVP8 API, supporting the inclusion of user-developed signal processing algorithms.

An advantage of SIGMET software is it contains signal processing and control features that are targets for future RDA enhancements. These new features will be disabled in the initial deployment; the SIGMET implementation requires validation, and RPG and display software may require modification. However, SIGMET provides a roadmap, if not a solution for future RDA technical improvements.

RSIS is developing the operator interface application and will utilize the IRIS API. The Human-Computer Interface (HCI) will be a Java-based application, permitting rapid implementation of an interface for local and remote users. The new HCI will replace the current command line interface with a more graphical presentation, but retain similar terminology and functional performance.

Another key objective of the ORDA Project is to improve supportability and reliability. The new system will allow the elimination of 48 receiver and processor assemblies and 131 cables. Preliminary data indicates the new ORDA components are more reliable and less expensive than the components they replace.

4. PROGRAM STATUS

The initial technical focus was to quickly become familiar with the SIGMET signal processor and control processor. Hardware testing, vendor training, requirements analysis, and technical interchange meetings SIGMET have pursued integration efforts using SIGMET's precursor products, the RVP7 and RCP2. Many of the fundamental characteristics of these systems are the same, allowing integration pathfinding to occur. With the cooperation of the ROC, RSIS and SIGMET utilized an RDA testbed to explore integration and design issues. Because this testbed does not control a pedestal or radiate from an antenna (radiating into a dummy load instead) this pathfinding effort was necessarily constrained, but was sufficient to support significant progress. Over a five week period in June and July of 2002, RSIS and SIGMET installed and tested all lines to/from the radar, with the exception of RF test signal

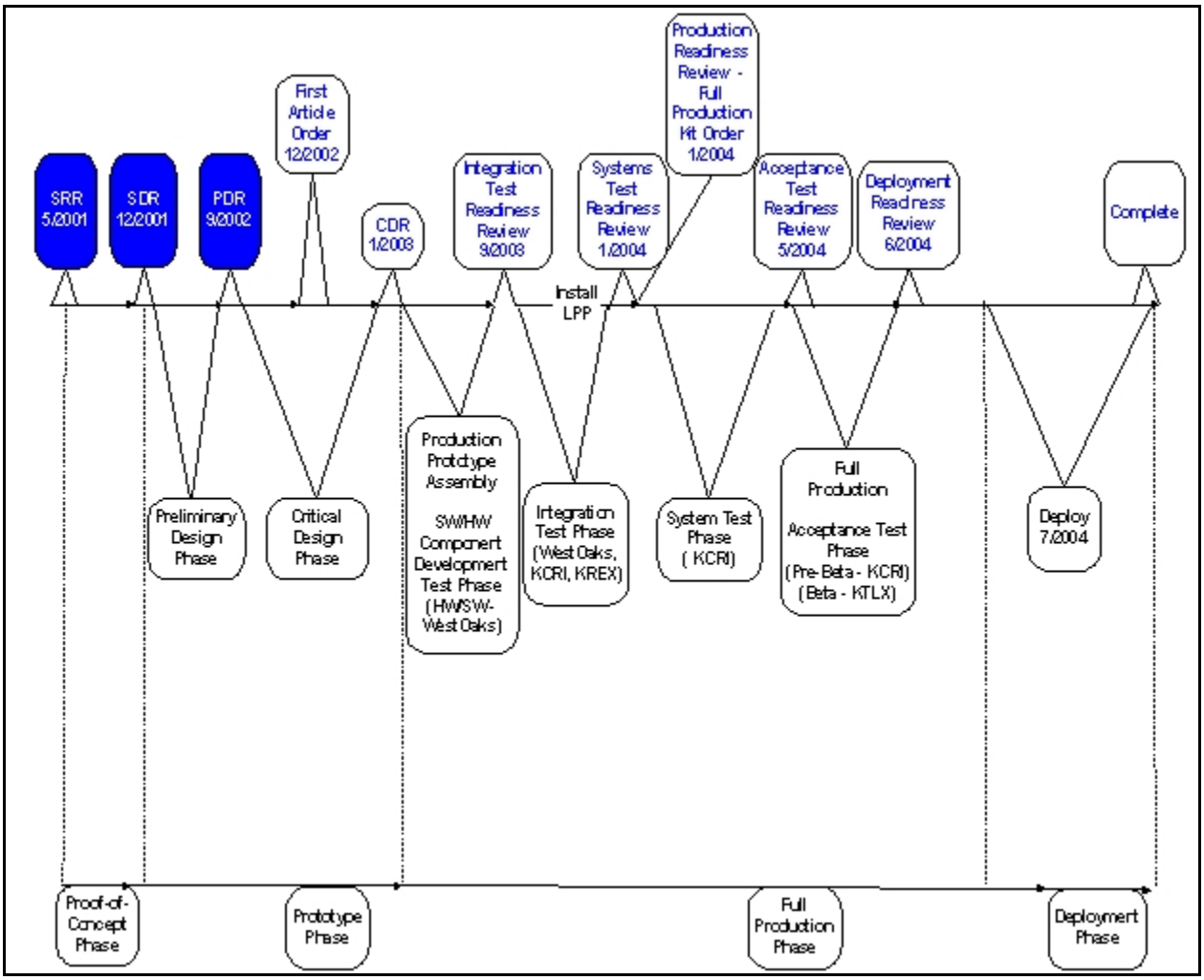

Figure 2 ORDA Program Schedule

became the order of the day. With the redirection to the SIGMET solution, the Government and the Contractor had to review and revise the plan for Program performance.

Pending the availability of SIGMET RVP8/RCP8 products (scheduled for December 2002), RSIS and pulse sampling. This effort included demonstration of such critical functions as transmitter control, Data Acquisition Unit and Data Control Unit communications. Because time on a radar is so important to the integration effort, we are working with the ROC and NSSL to develop options that will allow more access to a fully

operational WSR-88D.

Other activities key to the Program redirection include familiarization of ROC, RSIS, and OS&T's technical staff with SIGMET. This training equips the staff with the knowledge to accomplish the required development, integration, and better understand how SIGMET fulfills WSR-88D requirements.

Requirements traceability throughout the various phases of the program are central to validating the SIGMET ORDA is successfully integrated into the WSR-88D. Technical interchange meetings among subject-matter experts from SIGMET, RSIS, ROC and NSSL are regularly scheduled to ensure a common understanding of the performance of the legacy RDA, and how the ORDA will meet or exceed the level of legacy performance.

The Program redirection focused on integration of COTS equipment and software instead of development motivated a change to the Program phase structure (see Figure 2). Much of the required development and design activity have been subsumed under the prototype phase. (The Program is currently in the prototype phase, conducting a successful PDR in September 2002). Testing and production readiness activities occur in the full production phase, with the deployment phase scheduled to begin in the Summer of 2004. A prime objective is to deploy ORDA sub-systems to those sites most affected by the severe weather season by Spring 2005.

(Note: The views expressed are those of the author(s) and do not necessarily represent those of the National Weather Service.)

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