P1.26 **EVALUATION OF RADAR ARCHIVE LEVEL-III PRODUCTS**

Khien B. Nguyen*, Mary D. Buckingham, Jeffrey L. Fornear
National Weather Service, Silver Spring, Maryland

1. INTRODUCTION

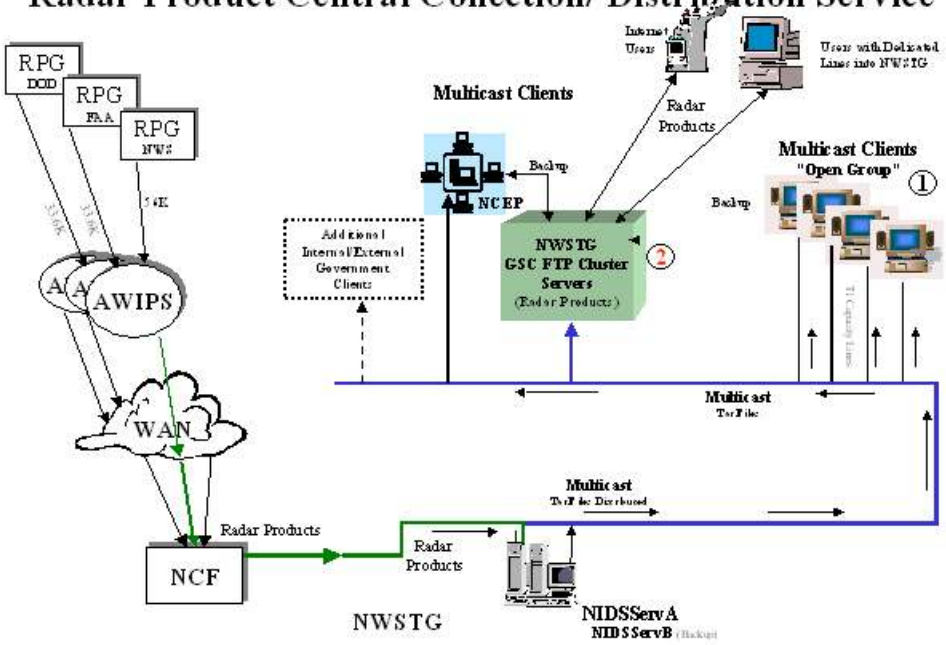
The National Weather Service(NWS) intends to use the existing Radar Product Central Collection /Distribution Service (RPCCDS) to deliver the Weather Surveillance Radar-Doppler 1988 (WSR-88D) Archive Level III products directly to the National Climatic Data Center (NCDC). These products are delivered to the NCDC on magnetic storage media, an expensive, time-consuming, and inefficient method. Using the RPCCDS to transmit these products to the NCDC will allow the NWS WSR-88D sites to discontinue shipping magnetic storage media to NCDC, thereby resulting in a more timely, efficient, and cost avoidance operation.

The impact of these new radar products on the Advanced Weather Interactive Processing System (AWIPS) Wide Area Network (WAN) and the current RPCCDS system must be determined prior to the official application of this new approach. The Product Availability Monitoring System (PAMS), developed by the NWS Office of Operational systems, was used to analyze the RPCCDS performance in the initial RPCCDS testing (Ref. 2. Buckingham and Nguyen, 2001) and deployment, and has been used continuously for two years to monitor the communications data flow. PAMS was again used to quantify the effect of the additional new radar products on the AWIPS WAN and the RPCCDS. The network performance over the last two years, prior to and after the inclusion of these new products, will be analyzed and presented in this paper.

2. RPCCDS OPERATIONS

The RPCCDS uses the AWIPS WAN frame relay communication network to deliver radar products from the WSR-88D Radar Product Generator (RPG) systems to the AWIPS sites, then transmits the products by the AWIPS WAN to the Network Control Facility (NCF) in Silver Spring, Maryland. From the NCF, radar products are transmitted to the radar servers, (i.e., the primary and back-up servers, NIDSServA and NIDSServB, collectively known as the NIDS Server) and to NOAAPort.

Figure 1
Radar Product Central Collection/ Distribution Service



The NIDS Server, located in the NWSTG, collects the products from all the sites into Unix "tar" files every ten seconds. The NIDS Server then sends the "tar file simultaneously to each user, including NCDC and an FTP Server collocated in the NWSTG, using "multicast" broadcast technology.

Figure 1 illustrates the data path for the radar products. There are two methods for distributing the radar products:

1. Multicast "Open Group"
2. Gateway Server Center (GSC) FTP Cluster Servers located in the NWSTG

* *Corresponding author address:* Khien B. Nguyen, National Weather Service, 1325 East-West Highway, Room 4390, Silver Spring, MD 20910;
email: Khien.Nguyen@noaa.gov

The views expressed herein are those of the authors and do not necessarily reflect the position of the National Weather Service.

Users can access WSR-88D products from the RPCCDS using Multicast "open group" technology. Multicast "open group" delivery requires users to register their connection with the NWSTG. The FTP server (item 2 above) allows anonymous FTP access to all the radar data by Internet or by any client who has a direct line to any of the circuits in the NWSTG.

The RPCCDS was implemented in January 2002, but collection of all Archive Level III products required more network and RPCCDS capability than was available at the time. With the introduction of the Open Radar Products Generator (ORPG) Build 5.2.1 and AWIPS Maintenance Release 5.2.1.1, there is sufficient capability to route all the Archive Level III products over an ORPG-AWIPS LAN connection to the AWIPS WAN and RPCCDS. The NCDC can then receive the entire Archive Level III products suite from the RPCCDS multicast server.

3. EVALUATION OBJECTIVES AND CRITERIA

The operational demonstration was designed to provide measurements and analysis of system performance of the WSR-88D products available on the RPCCDS and delivery of Archive Level III products to the NCDC. These data will be used by the NWS management in determining the system's effectiveness and suitability.

The principal objectives of the operational demonstration are to verify: 1) the availability and reliability of the broadcast of WSR-88D Archive Level III products to the NCDC, and 2) the timeliness of the RPCCDS while adding the Archive level III products.

Specifically, the success criteria for the demonstration are: The average availability (reliability) of the RPCCDS products are better than 95%, and 2) The average delivery time for the RPCCDS products to the FTP cluster servers is no more than 60 seconds.

The NCDC will monitor and log receipt of the Archive Level III products at their site.

4. EVALUATION METHODOLOGY

The demonstration began on June 05, 2002 and ended at the end of October, 2002. The Test and Evaluation Branch (OPS24), under the Field Systems Operations Center, monitored the reliability and timeliness of the RPCCDS products daily, using PAMS, for the entire demonstration period. The PAMS data were constructed for two phases:

1. Baseline RPCCDS data: Analyze the available historical RPCCDS prior to the introduction of the additional Archive Level III products to derive a bench mark for comparison with the data obtained after the introduction of the new Archive Level III products.

2. Archive Level III data: Collect and analyze RPCCDS data on a daily basis as radar sites began to release new Archive Level III products. PAMS continued monitoring data until all radar sites are activated and successfully transmitting these new products.

The NCDC monitored and logged receipt of the Archive Level III products at their site. Timeliness is not a significant factor in the NCDC's receipt of products, as the products are used for archival purpose and under the current system, take weeks to get there.

5. PAMS OVERVIEW

PAMS was developed by the Office of Operational Systems of the NWS to quantify the effectiveness of the AWIPS communication networks in delivering weather-related products from data sources to field sites, as well as from field sites to field sites. PAMS has been a powerful and indispensable aid in previous NWS communication system test and monitoring efforts, including the AWIPS Operational Test and Evaluation (Ref. 4. Nguyen and Buckingham 2001; 6. Nguyen and Facundo, 2000), AWIPS Commissioning (Ref. 3. Nguyen and Facundo, 2001), the Alphanumeric Backup System, Radar Product Central Collection/Distribution Service (RPCCDS) [Ref. 2.Buckingham and Nguyen, 2001; 4. Nguyen and Buckingham, 2001], and the AWIPS Linux Communications Processor Replacement Evaluation (Ref. 1. Nguyen and Buckingham).

The design of PAMS as well as the application of PAMS to various test and commissioning tasks were presented in four previous AMS Papers (Ref. 3. Nguyen and Facundo, 2001; 4. Nguyen and Buckingham, 2001; 5. Nguyen and Facundo, 2000; 6. Nguyen and Facundo, 2000). PAMS was redesigned in 2000 to increase its processing capability from a few hundred products to a million products a day from all AWIPS sites for the RPCCDS evaluation.

PAMS produces several reports daily, covering the previous 24-hour period. Together, they portray the product throughput in both a quantitative and qualitative manner. PAMS can detect invalid products, missing products, and delayed products, all in a timely manner. The reports can be combined to produce weekly, monthly, or yearly analyses of the NWS communication system performance. The information revealed by these reports is an invaluable asset in identifying future needed AWIPS enhancements. The PAMS Server generates these reports automatically at night so they are available early every morning.

6. DISCUSSION OF EVALUATION DATA

The PAMS data are shown in Table 1 and Figures 2, and 3. The right hand side of Table 1 (Existing Radar Products in the RPCCDS) shows the Archive Level III products already available in the current RPCCDS product suite. The left hand side of Table 1 (New Radar Products to the RPCCDS) shows the arrival of new Archive Level III products. For a given day, if a product group is available, the column associated with that product group is indicated by "1"; otherwise "0". The

complete table, containing entries for 120 radar sites are monitored daily to ensure each activated radar actually send out the required products, taking into consideration for seasonal weather patterns.

Figure 2 shows the reliability and timeliness of the RPCCDS prior to the introduction of the additional Archive Level III products. Note the seasonal variation in the number of products and the corresponding reliability and timeliness. It appears the timeliness proportionally increases with respect to the number of products, and the reliability proportional decreases.

Figure 3 shows the reliability and timeliness of the RPCCDS during the introduction of the additional Archive Level III products (Figure 2). The radar sites were activated gradually, about 10 per week. It was observed, during the Archive Level III product activation of each new radar groups, the RPCCDS communications network experienced some temporary degradation and subsequently stabilized at an acceptable level. It is believed the sudden release of a significant number of new products onto the system causes a finite-capacity channel to experience a transient queue buildup, requiring more time to empty and allow the throughput of these products to recover to acceptable levels. For this reason, the transient data were removed from the plot to project a steady-state level of performance.

7. CONCLUSION

The test and evaluation method used by the NWS to evaluate the Archive Level III products delivery using the RPCCDS has been described. The evaluation data to date were presented and discussed. Because the operational evaluation is still on-going at the publication of this paper, the complete evaluation will be presented at the conference. For now, the results are indeed promising. If this trend continues, the RPCCDS will be capable of delivering the new Archive Level III products as planned.

8. REFERENCES

1. Nguyen, Khien B. and Buckingham, Mary D., 2003. *The AWIPS Linux Communications Processor Replacement Test Results*, Paper 4.3, 19th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography and Hydrology

2. Buckingham, Mary D. and Nguyen Khien B., 2001, *Application of the Product Availability Monitoring System (PAMS) to the Radar Product Central Collection/Distribution Service (RPCCDS)*, Paper 1.8, 17th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography and Hydrology

3. Nguyen, Khien B. and Facundo, Joseph, 2001. *Product Availability Monitoring Systems Use During the AWIPS Commissioning Process*, Paper 12.2, 17th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography and Hydrology.

4. Nguyen, Khien B. and Buckingham, Mary D., 2001. *Recent Advances in Product Availability Monitoring System*, Paper 12.11, 17th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography and Hydrology.

5. Nguyen, Khien B. and Facundo, Joseph, 2000. *Product Availability Monitoring System An Indispensable Test and Evaluation Tool for AWIPS*, Paper 9.5, 16th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography and Hydrology

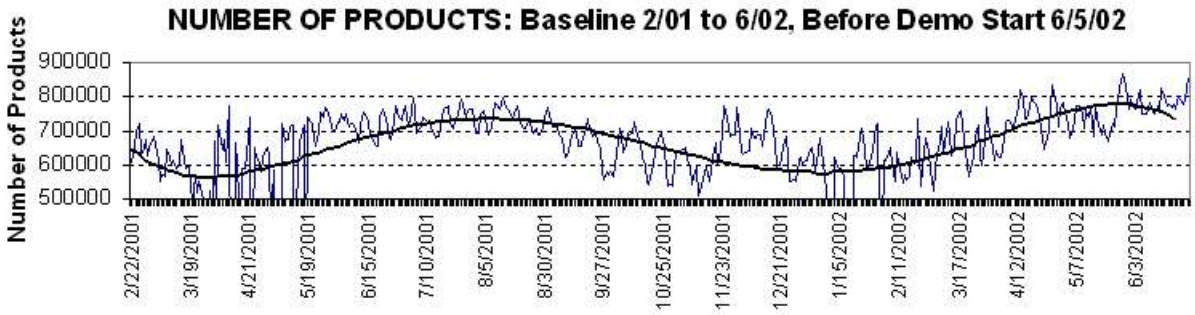
6. Nguyen, Khien B. and Facundo, Joseph, 2000. *Application of Products Availability Monitoring System To AWIPS OT&E Testing*, Paper 9.6, 16th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography and Hydrology.

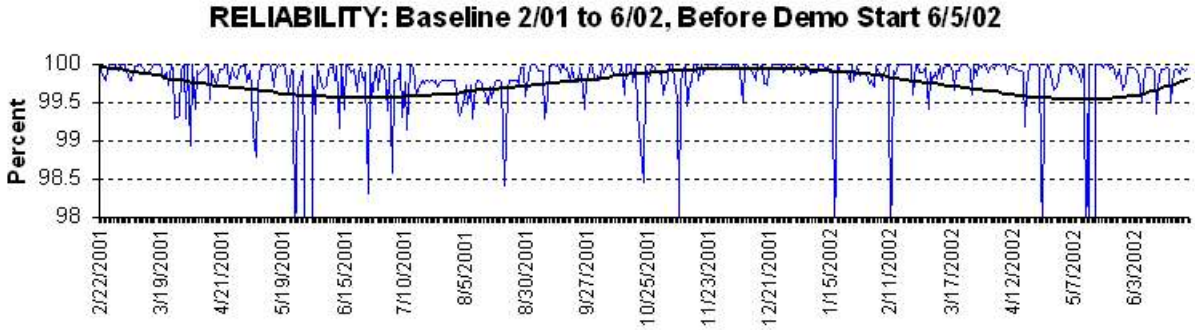
Table 1
One Day Sample of Activated Archive Level III Products

Radar Sites	New Radar Products to the RPCCDS												Existing Radar Products in the RPCCDS												
	IRM	**NCF**	**NHI**	**NME**	**NOW**	**NSP**	**NSS**	**NST**	**NSW**	**NTV**	**NWP**	**SPD**	**DPA**	**GSM**	**N1P**	**NCO**	**NCZ**	**NET**	**NOR**	**NOS**	**NOV**	**NOZ**	**NTP**	**NVL**	**NVW**	**RCM**
ABR	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	1	1	1	0	1	1	0	0	0	0	1	1	1	1
ABX	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	1	1	1	0	1	1	0	0	0	0	1	1	1	1
AKQ													1	1	1	0	1	1	0	0	0	0	1	1	1	1
BGM													1	1	1	1	1	1	0	0	0	0	1	1	1	1
---- etc. –-																										
UEX	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	1	1	1	0	1	1	0	0	0	0	1	1	1	1
VTX	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	1	1	1	0	1	1	0	0	0	0	1	1	1	1
YUX	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	1	1	1	0	1	1	0	0	0	0	1	1	1	1

Figure 2

RPCCDS HISTORICAL DATA





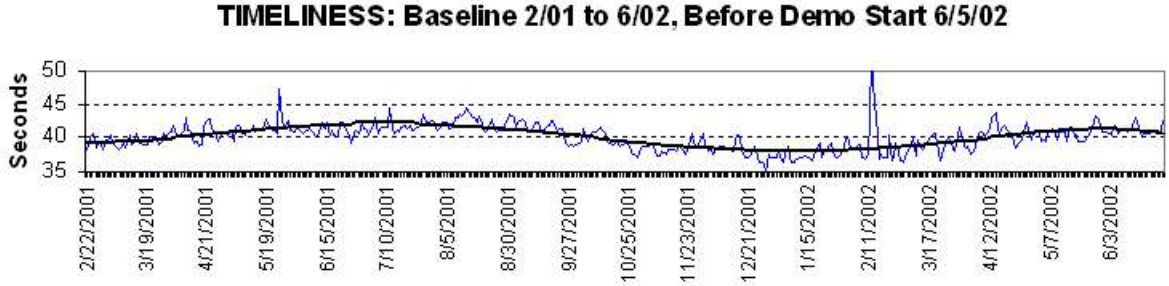


Figure 3

ARCHIVE LEVEL III DEMONSTRATION DATA