10.5 SBN Data Compression and Digital Video Broadcasting Test Results

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1. INTRODUCTION

The National Weather Service (NWS) recently completed an Operational Acceptance Test (OAT) on the use of satellite data compression and Digital Video Broadcasting (DVB-S) on the Advanced Weather Interactive Processing System (AWIPS) Satellite Broadcasting Network (SBN). This was part of a series of steps designed to increase the data sent on the SBN to the field sites. Necessary software changes were added to previous AWIPS releases as well as the Linux Operating System upgrades to the Communication Processors (CP) and the addition of the Pre-processors (PX) in preparation for this activity. The OAT involved 18 test sites and 3 additional control sites. In this OAT, the reliability and timeliness of products passing through the SBN communication network were assessed, and the impact of the new hardware in the system was monitored. The Product Availability Monitoring System (PAMS) was used to monitor roughly one million products per day flowing from the Network Control Facility (NCF) to each field site. This paper summarizes the results of the OAT and provides a performance comparison between the old and the new product transmission techniques.

2. EVALUATION OBJECTIVES

The AWIPS DVB-S must receive operational SBN products in a reliable and timely manner. The evaluation objectives were to verify:

a. The AWIPS DVB-S Installation Instructions allow site personnel to install the new DVB-S equipment, connect it to AWIPS, and configure the new system with a minimum of disruption to the site data flow and operations.

b. The AWIPS DVB-S operates reliably during routine operations in a 30-day demonstration at 18 sites.

c. The products and data throughput of the DVB-S demodulators are as fast or faster than from the existing demodulators.

d. The DVB-S can be switched to its backup configuration and support the site's data needs.

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3. EVALUATION METHODOLOGY

The OAT validated the installation and operational use of the AWIPS DVB-S at fourteen Weather Forecast Offices (WFO), three Rivers Forecast Centers (RFC), and the NEXRAD Operational Support Facility (OSFW), over a period of 30 days. The test sites were chosen to represent the characteristics of each region, the types of AWIPS sites, and were approximately 12% of all AWIPS sites.

The OAT consisted of installing the DVB-S demodulators and a line amplifier or a RFI filter if required at some sites, making software changes and data changes, performing a CP fail-over test, and enabling the PAMS data analysis to ensure no data were lost during the transition and during the entire demonstration period.

The preparatory steps in the data compression were successfully accomplished earlier in September, 2003. They involved combining the GOES-E and GOES-W satellite channels onto the single GOES-E channel to freeup the GOES-W channel, and addressing the CONUS sites which performed backup for the hurricane centers because the OCONUS satellite data were also moved to the NOAAPort 4th channel. The vacated GOES-W channel would be used to transmit additional products in the future. During the OAT, duplicated data stream from the existing NWS Telecommunication Gateway (NWS TG) channel was sent to the field sites simultaneously by both the GOES-E (TG1) and the vacated GOES-W (TG2) satellite channels.

The test sites received identical TG data streams from both the GOES-E and GOES-W satellite channels to test the communication loading, but only the TG1 channel data proceeded to the AWIPS Preprocessors (PXs) and Data Servers (DSs). This was to ensure duplicate data were not transferred to the site servers and data bases. When the test was successful, the extra data would cease and the NWS will proceed with implementing the DVB-S modification to send, in the future, additional products on the newly vacated GOES-W channel .

The performance evaluation relied on PAMS to analyze the availability and timeliness of products arriving at the CP, after passing through the demodulators. This was accomplished by collecting and analyzing the CP product logs from the test sites and the AWIPS Network Control Facility (NCF) on a daily basis.

The data throughput evaluation method can be summarized as follows:

1. For two weeks prior to the operational test, PAMS began monitoring the performance of the existing demodulators at the NHOW AWIPS system located

at the WSH. The data streams from the existing demodulators and the new DVB-S demodulators were compared. They were verified to be essentially the same. This was done in preparation for the DVB-S implementation at the 18 test sites.

2. During the test, PAMS monitored the performance of the DVB-S at the 18 test sites for one month. The results were also found to be essentially the same for the new DVB-S demodulators and the existing demodulators. They are summarized in Tables 1 and 2, at the end of this paper.

4. DAILY PAMS REPORTS

The 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, AWIPS Commissioning, the Alphanumeric Backup System, the Radar Product Central Collection/Distribution Service (RPCCDS), and the AWIPS Communication Processor Replacement.

The design of PAMS as well as the application of PAMS to various test and commissioning tasks were presented in several previous AMS Papers (among them were [1] Nguyen and Facundo, 2000; and [2] Nguyen and Buckingham, 2001). PAMS was redesigned in 2000 to increase its processing capability from a few hundred products to a million or more products a day from all AWIPS sites for the RPCCDS evaluation. The orders of magnitude increased capability make it an ideal tool to process and evaluate the large volumes of products flowing through the SBN CPs.

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.

5. DISCUSSION OF EVALUATION DATA

The data analysis showed little difference between the old TG1 data feed and the new TG2 data feed through the DVB-S hardware. In addition, there were no complaints from the sites' personnel and they could not tell if there was any difference after the new data feed was added to their sites. The new data feed did show a slight decrease in the success rate and products took slightly greater time to get to the sites in the worst cases. The data also showed on average a small increase in the number of retransmitted products. However, the differences were very small and well within the operational tolerances for the data delivery requirements.

6. CONCLUSION

The methods used by the NWS to evaluate the DVB-S performance during the OAT was described. The test ensured the new DVB-S can be installed at each AWIPS site in an orderly fashion and without problems. The OAT clearly demonstrated the potential for adding additional products to the sites via the new data compression technique, using existing satellites and new demodulators, without noticeable degradation to the sites' communications.

7. REFERENCES

1. 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.

2. 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.

Table 1

	TG2 from NCF to Sites					TG2 from NCF Retransmission to Sites				
	No. Of Products	Success Rate %	Std Dev %	Time (Minute)	Std Dev	No. Of Products	Success Rate %	Std Dev %	Time (Minute)	Std Dev
Average	935,005	99.99	0.05	0.043	0.032	652	96.83	2.174	6.131	0.487
Max	1,014,221	100	1.21	0.122	0.776	7958	100	20.55	29.01	7.301
Min	873,786	99.84	0	0.039	0.017	1	0	0	0.817	0

Table 2

	TG1 from NCF to Sites					TG1 from NCF Retransmission to Sites				
	No. Of Products	Success Rate %	Std Dev %	Time (Minute)	Std Dev	No. Of Products	Success Rate %	Std Dev %	Time (Minute)	Std Dev
Average	935,003	99.99	0	0.043	0.023	242	96.3	1.7	5.108	0.343
Max	1,014,221	100	1.2	0.047	0.029	8272	100	39	26.83	9.561
Min	873,786	99.86	0	0.039	0.019	1	0	0	0.883	0