4.3 THE AWIPS LINUX COMMUNICATIONS PROCESSOR REPLACEMENT TEST RESULTS

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1. INTRODUCTION

The existing Advanced Weather Interactive Processing System (AWIPS) hardware is now over six years old. As operational data volumes have increased, performance problems and throughput ceilings have been identified as important limiting factors. To address these problems, the NWS is investigating the use of open source Linux technology and high performance PC hardware. The first step in the AWIPS Linux PC migration was the successful Linux workstation augmentation during 2001. The second step in migration of AWIPS hardware to Linux PC-based equipment required hosting of the AWIPS Communications Processor (CP) software on a Linux PC-based platform. The Linux CP replacement provides a less expensive hardware platform and greater processing power and storage than the older Hewlett-Packard (HP) servers did. In addition, the HP servers will soon lose their contract maintenance.

The old HP servers had no storage capacity and consequently lost incoming data occasionally when the Data Server (DS) could not keep up with the product decoding tasks. In addition, AWIPS release upgrades usually required stopping the ingest and storage of products for a few hours which meant the site lost the incoming data permanently. The storage capacity on the Linux CPs allows buffering the incoming Satellite Broadcast Network (SBN) data for up to 12 hours. This feature allows an increased availability of the SBN data to each site and faster recovery of site operations following the downtime from software upgrades. Because of bottlenecks in the DS and increased products sent on the SBN, the Linux CPs were not expected to increase the speed at which the products were processed but were expected to deliver nearly all the products to the sites.

The National Weather Service (NWS) completed an Operational Acceptance Test (OAT) on the replacement of the current HP CPs with the Linux PC-based CP in the field during the Spring of 2002. The OAT involved 15 test sites and 5 additional control sites. During the test, the availability and timeliness of products passing through the CP were assessed and the impact of the new hardware in the system was monitored (Ref 3. Nguyen and Buckingham, 2002). The Product Availability Monitoring System (PAMS) was used to monitor the 700,000 - 900,000 products per day flowing through each new CP. This paper summarizes the results of the test.

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2. EVALUATION OBJECTIVES

The AWIPS Linux CP must provide timely throughput of products and data in the NWS operational environment. The evaluation objectives were:

a. Verify the AWIPS Linux CP Installation Instructions allow site personnel to uninstall the existing AWIPS SBN CP, install the new AWIPS Linux CP hardware, connect it to AWIPS and configure the new system with a minimum of disruption to the site data flow and operations.

b. Verify the AWIPS Linux CP operates reliably during routine operations in a 60-day demonstration at 15 sites.

c. Verify the AWIPS Linux CP product and data throughput are as fast or faster than the existing HP CP.

d. Verify the AWIPS Linux CP product and data throughput are as reliable as the existing HP CP.

e. Verify the AWIPS Linux CP can be switched to its backup configuration and support the site's data needs.

3. EVALUATION METHODOLOGY

The OAT validated the installation and operational use of the AWIPS Linux CP at nine weather Forecast Offices (WFOs), two River Forecast Centers (RFCs), one National Center for Environmental Prediction (NCEP), and three Regional Headquarters systems. They were chosen to represent the characteristics of each region, the types of AWIPS sites, and are approximately 10% of all AWIPS sites.

The Linux CP evaluation focused primarily on two aspects: 1) the removal of the existing SBN CP and installation of the new Linux SBN CP; and 2) the product and data throughput of the Linux CP compared to the existing SBN CP. A lesser emphasis was to ensure the replacement does not affect other aspects of the AWIPS system. Because the Linux CP replaces critical hardware and software in the AWIPS data stream, the installation was completed smoothly and quickly at each AWIPS site to prevent a large loss of data.

The evaluation began with a NWS regional headquarter's non-operational site installing the new

system using a draft AWIPS System Modification Note for guidance. The installation proceeded slowly at first to refine the Modification Note and to improve the installation procedures. Afterward, the installation went smoothly for the remaining sites, with few technical problems, and no significant impact to the sites. The HP CPs were pulled out of the racks but left operational during the entire hardware installation process until the cables were swapped to the new Linux CPs resulting in no impact on site operations and very little loss of data.

To ensure seamless operations at the test sites, a series of backup and switch-over tests were performed at each test site simulating CP failure scenarios. These verified the Linux CP backup function performed properly in the event of a Linux CP failure. The test sites were also asked to keep track of any system crashes or anomalies they might see during the evaluation.

The performance evaluation relied on PAMS to analyze the availability and timeliness of products arriving at the CP. 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 about 1 month prior to the operational test, PAMS began monitoring the performance of the existing CP at the 15 test sites to obtain baseline performance statistics. Subsequently, these sites were upgraded with the Linux CP for the evaluation.

2. During the test, PAMS monitored the performance of the Linux CP. These data were compared with the data obtained in Step 1 above.

3. PAMS also monitored the performance of the existing HP CPs on 5 non-test sites prior to and during the upgrade of the 15 test sites. This offered a direct comparison of the data throughput between the new Linux CP and the existing HP CPs using identical data streams.

4. DAILY PAMS REPORTS

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, and the Radar Product Central Collection/Distribution Service (RPCCDS).

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. 4. Nguyen and Facundo, 2001; 5. Nguyen and Buckingham, 2001; 6. Nguyen and Facundo, 2000; 7. 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. 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.

Table 1 is a sample report of the summary data for March 10, 2002. The report shows the availability and timeliness for product delivery from the NCF to the HP CP at the field sites for each day. Other detailed reports show availability and timeliness for each product group, for each hour, and for each site. Samples of these reports can be found in Ref. 1 and 5. The daily reports were combined to produce the summary data given in Tables 2 and 3.

5. DISCUSSION OF EVALUATION DATA

The PAMS data presented in Table 2 and Table 3 show the product availability of the Linux CP increased substantially over the existing HP CP from 99.04% to 99.94%, a savings of 71,132 products per day. The availability of GOES products increased from 99.41% to 99.92%.

The timeliness for NWSTG products is the same for both the Linux CP and the existing HP CP. The timeliness for GOES products is slightly degraded for the Linux CP but not significant enough to hinder service operations. In Table 3, Column 4, some of the Linux CP clocks were not properly set prior to 05/16/2002, causing an apparent performance drop for 05/10 - 05/13 and 05/16. These entries were excluded in the computation of the overall average.

6. CONCLUSION

The methods used by the NWS to evaluate the Linux CP performance during the OAT was described. The test ensured the new Linux CP can be installed in each AWIPS site in an orderly fashion and without problems. The PAMS data on the CP performance showed the product availability from the Linux CP is superior to the existing HP CP. The product timeliness with the Linux CP is about the same as with the HP CP. The evaluation data formed the basis for the NWS management to proceed with the Linux CP deployment

to all AWIPS sites.

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8. REFERENCES

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Table 1

SAMPLE AVAILABILITY AND TIMELINESS FOR PRODUCTS From NCF UPLINK to HP CP
Summary Baseline Data for March 10, 2002

SITE	NWSTG PRODUCTS			GOES PRODUCTS		
	Product Count	Success Rate (%)	Delivery Time (Minutes)	Product Count	Success Rate (%)	Delivery Time (Minutes)
KRF	799793	99.99	0.08	1514	100.00	0.10
DMX	799793	99.99	0.08	1514	100.00	0.10
LSX	799793	97.02	0.08	1514	100.00	0.10
ILN	799793	99.99	0.08	1514	100.00	0.10
BOX	799793	99.99	0.08	1514	100.00	0.10
EHU	799793	99.95	0.08	1514	100.00	0.10
TBW	799793	99.57	0.09	1514	100.00	0.10
LCH	799793	99.99	0.08	1514	100.00	0.10
PQR	799793	99.99	0.08	2167	100.00	0.97
PDT	799793	99.99	0.08	2167	100.00	0.97
VHW	799793	99.99	0.08	2167	100.00	0.97
AFC	799793	99.99	0.08	2167	100.00	0.97
HFO	799793	99.04	0.03	2167	99.70	0.92
GUM	799793	96.10	0.08	2167	99.70	0.90
OUN	799793	99.93	0.06	1514	100.00	0.10
BIS	799793	99.93	0.06	1514	100.00	0.10
CHS	799793	99.93	0.06	1514	100.00	0.10
LZK	799793	99.93	0.06	1514	100.00	0.10
BOI	799793	99.93	0.06	2167	100.00	0.97
ACR	799793	99.93	0.06	2167	100.00	0.97
Average	**799793**	**99.56**	**0.07**	**1775**	**99.97**	**0.44**

Table 2
PRODUCT AVAILABILITY AND TIMELINESS
HP Communications Processor
Summary Baseline Data 03/01/02 to 03/31/02

N1 , N2 = Daily Product Count
P1 , P2 = Availability (%)
T1 , T2 = Timeliness (Minutes)

DATE	NWSTG PRODUCTS			GOES PRODUCTS		
	N1	P1	T1	N2	P2	T2
03/01	793693	99.81	0.05	1863	99.82	0.41
03/02	833980	99.65	0.05	1692	99.31	0.39
03/03	807368	99.60	0.04	1674	99.42	0.37
03/04	768265	99.50	0.05	1596	99.16	0.30
03/05	745966	96.76	0.03	1686	97.50	0.42
03/06	763386	99.40	0.04	1642	99.50	0.39
03/07	814112	98.64	0.14	1720	98.67	0.40
03/08	849228	92.12	0.05	1749	99.64	0.46
03/09	838391	99.38	0.10	1713	99.24	0.40
03/10	799793	99.56	0.07	1790	99.99	0.48
03/11	764955	99.77	0.04	1775	99.97	0.44
03/12	838833	99.69	0.09	1810	99.91	0.47
03/13	812696	99.40	0.04	1728	99.95	0.49
03/14	777185	97.32	0.06	1841	99.62	0.40
03/15	783601	99.80	0.04	1711	99.87	0.45
03/16	843247	99.76	0.04	1716	99.99	0.43
03/17	846526	99.30	0.04	1745	97.58	0.45
03/18	867707	98.99	0.04	1687	98.72	0.37
03/19	846997	97.06	0.03	1788	99.98	0.47
03/19	846997	97.06	0.03	1788	99.98	0.47
03/20	847579	99.97	0.08	1743	99.74	0.49
03/21	783220	99.22	0.04	1752	99.30	0.46
03/22	724455	100.0	0.03	1743	100.0	0.44
03/23	724714	100.0	0.03	1723	99.82	0.41
03/24	747962	100.0	0.04	1747	100.0	0.47
03/25	807676	99.96	0.03	2020	100.0	0.49
03/26	833594	99.39	0.03	1955	99.51	0.55
03/27	759146	99.48	0.04	1777	99.33	0.44
03/28	330896	98.86	0.06	847	100.0	0.66
03/29	788447	99.92	0.04	1944	99.96	0.61
03/30	865324	100.0	0.04	1839	95.65	0.61
03/31	835584	99.92	0.04	1636	99.90	0.54
AVG	**790360**	**99.04**	**0.05**	**1732**	**99.41**	**0.46**

Table 3
PRODUCT AVAILABILITY AND TIMELINESS
Linux Communications Processor
Summary OAT Data 05/10/02 to 06/10/02

N1 , N2 = Daily Product Count
P1 , P2 = Availability(%)
T1 , T2 = Timeliness (Minutes)

DATE	NWSTG PRODUCTS			GOES PRODUCTS		
	N1	P1	T1	N2	P2	T2
05/10	842312	99.95	0.24	1871	99.54	1.31
05/11	886983	99.98	0.13	1945	100.0	0.73
05/12	891218	99.99	0.12	1928	99.99	0.73
05/13	895720	99.99	0.09	2108	99.99	0.79
05/14	819913	98.86	0.04	1861	98.74	0.66
05/15	822032	99.99	0.05	1856	99.96	0.67
05/16	863158	99.92	0.52	1830	99.94	1.11
05/17	901024	100.0	0.04	1814	100.0	0.64
05/18	870984	100.0	0.04	1825	100.0	0.63
05/19	829861	100.0	0.04	1823	100.0	0.63
05/20	845333	100.0	0.04	1823	99.99	0.61
05/21	847563	100.0	0.04	1819	99.82	0.61
05/22	810900	100.0	0.04	1855	100.0	0.61
05/23	826139	100.0	0.04	1857	99.98	0.60
05/24	835615	100.0	0.04	1929	99.99	0.63
05/25	846239	100.0	0.04	1893	99.99	0.64
05/26	875042	100.0	0.04	2057	100.0	0.73
05/27	820843	100.0	0.04	1980	100.0	0.68
05/28	975339	100.0	0.04	1890	100.0	0.68
05/29	953574	100.0	0.04	1833	100.0	0.64
05/30	922162	100.0	0.04	1956	100.0	0.68
05/31	884761	100.0	0.04	2006	100.0	0.69
06/01	899316	100.0	0.04	1907	100.0	0.66
06/02	889355	100.0	0.03	1836	100.0	0.64
06/03	891365	100.0	0.04	1844	99.97	0.63
06/04	900152	100.0	0.04	2011	100.0	0.72
06/05	933483	100.0	0.04	2100	100.0	0.72
06/06	865358	99.92	0.04	1794	99.67	0.64
06/07	860274	99.94	0.04	1983	99.98	0.54
06/08	866197	99.39	0.04	1993	99.99	0.59
06/09	889993	100.0	0.03	2049	100.0	0.61
06/10	661820	100.0	0.03	1257	100.0	0.49
AVG	**869500**	**99.94**	**0.05**	**1891**	**99.92**	**0.64**