PORTING THE AWIPS COMMUNICATIONS PROCESSOR TO LINUX

LeRoy Klet*
Litton/PRC, now a part of Northrop Grumman Information Technology (IT), McLean, Virginia

1. INTRODUCTION

The current Advanced Weather Interactive Processing System (AWIPS) Satellite Broadcast Network (SBN) Communications Processor (CP) was first deployed in the early 1990's and some of its major components will soon reach obsolescence. In addition, AWIPS data needs have increased since the initial system was deployed and additional data ingest capacity is now required. Therefore, there is a need to migrate the AWIPS CP functionality to a new more capable, yet cost effective hardware and software platform. An Intel microprocessor based PC server platform running the Linux Operating System (OS) is ideally suited for this task.

2. EXISTING AWIPS COMMUNICATIONS PROCESSOR SYSTEM

The existing AWIPS Communications Processor consists of a rack mounted VME system chassis that supports a Hewlett-Packard (HP) hp743rt PA-RISC based VME CPU card with 64 MB of memory and an intelligent VME serial I/O board configured for either 2 or 4 channels depending upon system requirements. There is no local disk and all of the CP software and log files are remotely accessed via a Network File System (NFS) mount to the site Data Server. All of the incoming data products are buffered in local memory and data can be lost due to network or Data Server problems. The operating system (OS) is the HP provided HP-RT real-time OS that is no longer being upgraded by the vendor.

3. LINUX COMMUNICATION PROCESSOR SOFTWARE AND HARDWARE CONFIGURATION

The Linux-based SBN CP is based on a standalone rack mounted Intel microprocessor based server with high performance and high availability local disk storage. The operating system will be based on the readily available Linux kernel version 2.2.16-x or later (i.e., RedHat 7.0 or later).

The prototype Linux SBN CP hardware is based on a Dell PowerEdge 2550 Server with a single 1 GHz Pentium III CPU, 256 MB RAM, 133 MHz system bus, 4 x 18 GB SCSI disk drives (hot-pluggable), hardware enabled RAID 5 disk configuration, 10/100/1000 BaseT onboard network interface, 3 PCI bus slots, and dual redundant 300 W power supplies. The server chassis is easily rack mounted in 2U (3.5") of vertical rack space. An SBE wanXL400 4-port PCI card provides the serial I/O connectivity.

* *Corresponding author address:* LeRoy Klet, Northrop Grumman Information Technology, McLean, VA 22102-0050; e-mail: klet_leroy@prc.com

The similarities between the HP-RT OS and the Linux OS allowed much of the existing SBN application software written entirely in C code to be easily ported to the new server platform. The Linux OS and ported application software are now capable of operating on a variety of similar hardware platforms so future systems are not limited to the above configuration.

4. SYSTEM ARCHITECTURE

The Linux SBN CP software functionality will include all features of the existing SBN CP in addition to a store and forward capability with data retention for up to 12 hours of SBN data.

The NOAAPORT broadcast, which provides the SBN data feed, consists of 3 T1 data streams and a 4th 1/2 T1 data stream. Most AWIPS field sites receive only 2 of the 4 data streams while OCONUS and national sites typically receive 3 and 4 streams, respectively. Each SBN data stream consists of a series of High Level Data Link Control (HDLC) frames that include sequencing and other product information in the broadcast headers. The body of each frame consists of up to 5,120 bytes of data. Software on the SBN CP reads and processes each incoming data frame before determining the disposition of the data. The major functions of the SBN CP software include the following:

- Product identification and logging
- Detect and log missing frames and/or products
- Product filtering based upon WMO headers
- Decompression of radar data
- Blank fill of missing imagery frames
- Request missing product retransmission
- Discard duplicate products
- Local store of data products
- Product distribution to multiple hosts
- Local replenishment of data

Data is distributed from the SBN CP across the LAN to one or more hosts via individual TCP/IP socket connections that provide reliable delivery regardless of network congestion or remote host processing degradation. Once the Linux Data Preprocessors are deployed at a site, the SBN CP will direct the applicable GRID and imagery products to the Data Preprocessor for decoding. Other SBN data products will continue to be directed to the site Data Server. Product disposition from the SBN CP is determined by local configuration files that identify separate disk based queues for each destination such that a failure or slowdown in one destination will not affect the data flow to others. Data flow and critical queue lengths can be monitored locally on the SBN CP via monitor and control utilities initiated by operator command and remotely from the central NCF via automated tools.

Also, with the large amount of available disk queue storage space, data destined for the Data Preprocessor or Data Server can be queued for hours during planned outages for hardware/software upgrades, as well as, for other unintended outages. However, this retention period for data is configurable by data group so that certain types of products can have a longer valid queue time than other data. Once a product in a waiting queue has exceeded its valid time limit, it is automatically removed from the distribution queue but retained on local disk storage. Additionally, if data needs to be recovered on the Data Server or Data Preprocessors, the SBN CP is capable of resending any of the previously received data up to the limitations of the local storage under manual operator control. This minimum retention period for data storage is 12 hours for a single SBN CP receiving all 4 channels of data at a full data rate.

Each AWIPS site will have two SBN CPs sharing the incoming data load with the ability to provide backup to each other in the event of a single CP failure as shown in Figure 1. Also because of the extended disk queuing capability of the SBN CP, a site will not lose any SBN data due to a limited duration Data Server failure, network problem, or planned site software upgrade. In addition, each AWIPS SBN CP is capable of generating automatic retransmission requests to the NCF via the terrestrial Wide Area Network (WAN) for any missing products. These retransmissions are rebroadcast from the central Network Control Facility (NCF) via the SBN as duplicate products that are discarded by all sites that received the valid data. Note that future versions of the AWIPS software may allow missing products to be received directly from the NCF via the WAN thereby conserving SBN bandwidth.

The Linux SBN CP is also capable of being configured as a standalone NOAAPORT Receive System on a non-AWIPS network. In this configuration the SBN CP will support transfer of data product via a variety of protocols, including FTP, NFS, and the TCP/IP socket based acquisition client/server from the SBN CP to one or more network accessible servers.

Currently, the Linux SBN CP is undergoing extensive stability testing in an operational hardware and software environment. All of the ported application software is fully functional and stable. A few problems that appear related to the Linux driver for the SBE I/O board under sustained input data error conditions have been isolated are being investigated. Possible solutions include an updated Linux driver module and other error recovery improvements.

5. SUMMARY

The Linux-based SBN CP will provide vastly expanded data handling capability relative to the existing hardware and software configuration. This additional capacity will allow the National Weather Service to broadcast additional products and higher resolution data products to all AWIPS field sites with greater reliability and availability.

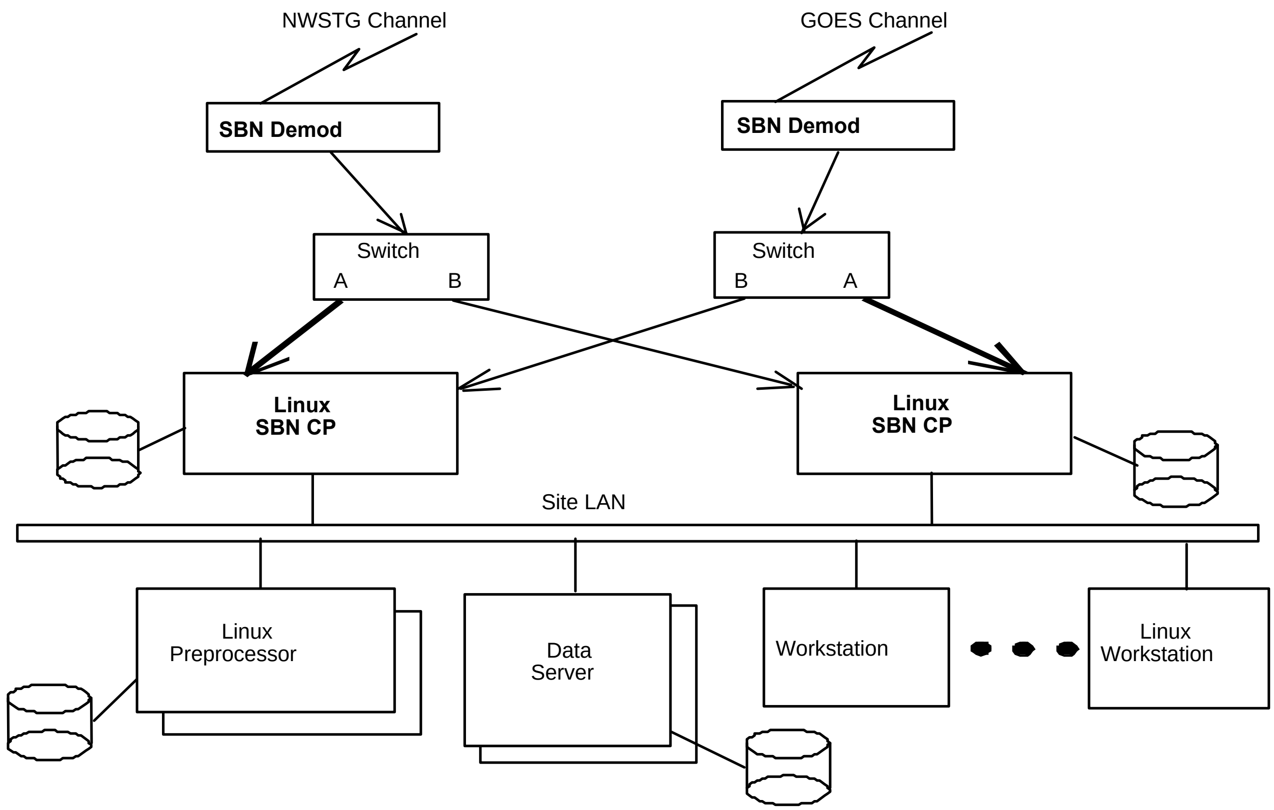

Figure 1. SBN CP Site Data Flow