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A NETWORK MESSAGE FORWARDER FOR THE NEXRAD RPG

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1. INTRODUCTION

The NEXRAD Radar Data Acquisition processor (RDA) supplies base data (Level II), radar reflectivity factor, mean radial velocity, and spectrum width, in polar coordinates, to the Radar Product Generator (RPG) processor over a high-speed data link. Level II data are also archived on 8-mm tapes. Copies of these tapes are available to the public from the National Climate Data Center (NCDC) in Asheville, North Carolina. This method of distribution has been recognized as inefficient and expensive for several reasons. (Droegemeier et al. 2001).

The University of Oklahoma. UCAR, NSSL, and the University of Washington have established the Collaborative Radar Acquisition Field Test (CRAFT) project to demonstrate real-time transmission of Level II data. Using the NSSL Radar Interface and Data Distribution System (Jain and Rhue 1995), CRAFT has shown the feasibility of transmitting compressed Level II data over traditional media to the Internet. Although an excellent source of data for CRAFT demonstrations, the RIDDS system is scheduled for obsolescence in the near future.

The NEXRAD Product Improvement Program aims to increase function and efficiency with efforts such as the Open Systems Architecture (Saffe and Johnson, 1999). The Open Systems Radar Product Generator (ORPG) includes the Base Data Distribution System (BDDS) to distribute base data to up to four users. Project CRAFT is being expanded to demonstrate distribution capabilities using BDDS (Droegemeier et al. 2001). Unfortunately, the BDDS system is limited to only four ports.

Enterprise Electronics Corporation was awarded the contract to deliver a Doppler Weather Radar in Evansville, Indiana. This radar is to provide real-time base data (Level II) to a standard ORPG (Stagliano *et al.* 2003). In designing the interface from the radar processor to the ORPG, it was recognized that a more flexible interface to Level II data could be provided. Designated the Packet Forwarder (PF), this interface includes data compression capabilities and straightforward connections to many users employing available network components.

2. OPERATION

Communications between the RDA and the RPG utilizes a concept of messages organized in data blocks using unique identifiers and a fixed format. Control, data, and status are exchanged using a typical command-response style of communications.

The Packet Forwarder is a TCP/IP server. At startup a connection is established to the RDA client. This client runs on the RDA computer and accepts packets containing NEXRAD command messages, responding with packets containing Level II data and status (meta-data).

The ORPG also connects to the Packet Forwarder as a client. Messages from the ORPG client are retransmitted directly to the RDA client, and any messages received from the RDA are sent directly to the ORPG client. This establishes the link needed to run the radar, but because the Packet Forwarder compresses the data stream, there is a significant decrease in the bandwidth needed for this link. Exact figures on the amount of decrease are not available, but the CRAFT project has shown an average decrease in packet size of 1/12 using the same compression technique (Droegemeier *et al*. 2001).

The Packet Forwarder also accepts user clients. Any packets received from the RDA are rebroadcast to these clients. Since data from the RDA include all of the Level II data and status in near real-time, an efficient stream is provided to a large number of simultaneous users. No limit was placed on the number of users, but, of course, there is a practical limit that is a function of computer power and available bandwidth. Provision is made for slower clients by silently discarding packets when the output buffer becomes too large. A priority scheme is implemented that discards status before data and old data before new.

3. STATUS DISPLAY

A status display is included to allow at-a-glance monitoring of the Packet Forwarder. For the RDA client and the ORPG client the connection status and transfer rate is displayed for the RDA client, the ORPG client as well as the each user client. The status screen is updated each second, allowing an operator to monitor each connection. The IP address and, if available, host name of each user client are also displayed. The Packet Forwarder is designed to work without the status monitor or with more than one to allow monitoring at different workstations or over the Internet.

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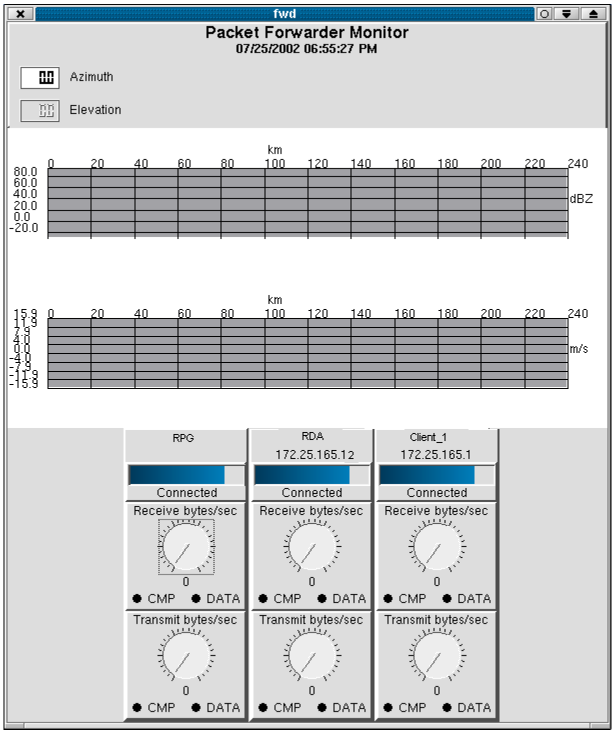

Figure 1, Status Screen

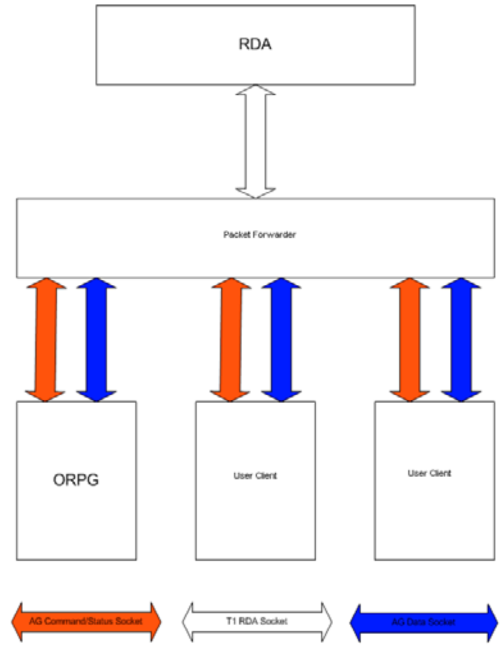

Figure 2, Block Diagram

4. DETAILS

PF begins by making a connection available on IP port used by the ORPG Atlas Gateway Device for communications to the RDA. The RDA server will connect to this port. PF then allows connections on the Atlas Gateway status and control port. The ORPG and any user clients will connect to this socket and issue connection commands for RDA port connections. Clients then may connect to the RDA data IP port. Only the ORPG will be allowed a connection that received commands to the RDA; other ports will only receive data from the RDA. As the PF receives and broadcasts data, statistics and status information are collected for display on the status screens, if any.

5. TESTS

PF was tested at the Enterprise Electronics Corporation engineering facility at Enterprise, Alabama, over a period of three weeks. An ORPG and OPUP were connected to a Linux PC. This PC was interfaced to an EEC ESP-7 signal processor and Radar Control Processor. A standard DWSR 2500C radar was installed on a 40-ft tower. The 100BaseT port normally connected to the Atlas Gateway device in the ORPG was instead connected to a hub on the same network as the Linux PC. No other changes to the standard ORPG/OPUP configuration were made.

A software simulator was written that provided several identifiable patterns, including the infamous “bulls-eye” pattern. This pattern could be inserted instead of data from the radar at times when it was not possible to radiate at the test site. This allowed uninterrupted operation during times that EEC was testing other C-band radars.

A simple application that connected to PF, displayed a real-time plot of the radar data and kept a count of missing data was developed. This application was run on another Linux PC on the same network and on a Windows PC located elsewhere on the WAN. These computers acted as user clients in the test.

During the test, the ORPG was commanded to execute various VCP scans and archive the Level III data. The OPUP was left running with the standard configuration.

The only operator interventions in the test were the occasional switching back-and-forth from the simulator and one inadvertent reboot of the Windows PC. Examination of the Level III archive at the ORPG showed no missing volumes during the test period. The Linux PC showed no lost data, and the Windows® computer missed only the data during the period it was restarted.

6. SUMMARY

The PF program shows the feasibility of distributing compressed base data at the point that the ORPG connects to the RDA. A design using existing protocols and ports can be implemented and will operate without configuration changes to the ORPG or OPUP. A status screen can be employed to allow easy monitoring of network connections to the program. Although more research is needed to determine the latency and other possible drawbacks of the scheme the operational test results were excellent.

7. REFERENCES

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