Transactions of the Korean Nuclear Society Autumn Meeting
Gyeongju, Korea, November 2-3, 2006

Development of the Kori Unit 2 PMS Network and Its Troubleshooting

See-Chae Jeong, Seung-Min Baek, Jeong-Kweon Lee, Hang-Bae Kim
Korea Power Engineering Company, Inc. (KOPEC)
scjeong@kopec.co.kr, smbaek@kopec.co.kr, jklee@kopec.co.kr, hbkim@kopec.co.kr

1. Introduction

The legacy Plant Monitoring System (PMS) of the Kori Unit 2 was dedicated to perform the basic process monitoring functions because of the limitations such as hard-wire based signal interfaces and centralized host architecture under the limited computational resource conditions. After 19 years of operation, this system was upgraded to the full scale PMS in Dec, 2002. The new system is a typical distributed monitoring system based on network subsystem so that the system performance is much dependent upon the network performance such as speed and throughput. After the system installation, the network system has been fine-tuned and optimized to enhance the network performance. As the result of three years of efforts, the network performance and reliability has been improved.

This paper summarizes the main concepts of network optimization including design approaches.

2. Network Design and Implementation

This section provides design information for network architecture and network management system applied to the Kori Unit 2 PMS.

2.1 Network Architecture

The PMS network architecture is based upon Ethernet switches and the TCP/IP protocol. The PMS servers which perform loggings, calculations and application program functions are connected via two-layered LAN. The lower layer subsystems performing data acquisitions are connected via Data Acquisition Network (DAN) with Unshielded Twist Pair (UTP) Cable or fiber Optic Cable. The upper layer subsystems having display and print functions are connected via Data Processing Network (DPN) with UTP Cable. The Figure 1 shows the Network Configuration for the Kori Unit 2 PMS.

The dual-switched Ethernet is applied to maintain the fault tolerance inherent in a channelized design. The acquisition data of each DAS is sent to computer servers via the two DAN switches connected in parallel for redundancy. The system will maintain full operational capability upon loss of either DAN switch. The DPN switches supply data communications to computer servers, printers, display stations and web server.

Ethernet switches provide segmentation of a network reducing the amount of traffic in a particular collision domain. 100Base-FX Ethernet switch is used for each remote DAS. Each switch acts as a local collision domain that improves overall network throughput as packet collisions, which occur in each local collision domain, do not propagate to the overall network and impact overall network throughput.

The PMS network was designed to support channelized independence, accommodate single failure within the network system, and meet the response time requirements between the computer servers and the DAS.

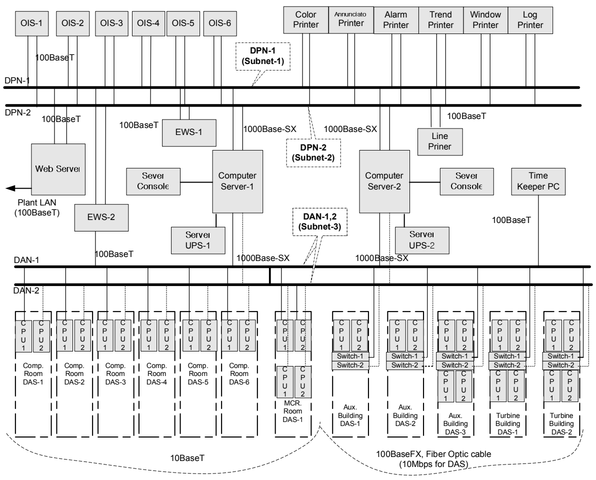

Figure 1. Network Configuration for Kori Unit 2 PMS

2.2 Network Management System (NMS)

The NMS is provided to manage the configuration, fault, performance, and security for network system. The NMS reduces the burden of the operator to maintain the overall network system operability at the Engineering Workstation.

The CiscoWorks software was used as a web based comprehensive network management tool for the Kori Unit 2 PMS network. It consists of Cisco View [1], WhatsUp Gold [2] and provides monitoring and configuration tools for administering network devices. The Cisco View enables to monitor the performance of different categories of information such as Ethernet collisions, management and physical. The WhatsUp Gold provides a mean to monitor devices through a topology map which allows network discovery, mapping and alarm tracking.

The Sniffer Investigator is a scaled-back version of Sniffer Pro [3] installed on a laptop computer. It was used as a network test tool to measure performance of the PMS network. All network traffic, including multicast packets, had been monitored using the port mirroring referred to as Switched Port Analyzer (SPAN). The SPAN mirrors or copies the traffic some or all of the ports on switch to the port to which the Sniffer Investigator is attached.

3. Troubleshooting Traffic for Network Optimization

After the installation of PMS at the Kori site, some troubleshooting has been performed for the purpose of fine-tuning and optimizing PMS network using the NMS and network test tools.

3.1 Fine-Tuning PMS Network

To improve network speed and reliability, the following tuning has been performed on the PMS network.

- Removed unnecessary protocol bindings from servers and clients (i.e. Routing protocols and Cisco proprietary protocols).
- Used the NMS to assess utilization on the DAN and DPN.
- Used the bumpless network failover technique at the application level.

3.2 Optimizing LAN Traffic with Network Test Tool

Some network performance degradations were found between server computers and DAS nodes in a few months later after power operation. The Sniffer Investigator was used to get packet capture, packet decode, application response time, current and trend statistics for system diagnostics. The Sniffer Expert System [3] detected the following symptoms:

- Fast Retransmission
- Too Many retransmission
- Acknowledge Too Long
- Idle Too Long

After evaluating the symptoms and using the computer system software, it was concluded that the above symptoms were resulted from an inadequate network response time implemented in the communication software between computer servers and DAS nodes. Time limitation in the software gave rise to the above symptoms. Adequate response time for PMS was decided by system testing and applied to the communication software. After optimizing the response time, the network system could be recovered and normally operated as shown in the Figure 2. The Figure 2 also shows that the unwanted packets such as errors, drops and collisions are not existed on the PMS network.

3.3 Ethernet Optimization

To minimize latency in Ethernet switches, the switches were configured to the cut-through mode. Then, an incoming data unit is routed directly to the output port without being buffered. The settings on port speed and duplex mode were manually configured based on actual characteristics of both the network ends to eliminate the abnormal operation due to the failure of autonegotiation mode between the network interfaces of different vendors. It was found that some local network switches were getting degraded in the first year after installation. That caused some "slow network" problems. After all, the low-performance local switches were replaced to reliable network switches.

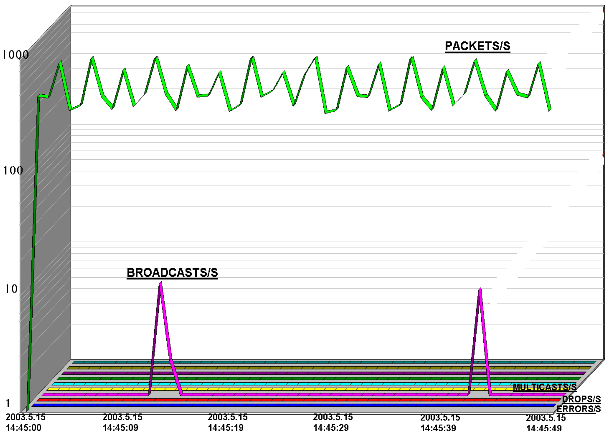

Figure 2. Traffic History for the DAN (Interval: 1Sec)

4. Conclusion

The switched Ethernet based the Kori Unit 2 PMS had been operated for about three years with the troubleshooting techniques including network fine-tuning, optimizing LAN traffic and Ethernet optimization. So far, the network system has been providing a highly reliable operation without any further network performance problem or failure.

It is believed that the reliable and optimized network system has been successfully settled in the Kori Unit 2 PMS.

REFERENCES

[1] Cisco Systems, Using CiscoWorks for Windows, Version 6.0, p.1-2, 2001.

[2] Ipswitch, WhatsUp Gold - User's Guide, Version 6.0, p.155, 2001.

[3] Robert J. Shimonski, Wally Eaton, Umer Khan and Yuri Gordienko, Sniffer Pro Network Optimization & Troubleshooting Handbook, Syngress, p. 48 & 188, 2002.

[4] Cisco Systems, Software Configuration Guide - Catalyst 4000 Family, Catalyst 2948G, and Catalyst 2980G Switches, Release 7.1, p.25-6, 2002.