A Survey of a Remote Diagnosis Center for Nuclear Power Plants

Yoo Rark Choi, Jae Cheol Lee, Jae Hee Kim
Korea Atomic Energy Research Institute, ISA Div., P.O.Box 105, Yuseong Daejeon, yrchoi@kaeri.re.kr

1. Introduction

Methodologies for remote diagnosis have been developed and applied to medical care and lots of industrial fields.

Modern science technologies such as a fast network, high computing power, sensing technology and advanced robot engineering make it possible to diagnose remote targets.

Nuclear power plant(NPP) has highly connected network enabling systems. The systems (accumulated data analysis systems, alarm systems, main control panel, NPP database systems and so on) are connected with each other through a network. But remote diagnosis researches for a NPP have been developed individually. Efficient monitoring power, convenient management and a cost-cutting of the diagnosis will be provided through integration of the remote diagnosis technologies.

The result of the integration can be represented as a remote diagnosis center. We propose an architecture of the remote diagnosis center for a NPP in this paper.

2. Consideration

We must consider several factors to build a reliable remote diagnosis center.

a. *data processing capacity :* Most of the remote diagnosis systems have a dilemma. It is a real time problem. Some acquisition data must be processed in almost a real time band. But some data doesn't have to be so.

b. *Convenient access :* Convenient methods for accessing the remote diagnosis systems and DBMSs must be provided to users. Various computer architectures and operating systems create many problems in a compatibility. There are communication problems among the computers connected with a network.

c. *handle the diagnosis system :* In the case of imported diagnosis systems, sometimes we can't handle the low level data stream. The worst case is that the system only provides some graphic displays and printings. If we can't handle the data, the system can't be a member of the remote diagnosis center.

There are two ways to process the acquisition data. One is processing the data beside the data acquisition system, the other is processing the data on a remote computer by transferring the data to it. But it is very difficult to transfer bulky data to a remote computer within a real time band.

Economic interface between user computers and remote diagnosis systems must be provided to access the data and control the systems. Java can be a good solution.

The imported systems used in a domestic NPP may be replaced with home manufactured systems in the future. But we must have a data analyzing skill.

3. Architecture and overview

3.1 Remote Diagnosis System Architecture

We have developed several remote inspection systems. We made a reactor wall inspection system and a guide tube split pin inspection system. Other laboratories have developed a loose part monitoring system, a cable health management system and a water quality management system.

We applied the system architecture as shown in Figure1 to some of these remote diagnosis systems.

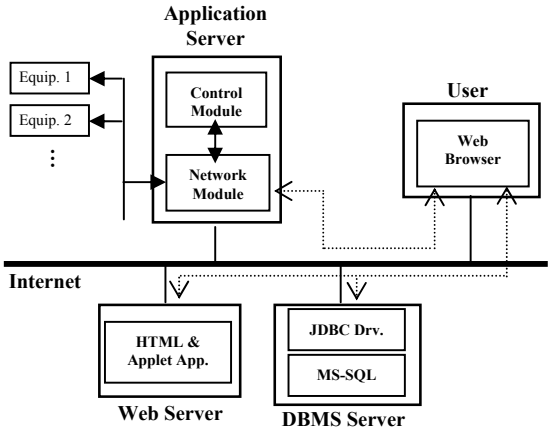

Figure 1. A Remote Diagnosis System Architecture

The application server consists of a control module and a network module. The network module communicates with a remote user's web browser interface that is downloaded from the web server and with the diagnosis equipment simultaneously. The commands transferred from a user's web browser are passed to the control

module. The control module interprets the commands and passes a set of inspection commands to the network module.

DBMS server is operated locally. Users can access the DBMS in the same way as a web-java.

This is the case of a remote diagnosis system. We use both the web-java and traditionally sophisticated techniques.

If we want to make a remote diagnosis center, many remote diagnosis systems must be integrated and managed in a particular architecture. After the integration, a remote diagnosis center for a NPP will be developed.

3.2 Remote Diagnosis Center

Generally, remote diagnosis systems adapt the client/server model. The architecture for the remote diagnosis center that we suggest also uses the client/server model.

This center may accommodate all the NPPs in Korea. It must have significant capacities of a data processing and generating a user interface. Distributed processing model can be an alternative way to increase the data processing capability. Web-java model is a very useful method for providing a user interface.

Suggested architecture for the remote diagnosis center adapts client/server model, the distributed processing model and the web-java model.

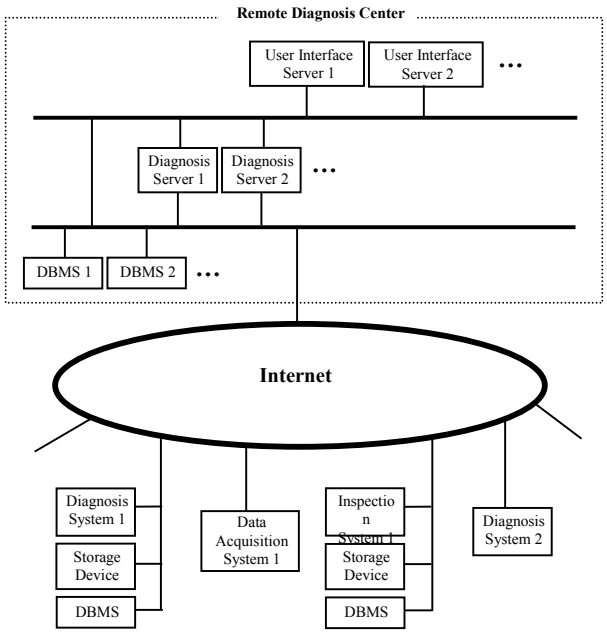

Figure 2. A Remote Diagnosis Center Architecture

Various kinds of remote systems are connected to a network. Some systems have DBMS and a storage device with a diagnosis(inspection) system. But some have only a diagnosis system. Each NPP will have these systems.

The remote diagnosis center provides a coupling of diagnosis servers for each remote diagnosis system that has only diagnosis and data acquisition system. It has multiple DBMSs and user interface servers for all the remote diagnosis systems.

Some remote systems in a NPP will have only data acquisition system and the data will be transferred to the diagnosis server in the remote diagnosis center. Diagnosis servers will be operated in distributed processing environment.

But some remote systems in NPP have their own diagnosis system, DBMS and storage device. These systems may produce bulky data. Though this system has its own DBMS, the corresponding dual DBMS can be operated in the remote diagnosis center. A data consistency is essential in this case.

The user interface servers provide control interfaces for the remote systems and database access methods. Interface facilities are stored in user interface servers. Sometimes diagnosis servers will produce particular interfaces. But user interface servers will manage these interfaces, too.

4. Conclusion

We described some considerations for the remote diagnosis center of a NPP and suggest a conceptual architecture based on remote the inspection systems we developed in this paper,.

Remote diagnosis techniques have been applied to many industry fields. But they are unfamiliar with nuclear energy, even though many researches have been executed. This problem may be a critical factor.

Various researches for a remote inspection and diagnosis must be executed systematically and cooperatively to construct a remote diagnosis center

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