# Introduction of the Intranet Portal System for Analysis

Mitsuyoshi Ejiri,
Taikai Mise,
Hiroki Sakamoto,
Katsushige Takatsu

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**Abstract**

**Technologies of simulation-based analyses are indispensable in product development. Since analysis models like those of a cooling design for large generators are becoming large scale, we introduced a high performance parallel computer. We also introduced a highly efficient computation system and analysis data management system.**

**The computer nodes are composed mainly of a pre-post node that processes computation results after establishing an analysis model and a computation node that performs parallel computing. The system as a whole is composed of a remote graphic server for pre-post processing via the Web, an Internet portal system that manages computational work, and a data management system that manages analysis data.**

**Our company is the industry's first in introducing such an Internet Web system for analysis in Japan. Going forward, we would like to increase such applicable products.**

## 1 Preface

As our business becomes more global, our customers demands likewise, have become more diverse and sophisticated. Especially overseas, our products are being used in various installation environments and operating conditions. It is, therefore, necessary to release our products meeting on-site requirements in a timely manner. To meet these requirements, it has become necessary to accelerate development speed and improve quality assurance. In order to realize a front loading design, we have been promoting Computer Aided Engineering (CAE) programs since the mid-1970s.

It is essential to adopt the CAE-based simulation system by using the finite element method for the development and designing of products. Such a method is needed to realize and continue developing advanced products. For this purpose, our Analytic Simulation and Material Evaluation Center at its Basic & Core Technology Research Laboratories aims to upgrade analysis technologies through education and information sharing. Our goal is also to upscale computing infrastructure to meet the ever increasing demands of data scale and volume. It also spreads the promotion of analysis applications

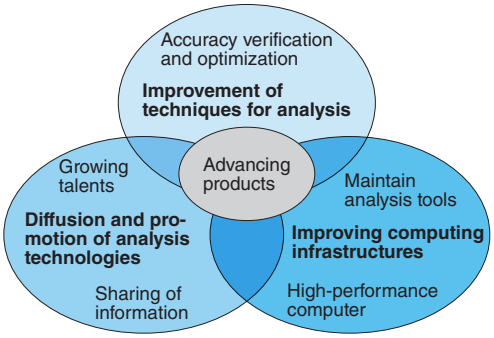



**Fig. 1** Policies for Analysis Technologies

Improvement of analysis techniques, taking actions for expanded scales, and the promotion of distribution are developed.

such as techniques for the verification of analysis accuracy and optimization technologies. Fig. 1 shows our policy for analysis technologies. In the field of analysis technologies, we are promoting the research of structural analysis, thermal fluid analysis, electromagnetic field analysis, circuit analysis, and material design. Table 1 shows examples of our application. In the cooling design in particular, it became vital to predict the cooling performance of large generators and transformers by using analysis technologies. As such, the necessity for analysis

calculation has been increasing.

As a result of recent improvements of analysis tool software and computer performance, the standard for using analysis tools and how to manage such results is becoming an issue for many of our business units. In order to make an overall analysis, the models are becoming large. It prompted the need for parallel computing which uses multiple CPU cores at the same time. This paper introduces our newly introduced computer system that is capable of high parallel computing by using tens of cores or more. We also introduce a system that can manage the computers and efficient parallel computing. The system can manage constantly increasing analysis data.

**Table 1** Examples of Analysis Work

The following shows samples of analysis work.

| Technological field | Typical case |
|---|---|
| Structural analysis | Vibration of the inverter panel<br>Dynamometer rotor dynamics |
| Thermal fluid analysis | Generator cooling design<br>Transformer oil cooling design<br>Inverter panel cooling design<br>Bubble flow in water treatment tank |
| Electromagnetic field analysis | EV motor characteristics<br>Electric field in circuit breakers |
| Circuit analysis | Inverter noise |
| Design of materials | Strength characteristics of breaker electrodes |

## 2 Server Hardware for Analysis Computation

Fig. 2 shows the hardware configuration. The computer hardware for analysis computation introduced in 2013 is composed of portal server nodes, pre-post transaction nodes, parallel computing nodes (thermal fluid and structure), file server nodes, and data management server nodes.

The pre-post transaction node is equipped with a 256GB memory in order to deal with the large-scale model. They are equipped with three such node units so that multiple operators can use them simultaneously. The parallel computing node for structural analysis comes with a Solid-State Drive (SSD) so that eigenvalue analysis with many file I/O transactions can be carried out at a high speed. Generally speaking, since the effect of parallel computing can be easily produced, the parallel computing node for thermal fluid analysis is of the blade type so that many CPUs can be densely incorporated. Since each node is connected through the Infiniband FDR (Fourteen Data Rate), there is no performance decrement even in the case of cluster type parallel computation. The file server node is equipped with 10TB of memory connected through the fiber channel. Common access is possible from each node via the Network File System (NFS).

In 2015, a fluid parallel computing node with 768 cores and three units of pre-post transaction

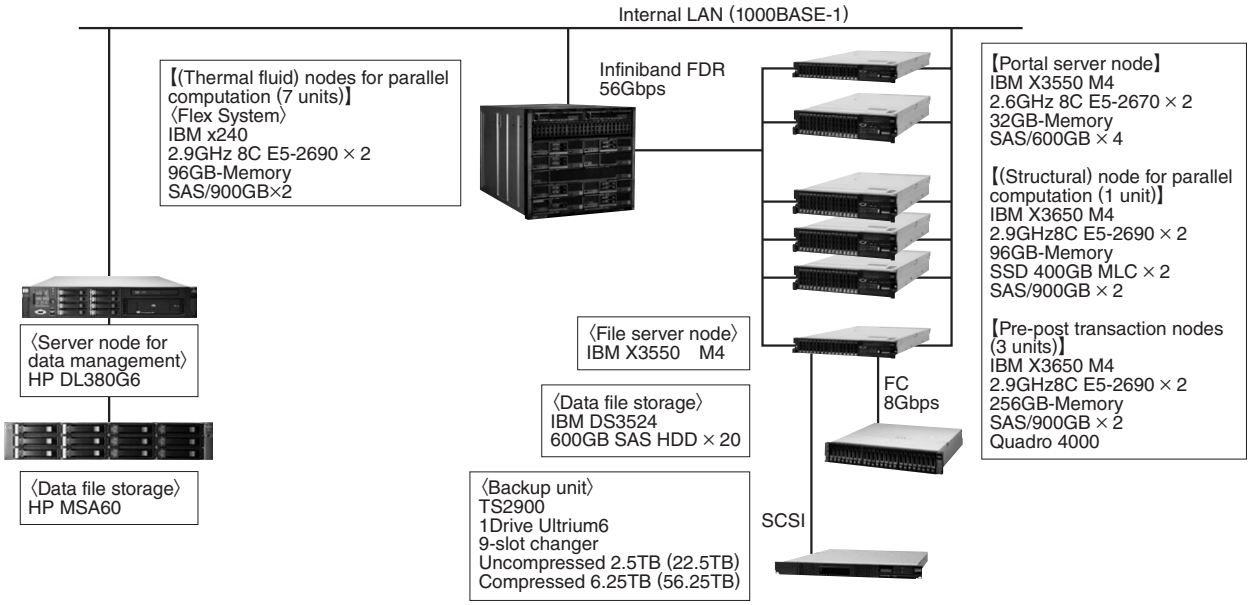



**Fig. 2** Hardware Configuration

Hardware of the Intranet portal system for analysis is composed mainly of the portal server, pre-post nodes, computation nodes, file server, and data management server.

nodes, each equipped with a 512GB memory, were additionally installed.

## 3 Intranet Portal System for Analysis

Software for the Intranet portal system for analysis to manage parallel computing in the newly introduced computer system is composed of the portal server (EngineFrame), job management system (Univa Grid Engine), remote graphic server (DCV), license management tool (License Orchestrator), and various analysis tool software (ANSYS Workbench, Fluent, CFX, Icepak). **Fig. 3** shows the software configuration.

The portal server works via a Web browser as it can enter an analysis job, check the job list, and also the working status of computation nodes. **Fig. 4** shows an image of an example screen of the Intranet portal system for analysis. To enter an analysis job, one has to select an analysis model file already configured by each Engineering Workstation (EWS) and specify the number of cores to be used. Using a remote graphic server, a screen of Graphical User Interface (GUI) is remotely displayed for the analysis tool software. It has interactive job functions which are pre-processing to produce an analysis model, the monitoring of computation, and conducting a series of analysis computation work for post processing of visualize the computation results. This facility is very useful due to its large-scale computation on the same level of operability of a normal EMS in using the analysis software.

The job management system checks the conditions of core availability and memory vacancy for each computation node and also confirms the license vacancy level of analysis tool software by using a license management tool. In so doing, it can decide the number of computation execution nodes and cores needed to set up the conditions of standby or to execute jobs. In this manner, jobs can continue be executed during a weekend or holiday so that these jobs are sequentially implemented and the result of the computation can be obtained on the following work day. Presently, the working range of analysis software for the Intranet portal system for analysis is limited to ANSYS structure analysis and thermal fluid analysis. It can, however, perform an electromagnetic field analysis individually, and separately. **Table 2** shows the applicable analysis tool

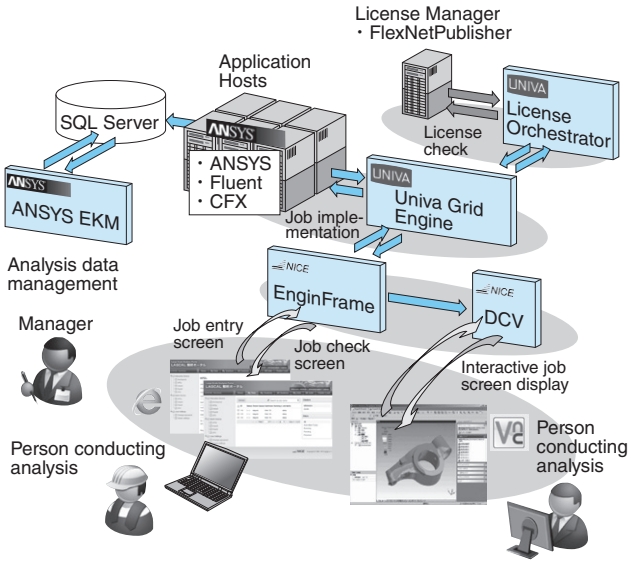



**Fig. 3** Software Configuration

Software of the Intranet portal system for analysis is composed mainly of the portal server, job management system, remote graphic server, various analysis software, and data management server.

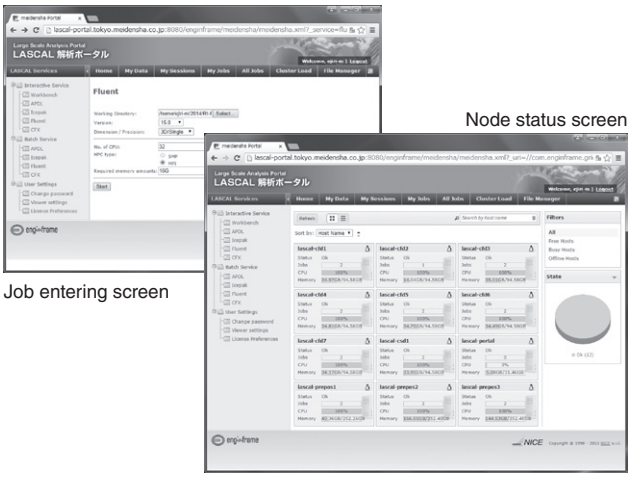


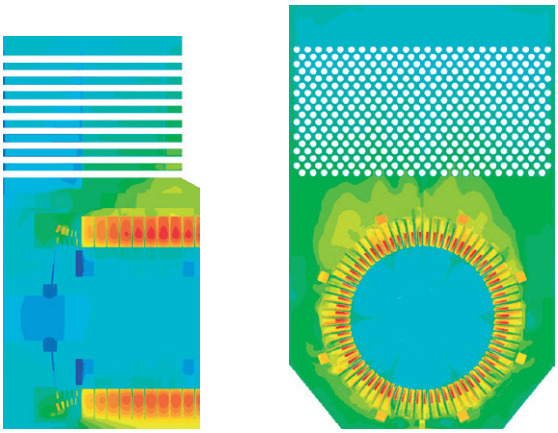

**Fig. 4** Example of Intranet Portal System for Analysis Screen

When an analysis job is entered, the operating status of the job or node can be confirmed.

**Table 2** Analysis Tools of the Intranet Portal System for Analysis

Analysis tools are shown. They check operation in the Intranet portal system for analysis.

| Technological field | Tool name | Vender name | Job management feature |
|---|---|---|---|
| Structural analysis | ANSYS | Cyber net system | ○ |
| Thermal fluid analysis | FLUENT | ANSYS Japan | ○ |
| | CFX | ANSYS Japan | ○ |
| | Icepak | ANSYS Japan | ○ |
| Magnetic field analysis | JMAG | JSOL | × |
| | HFSS | ANSYS Japan | × |



(a) Temperature distribution on the shaft cross section

(b) Temperature distribution on the center cross section

**Fig. 5** Example of Thermal Fluid Analysis for Large-Scale Generator

Thermal fluid analysis can be carried out for a large-scale generator model.

software of the Intranet portal system for analysis.

If the number of fluid analysis high parallel computing nodes is insufficient for thermal fluid analysis, pre-post nodes or parallel computing nodes for structural analysis are additionally used. In this manner, parallel computing for a maximum of 768 cores in parallel can be carried out in the current circumstances. Fig. 5 shows an example of thermal fluid analysis for a large-scale generator.

## 4 Data Management System

When analysis work can be performed easily, the number of analyses conducted increases and it becomes difficult to tell when and for what purpose such analysis works is conducted. For this reason, we introduced an analysis the data management system.

Fig. 6 shows an example screen of the data management system. The data management system (ANSYS EKM) checks the past analysis cases and performs a repeated similar analysis for the active reuse of analysis data. For the registration of analysis data, the analysis folder create function is used to make the property setup needed for data registration and the data are saved in the database together with image results. As a reference for documents it can store drawings or excel files with analysis conditions. Since analysis data generally come in large volumes, files are not directly stored in the database. These files are stored as link information.

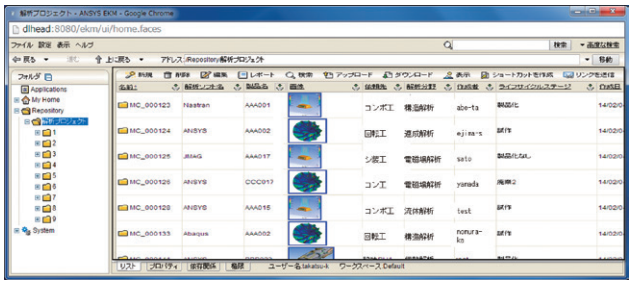


**Fig. 6** Example of Data Management System Screen

A folder is made for each case of analysis work case as it registers documents and data.

Information can then be used in a file server, is then registered, and the analysis data file in the designated file server becomes the only object to be stored. Any data analyzed in each PC other than the portal system can also be registered.

Attributes to be registered are the product classification, product name, our related business unit name, the person who conducted the analysis work, the analysis field, purpose of the analysis, and each explanation. Attributes can be confirmed based on the list of analysis data and by the search function in order to narrow down the analysis data to be displayed. When the access to past analysis data becomes fluid, these data can be utilized as a future design guide or be reused for the analysis of new material shapes. In addition, a present analysis result can be compared with the result of past analysis and the obtained knowledge can be reprocessed as the knowledge base.

## 5 Postscript

Presently, this system works mainly for thermal fluid analysis on large-scale generators. Practical level introduction of the job management system capable of interactive jobs and analysis data management system is Japan's first by our company. The functional and operational performance of the EWS feels as if it were a supercomputer. These are the systems that can be used with great ease.

These systems are facing issues of high availability and it is predicted that there will be a growing number of larger analysis models. We will upgrade the hardware for wider applications for our products.