

Batch Computing in Client/Server IT-Infrastructures using LSF and the MSC/Analysis Manager

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ABSTRACT

In typical CAE downsizing projects the functionality of Batch-Queueing systems existing on the old mainframe based architecture must be replaced with equivalent or better systems on the new client server based architectures.

Daimler Benz Aerospace Airbus has realized this with the integration of the MSC/Analysis Manager (P3/AM) and LSF (Load Sharing Facility).

LSF integrates all participating workstations to a "virtuell cluster". LSF measures a number of load indices, basis for the decision on which workstation a batch-job will be executed. P3/AM prepares the job data to be copied to the execution workstation and at the end of the job to be copied back to the submit workstation. During the runtime of a big CAE job no network traffic occurs. The CAE-user sees only "one" system and did not have to setup any OS-command to run a batch job on other machines than his own. The overall turn around time of CAE jobs can be dramatically reduced because the integration and accessibility of non or only light-loaded workstations.

P3/AM is the end-user tool for CAE batch submit and monitoring. Beside MSC/NASTRAN other standard CAE-applications (e. g. Marc, Emas, LS-Dyna) can be used with P3/AM, as well as self-developed Fortran based job chains. Not only on the user's own workstation but also on pure batch-servers without any interactive access. P3/AM is an easy to use and customizable graphical user I/F, therefore the development of GUI's (which is often done by companies running downsizing projects) can be minimized.

Daimler-Benz Aerospace Airbus (DASA Airbus), the German partner of the Airbus consortium of European aerospace companies, is responsible for the design of about one third of the sections of the Airbus aircrafts. The engineers work is based on the use of computers and application packages for structural analysis like MSC/NASTRAN in combination with MSC/PATRAN, as well as self developed tools. Computational Fluid Dynamics (CFD) analyses are undertaken with different commercial and proprietary codes. The MSC/NASTRAN derivate EMAS is used for some electromagnetics analyses.

As in most companies, DASA Airbus' engineers had accessed central IBM- mainframes in the past. For peak performance in the CFD area they still use external supercomputers like Crays, NECs and Fujitsus. The paradigms in data processing changed to client-server architectures and powerful workstation on the user's desk, to reduce the turn-around time of the jobs. DASA Airbus decided to install distributed workstation and server systems. They formed clusters of high-capacity Hewlett-Packard workstations as the standard engineering desktop. These HP machines are located at both the Bremen and Hamburg engineering centres with currently over 100 systems ranging from HP K-Series, over J220 and J200 servers to 700-series workstations in all colours. In the CAE-area 2 powerful IBM-RS6000/R24 batch servers were available at each of the two sites in addition to the desktop systems up to November 1997. These 2 will be replaced by some decentralized HP-Servers in the current months, to achieve a more or less homogenous Unix-environment.

(Note: in addition to DASA Airbus' CAE departements, the complete european Airbus Consortium has also made the decision to use as the standard CAD-workplace HP-Workstations with Computervisions CAD-System CADD5 and the PDM-System Optegra).

A main issue in DASA Airbus' downsizing project was, to migrate all MSC/NASTRAN and the self-developed CAE specific Fortran applications from IBM mainframe to decentral Unix-based workstations. MSC/NASTRAN was the driving factor for the decision to be made, because approx. 50% of the CAE mainframe load was caused by batch-jobs running with DASA Airbus' standardly used FEM-Solver.

This transition to UNIX systems normally requires a detailed in-depth knowledge and experiences in using such machines. As the engineers have to concentrate on their design work and not to spend too much time for data processing activities, tools are needed that free them from this unnecessary work. In an effort to replicate the easy-to-use, centralised environment on the mainframes, DASA Airbus looked for different tools:

- graphical user interface to easily produce and submit batch jobs
- automatic distribution of batch jobs and fair scheduling and queuing

DASA Airbus decided to install the MSC/Analysis Manager, developed by The MacNeal-Schwendler Corp., as a general CAE batch submitting tool. It is an easy to use graphical user interface (GUI) to submit and monitor typical CAE batch-jobs. Furtheron other program packages can easily be integrated. The MSC/Analysis Manager is used at DASA Airbus in two ways: fully integrated in MSC/PATRAN, as well as running as a standalone tool for batch-job submission.

LSF (Load Sharing Facility) from Platform Computing, Toronto - in Germany supported by science+computing from Tuebingen - serve as the batch queuing and load levelling system (or in new words workload management tool). As both tools interplay excellently, the user does not notice, when submitting jobs via the Analysis Manager that in the background LSF is distributing the jobs to the appropriate and free workstation.

The approach at DASA Airbus is as follows:

All kind of typical CAE-batch systems can be integrated in this GUI. Actually the MSC/Analysis Manager is used for MSC/NASTRAN, LS-Dyna3D, Marc, VSAERO, USAERO and self developed CAE programs. In addition DASA Airbus implemented a special feature in the MSC/Analysis Manager that allows users to compile, link and go each kind of Fortran 77 job even on a pure batch-server without interactive access to users. The GUI changes the outfit according to the application.

The engineer chooses his application with a click on the group button. The GUI presents him all the settings that are available for this program package. In the MSC/NASTRAN window he selects the input file and then just clicks on the apply button. The monitoring window appears on the screen and lists the important tasks, the job status for example. In the background the Analysis Manager can change the MSC/NASTRAN specific FMS-commands and sets up a Unix-script that is invisible to the user. This script is submitted to the chosen batch-queue - to LSF. Then LSF considers which workstation is capable and available to run the job and transmits it to that machine. All the files that are needed are automatically copied to the executing machine, then for example MSC/NASTRAN is executed. After finishing, all generated files are transmitted back to the submit host. In the case of MSC/NASTRAN, the output file is searched for instance for FATAL messages. All this is produced automatically and the user does not need to use any Unix-command. In the latest release of the MSC/Analysis Manager one special request of DASA Airbus is implemented:

The user can access (view/copy) the output files of a job during the execution on a remote machine from within the monitoring window of the MSC/Analysis Manager. This is very useful especially for long duration jobs (like crash analyses).

The operational and flexible behaviour of LSF can be described as follows. The workstation resources are optimally used around the clock and form a "virtual computer", so the engineer does not need to worry about which machine to use. The definition of batch queues is flexible, to ensure fair-sharing. Interactive work can be prioritised to make sure that background jobs do not interfere with workstation owners. DASA Airbus defined several batch queues, for example a server queue to target large machines with more than 500 MB memory and high CPU speed, whereas about 120 HP workstations (including also the old HP 9000/710's) are used by a queue for jobs using less than 22 MB of memory (the MSC/NASTRAN default memory usage).

As mentioned above, DASA Airbus has two engineering locations in the north of Germany, Bremen and Hamburg, about 100 miles in distance. Naturally one wants to share the resources at these locations. Since the release of LSF 3.0 the new Multi Cluster product addresses this need. It links multiple geographic locations and different clusters together and allows for example the jobs from Bremen automatically to be sent to Hamburg for processing, when these machines are unused. Organisational changes in the company brings more flexibility and independence to the functional departments. This is reflected in the IT-infrastructure. With LSF MultiCluster several clusters can now be set up, which are independently managed and run by the departments. If necessary it is possible to combine them together, to form a 'virtual supercomputer'.

The CAE-users from DASA Airbus are very satisfied with the way the MSC/Analysis Manager and LSF have been set-up, the system can be used as a black box (from within MSC/PATRAN). He even does not have to know anything about LSF, because the Analysis Manager handles his job automatically to and from LSF. The way both tools work together makes it absolutely easy to run batch-jobs with getting full access to the computing environment, without having to know too much about it or use Unix commands. The job throughput and the elapsed/CPU comparisons are dramatically better than on the former mainframe.