

Windows Hardware Performance Tuning for Nastran

By

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NX Nastran is a very I/O intensive application. It is important to select the proper hardware to satisfy expected performance goals. Hardware bottlenecks can limit the effectiveness of software tuning. The table below provides important consideration to help remove some of the performance bottlenecks.

Component	Recommendation
Processors	When the option is available, a 64-bit processor should be chosen as this provides additional address space if the system has more than 4GB RAM
Cache	Choose large L2 or L3 processor caches. The larger caches generally provide better performance and often play a bigger role than raw CPU frequency.
Memory (RAM) and Paging Storage	<p>Install as much RAM as possible. The system will use a percentage of unallocated memory for I/O cache.</p> <p>When the computer runs low on memory it will use hard disk space to supplement memory through a procedure called paging. Excessive paging can degrade overall system performance.</p> <p>For smaller servers, a page file of 1.5 times the amount of RAM is needed by default. For servers that have hundreds of gigabytes of memory, the benefit of a paging file of larger than 50 GB is unclear</p> <p>Paging can be optimized by</p> <ol style="list-style-type: none">1. Place the pagefile and operating system files on separate physical disk drives (not on separate disk partitions)2. Use multiple disks or a disk array if additional disk bandwidth is needed for paging.
Disks	<p>Higher rotational speeds reduce random request service times. Ultra SCSI, SAS and SATA drives with higher RPM would be beneficial.</p> <p>Disk I/O will benefit from RAID striping. Choose Raid-0 or Raid-5 configuration. Raid-0 is a data layout scheme where in sequential logical blocks of a pre-chosen size (the stripe unit) is laid out in a round-robin manner across multiple disks. It presents a logical disk that stripes disk accesses over a set of physical disks.</p>

Antivirus and Anti-Spyware

Installing antivirus and anti-spyware software greatly affects overall system performance, especially on the CPU usage. Performance can be enhanced if a list of files/folders (for eg., Nastran scratch directory and files) are excluded from active monitoring.

Disabling File Last Access Time Check

Windows Server 2003 and earlier Windows operating systems update the last-accessed time of a file when applications open, read, or write to the file. This increases the number of disk I/Os, which further increases the CPU overhead of virtualization. If applications do not use the last-accessed time on a server, system administrators should consider setting this registry key to disable these updates.

NTFSDisableLastAccessUpdate

```
HKLM\System\CurrentControlSet\Control\FileSystem\ (REG_DWORD)
```

By default, both Windows Vista and Windows Server 2008 disable the last-access time updates.

I. Memory

System Memory

Memory consists of physical memory (RAM) and pagefile (swap or virtual) memory. Pagefile or swap memory uses disk storage to supplement memory.

NX Nastran performance will degrade if the memory requested by the “mem or memory” keyword exceeds physical memory or the RAM. It is strongly recommended not to specify more than 50 – 60 % of available memory to NX Nastran using the “mem” keyword.

On Windows as well as other on operating systems, a part of the unallocated RAM is used for I/O caching. Therefore, when physical memory on the system is increased, the disk I/O performance is enhanced. Unfortunately, there is no parameter setting available in Windows to specify the amount of physical memory to be dedicated for I/O cache.

Therefore, it is important to only request (via. the “mem” keyword) as much memory as needed for individual solution run. Requesting substantially more memory than needed (for example, requesting “mem=6.5GB” for a run that just requires “1.0GB”) will prevent the extra memory from being used for I/O cache by the operating system. Additionally, the operating system and any other running processes consume system resources such as memory and cpu time.

The memory available for NX Nastran will therefore be

Available memory for NX Nastran = RAM – memory used by other processes – memory for I/O cache

The more memory specified for NX Nastran would mean less memory available for (process memory + I/O cache). Since NX Nastran is a highly I/O intensive application, the performance will deteriorate if more memory is specified for Nastran and less memory is available for I/O cache.

The amount of memory needed by the solver is output in the F04 file. Important values are (a) minimum memory required, (b) memory required to avoid spill, and (c) memory available. An excerpt is shown below

```
*** USER INFORMATION MESSAGE 4157 (DFMSYN)
PARAMETERS FOR SPARSE DECOMPOSITION OF DATA BLOCK KLL      ( TYPE=RDP ) FOLLOW
      MATRIX SIZE = 70345 ROWS          NUMBER OF NONZEROES = 2701957 TERMS
      NUMBER OF ZERO COLUMNS = 0        NUMBER OF ZERO DIAGONAL TERMS = 0
      CPU TIME ESTIMATE = 78216 SEC      I/O TIME ESTIMATE = 25 SEC
      MINIMUM MEMORY REQUIREMENT = 1364 K WORDS      MEMORY AVAILABLE = 32615 K WORDS
      MEMORY REQR'D TO AVOID SPILL = 12305 K WORDS  MEMORY USED BY BEND = 3651 K WORDS
      EST. INTEGER WORDS IN FACTOR = 87006 K WORDS  EST. NONZERO TERMS = 174758 K TERMS
```

In this case, the minimum memory required is just 1364 K words. This is the bare minimum memory needed for the matrix decomposition. The amount of memory required to avoid spill is 12305 K words and the memory available is 32615 K words. Since the amount of memory available is greater than the minimum amount of memory needed to avoid spill, Nastran will not use the spill logic (essentially when spill logic is activated, Nastran moves information back and forth from memory to disk). Typically, the decomposition module in Nastran requires more memory than other modules. It is therefore recommended that the user specify memory which is greater than the memory required to avoid spill.

II. Disks:

NFS disks are disks that are mounted remotely to a computer. Performance may degrade significantly if NFS disks are used for the Nastran scratch files. If databases need to be kept for restart runs it is recommended that the user specify a database directory where all Nastran database files can be stored (preferably on the scratch file system setup for Nastran) using the “**db=**” keyword. If no restart files need to be saved, it is recommended that the user run nastran using the command “**scr=yes**”. In this case, all the database files will get written out to the scratch file system of nastran and will be removed at the end of the run.

Physical Disks

Disk Type

The following are the different disk types that are currently available: IDE, SATA, SAS, SCSI and Solid State Disks. The OS can reside on any type of disk without significant

performance degradation. However, the Nastran scratch file system should not reside on an IDE disk. NX Nastran will run significantly slower (compared to a SCSI/SATA/SAS disk drives) if IDE disks are used for scratch files.

SATA/SAS disks are cheaper than SCSI disks but may need to be configured to achieve good performance. On some of the older systems the SATA disks are configured in the BIOS settings to be in the “compatible mode” - This mode essentially means compatible with IDE drives and should be changed in the BIOS (in “CONTROLLER MODULE”) from “COMPATIBLE” to “ENHANCED”. Also, In the BIOS, SATA AHCI (Advanced Host Controller Interface) should be set to “ENABLED.” This setting allows the SATA disk to be read as a SCSI disk.

Solid-State and Hybrid Drives

Until recently, the cost of large quantities of nonvolatile memory was very prohibitive for server configurations. Newer laptops and desktop systems have begun to incorporate flash memory in the form of “hybrid” disk drives. In these configurations, Windows can explicitly request that some data be cached in a drive’s non-volatile memory and other blocks be sent directly to the magnetic media. The typical vehicle for incorporating non-volatile memory in a server is the solid-state disk (SSD). The most cost-effective way is to place only the “hottest” data (Nastran scratch files) of a workload onto non-volatile memory

Recommendations for NX Nastran

In general a windows server is more tuned to higher I/O performance than a windows desktop platform and is preferable for running NX Nastran.

Running NX Nastran on a desktop or a non-server machine will cause the machine to appear stalled while NX Nastran is running (since by default the priority for foreground applications are higher on a desktop configuration). This happens when Nastran is performing the I/O operations. Other applications that were up and running might be paged out while Nastran is running in the foreground with high priority. The I/O bottle neck can be overcome by installing the operating system on a separate disk. The pagefile or the swap file should preferably go to a drive which is on a physically different disk. If possible, the operating system, the pagefile/swap file system, and the Nastran scratch files should be on physically different disks. Alternatively, this can be accomplished by using disks in a RAID-0 configuration.

Care needs to be exercised to make sure that the total memory requirements do not exceed the memory limits of the system, especially, while running multiple Nastran jobs specifying same amount of memory. On a desktop box, it is recommended that only one Nastran job be run at any given time.

NX Nastran uses file mapping on windows XP and older OS to perform I/O operations. File Mapping is the association of a file’s contents with a portion of the virtual address space of the process. In other words, a part (view of file) of the file is read into the

memory and I/O is performed from this memory. Additionally, the operating system itself caches the data that is being written out and commits to the disk when this cache becomes full. Therefore, it is important to only request (via. the “**mem**” keyword) as much memory as needed for individual solution run. Requesting substantially more memory than needed (eg., requesting “mem=6.5GB” for a run that just requires “1.0GB”) will prevent the extra memory from being used for I/O cache by the operating system resulting in increased elapsed time for nastran runs.

If NX Nastran job is run from a pre-processor, there may not be sufficient memory available for Nastran and or I/O cache. It is recommended that the user export a Nastran input file from the pre-processor and then run NX Nastran via. the NX Nastran GUI or via. NX Nastran command line syntax.