Lenovo Workstations: Enabling ANSYS Users To Do More

Eric Irwin,
Technical Sales Manager,
Lenovo ThinkStation
Agenda

Global Product Data Interoperability Summit | 2015

• Workstation products offered/ choices
• Getting the best workstation performance
  • Lenovo performance settings/unique advantages
  • Processor selections— when cores help/ don’t help
  • When to use Nvidia Tesla and how many
  • ThinkPad Mobile Workstation performance

• Servers
• Questions
How many workstations would you need to get the following?

• 36 cores @ 2.3GHz
• 1TB DDR4 memory
• 36GB GDDR5 discrete video with over 9,000 CUDA cores
• 1TB NVMe PCIe SSD @ 32Gbps
• 4TB SSD storage
• 16TB 7200PRM SATA storage
• 2x 10Gb connections + 2x 1Gb connections

Answer: Just one, if it’s a ThinkStation P900.
Another question…

What kinds of workloads could you handle with this workstation configuration?
• 4-core Intel Xeon processor at 2.9GHz
• 64GB ECC DDR4 memory
• 8GB GDDR5 discrete video memory with over 1,500 CUDA cores
• 1TB NVMe PCIe SSD @ 32Gbps
• 2TB SSD storage

…What if I told you that you could close it and carry it home with you?

Oh yeah, and it also has a 17” 4K display, Thunderbolt/USB3.1, and an integrated Pantone color calibrator…
Lenovo Workstations
Enabling good engineers to become great

P SERIES
ThinkStation Power

P SERIES
ThinkPad Strength

W550s
P50
P70
P900
P700
P500
P300 Tower
P300 SFF
ANSYS Mechanical Benchmarks

- ANSYS Mechanical Benchmarks
- Release 16.0 Test Cases
  - Power Supply Module (V16cg-1)
  - Tractor Rear Axle (V16cg-2)
  - Engine Block (V16cg-3)
  - Gear Box (V16In-1)
  - Radial Impeller (V16In-2)
  - Peltier Cooling Block (V65sp-1)
  - Semi-Submersible (V16sp-2)
  - Speaker (V16sp-3)
  - Turbine (V16sp-4)
  - BGA (V16sp-5)

Backup data will have all benchmarks shown
Impact of Lenovo Performance Settings
Release 16.0 Test Cases Benchmarks – Engine Block V16cg-3

Static structural analysis of an engine block without the internal components

Analysis Type: Static Linear Structural
Number of Degrees of Freedom: 14,200,000
Equation Solver: PCG
Matrix: Symmetric

Plots: Core Solver Rating
Large size job for iterative solvers

Comparison of Standard Settings to Lenovo Performance Settings

Engine Block

Solver Rating

<table>
<thead>
<tr>
<th>Cores</th>
<th>Standard Settings</th>
<th>Lenovo Performance Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.31x</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Comparison of Standard Settings to Lenovo Performance Settings

Release 16.0 Test Cases Benchmarks – Turbine V16sp-4

Static nonlinear structural analysis of a turbine blade as found in aircraft engines

Analysis Type: Static Nonlinear Structural
Number of Degrees of Freedom: 3,200,000
Equation Solver: Sparse
Matrix: Symmetric
Analysis with 1 iteration

Plots: Core Solver Rating
Large size job for direct solvers
Processor speed versus core count
Comparing Cores Used Per Processor

Release 16.0 Test Cases
Benchmarks – Engine Block
V16cg-3

Static structural analysis of an engine block without the internal components

Analysis Type: Static Linear Structural
Number of Degrees of Freedom: 14,200,000
Equation Solver: PCG
Matrix: Symmetric
Plots: Core Solver Rating
Large size job for iterative solvers

Recommendation:
Run on all cores available
Frequency still important

* Percentage compares the 2 18 core processors to the 2 8 core processors

-27% 
+38% 
+6% 
+45%*

Cores Utilized in Processor

0 50 100 150 200 250 300 350 400 450 500

8 core 3.2 GHz E5-2667v3 Qty 2
10 core 3.1 GHz E5-2687 v3 Qty2
16 Core 2.3 GHz E5-2698 v3 Qty2
18 Core 2.3 GHz E5-2699 v3 Qty 2
Comparing Cores Used Per Processor

Global Product Data Interoperability Summit | 2015

Release 16.0 Test Cases
Benchmarks –
Turbine V16sp-4

Static nonlinear structural analysis of a turbine blade as found in aircraft engines

Analysis Type: Static Nonlinear Structural
Number of Degrees of Freedom: 3,200,000
Equation Solver: Sparse
Matrix: Symmetric

Plots: Core Solver Rating
Large size job for direct solvers

Recommendation: Run on all cores available
Frequency still important

* Percentage compares the 2 18 core processors to the 2 8 core processors

<table>
<thead>
<tr>
<th>Cores Utilized in Processor</th>
<th>Solver Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>32</td>
<td>24</td>
</tr>
<tr>
<td>36</td>
<td>26</td>
</tr>
</tbody>
</table>

- 8 core 3.2 GHz E5-2667v3 Qty 2
- 10 core 3.1 GHz E5-2687 v3 Qty2
- 16 Core 2.3 GHz E5-2698 v3 Qty2
- 18 Core 2.3 GHz E5-2699 v3 Qty 2
Cores vs. Clock speed

- Generally more cores give better performance.
- **Average Improvement going from 16 to 32 cores is 26%**
- Size your core selection to your expected usage.
- Performance improvement is not linearly proportional to cores added.
- Generally recommend the maximum cores per processor
  - Some minor performance anomalies exist,
  - 2 out of 10 benchmarks don’t run the fastest on 2 18 core processors (V16ln-2 Radial Impeller & V16sp-2 Semi-Submersible)
NVidia Tesla impact on performance
ThinkStation P900

Unique advantage

The ThinkStation P900 is the only workstation on the market today that can support Up to 3 NVIDIA Quadro M6000 or 3 Tesla K40 graphics cards.
Release 16.0 Test Cases

Benchmarks

Note: V16cg-3 not supported on Tesla

Performance improvement in all cases except V16sp-2

Average improvement = 55%

Recommend 1 Nvidia K40 Tesla for those who only have a base license (2 cores)
Release 16.0 Test Cases

Benchmarks

Note: V16cg-3 not supported on Tesla

- 1 Tesla is significant gain (1.27x to 2.42x) Average = 63%
- 2 Teslas are a significant gain (1.24x to 2.83x)
  - Average = 77%, cg1 = +12%, SP3 = +23%, SP4 = +22%
- 3 Teslas provide no gain

For those that have a Main License and 1 HPC pack
We recommend 1 Nvidia K40 Tesla, or 2 K40s for cg-1, sp-3 and sp-4.
Improvement from Nvidia Tesla K40

Release 16.0 Test Cases Benchmarks

Note: V16cg-3 not supported on Tesla

• 1 Tesla average gain is 3%
  (cg-1 = 21%, ln-2=34%, sp-3=9%, sp-4=11%)

• 2 Teslas average gain is 11%
  (cg-1 = 69%, cg-2 = 22%, ln-1=31%, sp-1=8%, sp-4=16%)

• 3 Teslas average gain is 22%
  (cg-1 = 107%, ln-1=35%, sp-4=8%, sp-5=12%)

For those that have a Main License and 2 HPC packs
Recommendation – Number of Nvidia K40 Teslas recommended is dependent on your problem set
Is there a mobile workstation recommended for ANSYS?
Most Powerful Mobile Workstation ever

Global Product Data Interoperability Summit | 2015

Lenovo ThinkPad P70 Mobile Workstation

• Nvidia Quadro M graphics with GPU power
• Intel® Core™ and mobile Xeon processors
• Memory: up to 64 GB with ECC option
• Unique FLEX dual fan cooling
  • Enables Turbo Boost
• 17 inch 4K IPS Display, touch option
• NVMe PCIe Storage

New Use Cases – GPU/CUDA
- much faster rendering, analysis, simulation

17” Cooling design exclusive to Lenovo
MEET THINKPAD P70

Global Product Data Interoperability Summit | 2015

The Complete P70 Picture
Power Defined
A machine for designers and engineers who need the highest performing CPU along with the highest performing GPU available in a mobile device. Also for power users who just want a large screen and screaming fast CPU and storage.

P70 - Why is it “Power Defined?”

- Designed for Designers and Engineers
  - Intel 6th Gen Core i CPUs & Fastest Available Mobile Xeon
  - All new NVIDIA Maxwell GPUs
  - PCIe storage that is up to 9x faster than HDD
  - DDR4 Memory up to 64GB
  - 4k Display with 92% Color Gamut
  - All new Color Calibrator for absolute accurate colors
  - Intel Thunderbolt port for the fastest possible connection
  - ISV Certified

P70 – Design Features
BIGGER, FASTER, and more POWERFUL

- <30mm thin and 7.55lbs
- Dual cooling fans
- Mil Spec Tough

Continued Evolution of User Interaction

- New 3+3 button Touchpad specific to MWS users
- High resolution 4k panels for more accurate designs
- Legendary ThinkPad Keyboard

ThinkPad Precision Backlit Keyboard

Award winning keyboard design now enhanced backlit for better experience.
MEET THINKPAD P50

The Complete P50 Picture

Next Level Performance

A machine for designers and engineers who need a balance of portability and performance with top level CPU offerings and mid-range GPU offerings coupled with the ISV certifications they require to run their resource intensive applications.

P50 - Why is it “Next Level Performance?”

Designed for Designers and Engineers

- Intel 6th Gen Core i CPUs & Mobile Xeon
- All new NVIDIA Maxwell GPUs
- PCIe storage that is up to 5x faster than HDD
- DDR4 Memory up to 64GB
- 4k Display with 100% Color Gamut
- All new Color Calibrator for absolute accurate colors
- Intel Thunderbolt port for the fastest possible connection
- ISV Certified

P50 – Design Features

THINNER, LIGHTER, and more CONNECTED

- <25mm thin and 5.6lbs
- Dual Cooling fans
- Mil Spec Tough

Continued Evolution of User Interaction

- New 3+3 button Touchpad specific to MWS users
- High resolution 4k panels for more accurate designs
- Legendary ThinkPad Keyboard

ThinkPad Precision Backlit Keyboard

Award winning keyboard design now enhanced backlit for better experience.
Lenovo server solutions
# Lenovo Datacenter Solutions

## Global Product Data Interoperability Summit | 2015

<table>
<thead>
<tr>
<th>RACK &amp; TOWER</th>
<th>MISSION-CRITICAL</th>
<th>BLADES/CONVERGED</th>
<th>HIGH DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perfect for</strong></td>
<td>General purpose server capabilities for organizations of all sizes</td>
<td>Large workloads that gain advantage by running on a single machine</td>
<td>Customers focused more on total cost of ownership and operational expenses</td>
</tr>
<tr>
<td><strong>Key features</strong></td>
<td>Extreme hard drive density</td>
<td>Extreme performance and scalability</td>
<td>Great density with up to 8-socket nodes</td>
</tr>
<tr>
<td></td>
<td>Solid state drive support</td>
<td>Tool-less, lid-less modular book design</td>
<td>Simpler system management</td>
</tr>
<tr>
<td></td>
<td>Hot-swap and redundant power and cooling</td>
<td>Can be serviced and upgraded in the rack</td>
<td>High performance networking options</td>
</tr>
<tr>
<td></td>
<td>GPU support</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td>Reliable and expandable</td>
<td>Easy manageability</td>
<td>Optimized for energy, space, and thermal efficiency</td>
</tr>
<tr>
<td></td>
<td>Among the quietest servers in the industry with leading storage flexibility and capacity</td>
<td>Flexibility to grow infrastructure as technology needs dictate</td>
<td>Resilient to maximize application uptime</td>
</tr>
</tbody>
</table>

- ThinkServer TD350
- System x3650 M5
- System x3650 X6
- Flex System Chassis
- NoXtScale System M5
Thank you!!!
Backup charts
This section compares typical performance of ANSYS Mechanical running on a Lenovo P900 ThinkStation with standard settings to a P900 ThinkStation with special settings for ANSYS.

ANSYS Standard Benchmarks are used V16

The hardware configuration is the same except for the change in set up. P900, 2xE5-2667v3’s (8 core/ 3.2 GHz), 128 GB, K2200, RAID 0 with 4x Intel 240GB SSDs, Windows 7 64 Bit. Hyper-threading set to off.

All testing is done in Lenovo Performance labs by William Otto and team.
ANSYS Mechanical Benchmarks

• **ANSYS Mechanical Benchmarks**
• **Release 16.0 Test Cases**
  – Power Supply Module (V16cg-1)
  – Tractor Rear Axle (V16cg-2)
  – Engine Block (V16cg-3)
  – Gear Box (V16In-1)
  – Radial Impeller (V16In-2)
  – Peltier Cooling Block (V65sp-1)
  – Semi-Submersible (V16sp-2)
  – Speaker (V16sp-3)
  – Turbine (V16sp-4)
  – BGA (V16sp-5)
Results from Lenovo Performance Settings
V16cg-1 ANSYS Benchmark - Power Supply Module

Comparison of Standard Settings to Lenovo Performance Settings

Release 16.0 Test Cases Benchmarks – Power Supply Module

Thermal analysis power supply module

Analysis Type: Static Linear Thermal Analysis
Number of Degrees of Freedom: 5,300,000
Equation Solver: JCG
Matrix: Symmetric

Plots: Core Solver Rating
Medium size job for iterative solvers

Comparison of Standard Settings to Lenovo Performance Settings

Cores

Solver Rating

Standard Settings
Lenovo Performance Settings

1 2 4 8 16

4.12x

V16cg-1 Benchmark Model
V16cg-2 ANSYS Benchmark - Tractor Rear Axle

Comparison of Standard Settings to Lenovo Performance Settings

<table>
<thead>
<tr>
<th>Cores</th>
<th>Standard Settings</th>
<th>Lenovo Performance Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>2.86x</td>
</tr>
</tbody>
</table>

Release 16.0 Test Cases
Benchmarks – Tractor Rear Axle

Static structural analysis of a farm tractor rear axle assemble

Analysis Type: Static Linear Structural
Number of Degrees of Freedom: 12,300,000
Equation Solver: PCG
Matrix: Symmetric

Plots: Core Solver Rating
Large size job for iterative solvers
Comparison of Standard Settings to Lenovo Performance Settings

Release 16.0 Test Cases
Benchmarks – Engine Block

Static structural analysis of an engine block without the internal components

Analysis Type: Static Linear Structural
Number of Degrees of Freedom: 14,200,000
Equation Solver: PCG
Matrix: Symmetric

Plots: Core Solver Rating
Large size job for iterative solvers

Comparison of Standard Settings to Lenovo Performance Settings

<table>
<thead>
<tr>
<th>Cores</th>
<th>Standard Settings</th>
<th>Lenovo Performance Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph showing a 2.31x improvement with 16 cores.
V16ln-1 ANSYS Benchmark - Gear Box

Comparison of Standard Settings to Lenovo Performance Settings

Release 16.0 Test Cases Benchmarks – Gear Box

Modal analysis of a transmission housing without the internal components

Analysis Type: Modal Linear Structural
Number of Degrees of Freedom: 7,700,000
Equation Solver: PCG Lancro eigensolver
Matrix: Symmetric
Analysis requesting 10 modes

Plots: Core Solver Rating
Medium size job for iterative solvers

Comparison Graph:
- Standard Settings
- Lenovo Performance Settings

Graph shows a performance improvement of 3.97x when using Lenovo Performance Settings compared to Standard Settings.

V16ln-1 Benchmark Model
Release 16.0 Test Cases
Benchmarks – Radial Impeller

Cyclic symmetric modal analysis of a single blade of an impeller

Analysis Type: Modal--Cyclic Symmetry, Linear Structural
Number of Degrees of Freedom: 2,000,000
Equation Solver: Subspace eigensolver
Matrix: Symmetric
Analysis requesting 50 modes

Plots: Core Solver Rating
Medium size job for direct solvers
V16sp-1 ANSYS Benchmark - Peltier Cooling Block

Comparison of Standard Settings to Lenovo Performance Settings

Release 16.0 Test Cases Benchmarks – Peltier Cooling Block

Static nonlinear thermal-electric coupled field analysis of a Pelletier cooling block

Analysis Type: Static Nonlinear Thermal-Electric Coupled Field
Number of Degrees of Freedom: 650,000
Equation Solver: Sparse
Matrix: Non-symmetric (Unsymmetrical)

Plots: Core Solver Rating
Medium size job for direct solvers
V16sp-2 ANSYS Benchmark - Semi-Submersible

Comparison of Standard Settings to Lenovo Performance Settings

Release 16.0 Test Cases Benchmarks – Semi-Submersible

Transient nonlinear structural analysis of a submersible drilling rig

Analysis Type: Transient Nonlinear Structural
Number of Degrees of Freedom: 4,700,000
Equation Solver: Sparse
Matrix: Symmetric

Plots: Core Solver Rating
Medium size job for direct solvers
**V16sp-3 ANSYS Benchmark - Speaker**

**Comparison of Standard Settings to Lenovo Performance Settings**

<table>
<thead>
<tr>
<th>Cores</th>
<th>Standard Settings</th>
<th>Lenovo Performance Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
<td>21</td>
</tr>
</tbody>
</table>

**Release 16.0 Test Cases Benchmarks – Speaker**

Harmonic linear structural analysis of a speaker and its surroundings

- Analysis Type: Harmonic Linear Structural
- Number of Degrees of Freedom: 1,700,000
- Equation Solver: Sparse
- Matrix: Symmetric
- Requesting 1 Frequency

Plots: Core Solver Rating
- Medium size job for direct solvers
Comparison of Standard Settings to Lenovo Performance Settings

V16sp-4 ANSYS Benchmark - Turbine

Release 16.0 Test Cases Benchmarks – Turbine

Static nonlinear structural analysis of a turbine blade as found in aircraft engines

Analysis Type: Static Nonlinear Structural
Number of Degrees of Freedom: 3,200,000
Equation Solver: Sparse
Matrix: Symmetric
Analysis with 1 iteration

Plots: Core Solver Rating
Large size job for direct solvers
V16sp-5 ANSYS Benchmark - BGA

Release 16.0 Test Cases Benchmarks – BGA

Transient nonlinear structural analysis of a electronic ball grid array

Analysis Type: Static Nonlinear Structural
Number of Degrees of Freedom: 6,000,000
Equation Solver: Sparse
Matrix: Symmetric
Analysis with 1 iteration

Plots: Core Solver Rating
Large size job for direct solvers
Conclusions

• Lenovo Performance Settings
  • Significantly help in all situations where 8 or more cores are used.
  • The average improvement at 16 cores is 2.1x the performance without the tuned settings.
  • Performance settings do not degrade any of the benchmark examples
  • At 16 cores the performance improvement ranges from 1.1 x to 4.12x with the iterative solvers greater than 2x improvement.

Recommendation: Lenovo Performance Settings for all ANSYS use cases
Processor clock speed vs. core count
Release 16.0 Test Cases
Benchmarks - Power Supply Module

Steady state thermal analysis of a power supply module

Analysis Type: Steady State Thermal

Number of Degrees of Freedom: 5,300,000
Equation Solver: JCG
Matrix: Symmetric

Plots: Core Solver Rating

Recommendation: Run ANSYS on all cores available - Frequency still important

* Percentage compares the 2 18 core processors to the 2 8 core processors
V16cg-2 ANSYS Benchmark - Tractor Rear Axle

Comparing Cores Used Per Processor

- 8 core 3.2 GHz E5-2667v3 Qty 2
- 10 core 3.1 GHz E5-2687 v3 Qty2
- 16 Core 2.3 GHz E5-2698 v3 Qty2
- 18 Core 2.3 GHz E5-2699 v3 Qty 2

Release 16.0 Test Cases
Benchmarks – Tractor Rear Axle

Static structural analysis of a farm tractor rear axle assemble

Analysis Type: Static Linear Structural
Number of Degrees of Freedom: 12,300,000
Equation Solver: PCG
Matrix: Symmetric

Plots: Core Solver Rating

Recommendation: Run ANSYS on all cores available - Frequency still important

* Percentage compares the 2 18 core processors to the 2 8 core processors
Release 16.0 Test Cases

Benchmarks – Engine Block

Static structural analysis of an engine block without the internal components

Analysis Type: Static Linear Structural

Number of Degrees of Freedom: 14,200,000

Equation Solver: PCG

Matrix: Symmetric

Plots: Core Solver Rating

Recommendation: Run on all cores available

Frequency still important

* Percentage compares the 2 18 core processors to the 2 8 core processors
V16In-1 ANSYS Benchmark - Gear Box

Release 16.0 Test Cases
Benchmarks – Gear Box

Modal analysis of a transmission housing without the internal components

Analysis Type: Modal Structural
Number of Degrees of Freedom: 7,700,000
Equation Solver: PCG
Matrix: Symmetric
Plots: Core Solver Rating

Recommendation: Run on all cores available
Frequency still important

* Percentage compares the 2 18 core processors to the 2 8 core processors
Cyclic symmetric modal analysis of a single blade of an impeller

Analysis Type: Modal - Cyclic Symmetry, Structural
Number of Degrees of Freedom: 2,000,000
Equation Solver: Block Lanczos
Matrix: Symmetric

Plots: Core Solver Rating

Recommendation: Run on all cores available
Best performer is 2x10 core processor

* Percentage compares the 2 18 core processors to the 2 8 core processors
Release 16.0 Test Cases
Benchmarks –
Peltier Cooling Block

Static nonlinear thermal-electric coupled field analysis of a Pelletier cooling block

Analysis Type: Static Nonlinear Thermal-Electric Coupled Field
Number of Degrees of Freedom: 650,000
Equation Solver: Sparse Matrix: Non-symmetric (Unsymmetrical)

Plots: Core Solver Rating

Recommendation: Run on all cores available, frequency still important
V16sp-2 ANSYS Benchmark - Semi-Submersible

Release 16.0 Test Cases
Benchmarks – Semi-Submersible

Transient nonlinear structural analysis of a submersible drilling rig

Analysis Type: Transient Nonlinear Structural
Number of Degrees of Freedom: 4,700,000
Equation Solver: Sparse
Matrix: Symmetric
Plots: Core Solver Rating

Recommendation: Run on all cores available
2x16 core processors run the fastest

* Percentage compares the 2 18 core processors to the 2 8 core processors
Release 16.0 Test Cases  
Benchmarks – Speaker

Harmonic structural analysis of a speaker and its surroundings

Analysis Type: Harmonic Linear Structural
Number of Degrees of Freedom: 1,700,000
Equation Solver: Sparse
Matrix: Symmetric

Plots: Core Solver Rating

Recommendation: Run on all cores available  
Frequency still important

* Percentage compares the 2 18 core processors to the 2 8 core processors
Release 16.0 Test Cases Benchmarks – Turbine

Static nonlinear structural analysis of a turbine blade as found in aircraft engines

Analysis Type: Static Nonlinear Structural
Number of Degrees of Freedom: 3,200,000
Equation Solver: Sparse Matrix: Symmetric
Plots: Core Solver Rating

Recommendation: Run on all cores available
Frequency still important

* Percentage compares the 2 18 core processors to the 2 8 core processors
Conclusions

• Cores vs. Clock speed
  • Performance improvement based upon core increase is not directly proportional to cores added.
  • Generally more cores give better performance.
  • Size you core selection to your expected usage/licenses available to maximize frequency.
  • Generally recommend the maximum cores per processor
    • Some minor performance anomalies exist,
    • 2 out of 10 benchmarks don’t run the fastest on 2 18 core processors (V16ln-2 & V16sp-2)
NVidia Tesla impact on performance
NVidia Tesla Comparisons

- Nvidia Tesla K40 counts as 1 license core
- We will compare
  - Main License = 2 cores  - Will compare 2 cores versus 1 core + K40
  - 1st HPC Pack = 8 cores
    - Will compare 8 cores versus 7 core + K40 and 6 cores + 2 K40s
  - 2nd HPC Pack = 32 cores
    - Will compare 16 cores versus 16 cores + K40 and 16 cores + 2 K40s
    - Will compare 32 cores versus 31 cores + K40 and 30 cores + 2 K40s
  - 3rd HPC Pack = 128 cores
    - Will compare 36 cores versus 36 cores + K40 and 36 cores + 2 K40s
Configuration used to test

The hardware configuration is the same for each test, except for the change in Processors, and Nvidia K40 Teslas

Lenovo P900 ThinkStation
• 2x Intel Xeon E5-2698v3s (16 cores per cpu, 2.3 GHz) (Unless otherwise specified)
• 128 GB Memory
• Nvidia Quadro K2200,
• Nvidia K40 Teslas as indicated in the chart
• M.2 PCIe drive (OS)
• Intel 240 GB Temple Star SSD
• Windows 7 64 Bit.
• Hyper-threading set to off.
• Lenovo Performance settings on
### ANSYS V16 Benchmarks – Main License only (2cores)

#### Global Product Data Interoperability Summit | 2015

**Release 16.0 Test Cases**

**Benchmarks**

Note: V16cg-3 not supported on Tesla

Performance improvement in all cases except V16sp-2

Recommend 1 Nvidia K40 Tesla for those who only have a base license (2 cores)

---

**Solver Rating Improvement from Nvidia Tesla K40**

- **V16cg-1**: 3.0x
- **V16cg-2**: 1.23x
- **V16ln-1**: 1.09x
- **V16ln-2**: 1.25x
- **V16sp-1**: 1.32x
- **V16sp-2**: 0.73x
- **V16sp-3**: 1.65x
- **V16sp-4**: 2.28x
- **V16sp-5**: 1.48x

---

**Cores and Tesla K40**

- 2 Cores
- 1 Core + K40

---

**Solver Rating Ratio**

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5

---

**Test (improvement)**

- 3.0x
- 2.28x
- 1.65x
Release 16.0 Test Cases
Benchmarks

Note: V16cg-3 not supported on Tesla

• 1 Tesla is significant gain (1.27x to 2.42x)
• 2 Teslas are a significant gain (1.61x to 4.04x)
• 3 Teslas are a significant gain in 5 out of 9 cases (2.26x to 4.96x)

For those that have a Main License and 1 HPC pack, we recommend 1 Nvidia K40 Tesla, or 2 K40s for cg-1 or sp-4.
ANSYS V16 Benchmarks - Main License + 2 HPC Packs

Solve Rating Improvement from Nvidia Tesla K40s

- 32 cores
- 31 Cores + 1 K40
- 30 Cores + 2 K40s
- 29 Cores + 3 K40s

Release 16.0 Test Cases Benchmarks

Note: V16cg-3 not supported on Tesla

- 1 Tesla is a gain in 4 benchmarks
- 2 Teslas are a gain in 4 benchmarks
- 3 Teslas are a gain in 4 benchmarks 9 cases

- This is Still in development

For those that have a Main License and 2 HPC packs
Recommendation – Number of Nvidia K40 Teslas recommended is dependent on your problem set