IBM System Cluster 1350
ANSYS
Microsoft Windows Compute Cluster Server

IBM FLUENT Benchmark Results
IBM & FLUENT

Recommended Configurations
IBM 16-Core BladeCenter S Cluster for FLUENT

- **Systems:**
  - Up to Six BladeCenter HS21 XM (Xeon) nodes, each dual socket / dual core
    - Four cores per compute node
    - LS21 (Opteron) nodes also available
    - Node one doubles as head node

- **Options:**
  - Head node can be utilized for large jobs and/or pre/post processing utilizing integrated SAS or SATA storage in chassis

- **Cluster configuration:**
  - 8 GB/core (32 GB/node) on head node
  - 2 or 4 GB/core (8 or 16 GB/node) on each 3 remaining compute nodes

- **Cluster Interconnects:**
  - Integrated Gigabit Ethernet
  - Optional InfiniBand

- **Storage:** SAS or SATA drives integrated in chassis
  - Direct attach storage to any node in the cluster
  - Up to 9 TB of additional storage

- **Integrated storage & networking**
- Operates off 110V or 220V power
IBM 16-Core System x3550 for FLUENT

- **Systems:**
  - Four IBM System x3550 (Intel Xeon) nodes, each dual socket / dual core
  - Four cores per compute node
  - x3455 (Opteron) nodes also available
  - Node one doubles as head node

- **Options:**
  - Head node can be utilized for large jobs and/or pre/post processing utilizing integrated SAS or SATA storage in node

- **Cluster configuration:**
  - 8 GB/core (32 GB/node) on head node
  - 2 or 4 GB/core (8 or 16 GB/node) on each 3 remaining compute nodes

- **Cluster Interconnects:**
  - Onboard Gigabit Ethernet
  - Optional InfiniBand

- **Storage:** SAS or SATA drives integrated in node
  - Up to 1.5 TB per node

- **1U Form Factor
- Additional scalability can be achieved by incorporating additional nodes
- Reduced power options also available

http://www-03.ibm.com/systems/x/rack/x3550/index.html
IBM 32-Core BladeCenter E Cluster for FLUENT

**Systems:**
- Up to 14 BladeCenter HS21 XM (Xeon) nodes, each dual socket / dual core
  - Four cores per compute node
  - 146 GB SAS drive

**Options:**
- Head node can be utilized for decomposition, large jobs, and/or pre/post processing. (Up to four 146 GB SAS Drives utilizing BladeCenter SIO blade suitable for head node)

**Cluster configuration:**
- 2 GB/core (8 GB/node)
- Head Node: Recommend 8 GB/core (32 GB/node)

**Cluster Interconnects**
- Integrated Gigabit Ethernet
- Optional InfiniBand
- Myricom

**Storage: Optional BladeCenter Storage & I/O Blade**
- Extend direct attached storage on the head node
  - Up to three additional SFF hot-swap SAS drives

**For additional performance, cluster can be upgraded to BladeCenter H chassis using existing nodes & switches**
IBM 32-Core System x3550 for FLUENT

- **Systems:**
  - Eight IBM System x3550 (Intel Xeon) nodes, each dual socket / dual core
  - Four cores per compute node
  - x3455 (Opteron) nodes also available
  - Node one doubles as head node

- **Options:**
  - Head node can be utilized for large jobs and/or pre/post processing utilizing integrated SAS or SATA storage in node

- **Cluster configuration:**
  - 8 GB/core (32 GB/node) on head node
  - 2 or 4 GB/core (8 or 16 GB/node) on each 7 remaining compute nodes

- **Cluster Interconnects:**
  - Onboard Gigabit Ethernet
  - Optional InfiniBand

- **Storage:**
  - SAS or SATA drives integrated in node
  - Up to 1.5 TB per node

- **1U Form Factor**
- Additional scalability can be achieved by incorporating additional nodes
- Reduced power options also available

http://www-03.ibm.com/systems/x/rack/x3550/index.html
FLUENT 6.3

IBM Benchmark Results
FLUENT Benchmark Environment

- FLUENT 6.3
- Microsoft Windows Compute Cluster Server 2003 R2
  - Service Pack 2
- Microsoft Windows Compute Cluster Pack
  - Service Pack 1
FLUENT Benchmark Hardware Details

- **IBM System x3550**
  - 2 x Intel Xeon 5160 (3.0 GHz) processors (4 cores total)
  - 8GB RAM
  - Cisco 4x InfiniBand

- **Interconnect**
  - HP-MPI used for all runs with both Gigabit Ethernet & InfiniBand
## FLUENT Medium Class Benchmarks

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Cells</th>
<th>Solver</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL5M1</td>
<td>155,188</td>
<td>Segregated implicit</td>
<td>Coal combustion in a boiler</td>
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<tr>
<td>FL5M2</td>
<td>242,782</td>
<td>Segregated implicit</td>
<td>Turbulent flow in an engine valveport</td>
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<tr>
<td>FL5M3</td>
<td>352,800</td>
<td>Segregated implicit</td>
<td>Combustion in a high velocity burner</td>
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**FL5M1**

**FL5M2**

**FL5M3**
FLUENT InfiniBand Scaling
Medium Class Benchmarks

- Performance relative to single core (bigger is better)
- Cores: 2, 4, 8, 16, 32
- FL5M1, FL5M2, FL5M3
FLUENT Rating
Medium Class Benchmarks
# FLUENT Large Class Benchmarks

<table>
<thead>
<tr>
<th>Benchmark</th>
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<th>Solver</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>FL5L1</td>
<td>847,746</td>
<td>Coupled implicit</td>
<td>Transonic flow around a fighter</td>
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<tr>
<td>FL5L2</td>
<td>3,618,080</td>
<td>Segregated implicit</td>
<td>External aerodynamics around a car</td>
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<td>FL5L3</td>
<td>9,792,512</td>
<td>Segregated implicit</td>
<td>Turbulent flow in a transition duct</td>
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**FL5L1**  
**FL5L2**  
**FL5L3**
FLUENT InfiniBand Scaling
Large Class Benchmarks – FL5L1 & FL5L2

Performance relative to single core (bigger is better)

- FL5L1
- FL5L2

Cores: 2, 4, 8, 16, 32, 64, 128
FLUENT InfiniBand Scaling
Large Class Benchmarks – FL5L3

Performance relative to 8 cores (bigger is better)

<table>
<thead>
<tr>
<th>Cores</th>
<th>FL5L3</th>
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<tbody>
<tr>
<td>16</td>
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<tr>
<td>32</td>
<td></td>
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<tr>
<td>64</td>
<td></td>
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<tr>
<td>128</td>
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</table>
FLUENT Rating
Large Class Benchmarks
FLUENT Rating
Large Class Benchmarks
For More Information

- IBM System x
  - www.ibm.com/systems/x
- IBM BladeCenter
  - www.ibm.com/bladecenter
- IBM System Cluster 1350
- IBM HPC Solutions for CAE
  - http://www-03.ibm.com/systems/x/solutions/industry/auto/hpcsolutions/
# IBM Contacts – Worldwide & Americas

## IBM Worldwide

<table>
<thead>
<tr>
<th>Name</th>
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</tr>
</thead>
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</table>

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</tr>
</thead>
<tbody>
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</table>
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### IBM Asia Pacific and Japan

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