



PERFORMANCE  
RELIABILITY  
ULTRA-QUIET

**GPU** TECHNOLOGY  
CONFERENCE



# From DataCenters to Supercomputers

## A Deep Dive Into ASUS Solutions

Christopher Liang / Server/WS Product manager

## Who is ASUS?

ASUS is a global technology leader in the digital era. We focus on the mastery of technological innovation and design perfection. We're very critical of our own work when it comes to only delivering consumers our very best.

# ASUS Worldwide

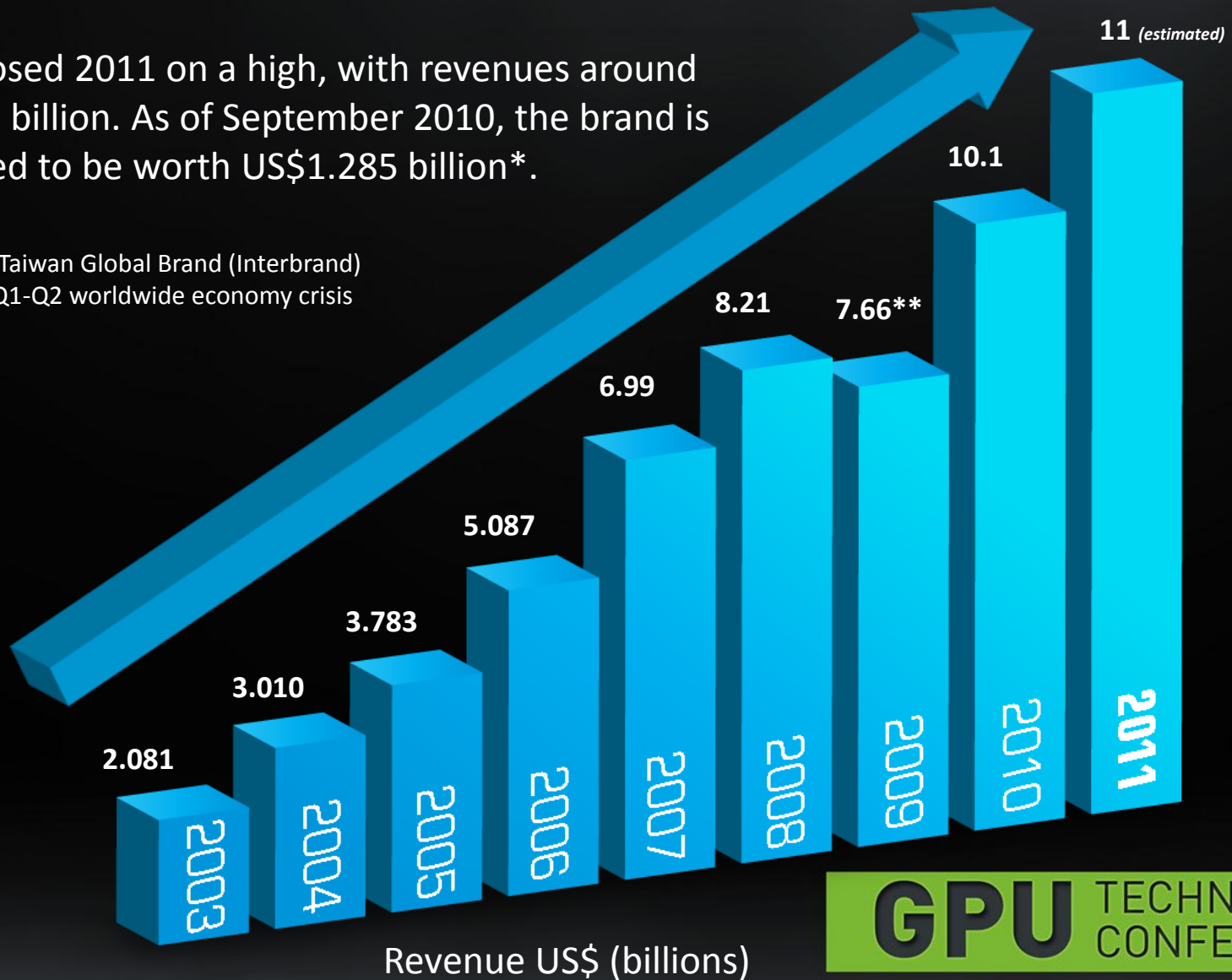
ASUS has a strong presence in over 50 countries, with offices in Europe, Asia, Australia and New Zealand, the Americas, and South Africa.

- **> 11,000** employees worldwide (source : HR dept )
- **> 3,100** R&D employees (source : HR dept )
- **900+** support centers worldwide (source : TSD dept )

ASUS closed 2011 on a high, with revenues around US\$11.8 billion. As of September 2010, the brand is estimated to be worth US\$1.285 billion\*.

\*2010 Top Taiwan Global Brand (Interbrand)

\*\* Due to Q1-Q2 worldwide economy crisis





## #1 Motherboard

Since 1989, ASUS has shipped over **420 million** motherboards. Placed end to end, they can form a chain long enough to circumnavigate the globe more than **three times**.

**NO. 1** IN DESKTOP PC  
**RELIABILITY**

## #1 Windows-based Desktop PC Reliability

Ranked most reliable Windows based PC brand **2 years in a row** by PCWorld. The 2011 PCWorld Reliability and Service survey was conducted with **63,000** PCWorld readers.

## Why ASUS ?

1. Tough design thinking to provide cutting edge SPEC
2. BIOS – superior performance through increased functionality and upgradeability
3. Local support , inventory, and product management
4. Win-Win Partnership, never compete against channel partners
5. Best Total Cost Ownership(TCO) in combination

# 2011 GPU Engagement

Top500 Rank	Green500 Rank	Name	Computer
77	122	VSC-2	Megware Saxonid 6100, Opteron 8C 2.2 GHz, Infiniband QDR
234	37	Formosa 4	ASUS ESC4000, Xeon X56xx (Westmere-EP) 2.93 GHz, Infiniband QDR
328	6	DEGIMA	DEGIMA Cluster, Intel i5, ATI Radeon GPU, Infiniband QDR



**x1315**

**KGMH-D16/QDR**



**x88**

**ESC4000**



**x225**

**P8P67 WS Revolution**



- CPU R<sub>peak</sub> (HPL, High-Performance Linpack)
  - ✓ R<sub>peak</sub> = CPU frequency
    - x floating pt. per clock cycle
    - x CPU core count
    - x No. of CPU
  - ✓ R<sub>max</sub> = Real LINPACK score
- GPU R<sub>peak</sub> = 515 GFLOPS (source: Nvidia for M2070)
  - x No. of GPU cards
- 1 Node R<sub>peak</sub> = CPU R<sub>peak</sub> + GPU R<sub>peak</sub>

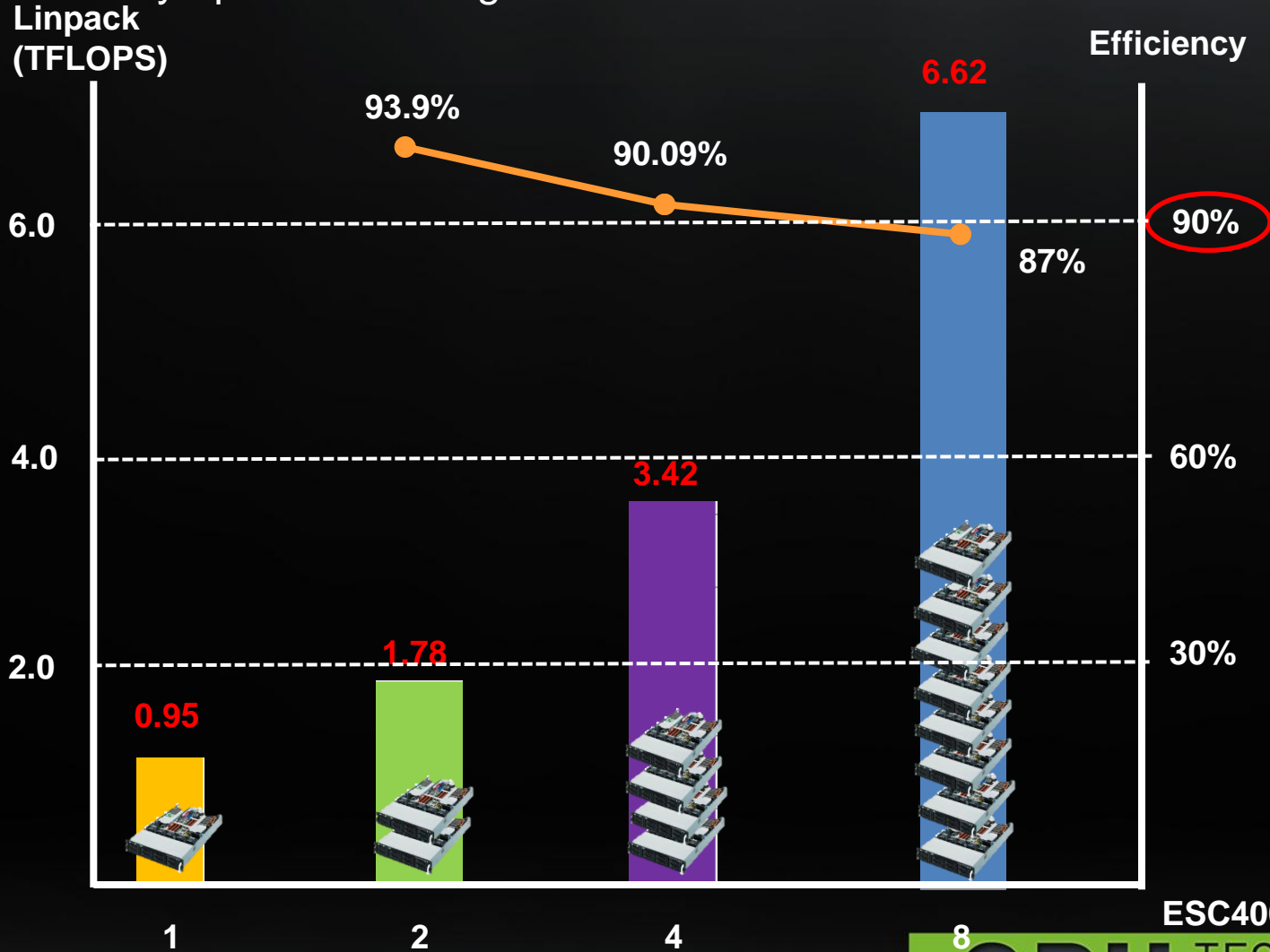
# Planning Target Rmax=70TFlops

- CPU+GPU computing with Rmax/Rpeak efficiency average efficiency level is **47%**
  - Rmax = 70TFlops as requirement of computational result:
    - Target70TFlops / 47% efficiency= **Rpeak 148,936GFlops**
- With
- CPU : Xeon X5670 2.93GHz, 6core
  - GPU: Tesla M2070
- 1 Node Rpeak  
=(CPU Rpeak+ GPU Rpeak)  
= Xeon 5670 CPUs+GPU Tesla GPUs  
= ( (2.93 GHz\*12 cores\*4 GFLOPS per cycle per core ) + 515GFLOPS\*3)  
=140.64GFLOPS+1,545GFLOPS  
=1,685.64GFLOPS
- All Nodes Rpeak/1 Node Rpeak = **88 nodes**

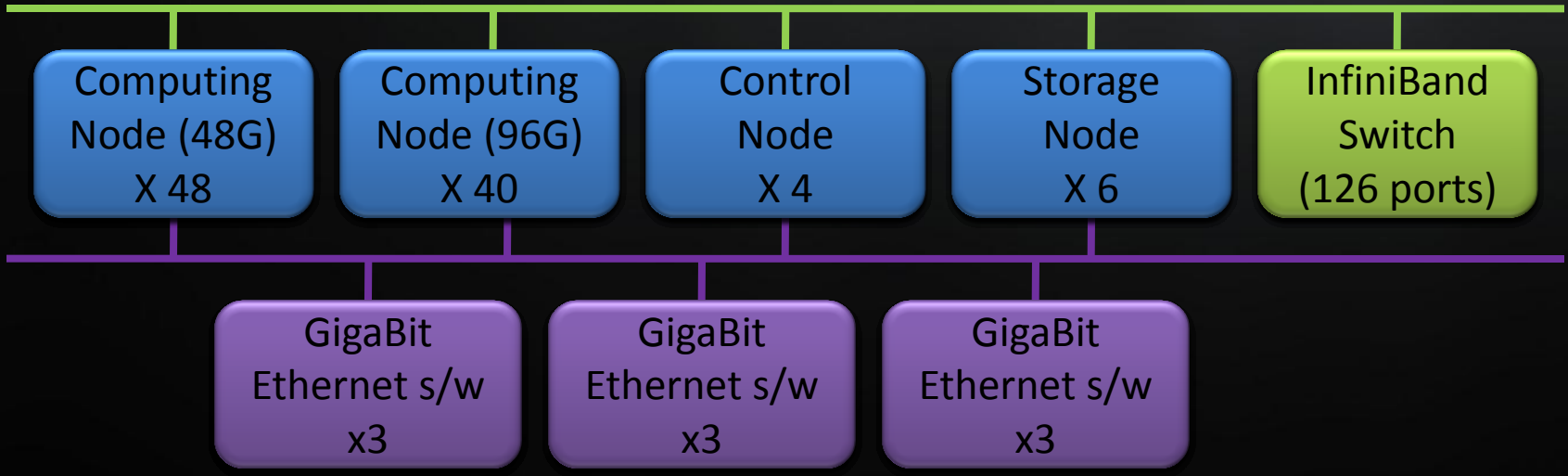
- ✓ Problem Size (N\*N)= 80%
  - x memory size/node (in bit)
  - x No. of node
  - =  $0.8 * 88 * 1,024 * 1,024 * 1,024 / 8$
  
- ✓ CPU Cores = 88nodes x 6cores x 2CPU
- ✓ Accelerator Cores = 88nodes x 3 M2070
  - x 448cores/32 (streaming multiprocessor)
- ✓ Total Cores = CPU Cores + GPU Cores = 3,696

# ESC4000 Rmax

Efficiency up to **87%** of eight ESC4000 w/ onboard-IB architecture



- Configuration : ESC4000(Xeon 5670\*2, 8GB\*12, M2050\*3), InfiniBand Switch,  
- Tools : Redhat 5.5 , CUDA3.2 Tool Kit, Linpack

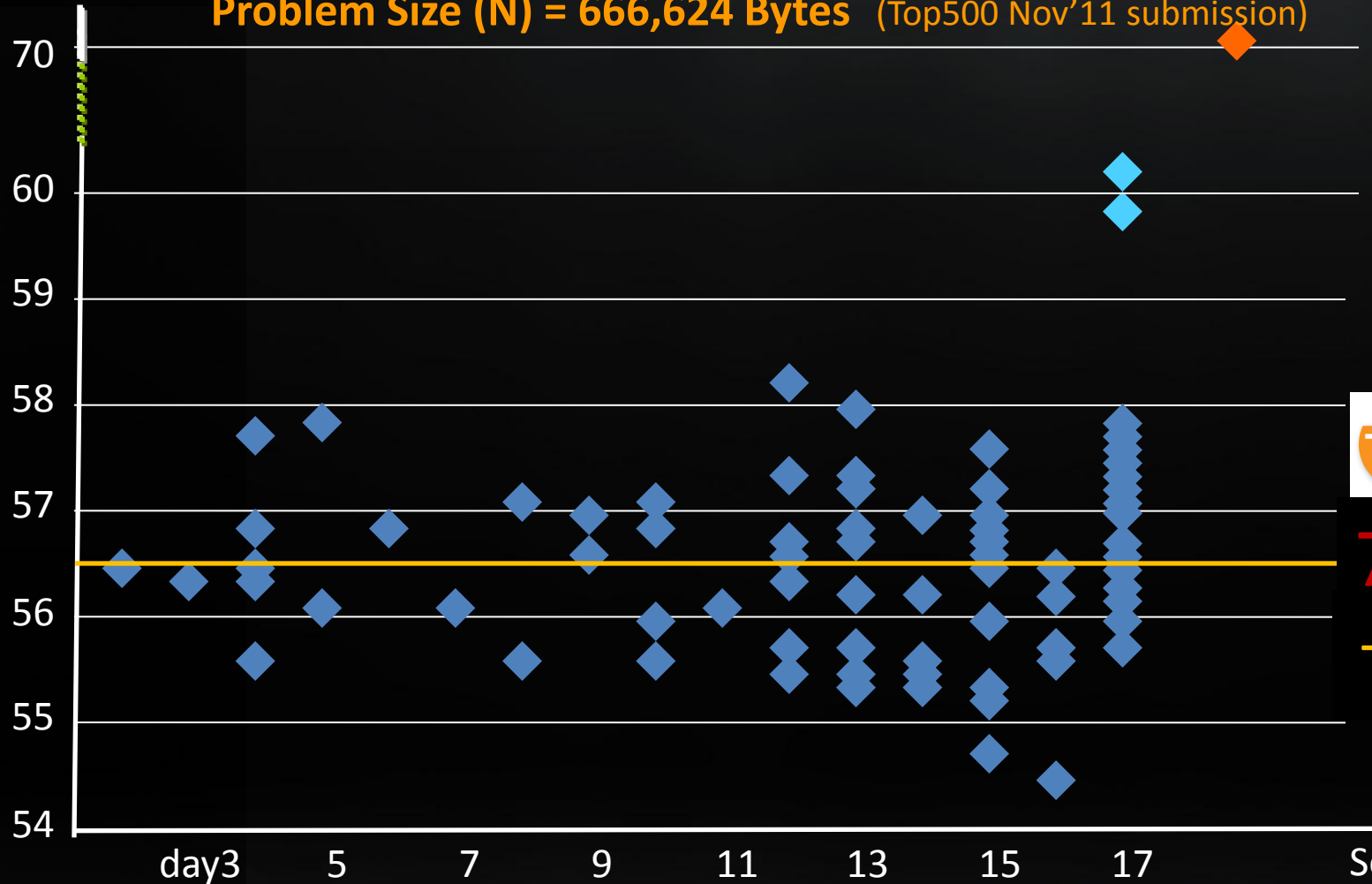


- 6 Storage Nodes
- Intel X5670 x2
- 48G DDR3-1533
- 48G DDR3-1533
- Intel X5670 x2
- 48G DDR3-1533
- 48G DDR3-1533
- 120G SAS HDD x1
- 120G SLC SSD x1
- Mellanox InfiniBand ConnectX-2 HCA x1
- Nvidia M2070 GPU x3
- Dual port 8Gbps HBA x1
- Mellanox InfiniBand ConnectX-2 HCA x1
- 1+1 Redundant 1400Watt 80+ Gold PSU
- 1+1 Redundant 1400Watt 80+ Gold PSU

# HPL Performance

Problem Size (N) = 460,800 Bytes (system stability fine tune)  
Problem Size (N) = 500,736 Bytes (last trial before hand-over NCHC)  
Problem Size (N) = 666,624 Bytes (Top500 Nov'11 submission)

TeraFLOPS



70.43

TFLOPS

\*This HPL (High Performance Linpack) results were run under CUDA Fermi version

# 70 TFLOPS Super Computer

48 Computing Nodes (48G memory)

40 Computing Nodes (96G memory)

4 Control Nodes

6 Storage Nodes

126 ports InfiniBand Switch

9 GigaBit Ethernet Switches

with US\$ **1million** budget

# GPU SC vs CPU SC -Top500

	Formosa4-Rank234		Pure X5670 CPU Cluster
Rmax	70.43TFlops		70.43TFlops
Rpeak	148.336TFlops		88% efficiency (very high)
Nodes	88	6.46X	569

	Formosa4-Rank234		Pure X5670 CPU Cluster
Rmax	70.43TFlops	6.46X	10.89TFlops
Rpeak	148.336TFlops		2.93*6*2*4*88% efficiency= 123.7632Gflops
Nodes	88		88



# GPU SC vs CPU SC -Top500

	Formosa4-Rank234		CPU Cluster-Rank 237
Rmax	70.43TFlops		70TFlops
Rpeak	148.336TFlops		74.5472TFlops
Nodes	88	9.45X	832
Cost	1 million	4X	4 million
Electricity	91.98 KW	3.8X	350KW

# Target Market for GPU usage



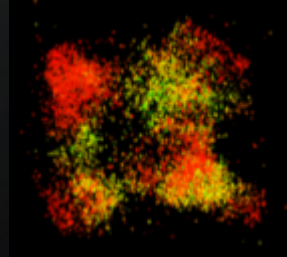
Molecular  
Dynamics /  
Quantum  
Chemistry

AMBER  
ABINIT  
DL\_POLY  
GROMACS  
LAMMPS  
MADNESS  
NAMD  
Q-Chem  
TeraChem



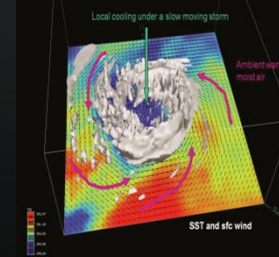
Computational  
Fluid Dynamics

OpenCurrent  
BAE Systems  
ANDSolver  
Euler Solvers  
Lattice  
Boltzman  
Navier Stokes



Astrophysics

N-body  
Chimera  
GADGET2  
Many published  
papers



Weather &  
Climate Modeling

ASUCA (Japan)  
CO2 Modeling  
(Japan)  
HOMME  
Tsunami  
modeling  
NOAA NIM  
WRF



Many More

- Materials Science
  - DCA++
  - gWL-LSMS
- Combustion
  - S3D
- Lattice QCD
  - Chroma (QUDA)

## ASUS GPU solution from Basic to Advance!

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ESC1000 G2

ESC2000 G2

ESC4000 G2 Series

RS920-E7 Series

Single Socket + 2 x16 Gen3

Dual Socket + 4 x16 Gen3

Dual Socket + 4 x16 Gen3

Quad Socket + 2 x16 Gen3

# ASUS® ESC1000 G2

Inspiring Innovation • Persistent Perfection

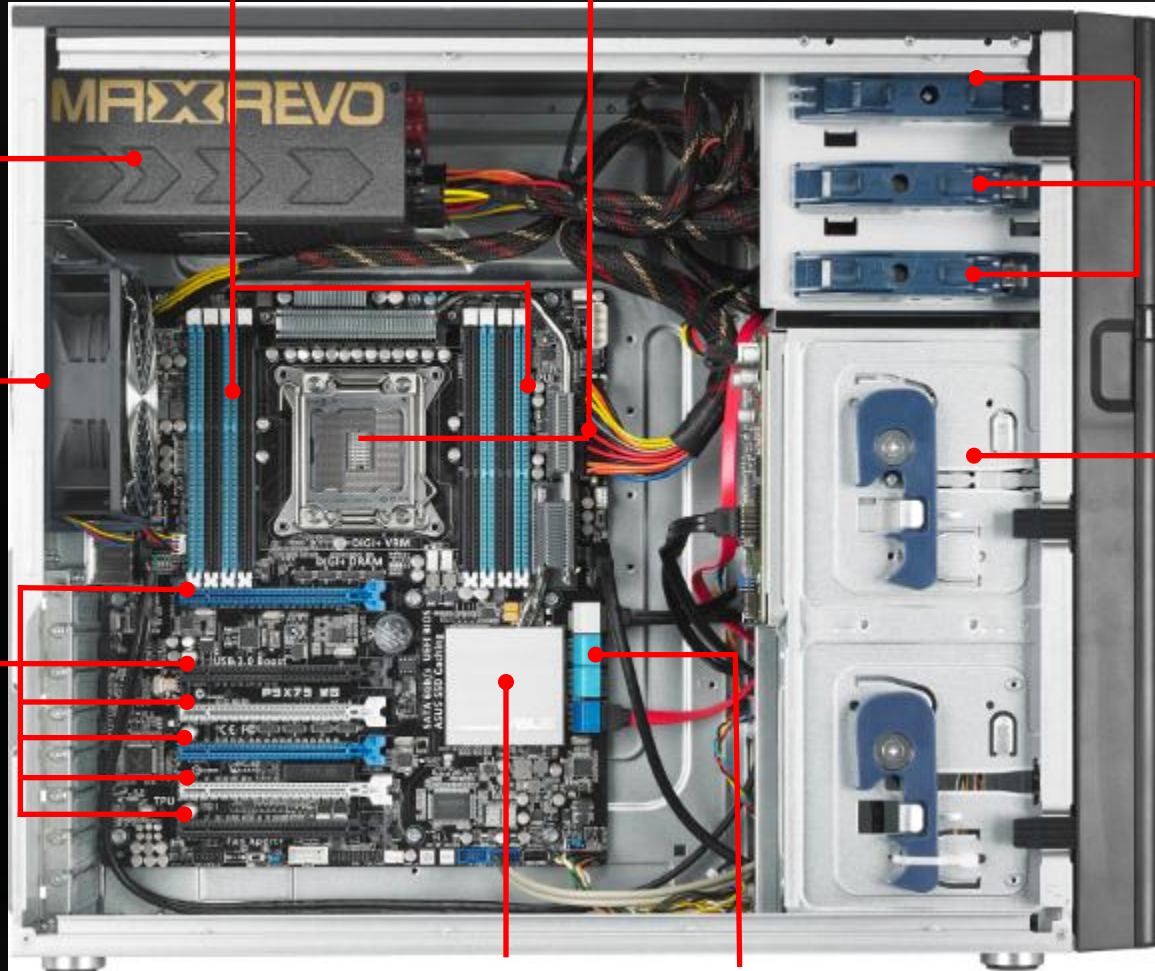
Intel® Xeon® E5-1600/Core i7-3900/3800  
Processor Family

8-DIMM DDR3  
1333/1600/1866(O.C.)/2000(O.C.)/2133(O.C.)/2400(O.C.)

80Plus Golden 1350W  
Single Power Supply

120 x 38 mm  
System Cooling Fan

6 \* PCI-E x16 slots  
(2\* Gen3 x16 or  
4\* Gen3 x8 link;  
2\* Gen3 x4 (white))



3 \* 5.25" media bays

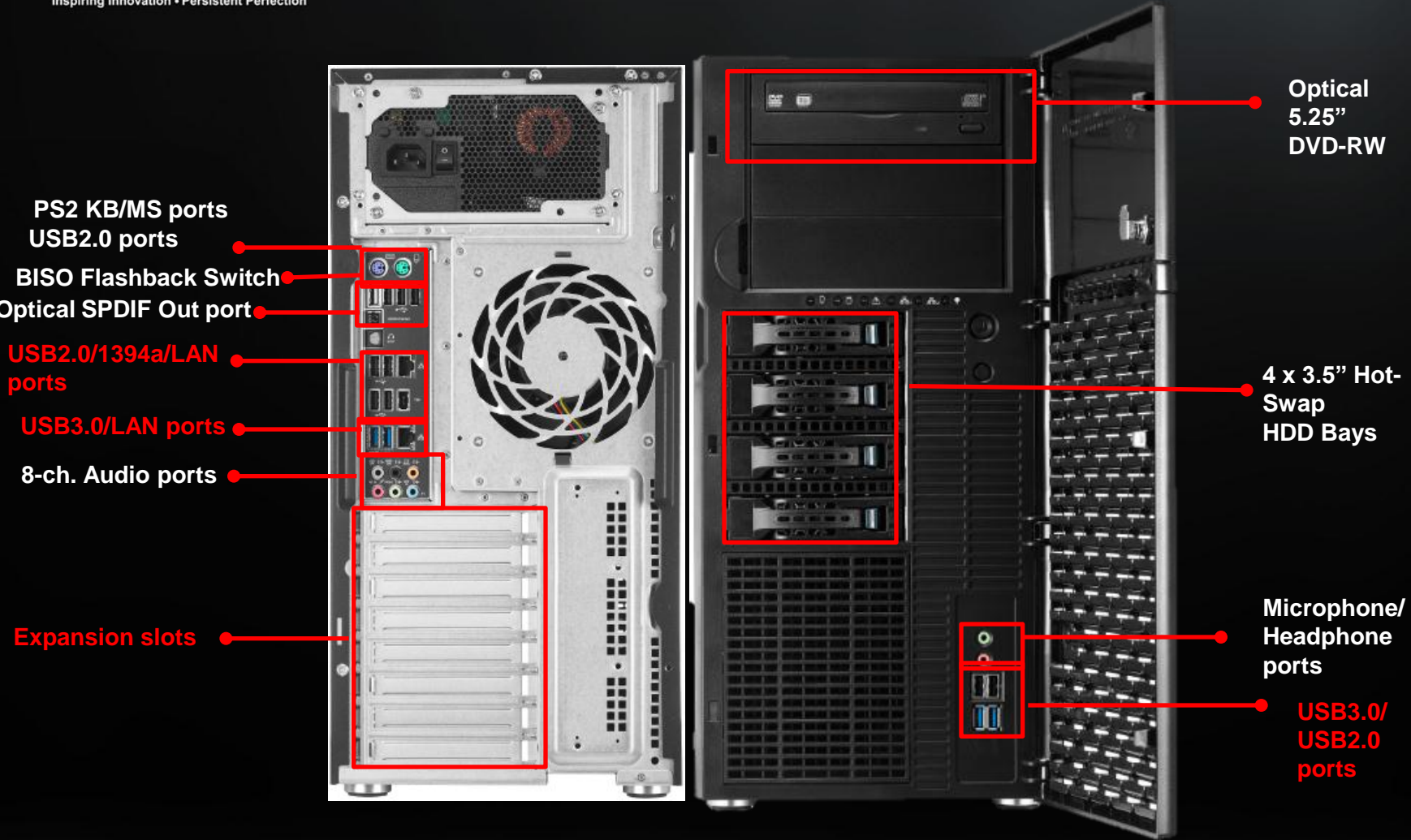
4 \* Hot-swap  
3.5" SATA HDDs Cage

Intel® X79 Chipset

4 \* SATA6G ports  
4 \* SATA3G ports

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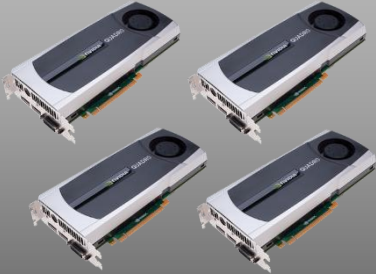
# ESC1000 G2



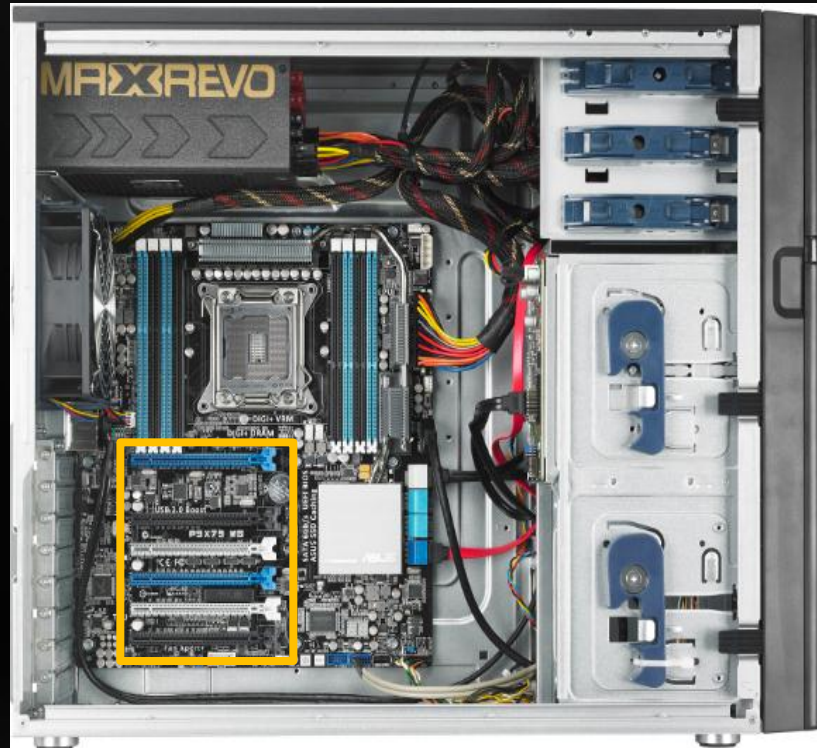
# Flexible Configurations

- 6 PCIe Gen3 x16 slots for Flexible Expansions
  - **Professional-oriented:** Full Compatible with Quadro GPUs
  - **Computing-oriented:** Tesla C-Series Cards for unmatched paralleled computing

## Quadro



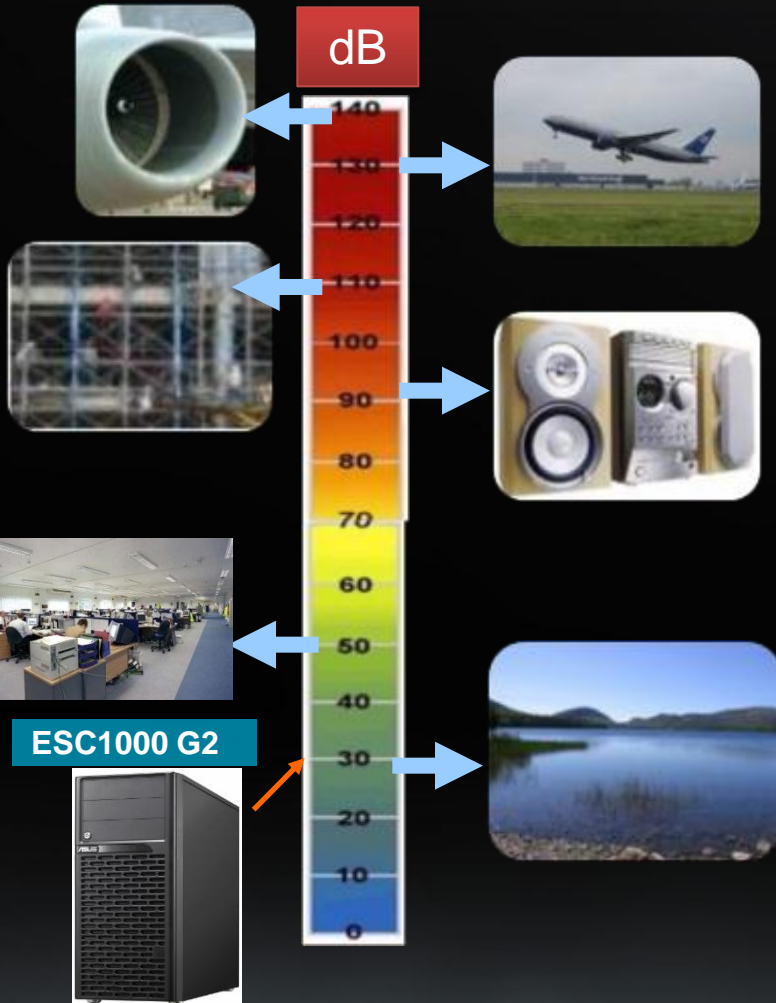
## Tesla



# Quiet Working Environment

## ■ Quieter Environment; Better Performance

- Intelligently detect system loading and auto adjust fan speed and power consumption
- Noise reduction to 30.3/28.3 (Air/Liquid) dBA\*



	Idle	Operating
<b>Air Cooling</b>	<b>30.3 dBA</b>	<b>40.2 dBA</b>

\* For CPU & PSU & chassis Fan, idle mode,  
Seagate 7200RPM HDD\* 4, Intel Xeon E5-1660,  
C2050\* 2, 1350W PSU

\* It is subject to change in different configuration

# ASUS SSD Caching



Convert 3GB ISO File From (C:) to (D:)  
**Transfer Time (sec)**  
(Lower is better)

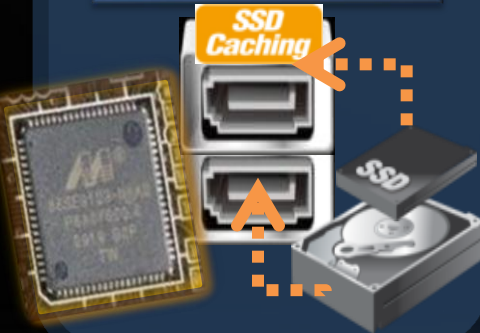
85s

27s

W/O  
SSD Caching

With  
ASUS SSD Caching

Plug in  
SSD/HDD



One Click &  
Caching



Test Configuration:  
-CPU : Intel E5 160 3.3G  
-MB : P9X79 WS  
-DRAM: Kingston KHX1600C9D3K2  
8GX \*4 16GB  
-VGA:ASUS ENGT220

- SSD: OCZ SOLID 3 60G  
- Serial ATA HD:WD WD1002FAEX 1TB  
- O.S: Win7 Ultimate 64bit



# ASUS® ESC2000 G2

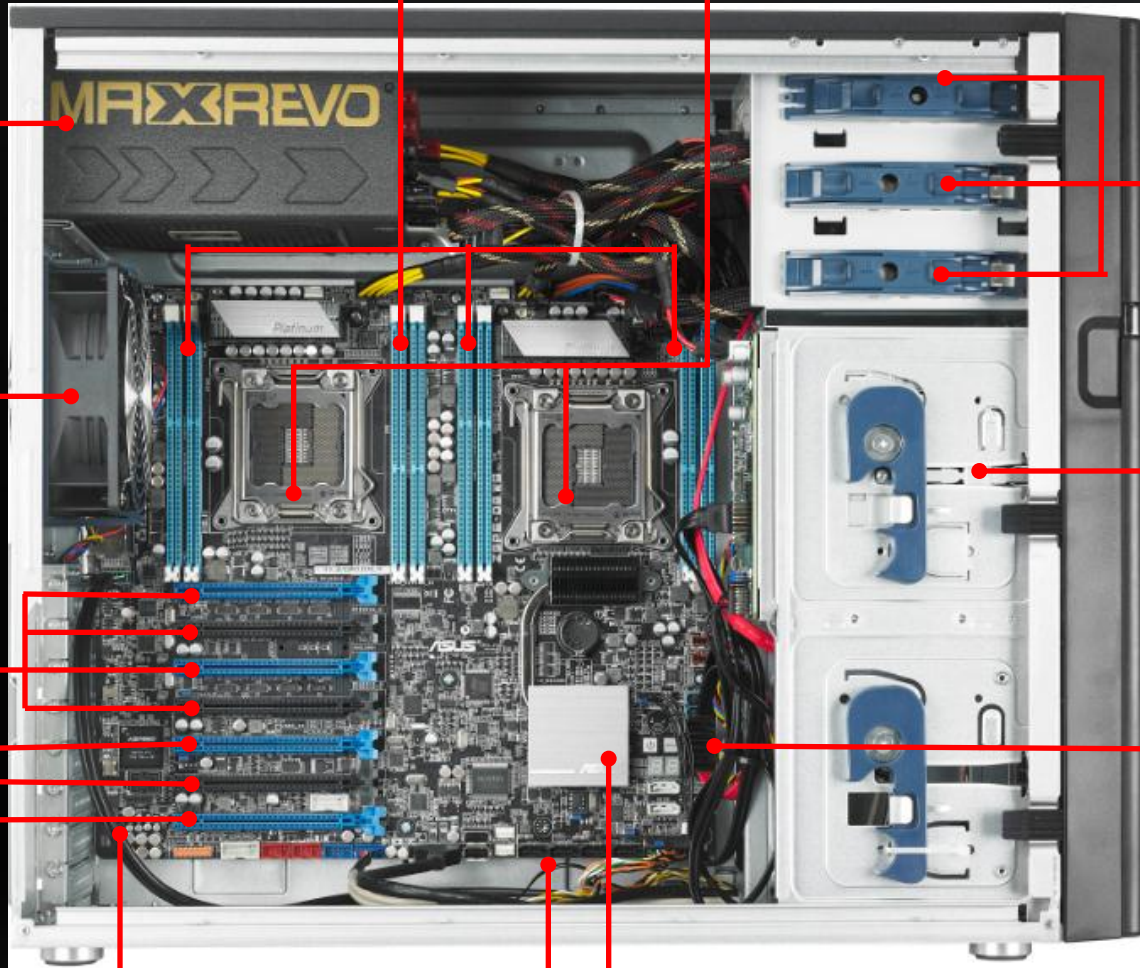
Inspiring Innovation • Persistent Perfection

8-DIMM DDR3

1333/1600/1866(O.C.)/2000(O.C.)/2133(O.C.)

Dual Intel® Xeon® E5-2600 Processor Family

80Plus Golden 1350W Single Power Supply



120 x 38 mm System Cooling Fan

3 \* 5.25" media bays

4 \* Hot-swap 3.5" SATA HDDs Cage

4 \* PCI-E x16 (2\* Gen3 x16 or 4\* Gen3 x8 link)

1\*PCI-E x16(Gen3 x16 link)

1\*PCI-E x16(Gen3 x8 link)

1\*PCI-E x16(Gen3 x16 link)

6 \* SATA6G ports  
4 \* SATA3G ports

ASMB6-iKVM(optional)

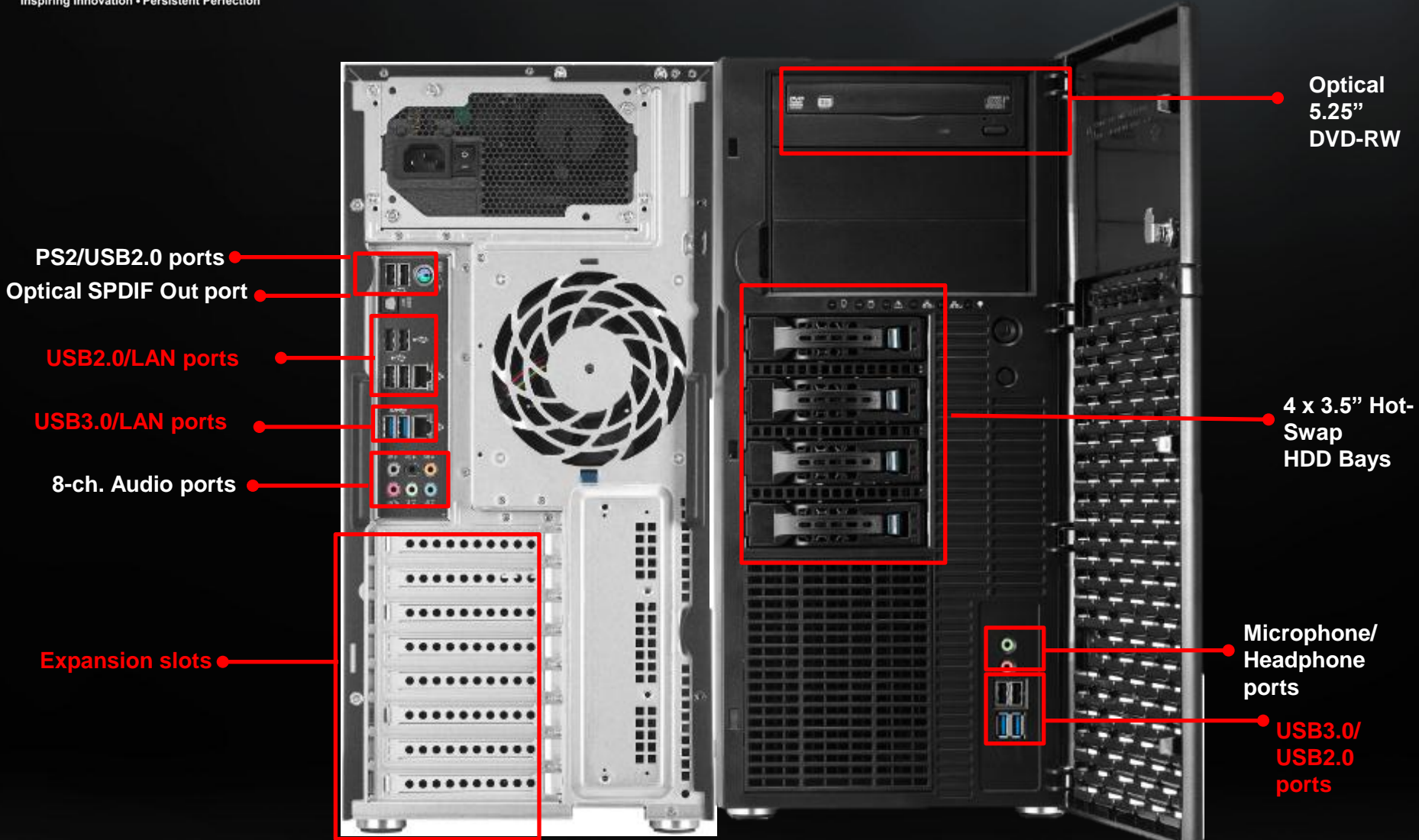
Intel® C602 Chipset

4 \* SATA 3Gb/s ports

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# ASUS<sup>®</sup> ESC2000 G2

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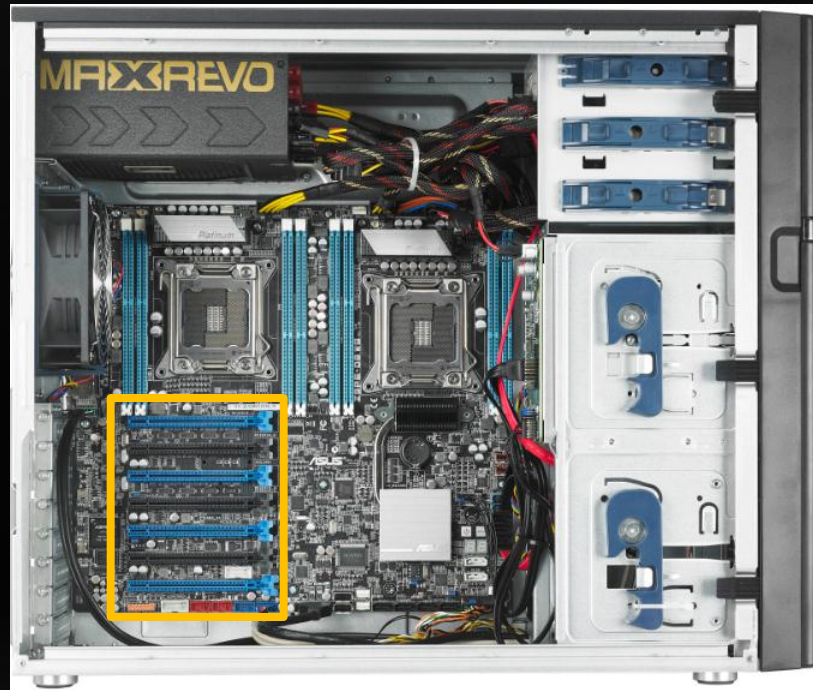
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  - **Computing-oriented:** Tesla C-Series Cards for unmatched parallel computing

## Quadro



## Tesla



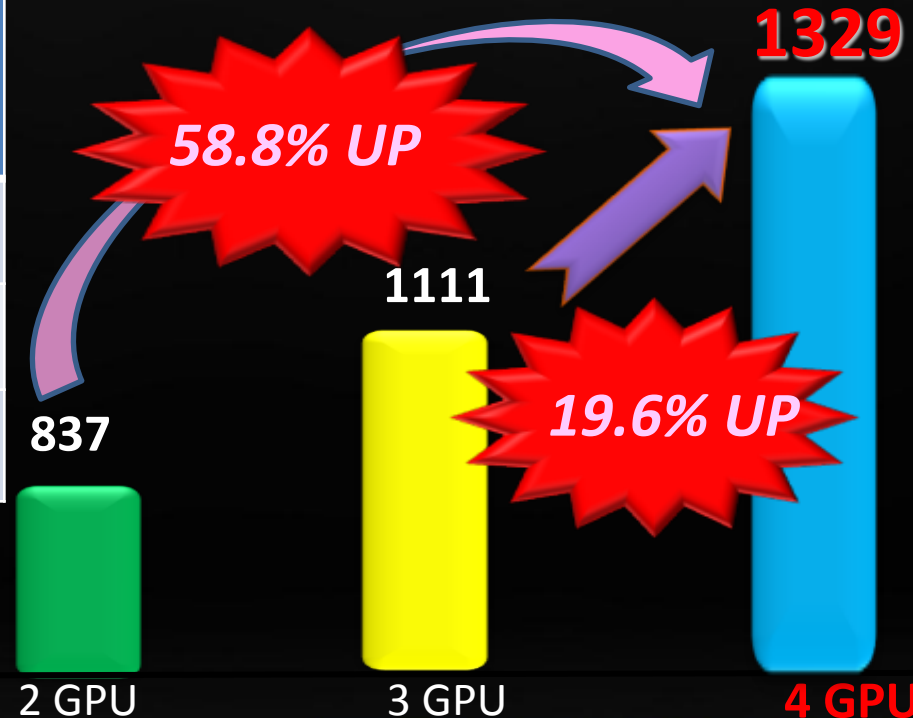
# ASUS<sup>®</sup> Hybrid Computing Power

Inspiring Innovation • Persistent Perfection

- Dual CPUs + Quad GPUs for Hybrid Computing Power
  - Support up to 150W dual processors
  - 4 True x16 PCIe Gen3 Links unleash GPU's Performance
  - Up to 1.3 Tflops parallel computing performance
  - At least **18.7%** performance gain than previous generation

## HPL Linpack Score (Gflops)

Linpack Performance (Gflops)	ESC2000 Xeon 5680*2 4G*18	ESC2000 G2 Xeon E5-2687W*2 8G*8	Gen-to-Gen
GPU x 2	705.3	837	<b>18.7%</b>
GPU x 3	N/A	1111	--
GPU x 4	N/A	1329	--



\* Test Configuration:

MB: Z9PE-D8 WS / CPU : Intel Xeon E5-2687W x 2 / DRAM: 8GB x 8  
 GPU: NVIDIA Tesla C2075 x 4 / O.S.: Fedora 14 x86\_64-bit / HDD:

**GPU** TECHNOLOGY CONFERENCE

# ASUS® CPU & Memory Overclocking

Inspiring Innovation • Persistent Perfection

## ■ CPU Overclocking on 2-Way Platform

- CPU BCLK Overclock-able from 100MHz to **105MHz\***
- **4.47% EXTRA** performance gain on CINEBENCH

**CPU-Z** Version 1.60.x64

**Processor**

Name	Intel Xeon		
Code Name	Sandy Bridge-EP/EX	Max TDP	150 W
Package	Socket 2011 LGA		
Technology	32 nm	Core VID	0.801 V

**Specification**

Intel(R) Xeon(R) CPU E5-2687W 0 @ 3.10GHz (ES)

Family	6	Model	D	Stepping	7
Ext. Family	6	Ext. Model	2D	Revision	C2

**Clocks (Core #0)**

Core Speed	1260.00 MHz
Multiplier	x 12.0 ( 12 - 31 )
<b>Bus Speed</b>	<b>105.00 MHz</b>
QPI Link	3360.00 MHz

**Cache**

L1 Data	8 x 32 KBytes	8-way
L1 Inst.	8 x 32 KBytes	8-way
Level 2	8 x 256 KBytes	8-way
Level 3	20 MBytes	20-way

Selection: Processor #1 | Cores: 8 | Threads: 16

Test Configuration:

MB:Z9PE-D8 WS / CPU : Intel Xeon E5-2687W x 2/4GB \* 8, Quadro FX3800

O.S.: Windows 7 x64

\* When adjusting BCLK frequency, you have to lower the QPI link from 8.0GTs to 6.4GTs

**CINEBENCH** RELEASE 11.5

OpenGL — Run

CPU **25.51 pts** Run

**Your System**

Processor: Intel Xeon CPU E5-2687W 0  
Cores x GHz: 16 Cores, 32 Threads @ 3.12 C  
OS: Windows 7, 64 Bit, Ultimate Edi  
CB Version: 64 Bit  
GFX Board: Quadro FX 3800/PCIe/SSE2

**Ranking**

Rank	System	Score
1	16C/32T @ 3.26 GHz, Intel Xe	26.65
2	16C/32T @ 3.12 GHz, Intel Xe	25.51
3	16C/32T @ 2.90 GHz, Intel Xe	24.73
4	16C/16T @ 2.90 GHz, Genuir	24.63
5	8C/16T @ 3.20 GHz, Intel Xeo	11.58
6	12C/12T @ 3.21 GHz, AMD O	10.41
7	8C/16T @ 2.92 GHz, Intel Xeo	10.33
8	12C/12T @ 3.18 GHz, AMD O	10.28
9	12C/12T @ 3.00 GHz, AMD O	10.14

■ Your Score ■ Identical System

**MAXON** 3D FOR THE REAL WORLD

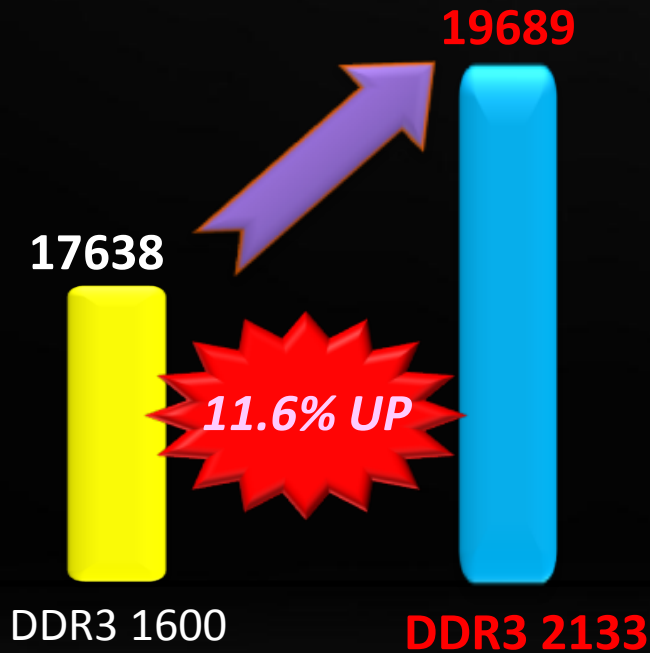
**GPU** TECHNOLOGY CONFERENCE

# ASUS<sup>®</sup> CPU & Memory Overclocking

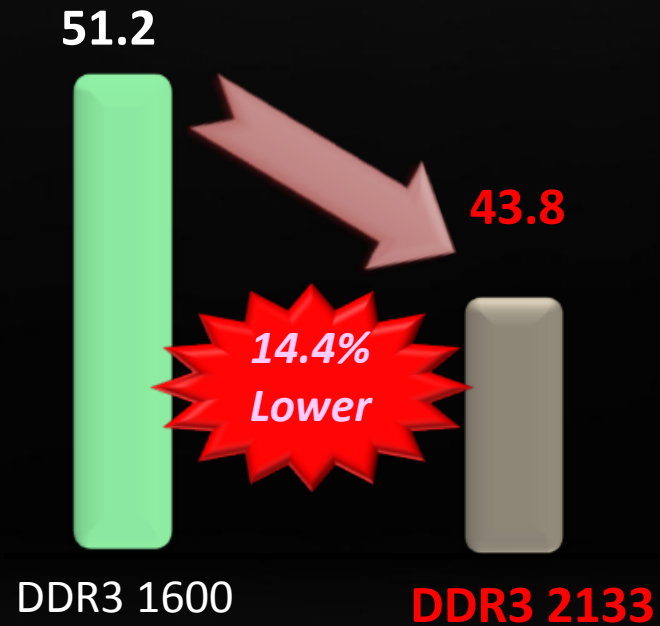
Inspiring Innovation • Persistent Perfection

- Memory Overclocking on 2-Way Platform
  - Up to **11.6%** memory read performance improvement
  - Lower **14.4%** Latency

Read Speed (MB/s)



Latency (ns)



Test Configuration:  
MB:Z9PE-D8 WS / CPU : Intel Xeon E5-2687W x 2/DRAM: 4GB x4  
O.S.: Windows 7 x6464-bit/

# ASUS SSD Caching



Convert 3GB ISO File From (C:) to (D:)  
**Transfer Time (sec)**  
(Lower is better)

85s

27s

W/O  
SSD Caching

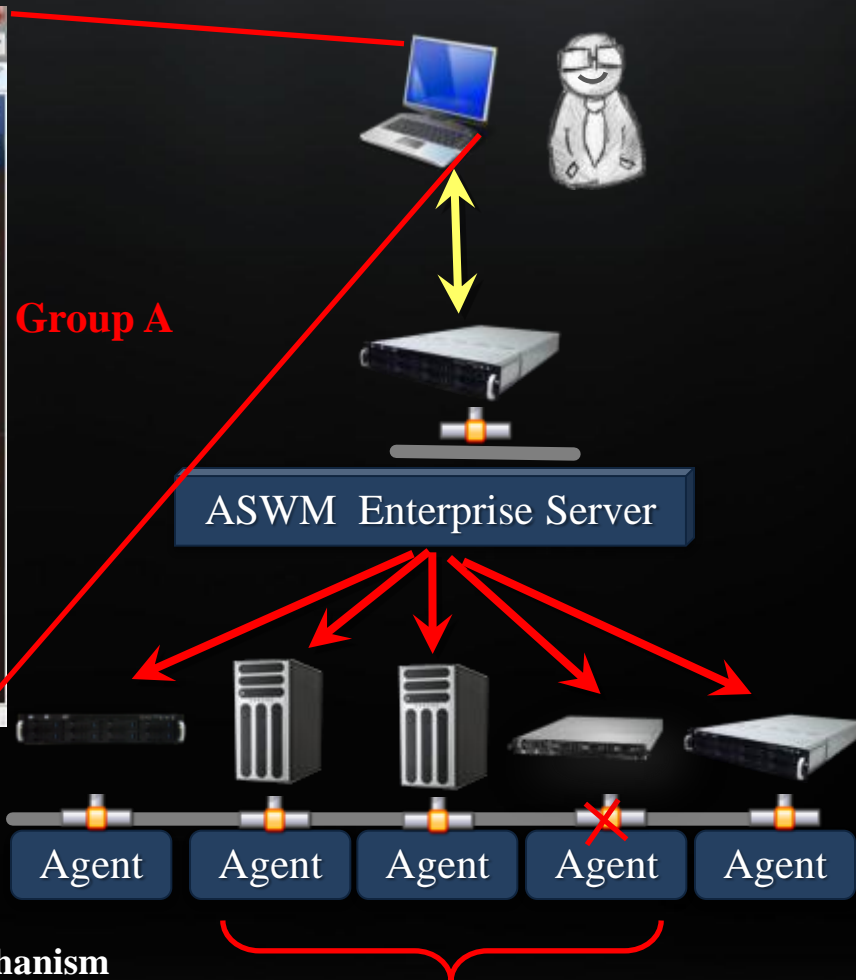
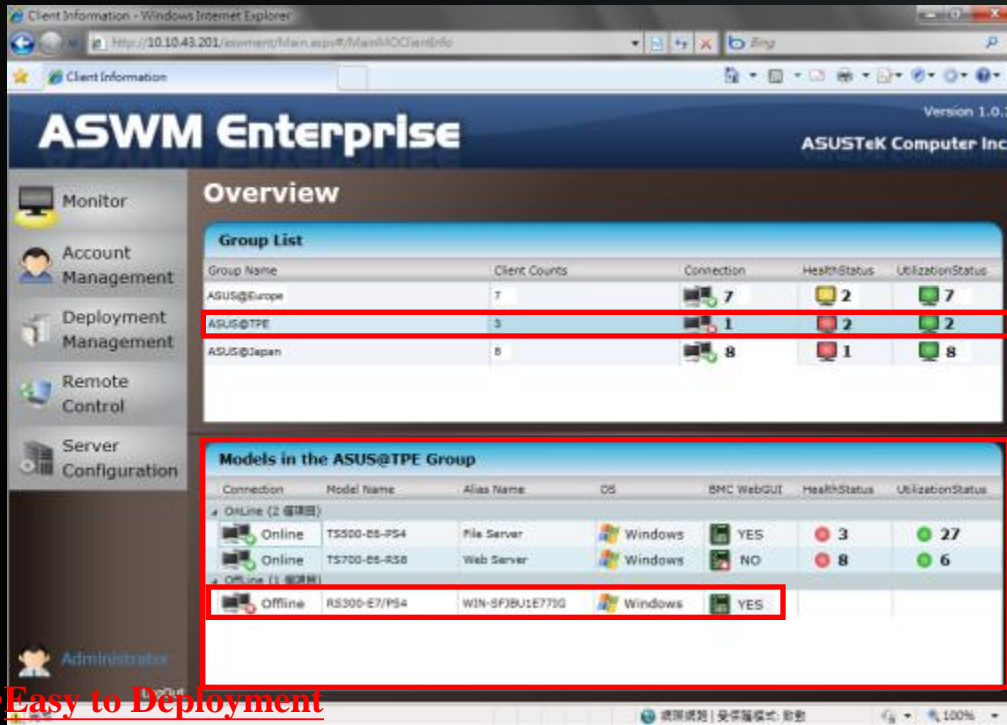
With  
ASUS SSD Caching

Plug in  
SSD/HDD

One Click &  
Caching

Test Configuration:  
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-MB : P9X79 WS  
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8GX \*4 16GB  
-VGA:ASUS ENGT220

- SSD: OCZ SOLID 3 60G  
- Serial ATA HD:WD WD1002FAEX 1TB  
- O.S: Win7 Ultimate 64bit



- Easy to Deployment
- Integrated Active Directory
- Support Manual Deployment
- Easy to Understand
- Traffic Light & Dashboard
- User Friendly UI

- Easy to Manage
- Centralized Management
- Asset Management
- A Variety of Notification Mechanism
- (Event Log, Email, SNMP Trap)
- Integrated BMC
- (SEL, ASMB Web GUI)
- BIOS Update



# ESC4000 G2 Series

Intel® C602 Chipset

16-DIMM DDR3 1333/1600

1+1 1620W 80+  
Platinum RPSU

InfiniBand FDR\*

8 \* Hot-swap  
3.5" SAS/SATA  
HDDs Cage

8 \* PCI-E x16  
( 4 \* Gen3 x16 or 8 \* Gen3 x8 link)

Dual Intel® Xeon® E5-2600  
Processor Family

7 \* System Cooling Fan

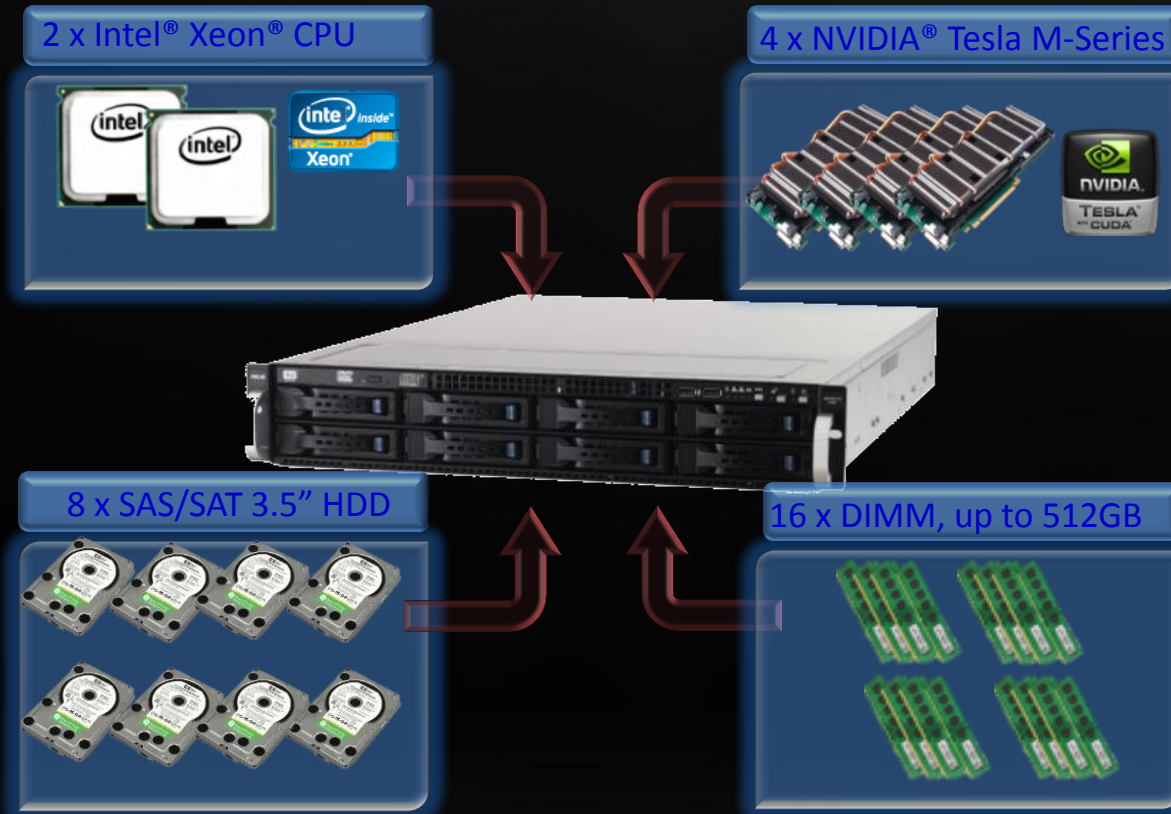
1 \* PCI-E x16 ( Gen3 x8 ) or  
1 \* PIKE slot (optional)

\*only for ESC4000/FDR G2 SKU

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## Hybrid Computing of High Density

- Ultra-high density solution in 2U system
- **2** CPUs(up to **135W**), **4** double-deck GPUs, **8** HDD Bays and **16** DIMMs

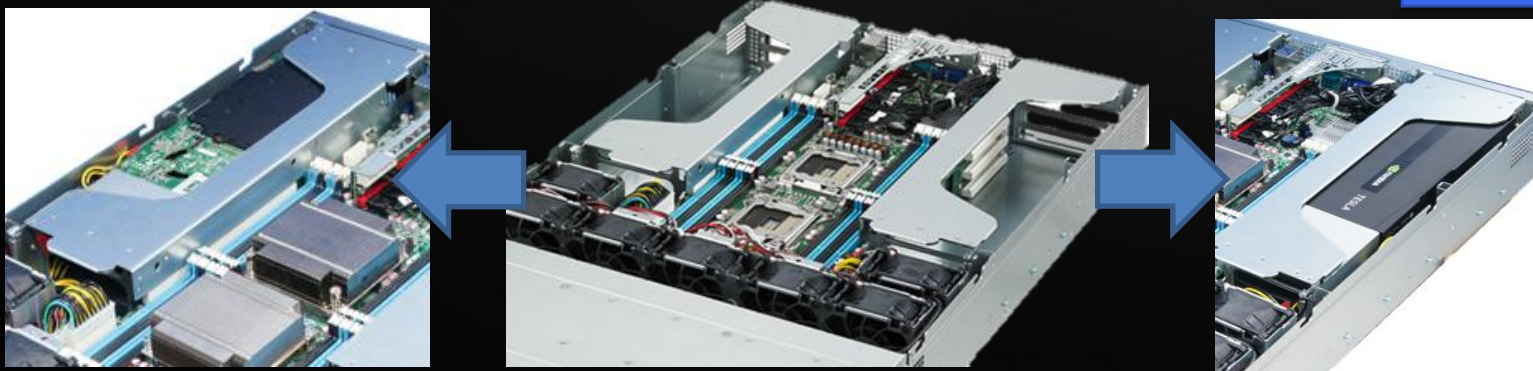


# 8+1 Flexible Expansion Configuration

*Fully Unleash GPU's Computing Power*

- Up to 8 PCI-E Gen3 x16 slots for expansion
- Compatible with versatile expansion cards

4 double-deck  
graphic units  
support



## "And 1" expansion slot

- Bundled risers for LP/HL PCI-E card & PIKE Solution

PIKE

HL/LP  
PCI-e

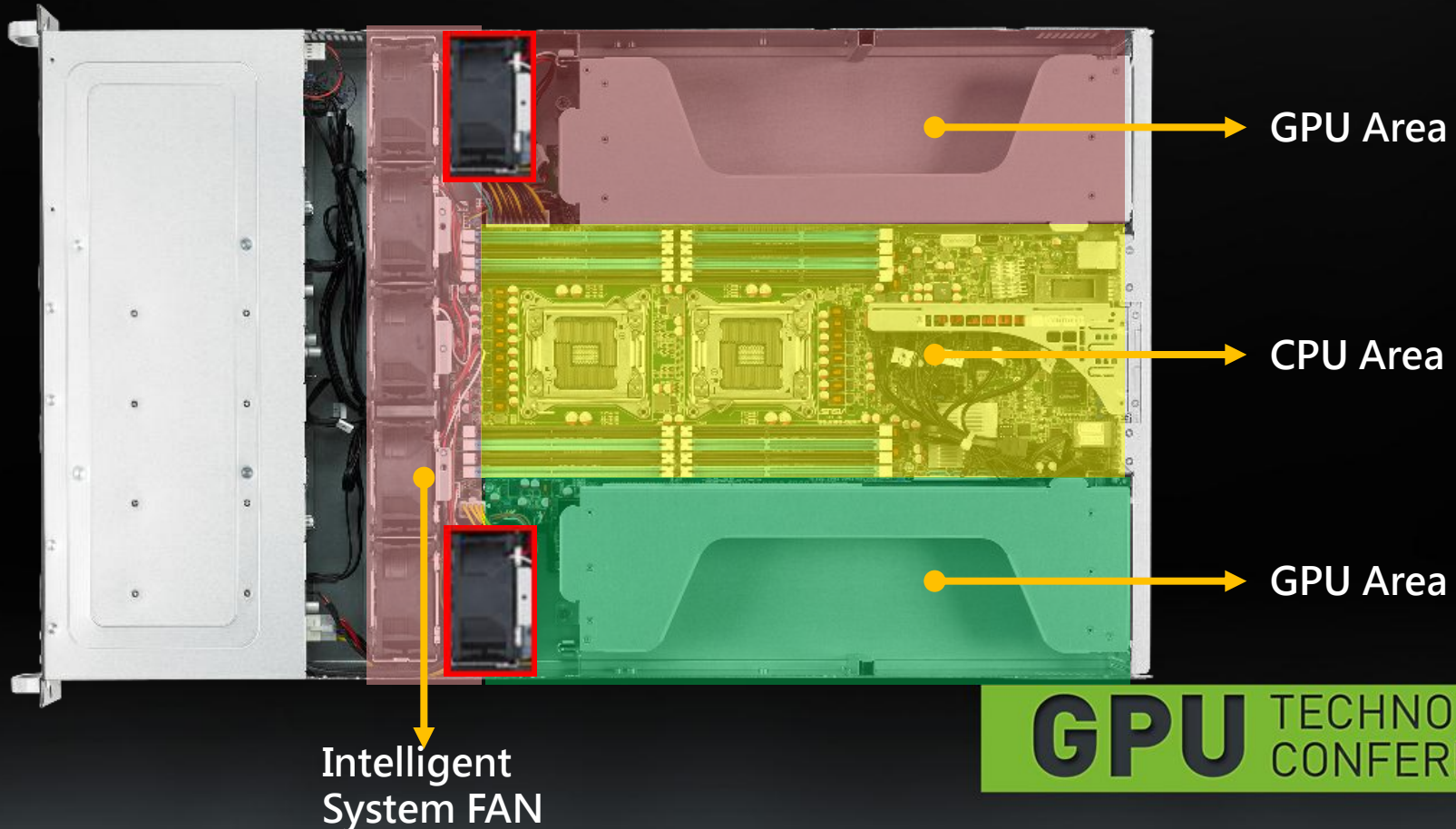


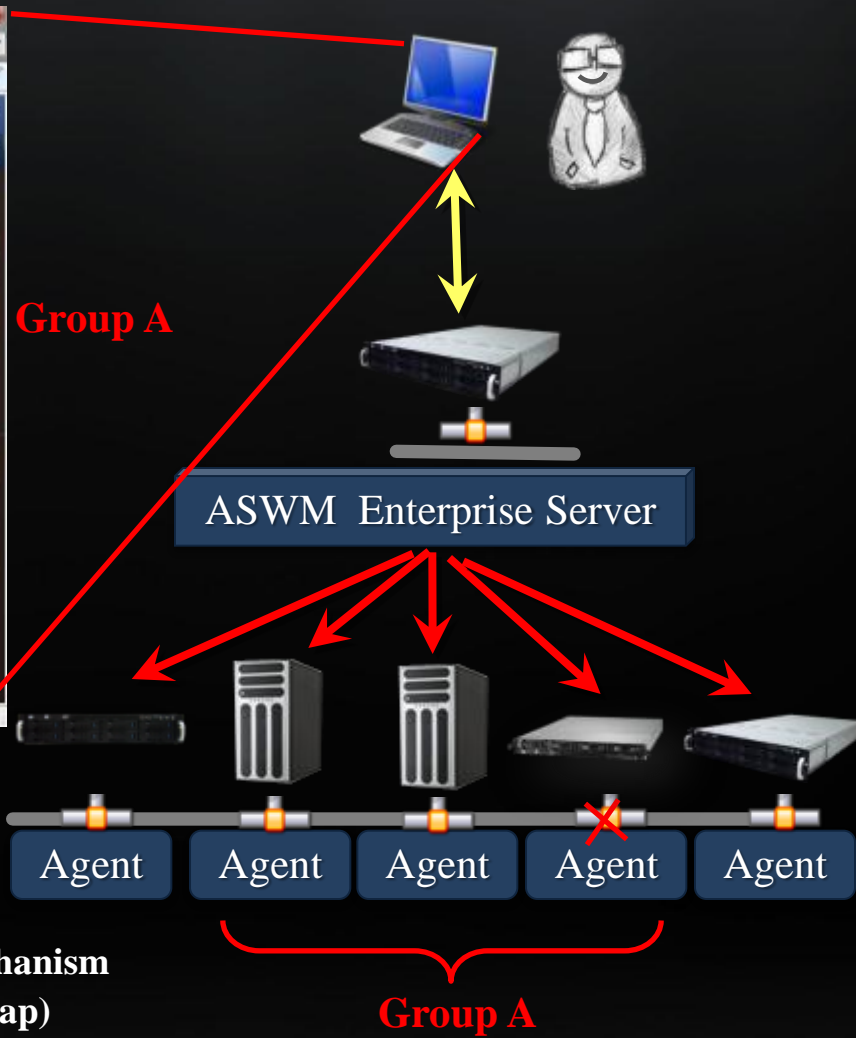
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\*With PCIe/PIKE riser card

## *Dynamic Adjustments of Independent Thermal Areas*

- Independent smart FAN for each area of GPU and CPU separately
- **Duo-FAN** design for thermal back-up solution of GPU cards





**• Easy to Deployment**

- Integrated Active Directory
- Support Manual Deployment

**• Easy to Understand**

- Traffic Light & Dashboard
- User Friendly UI

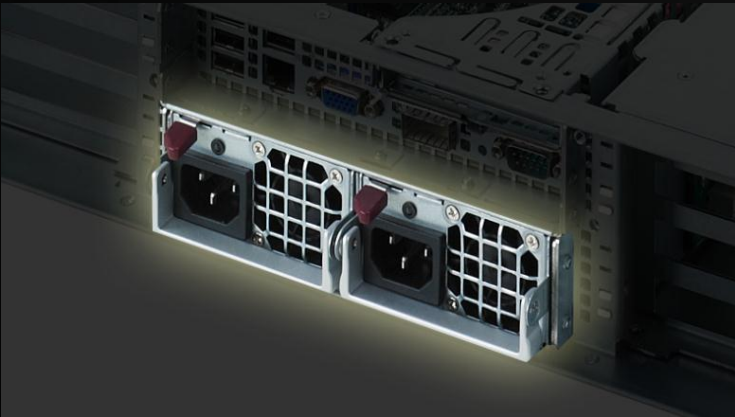
**• Easy to Manage**

- Centralized Management
- Asset Management
- A Variety of Notification Mechanism
- (Event Log, Email, SNMP Trap)
- Integrated BMC
- (SEL, ASMB Web GUI)
- BIOS Update

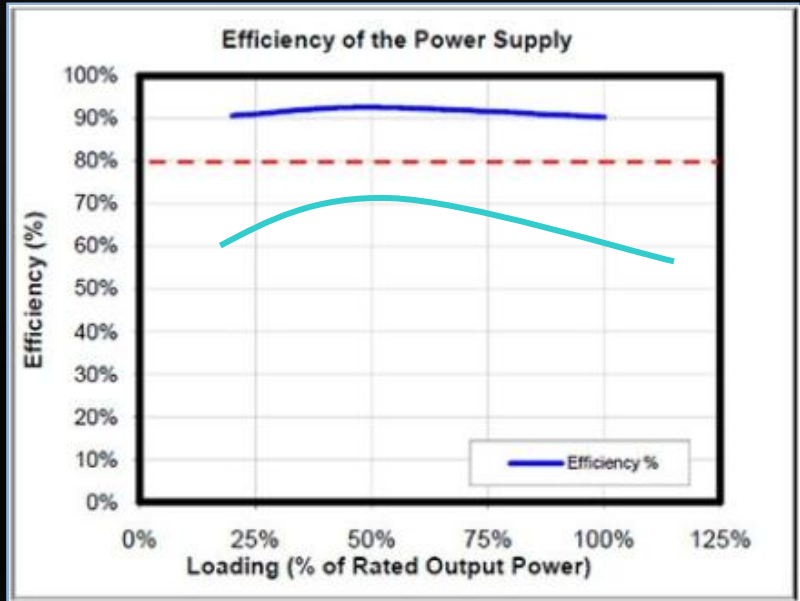
## Hot-Swap Features for online service



- Up to **94%\*** power efficiency for energy saving
- Lower power loss, better power efficiency, saving more TCO



— 80+ Platinum PSU Power Efficiency  
— Non-80 PLUS PSU Power Efficiency



\*at 50% output loading, 230Vac



## Quad Lan

- High networking bandwidth
- Ideal for Virtualization Applications



## High Power Efficiency

- 1+1 Redundant 1620W 80PLUS (Platinum level) power supply

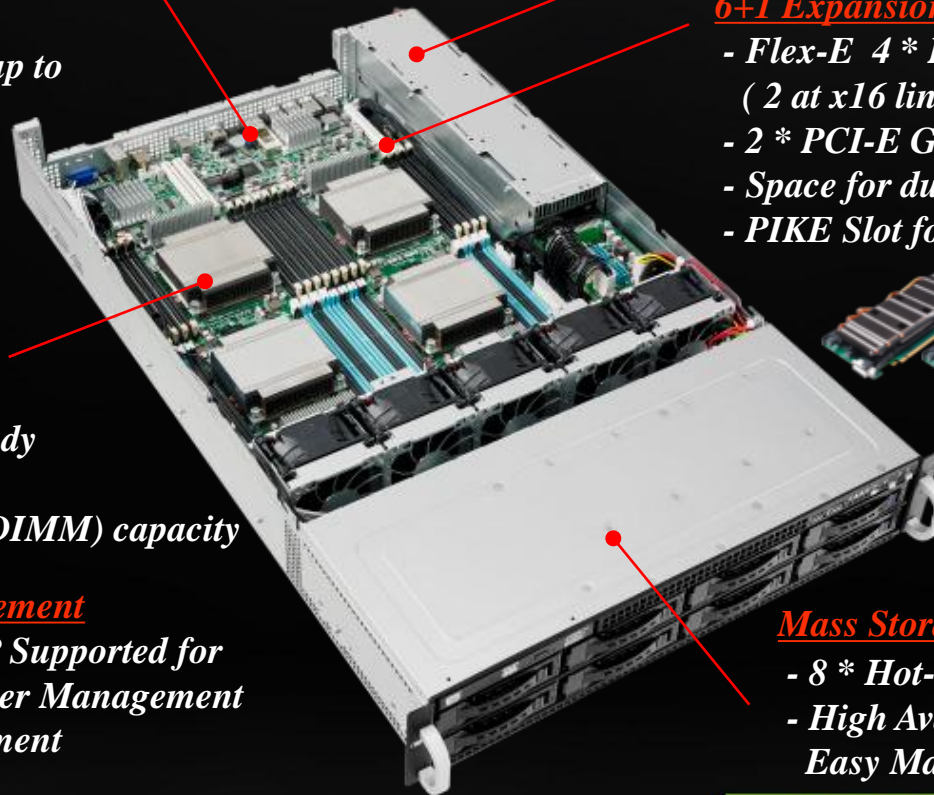
## High-Speed Interconnection

- On-board InfiniBand FDR up to to 56Gbps transfer rate



## 6+1 Expansion Slot

- Flex-E 4 \* PCI-E G3 x16 slots ( 2 at x16 link or 4 at x8 link)
- 2 \* PCI-E G3 x8 slots(x8 links)
- Space for dual double-deck GPU module
- PIKE Slot for ASUS PIKE RAID card



## Outstanding Computing Power

- Quad Processors Platform ready for Romley-EP 4S
- 32 DIMMs, up to 1024GB (RDIMM) capacity

## Comprehensive Server Management

- IPMI 2.0 with KVM-over-IP Supported for Out-of-Band & Remote Server Management
- ASWM-Enterprise Management Software

## Mass Storage Capacity

- 8 \* Hot-Swap HDD Bays
- High Availability and Easy Maintenance

# 4 CPUs + 2 GPUs Hybrid Power

- *Quad PCI-E Gen3 x16 slots (2 at x16 or 4 at x8 link)*
- *Support Full-length & Full-height cards for flexible expansion in 2U*

Two Double-deck Graphic Card in 2U System



## Intel 4-Way System



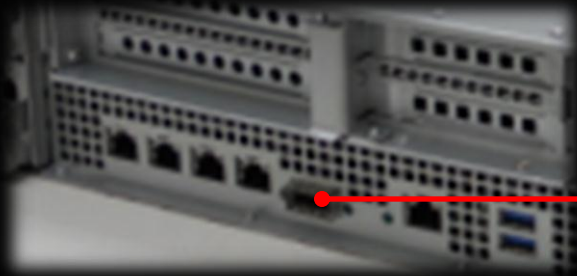
*2 x double-deck  
graphic/GPU card  
support*





# High-speed Interconnection

- *InfiniBand FDR on board (RS926-E7/RS8)*
- *56Gbps inter-connective performance*
- *High-speed interconnection for data centers, cloud-computing and HPC (high-performance computing)*






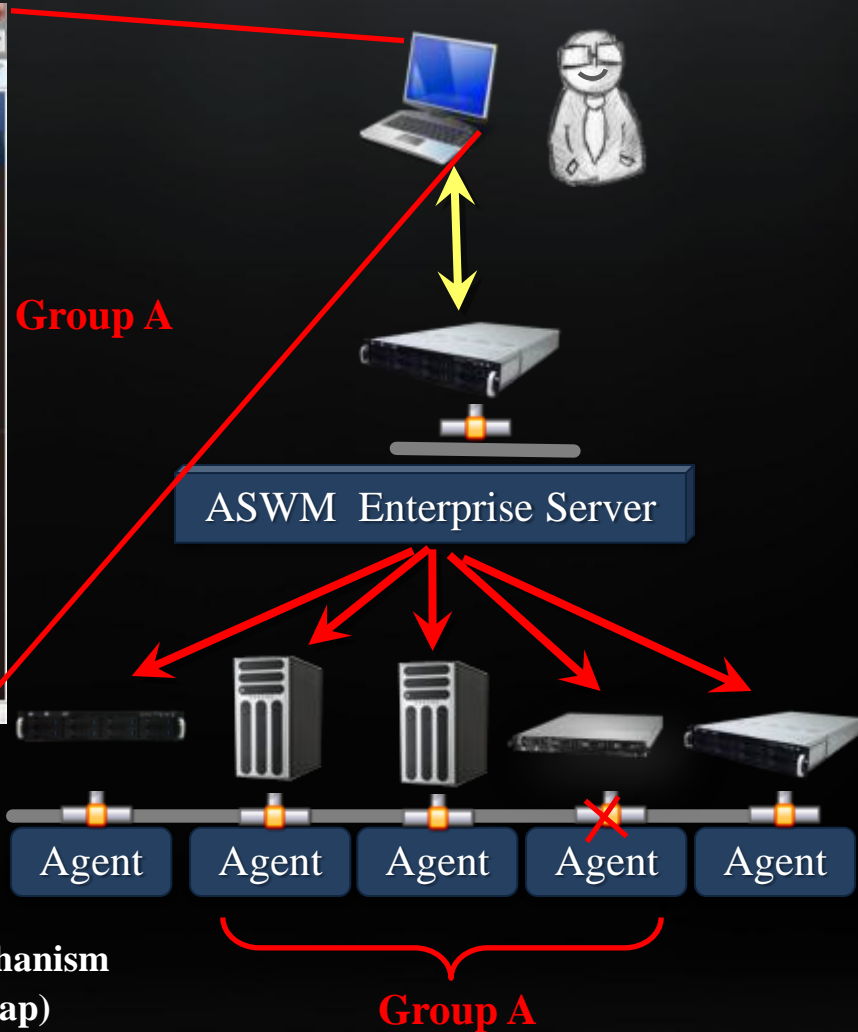
**InfiniBand QDR (56Gb/s)  
with QSPM port**

# ASUS Exclusive PIKE Solution

- *Flexible to upgrade SAS **6Gb** interface*
- *Full-compatible & cost-effective RAID solution*
- *No expansion slot is occupied for the upgrade*



<i>Model</i>	<i>Ports</i>	<i>RAID Support</i>	<i>Interface</i>	<i>Cache Protection</i>	<i>Photos</i>
<b>PIKE 2108</b>	<b>8-port SAS2</b>	<b>H/W RAID 0, 1, 10, 5, 6, 50, 60</b>	<b>PCI-E Gen 2</b>	<b>BBU07 BBU08</b>	 •Chipset : LSI SAS2108
<b>PIKE 2008</b>	<b>8-port SAS2</b>	<b>RAID 0, 1, 10, 1E</b>	<b>PCI-E Gen 2</b>	--	 •Chipset : LSI SAS2008
<b>PIKE 2008 IMR</b>	<b>8-port SAS2</b>	<b>RAID 0, 1, 10, 5, 50</b>	<b>PCI-E Gen 2</b>	--	 •Chipset : LSI SAS2008



**• Easy to Deployment**

- Integrated Active Directory
- Support Manual Deployment
- Easy to Understand
- Traffic Light & Dashboard
- User Friendly UI

**• Easy to Manage**

- Centralized Management
- Asset Management
- A Variety of Notification Mechanism
- (Event Log, Email, SNMP Trap)
- Integrated BMC
- (SEL, ASMB Web GUI)
- BIOS Update



# Q & A

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