Application Optimized GPU System Solutions: Winning Strategies for Selecting Best Platforms

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Session Overview

- **GPU Hardware System Challenges and Tradeoffs:**
  - Form Factors / Density
  - Power Budgets / Power & Thermal Efficiencies
  - CAPEX & OPEX Targets / Performance Expectations
  - Compressed Deployment Schedules / Compatibility / Manageability / Serviceability

- **What’s the “Right” hardware Platform?**
  - Hint: This is a loaded question

- **Session Goal:**
  - To gain a basic perspective of available system architectures in order to select optimized GPU System Platforms
Supermicro Corporate Overview
Supermicro Overview

- Founded in 1993, headquartered in Silicon Valley, USA (NASDAQ 2007: SMCI)
- **Time-to-Market Leader** in server technology innovation and green computing
- **Broaderest server portfolio** in the industry:
  - Multi-Use Building-Block approach / In-House design
- **Application-optimized**, high-efficiency servers, GPU systems, blades, networks, storage and workstations are deployed globally across data centers, HPC and mission critical IT infrastructures

*Profitable EVERY year of existence*
Supermicro – A Global Server Company

**Global Footprint:** >70 Countries

**Production:** Logistics Centers in **USA, Asia** and **EMEA**

**Engineering:** Over 50% of workforce in engineering

**Market Share:** >10% Server-unit share = #4 WW unit rank
(#1 in traditional server distribution channel)

**Customers:** Diverse Base: Channel, SI/VAR, OEM, Direct

**Corporate Focus:** Product Driven Server Technology

(Earth-Friendly, Energy Efficient, High-Density)
Technology Driven: Time-to-Market Advantage

- Broadest IT, HPC & Data Center solutions available in the industry
- Leader in high efficiency computing solutions

New Generation Server Solutions

- FatTwin™ F627R3 Series
- FatTwin™ F627R2 Series
- Twin Systems
- 2U Twin® 2027R-HTRF
- 2U Twin® 6027R-DTRF

Data Center Optimized (DCO)

- 1U SuperServer® 6017R-TDF
- 1U SuperServer® 6017R-751RF
- Wide I/O (WIO) Optimized
- 2U SuperServer® 2027R-WRF

Power Supplies / UPS Backup

- High-Efficiency (95%) Digital Switching Technology
- Battery Backup Modules

UP & Mainstream

- GPU SuperBlade®
- GPU SuperWorkstation 7047A-T
- SC625/615 Chassis
- SC118G/818G Chassis

SuperStorage

- 4U 38x HDDs 6047R-E1R36N
- 3U MicroCloud 5037MR-HSTRF
- 4U 24x HDDs 6047R-E1R24N
- SC625/732/733/826 Chassis

SuperBlade®

- TwinBlade® 10x SBI-7227R-T2
- DatacenterBlade® 14x SBI-7427R-53/73
- GPU Blade 10x SBI-7127R6
- Storage Blade 10x SBI-7127R-S6

Complete Integrated Rack Solutions

- 42U SuperRack®
- 14U SuperRack®
- SSE-X3485/SR 48 Port 10GBase w/ 4 Port 40GBase
- SSE-X245/SR 24 Port 10GBase
- SSE-G48-TG4 1/10 GBase

Software

- Complete Rack Solutions
Strong Core Foundation

EXAMPLE: in the last 24-26 months:

- >90% Engineering resource increase
- >3X Facility Expansion & Logistics Capability
- Established Complete rack installation, validation & shipment process
- Established software & on-site service capability
- Built network & switch business unit

Computing • Communication • Content • Culture • Connectivity
Our engineers enjoy the challenge. They are doing something that will help them make money, help customers save money, and help our Earth – they are very proud of this.

- Charles Liang
GPU Server Solutions

Overview
Supermicro GPU Servers - OVERVIEW

1U UP – Value

- 1017GR-TF
- 5017GR-TF

# of GPU per node: n

1U/2U DP, Scalable, High Density

- 1027GR-72R2
- 1027GR-72RT2
- 1027GR-TR2
- 1027GR-TRT2

NEW

- 2027GR-TRFH
- 2027GR-TRFHT

- 1027GR-TRF+
- 1027GR-TRFT+

- 2027GR-TR2
- 2027GR-TRT2

- 2027GR-TQF
- 2027GR-TQFT
GPU Servers

3U & Above – Powerful

- 7047GR-TPRF
- 6037R-72RFT+
- GPU FatTwin
  - F627G3-FT+
  - F627G3-F73+
  - F627G3-F73PT+
  - F627G2-FT+
  - F627G2-F73+
  - F627G2-F73PT+
- GPU Blade
  - SBI-7127RG-E
- SYS-F647G2-FT+/FTPT+
- SYS-F647G2-F73+/F73PT+
- SYS-4027GR-TR
- SYS-4027GR-TRT
Typical Questions to Ask

- What kind of application?
  - Oil & Gas, HPC, Computational Finance → Tesla K10/K20/K40
  - Virtualization → GRID K1/K2/K520/K340
  - Graphical design & simulation, media and video production → Tesla K20C/K40C and Quadro K5000

- Form Factors?
  - Standard Rackmount vs. Blade

- Any power or network specification?
  - 12K or 15K power rail for 42U rack → 2U or 4U GPU server
  - IB card, FPGA card, or GPU sync card → 4U or 2U 6GPU
Performance vs. Efficiency Tradeoffs

- Scale-up / Scale-Out Performance Boosters
  - **SCALE UP:**
    - Maximize GPU / Node
    - Maximize Cache & System Memory
    - Optimize Thermals and Power
  - **SCALE OUT:**
    - Maximize # Nodes
    - Faster / Efficient Interconnects
    - Optimize chassis and racks
    - Optimize Thermals and Power

- **Key:** Match Performance Resources with Optimized Architecture.

**Supermicro power supplies (often >94% electrical efficiency) and cooling subsystems are designed to support maximum performance at higher loading (>80%) ... greater utilization yields greater overall system efficiency.**
Performance vs. Efficiency – Industry Trends

Energy Efficiency Requirements

HISTORICAL CONTEXT

1.5 MWatts / PFLOP

2014 < 0.33 MWatts / PFLOP

GigaFLOPs Challenge

TeraFLOPs Challenge

PetaFLOPs Challenge

Scalability and Performance / $$$

SMP / MPP
Proprietary Solutions

Commodity Components
General Purpose, off the shelf PC cluster

Efficiency & Density
Performance / Watt / FT²

Hybrid System
CPU + GPU

App. Optimized
Blades or High Density, High Efficiency Servers

Energy Efficiency Requirements


Performance

PFLOPs

TFLOPs

GFLOPs

MFLOPs
Performance / Watt improvement:

- Proprietary processor designs
- GPU Accelerators crack Top-10
- Special cooling subsystems
Confidential

Green500 #1 (Nov., 2013)

Green Top-10 all employ Heterogeneous GPU Architectures

http://www.supermicro.com/products/nfo/Green500.cfm

Tokyo Institute of Technology

Top500 #311 (~4.5GFLOPS per Watt)

GSIC Center, Tokyo Institute of Technology
is ranked 1st
on the world’s Green500 List of computer systems as of November 2013

The Green500
sponsored by
Supermicro®

This certificate is in recognition of your organization's achievements in reducing the environmental impact of high-performance computing.

Heterogeneous GPU Architectures

Complete Solution: NEC / SMCI 1U Server x 40

NEC/SMCI 1U Server x 48 Nodes: Each node:
- 2x Intel Xeon 5620 2.4GHz 8-Core
- 1x NVIDIA Tesla C2050 GPU
- 16GB DDR3 memory
- 12GB 950
- 4x 800GB (Raid 10)
- Total Peak: 210TFlops (SP) / 630TFlops (DP)


- Fluid Submersion Cooling + Outdoor Air Cooling = High Density GPU Supercomputing in a 20-feet container (16m²)
- Cooling Tower: Water 25-30°C ↔ Outdoor air

- World’s top power efficiency (~50FLOPS/kWatt)
- Average PUE 1.35, lower component power
- Field test GPU-HPC results, TBS/BARE3.0 Prototype
Scale Up Trends

● **Maximize GPU / Node**
  - Previous: 2 GPU / 1U, 4GPU/4U, 8GPU/3U* (in 3 chassis)*
  - Emerging: 6 GPU / 2U, 8GPU/4U, 4GPU/1U

● **Maximize Cache & System Memory**
  - Previous: 192-256GB / Node
  - Emerging: > 1TB / Node

● **Optimize Thermals and Power**
  - Previous: Redundant power not available in 1U, 1200-1400W / enclosure
    Node level IPMI
  - Emerging: Redundant Power in all form factors, 2000-3000W with higher system cooling efficiency
    Higher Efficiency Rack / System Level IPMI
DP GPU Server: SYS-2027GR-TR2/TR2

- Motherboard: X9DRG-HF+II/HTF+II
- 2U Chassis: 218GH-R1K65B

Key Features
- Support up to 4 or 6 double width GPU cards (K10/K20M/K20X/K2/K1)
- 16 DIMM, up to 512GB memories
- Platinum level 1600W power supply
- Optional rear fans to support 300W GPU cards
- Optional two by 8 rear I/O add on card slots
- Available Now

Processor Support
Dual Intel® Sandy/Ivy Bridge EP (Socket R) series CPU

Memory Capacity
16 DIMM, Max of 512GB Reg. ECC DDR3 up to 1600MHz

Expansion Slots
4 PCI-e x16 Gen 3 for double width GPU cards
1 x4 (in x16 slot) and 1 x8 (in x16 slot) LP card

I/O ports
1 VGA, 2 Gbit LAN, 2 USB 2.0, and 1 IPMI dedicated LAN port.

Drive Bays
10 hot-swap 2.5” drives bays

System Cooling
5 counter rotating fans with optimal fan speed control
1 air shroud

Power Supply
1600W Platinum level efficiency redundant power supply

Key Application
- Computational Finance
- HPC/Oil and gas
- Weather and Climate Analysis
GPU Solution

Fat Twin = Best Performance / Watt / $ / ft²

- 2 nodes in 4U, Front I/O
- Dual Intel Xeon CPU
- Up to 16 DIMM, 512GB memory
- 6 GPUs per node
- 2 additional PCI-E Gen 3 x8 slots
- 8 x 2.5” hot-swap SAS/SATA/SSD
- 10GbE onboard option
- 2308 SAS2 on board optional
- High efficient 2000W redundant power supply
- Hot-swappable cooling fans

SYS-F647G2-FT+/FTPT+
SYS-F647G2-F73+/F73PT+
4U 8GPU Solution

Best Performance & Cooling design

- 4U rack mount, within 30”
- Dual Intel Xeon CPU, up to 150W
- Up to 24 DIMM, 768GB memory
- 8 GPUs, up to 300W per GPU
- Dual 10GbaseT or GbE port onboard
- One dedicated IPMI 2.0 port
- 3 additional full-height, full-length PCIe slots (2 x8 Gen3 and 1 x4 Gen2)
- 24 x 2.5” hot-swap SAS/SATA/SSD
- High efficient 1600W redundant power supply (up to 4)

SYS-4027GR-TR
SYS-4027GR-TRT
4U 8 GPU Solution

**Advantages**
- GPU density – 8 GPU/4U
- 300W GPU supported
- Best performance CPU – 150W CPU
- Highest memory capacity – 24 DIMM
- GbE / 10GbE option
- Flexible expansion slots

**GPU**
- GRID K1/K2
- K10/K20/K20X

**Application**
- GRID Virtualization
- Cloud computing with GPU
- GRID certified solution
- HPC
Scale Out Trends

● Maximize # Nodes
  ● Previous: 42 Nodes/Rack (2GPU/Node)
  ● Emerging: 60 Nodes/Rack (2GPU/Node)
  ● Emerging: 40 Nodes/Rack (3GPU/Mode)

● Faster / Efficient Interconnects
  ● Previous: LOM: 1GbE, AOC: 10GbE, DDR-IB, QDR-IB
  ● Emerging: LOM: 10GbE, FDR-IB, AOC: 40GbE

● Optimize Chassis and Racks
  ● Previous: Rear Access
  ● Emerging: Front/Rear Access chassis and Racks

● Optimize Thermals and Power
  ● Previous: Redundant power not available in 1U, 1200-1400W / enclosure, Node level IPMI
  ● Emerging: Redundant Power in 1U, Digital Power (>95% efficiency)
    Higher Efficiency Racks / System Level IPMI
Intel® Sandy Bridge Qty: 8 DDR3 DIMM Slots

1x SSD or 1x SATA-DOM

Dual Port QDR/FDR IB or 10GbE Support

2 Kepler

Integrated BMC – IPMI 2.0, KVM-over-IP, Remote Virtual Media

Highest GPU Blade Density 20 GPU + 20 CPU per 7U

Greater TCO No Cables System Mgmt. System Maintenance

Enhanced 3000W redundant power supply

Dual Port QDR/FDR IB or 10GbE Support

Integrated BMC – IPMI 2.0, KVM-over-IP, Remote Virtual Media

Highest GPU Blade Density 20 GPU + 20 CPU per 7U

Greater TCO No Cables System Mgmt. System Maintenance

Enhanced 3000W redundant power supply
GPU Solution

Fat Twin = Best Performance / Watt / $ / ft²

- 4 nodes in 4U, Front I/O
- Dual Intel Xeon E5-2600 CPU
- Up to 16 DIMM, 512GB memory
- 3 GPUs per node
- 2 additional PCI-E Gen 3 x8 slots
- 6 x 2.5” or 2 x 3.5” hot-swap SAS/SATA/SSD
- 10GbE onboard option
- High efficient 1620W redundant power supply
- Hot-swappable cooling fans

SYS-F627G2-FT+/FTPT+
SYS-F627G2-F73+/F73PT+
SYS-F627G3-FT+/FTPT+
SYS-F627G3-F73+/F73PT+
1U UP GPU Solutions

**1U UP – Value**

- 1017GR-TF
- 5017GR-TF

**Advantages**

- Cost effective Solution
- GPU focus computation
- Power saving
- Support both active and passive card

**Application**

- Oil and Gas/seismic
- Scientifics
- Data mining

**n** # of GPU per node

**GPU**

- K10/K20/K20X
- GTX card
1U DP, Scalable, High Density

1027GR-72R2
1027GR-72RT2
1027GR-TR2
1027GR-TRT2

2

1027GR-TRF+
1027GR-TRFT+

# of GPU per node

1U DP GPU Solutions

Advantages

• GPU density
• Memory capacity
• SAS 2208
• Flexible expansion slots

GPU

• GRID K1/K2

Application

• GRID Virtualization
• Cloud computing with GPU
• GRID certified solution
1U/2U DP GPU Solutions

1U/2U DP, Scalable, High Density

3
1027GR-TRF
1027GR-TSF
1027GR-TRFT

4
NEW
2027GR-TR2
2027GR-TRT2

6
2027GR-TRFH
2027GR-TRFHT

# of GPU per node

Advantages

• GPU density
• Optimize cooling and redundant power
• Flexible storage and expansion slots

GPU

• K10/K20/K20X

Application

• Weather and Climate
• Computational Finance
• HPC
DP GPU Server: SYS-1027GR-72R2/72RT2/TR2/TRT2

- Motherboard: X9DRG-HF+/II-HTF+/II
- 1U Chassis: 118GH-R1K65B

**Key Features**
- Support up to 3 double width GPU cards (K10/K20M/K20X/K2/K1)
- 16 DIMM, up to 512GB memories
- SAS 2208 controller (72R2/72RT2)
- Platinum level 1600W power supply
- Available Now

**Key Application**
- VDI technology

**Processor Support**
Dual Intel® Sandy/Ivy Bridge EP (Socket R) series CPU

**Memory Capacity**
16 DIMM, Max of 512GB Reg. ECC DDR3 up to 1600MHz

**Expansion Slots**
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**Drive Bays**
4 hot-swap 2.5" drives bays

**System Cooling**
10 counter rotating fans with optimal fan speed control
1 air shroud

**Power Supply**
1600W Platinum level efficiency redundant power supply

**Key Application**
- VDI technology
Virtual Desktop Infrastructure (VDI) Solution with GPU Servers

Online Gaming

Enterprise CAD

Graphical Desktop
Benefit Of GPU VDI

● For User Experience
  ● Enjoy highly responsive desktops and rich multimedia experience
  ● Work from anywhere, on any device with a network connection
  ● Access all critical application including most 3D-intensive

● For IT Manager
  ● Improve productivity of all VDI users
  ● Security, manageability, and flexibility to allocate resources
  ● Provide solution to user requiring graphical-intensive needs

● Hypervisor
  ● Citrix, VMware, and Microsoft FX
NVIDIA GRID VDI Solution

500+ GPU systems shipped (A demo showed at Computex & GTC 2013 w/ NVIDIA)

Supermicro® Server Platforms use NVIDIA GRID™ Technology to Deliver Graphics-Accelerated Performance to Virtual Desktops

PR Newswire(Thu, May 23) ----- to Virtual Desktops SuperServer® GRID K1 and K2 Based Solutions Support up to 7,680 Concurrent Users per 42U SuperRack®
NVIDIA GRID Certified Systems

1U/2U DP, Scalable, High Density

- 1027GR-TRF
- 1027GR-TRFT
- 1027GR-TRF+
- 1027GR-TRFT+

3U & Above – Powerful

- 7047GR-TPRF
- SYS-F627G3-FT+
- SYS-F627G3-F73+
- SYS-F627G3-F73PT+

Enterprise CAD

Graphical Desktop

Online Gaming

# of GPU per node
4U DP GPU Solutions

4U DP, Powerful, High Density

Advantages

- Support highest power 150W CPU
- Flexible expansion slots and memory capacity
- Maximus Certified

GPU

- K10/K20/K20X
- Quadro/GTX series GPU

Application

- Imaging and Computer Vision
- Simulation and Creation Design
Thank you!

GPU SuperServer®
Supercomputing Solutions
Up to 6/4 Double-Width PCI-E 3.0 in 2U
Tesla® Kepler Ready!

- PCI-E 3.0 x8 low-profile add-on card
- 2 PCI-E 3.0 x16 for 2 GPU card
- 2 PCI-E 3.0 x16 for 2 GPU cards

SYS-2027GR-TRFH(T)
SUMMARY

● There is no Universal, “One-Size-Fits-All” GPU Solution…

Therefore, it’s vital to
● Analyze advantages and tradeoffs in order to select the best

● APPLICATION OPTIMIZED GPU System Platform

● Come talk with us in the Exhibits Area and visit us at www.Supermicro.com

● Thanks!