Interconnect Your Future
Enabling the Best Datacenter Return on Investment

TOP500 Supercomputers, November 2015
InfiniBand FDR and EDR Continue Growth and Leadership

The Most Used Interconnect On The TOP500 Supercomputing List

EDR InfiniBand Now Used in 4 Systems on the List, with More EDR Systems Being Deployed by End of 2015 Will Result in More Than 2X the Number of EDR Systems Worldwide Compared to June 2015

- Mellanox Delivers Up To 99.8% System Efficiency with InfiniBand, 4X higher versus Ethernet
  - Delivering highest datacenter return on investment
- For the first time many Chinese-based Ethernet Cloud/Web2.0 systems submitted and ranked on the list
  - Altering the trends perspective of high-performance computing systems on the TOP500 for Ethernet/InfiniBand connectivity
Explosive high-performance computing market growth

Clusters continue to dominate with 85% of the TOP500 list

Mellanox InfiniBand Solutions Provide the Highest Systems Utilization on the TOP500
InfiniBand is the most used interconnect on the TOP500 list, with 237 systems, or 47.4% of the list.

FDR InfiniBand is the most used technology on the TOP500 list, connecting 163 systems:
- 16% increase from Nov’14 to Nov’15

EDR InfiniBand now used in 4 systems on the List, with more EDR systems being deployed by end of 2015:
- More than 2X the number of EDR systems expected compared to July 2015

InfiniBand enables the most efficient system on the list with 99.8% efficiency — record!
- Delivering highest datacenter Return on Investment, 4X higher than 10GbE, 33% higher than Cray interconnect
- InfiniBand enables the top 9 most efficient systems on the list, and 28 of the TOP30

InfiniBand is the most used interconnect for Petascale systems with 33 systems:
- 45% of the Petascale systems, nearly 40% higher versus closest competition

Mellanox InfiniBand is the Interconnect of Choice for HPC Infrastructures
InfiniBand in the TOP500

- InfiniBand is the most used interconnect technology for high-performance computing
  - InfiniBand accelerates 237 systems, 47.4% of the list

- FDR InfiniBand is the most used technology on the TOP500 list, connecting 163 systems
  - 16% increase from Nov’14 to Nov’15

- EDR InfiniBand now used in 4 systems on the List, with more EDR systems being deployed by end of 2015
  - Expected to be deployed in more than 2X the number of EDR systems worldwide compared to June 2015

- InfiniBand connects the most powerful clusters
  - 33 of the Petascale-performance systems, 45% of the Petascale systems, nearly 40% higher versus closest competition

- InfiniBand is the most used interconnect technology in each category - TOP100/200/300/400/500
  - Connects 43% (43 systems) of the TOP100 while Ethernet only 7% (7 systems)
  - Connects 44.5% (89 systems) of the TOP200 while Ethernet only 23.5% (47 systems)
  - Connects 44.3% (133 systems) of the TOP300 while Ethernet only 32% (96 systems)
  - Connects 45.3% (181 systems) of the TOP400 while Ethernet only 35.8% (143 systems)
  - Connects 47.4% (237 systems) of the TOP500, Ethernet connects 36.2% (181 systems)
Mellanox in the TOP500

- **Mellanox EDR InfiniBand is the fastest interconnect solution on the TOP500**
  - 100Gb/s throughput, 150 million messages per second, less than 0.7usec latency

- **Mellanox InfiniBand is the most efficient interconnect technology on the list**
  - Enables the highest system utilization on the TOP500 – 99.8% system efficiency
  - Enables the top 9 highest utilized systems on the TOP500 list

- **Mellanox InfiniBand is the only Petascale-proven, standard interconnect solution**
  - Connects 33 out of the 76 Petaflop-performance systems on the list (45%)
    - 40% more systems versus closest competition
  - Connects 1.4X the number of Cray based systems in the TOP100, 5X in TOP500

- **Mellanox’s end-to-end scalable solutions accelerate GPU-based systems**
  - GPUDirect RDMA technology enables faster communications and higher performance

**Paving The Road to Exascale Performance**
InfiniBand is The De-Facto Interconnect Solution for Performance Demanding Applications
The Most Used Interconnect Solution for High-Performance Infrastructures
Mellanox InfiniBand is the Interconnect of Choice for Petascale Computing

Accelerates 45% of the Petaflop Systems
TOP500: Market Segments

**InfiniBand Accelerates 62% of HPC Research Systems**

**InfiniBand Accelerates 80% of HPC Academic Systems**

**InfiniBand Accelerates 25% of Cloud, Web2.0 etc. Industry Systems**

Mellanox InfiniBand is the Interconnect of Choice for HPC Infrastructures
- Number of Mellanox FDR InfiniBand systems grew 16% from Nov’14 to Nov’15;
- EDR InfiniBand now used in 4 systems on the TOP500

**More EDR Systems Being Deployed by End of 2015**

**Will Result in More Than Double the Number of EDR Systems Worldwide Compared to June 2015**
InfiniBand is The Most Used Interconnect of the TOP100, 200, 300, 400, 500 Supercomputers

Due to Superior Performance, Scalability, Efficiency and Return-On-Investment
InfiniBand’s Unsurpassed System Efficiency

The new Chinese based Cloud/Wed2.0 10GbE systems show extremely poor efficiency of 20-40%, not suitable for HPC applications.

InfiniBand is Key For the System Efficiency, Mellanox Delivers Up To 99.8% System Efficiency with InfiniBand More Than 4X Higher Efficiency Versus the New Additions of 10GbE Chinese-based Cloud/Wed2.0 Systems.

Average Efficiency
- InfiniBand: 85%
- Cray: 74%
- 10GbE: 57%
- GigE: 43%

TOP500 Systems Listed According To Their Efficiency

World Top500 Systems

InfiniBand • 1GbE • 10GbE • Cray • GPU
InfiniBand is the Best Price/Performance Interconnect for Every Scale of HPC Systems
InfiniBand Performance Trends

Mellanox InfiniBand is the Most Efficient and Scalable Interconnect Solution
Driving Factors: Performance, Efficiency, Scalability, Many-Many Cores
Proud to Accelerate Future DOE Leadership Systems ("CORAL")

"Summit" System

Oak Ridge National Laboratory

"Sierra" System

Lawrence Livermore National Laboratory

Paving the Road to Exascale
High-Performance Designed 100Gb/s Interconnect Solutions

**Adapters**

- **ConnectX-4**
  - 100Gb/s Adapter, 0.7us latency
  - 150 million messages per second
  - (10 / 25 / 40 / 50 / 56 / 100Gb/s)

- **ConnectX-4Lx**

**Switch**

- **SwitchIB™ 2**
  - 36 EDR (100Gb/s) Ports, <90ns Latency
  - Throughput of 7.2Tb/s
  - 7.02 Billion msg/sec (195M msg/sec/port)

- **Spectrum™**
  - 32 100GbE Ports, 64 25/50GbE Ports
  - (10 / 25 / 40 / 50 / 100GbE)
  - Throughput of 6.4Tb/s

**Interconnect**

- **LinkX™**
  - Transceivers
  - Active Optical and Copper Cables
  - (10 / 25 / 40 / 50 / 56 / 100Gb/s)

- VCSELS, Silicon Photonics and Copper
Interconnect Solutions Leadership – Software and Hardware

Comprehensive End-to-End Interconnect Software Products

Comprehensive End-to-End InfiniBand and Ethernet Portfolio

ICs | Adapter Cards | Switches/Gateways | Software and Services | Metro / WAN | Cables/Modules
---|---|---|---|---|---
ConnectX-4 | ConnectX-3 | Spectrum | SwitchIB-2 | metroDX | LinkX
ConnectX-3 | ConnectX-IB | SwitchX-2 | UMA | metroX | Mellanox Care
ConnectX-2 | | | | | |

At the Speeds of 10, 25, 40, 50, 56 and 100 Gigabit per Second

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Mellanox InfiniBand Solutions, Generation Lead over the Competition

Smart Network For Smart Systems
RDMA, Acceleration Engines, Programmability

Higher Performance
Unlimited Scalability
Higher Resiliency
Proven!

Gain Competitive Advantage Today
Protect Your Future

Power Consumption
Per Switch Port
25%
Lower

Message Rate
44%
Higher

Switch Latency
20%
Lower

Scalability
CPU efficiency
2X
Higher

100 Gb/s
Link Speed
2014

200 Gb/s
Link Speed
2017
End-to-End Interconnect Solutions for All Platforms

Highest Performance and Scalability for X86, Power, GPU, ARM and FPGA-based Compute and Storage Platforms

10, 20, 25, 40, 50, 56 and 100Gb/s Speeds

Smart Interconnect to Unleash The Power of All Compute Architectures
Mellanox End-to-End 100Gb/s EDR InfiniBand
Accelerates Research And Applications for TACC Users
Lenovo Innovation Center - EDR InfiniBand System

- “LENOX“, EDR InfiniBand connected system at the Lenovo HPC innovation center, Germany

- EDR InfiniBand provides ~25% higher system performance versus FDR InfiniBand on Graph500
  - At 128 nodes
- Magic Cube II supercomputer
- Sugon Cluster TC4600E system
- Mellanox end-to-end EDR InfiniBand
San Diego Supercomputing Center “Comet” System (2015) to Leverage Mellanox InfiniBand to Build HPC Cloud
Mellanox Interconnect Advantages

- Proven, scalable and high performance end-to-end connectivity
- Flexible, support all compute architectures: x86, Power, ARM, GPU, FPGA etc.
- Standards-based (InfiniBand, Ethernet), supported by large eco-system
- Offloading architecture – RDMA, application acceleration engines etc.
- Flexible topologies: Fat Tree, mesh, 3D Torus, Dragonfly+, etc.
- Converged I/O– compute, storage, management on single fabric
- Backward and future compatible

Speed-Up Your Present, Protect Your Future
Paving The Road to Exascale Computing Together
“Stampede” system

6,000+ nodes (Dell), 462462 cores, Intel Phi co-processors

5.2 Petaflops

Mellanox end-to-end FDR InfiniBand
Pleiades system
- SGI Altix ICE
- 20K InfiniBand nodes
- 3.4 sustained Petaflop performance
- Mellanox end-to-end FDR and QDR InfiniBand
- Supports variety of scientific and engineering projects
  - Coupled atmosphere-ocean models
  - Future space vehicle design
  - Large-scale dark matter halos and galaxy evolution
“HPC2” system
IBM iDataPlex DX360M4
NVIDIA K20x GPUs
3.2 Petaflops sustained Petaflop performance
Mellanox end-to-end FDR InfiniBand
- IBM iDataPlex and Intel Sandy Bridge
- 147456 cores
- Mellanox end-to-end FDR InfiniBand solutions
- 2.9 sustained Petaflop performance
- The fastest supercomputer in Europe
- 91% efficiency
- TSUBAME 2.0, first Petaflop system in Japan
- 2.8 PF performance
- HP ProLiant SL390s G7 1400 servers
- Mellanox 40Gb/s InfiniBand
- “Cascade” system
- Atipa Visione IF442 Blade Server
- 2.5 sustained Petaflop performance
- Mellanox end-to-end InfiniBand FDR
- Intel Xeon Phi 5110P accelerator
“Pangea” system
SGI Altix X system, 110400 cores
Mellanox FDR InfiniBand
2 sustained Petaflop performance
91% efficiency
- Occigen system
- 1.6 sustained Petaflop performance
- Bull bullx DLC
- Mellanox end-to-end FDR InfiniBand
- “Spirit” system
- SGI Altix X system, 74584 cores
- Mellanox FDR InfiniBand
- 1.4 sustained Petaflop performance
- 92.5% efficiency
- Bull Bullx B510, Intel Sandy Bridge
- 77184 cores
- Mellanox end-to-end FDR InfiniBand solutions
- 1.36 sustained Petaflop performance
IBM iDataPlex DX360M4
Mellanox end-to-end FDR InfiniBand solutions
1.3 sustained Petaflop performance
- Dawning TC3600 Blade Supercomputer
- 5200 nodes, 120640 cores, NVIDIA GPUs
- Mellanox end-to-end 40Gb/s InfiniBand solutions
  - ConnectX-2 and IS5000 switches
- 1.27 sustained Petaflop performance
- The first Petaflop systems in China
- "Yellowstone" system
- 1.3 sustained Petaflop performance
- 72,288 processor cores, 4,518 nodes (IBM)
- Mellanox end-to-end FDR InfiniBand, full fat tree, single plane
International Fusion Energy Research Centre (IFERC), EU(F4E) - Japan Broader Approach collaboration - #60

- Bull Bullx B510, Intel Sandy Bridge
- 70560 cores
- 1.24 sustained Petaflop performance
- Mellanox end-to-end InfiniBand solutions
- The “Cartesius” system - the Dutch supercomputer
- Bull Bullx DLC B710/B720 system
- Mellanox end-to-end InfiniBand solutions
- 1.05 sustained Petaflop performance
- Tera 100, first Petaflop system in Europe - 1.05 PF performance
- 4,300 Bull S Series servers
- 140,000 Intel® Xeon® 7500 processing cores
- 300TB of central memory, 20PB of storage
- Mellanox 40Gb/s InfiniBand
- Fujitsu PRIMERGY CX250 S1
- Mellanox FDR 56Gb/s InfiniBand end-to-end
- 980 Tflops performance
“Conte” system
HP Cluster Platform SL250s Gen8
Intel Xeon E5-2670 8C 2.6GHz
Intel Xeon Phi 5110P accelerator
Total of 77,520 cores
Mellanox FDR 56Gb/s InfiniBand end-to-end
Mellanox Connect-IB InfiniBand adapters
Mellanox MetroX long Haul InfiniBand solution
980 Tflops performance
“MareNostrum 3” system
1.1 Petaflops peak performance
~50K cores, 91% efficiency
Mellanox FDR InfiniBand