Highlights of the 55th TOP500 List

ISC 2020, Frankfurt, June 22, 2020

Erich Strohmaier
ISC20 TOP500 AWARDS

• TOP500: Europe #1, #3, #2, #1
• HPCG #1
• HPL-AI #1
• Green500 #1
HPC5 - PowerEdge C4140, Xeon Gold 6252 24C 2.1GHz, NVIDIA Tesla V100, Mellanox HDR Infiniband

Eni S.p.A., Italy

is ranked

No. 1 in Europe

among the World’s TOP500 Supercomputers

with 35.45 Pflop/s Linpack Performance

in the 55th TOP500 List published at the ISC 2020 Digital

on June 22nd, 2020.

Congratulations from the TOP500 Editors
Sierra - IBM Power System AC922, IBM POWER9 22C 3.1GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband

DOE/NNSA/LLNL, United States

is ranked

No. 3

among the World's TOP500 Supercomputers

with 94.64 Pflop/s Linpack Performance


Congratulations from the TOP500 Editors
Summit - IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband

DOE/SC/Oak Ridge National Laboratory, United States

is ranked

No. 2

among the World’s TOP500 Supercomputers

with 148.6 Pflop/s Linpack Performance


Congratulations from the TOP500 Editors
Supercomputer Fugaku - A64FX 48C 2.2GHz, Tofu interconnect D
RIKEN Center for Computational Science, Japan

is ranked

No. 1

among the World’s TOP500 Supercomputers

with 415.53 Pflop/s Linpack Performance


Congratulations from the TOP500 Editors

Erich Strohmaier
NERSC/Berkeley Lab

Horst Simon
NERSC/Berkeley Lab

Jack Dongarra
University of Tennessee

Martin Meuer
Prometeus
NUMBER 1

Fugaku
Riken R-CCS
Riken Center for Computational Science
JAPAN

ACHIEVED
13.4 Pflop/s

JUNE 2020
PRESENTED AT
ISC
High Performance

IN COLLABORATION WITH

SPONSORED BY
MN-3 - MN-Core Server, Xeon 8260M 24C 2.4GHz, MN-Core, RoCEv2/MN-Core DirectConnect
Preferred Networks, Japan
is ranked
____No. 1 in the Green500____
among the World’s TOP500 Supercomputers
with 21.11 GFlops/Watt Linpack Power-Efficiency
on the Green500 List published at ISC 2020 Digital Conference, June 22nd, 2020

Congratulations from the Green500 Editors
ISC20 TOP500 TOPICS

• A new and exciting #1
• Exaflops on the HPL-AI
• A renewed TOP10
• Green500 shows Progress
• Low Market Turnover
• Research Market vs Commercial Market
<table>
<thead>
<tr>
<th>#</th>
<th>Site</th>
<th>Manufacturer</th>
<th>Computer</th>
<th>Country</th>
<th>Cores</th>
<th>Rmax [Pflops]</th>
<th>Power [MW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RIKEN Center for Computational Science</td>
<td>Fujitsu</td>
<td><strong>Fugaku</strong> Supercomputer Fugaku, A64FX 48C 2.2GHz, Tofu interconnect D</td>
<td>Japan</td>
<td>7,299,072</td>
<td>415.5</td>
<td>28.3</td>
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<td>2</td>
<td>Oak Ridge National Laboratory</td>
<td>IBM</td>
<td><strong>Summit</strong> IBM Power System, P9 22C 3.07GHz, Mellanox EDR, NVIDIA GV100</td>
<td>USA</td>
<td>2,414,592</td>
<td>148.6</td>
<td>10.1</td>
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<tr>
<td>3</td>
<td>Lawrence Livermore National Laboratory</td>
<td>IBM</td>
<td><strong>Sierra</strong> IBM Power System, P9 22C 3.1GHz, Mellanox EDR, NVIDIA GV100</td>
<td>USA</td>
<td>1,572,480</td>
<td>94.6</td>
<td>7.4</td>
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<td>4</td>
<td>National Supercomputing Center in Wuxi</td>
<td>NRCPC</td>
<td><strong>Sunway TaihuLight</strong> NRCPC Sunway SW26010, 260C 1.45GHz</td>
<td>China</td>
<td>10,649,600</td>
<td>93.0</td>
<td>15.4</td>
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<td>5</td>
<td>National University of Defense Technology</td>
<td>NUDT</td>
<td><strong>Tianhe-2A</strong> ANUDT TH-IVB-FEP, Xeon 12C 2.2GHz, Matrix-2000</td>
<td>China</td>
<td>4,981,760</td>
<td>61.4</td>
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<td>6</td>
<td>Eni S.p.A</td>
<td>Dell EMC</td>
<td><strong>HPC5</strong> PowerEdge C4140, Xeon 24C 2.1GHz, NVIDIA T. V100, Mellanox HDR</td>
<td>Italy</td>
<td>669,760</td>
<td>35.5</td>
<td>2.25</td>
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<td>7</td>
<td>NVIDIA Corporation</td>
<td>NVIDIA</td>
<td><strong>Selene</strong> DGX A100 SuperPOD, AMD 64C 2.25GHz, NVIDIA A100, Mellanox HDR</td>
<td>USA</td>
<td>277,760</td>
<td>27.6</td>
<td>1.34</td>
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<td>8</td>
<td>Texas Advanced Computing Center / Univ. of Texas</td>
<td>Dell</td>
<td><strong>Frontera</strong> Dell C6420, Xeon Platinum 8280 28C 2.7GHz, Mellanox HDR</td>
<td>USA</td>
<td>448,448</td>
<td>23.5</td>
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<td>9</td>
<td>CINECA</td>
<td>IBM</td>
<td><strong>Marconi-100</strong> IBM Power System AC922, P9 16C 3GHz, Nvidia Volta V100, Mellanox EDR</td>
<td>Italy</td>
<td>347,776</td>
<td>21.6</td>
<td>1.98</td>
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<td>10</td>
<td>Swiss National Supercomputing Centre (CSCS)</td>
<td>Cray</td>
<td><strong>Piz Daint</strong> Cray XC50, Xeon E5 12C 2.6GHz, NVIDIA Tesla P100, Aries</td>
<td>Switzerland</td>
<td>387,872</td>
<td>21.2</td>
<td>2.38</td>
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<td>#</td>
<td>T</td>
<td>Site</td>
<td>Manufacturer</td>
<td>Computer</td>
<td>Country</td>
<td>HPCG [Pflop/s]</td>
<td>Rmax [Pflop/s]</td>
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<tr>
<td>1</td>
<td>1</td>
<td>RIKEN-CCS</td>
<td>Fujitsu</td>
<td><strong>Fugaku</strong> Supercomputer Fugaku, A64FX 48C 2.2GHz, Tofu interconnect D</td>
<td>Japan</td>
<td>13.400</td>
<td>415.5</td>
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<tr>
<td>2</td>
<td>2</td>
<td>Oak Ridge National Laboratory</td>
<td>IBM</td>
<td>Summit IBM Power System, P9 22C 3.07 GHz, Volta GV100, EDR</td>
<td>USA</td>
<td>2.926</td>
<td>148.6</td>
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<tr>
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<td>3</td>
<td>Lawrence Livermore National Laboratory</td>
<td>IBM</td>
<td><strong>Sierra</strong> IBM Power System, P9 22C 3.1 GHz, Volta GV100, EDR</td>
<td>USA</td>
<td>1.796</td>
<td>94.6</td>
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<td>4</td>
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<td>Eni S.p.A</td>
<td>Dell EMC</td>
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<td>0.860</td>
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<td>5</td>
<td>11</td>
<td>Los Alamos NL / Sandia NL</td>
<td>Cray</td>
<td><strong>Trinity</strong> Cray XC40, Intel Xeon Phi 7250 68C 1.4GHz, Aries</td>
<td>USA</td>
<td>0.546</td>
<td>20.2</td>
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<tr>
<td>6</td>
<td>7</td>
<td>NVIDIA Corporation</td>
<td>NVIDIA</td>
<td><strong>Selene</strong> DGX A100 SuperPOD, AMD 64C 2.25GHz, NVIDIA A100, Mellanox HDR</td>
<td>USA</td>
<td>0.509</td>
<td>27.6</td>
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<td>12</td>
<td>National Institute of Advanced Industrial Science and Technology</td>
<td>Fujitsu</td>
<td><strong>AI Bridging Cloud Infrastructure (ABCI)</strong> PRIMERGY CX2550 M4, Xeon Gold 20C 2.4GHz, IB-EDR, NVIDIA V100</td>
<td>Japan</td>
<td>0.509</td>
<td>19.9</td>
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<td>8</td>
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<td>Swiss National Supercomputing Centre (CSCS)</td>
<td>Cray</td>
<td><strong>Piz Daint</strong> Cray XC50, Xeon E5 12C 2.6GHz, Aries, NVIDIA Tesla P100</td>
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<td>National Supercomputing Center in Wuxi</td>
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<td>0.481</td>
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<td>18</td>
<td>Korea Institute of Science and Technology Information</td>
<td>Cray</td>
<td>Nurion Cray CS500, Intel Xeons Phi 7250 68C 1.4 GHz, OmniPath</td>
<td>South Korea</td>
<td>0.392</td>
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<td>Computer</td>
<td>Interconnect</td>
<td>Accelerator</td>
<td>Rmax/Power</td>
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<td>MN-3, Preferred Network MN-Core Server</td>
<td>Xeon 24C 2.4GHz</td>
<td>RoCEv2/MN-Core DirectConnect</td>
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<td>Selene, NVIDIA DGX A100 SuperPOD</td>
<td>AMD Zen-2 64C 2.25GHz</td>
<td>Mellanox HDR</td>
<td>NVIDIA A100</td>
<td>20.5</td>
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<td>NA-1, ZettaScaler-2.2</td>
<td>Xeon 16C 1.3GHz</td>
<td>Infiniband EDR</td>
<td>PEZY-SC2</td>
<td>*18.4</td>
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<td>A64FX Prototype, Fujitsu A64FX</td>
<td>Fujitsu A64FX 48C 2GHz</td>
<td>Tofu Interconnect D</td>
<td>-</td>
<td>16.9</td>
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<td>AiMOS, IBM Power System AC922</td>
<td>POWER9 20C 3.45GHz</td>
<td>Mellanox EDR</td>
<td>Volta GV100</td>
<td>16.3</td>
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<td>HPC5, Dell PowerEdge C4140</td>
<td>Xeon 24C 2.1GHz</td>
<td>Mellanox HDR</td>
<td>Tesla V100 SXM2</td>
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<td>Satori, IBM Power System AC922</td>
<td>POWER9 20C 2.4GHz</td>
<td>Mellanox EDR</td>
<td>Tesla V100 SXM2</td>
<td>15.6</td>
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<tr>
<td>Summit, IBM Power System AC922</td>
<td>POWER9 22C 3.07GHz</td>
<td>Mellanox EDR</td>
<td>Volta GV100</td>
<td>14.7</td>
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<td>Supercomputer Fugaku, Fujitsu</td>
<td>A64FX 48C 2.2GHz</td>
<td>Tofu interconnect D</td>
<td>-</td>
<td>14.7</td>
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<tr>
<td>Marconi-100, IBM Power System</td>
<td>Power9 16C 3.0GHz</td>
<td>Mellanox EDR</td>
<td>Volta GV100</td>
<td>14.6</td>
<td></td>
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</tr>
</tbody>
</table>

* Efficiency based on Power optimized HPL runs of equal size to TOP500 run.

[Gflops/Watt]
PERFORMANCE FRACTION OF THE TOP5 SYSTEMS
PERFORMANCE FRACTION
OF THE TOP5 SYSTEMS

NWT  ASCI Red  Earth Simulator  BlueGene/L  K-Computer  Tianhe-2A  TaihuLight


Fugaku

1  2  3  4  5
COUNTRIES / PERFORMANCE SHARE

- United States, 29%
- China, 25%
- Japan, 24%
- Italy, 4%
- France, 4%
- Germany, 3%
- United Kingdom, 1%
- Canada, 1%
- Netherlands, 1%
- Switzerland, 1%
- Ireland, 1%
- Other, 126, 6%
VENDORS / SYSTEM SHARE

- Lenovo, 180, 36%
- HPE/Cray, 74, 15%
- Sugon, 68, 14%
- Inspur, 64, 13%
- Atos, 26, 5%
- Fujitsu, 13, 3%
- Dell EMC, 10, 2%
- IBM, 12, 2%
- Nvidia, 7, 1%
- Huawei, 7, 1%
- Penguin, 6, 1%
- Others, 33, 7%

# of systems, % of 500
VENDORS / PERFORMANCE SHARE

- **Nvidia, 60, 3%**
- **Huawei, 11, 0%**
- **Dell EMC, 85, 4%**
- **Others, 216, 10%**
- **Lenovo, 358, 16%**
- **IBM, 346, 16%**
- **Fujitsu, 487, 22%**
- **HPE/Cray, 317, 14%**
- **Sugon, 116, 5%**
- **Inspur, 121, 5%**
- **Atos, 90, 4%**

Sum of Pflop/s, % of whole list
Markets for scientific computing and for commercial data processing are very different.

Extract proper sub-samples for these markets from the full TOP500 list

- TOP100 Research and Academic installations
- TOP100 Industry (and Vendor) installations
  - Could try to separate out Industry installations but difficult to do
- Ignore "Government, Classified, Others" for now
- 100 works reasonably well, more might become tricky
United States, 32%  
China, 12%  
Japan, 36%  
Germany, 5%  
France, 3%  
United Kingdom, 2%  
Others, 10%  

Research

United States, 16%  
China, 52%  
Japan, 2%  
France, 7%  
Others, 23%  

Commercial
VENDORS / SYSTEM SHARE

Research

- Cray, 22%
- HPE, 16%
- Atos, 13%
- IBM, 9%
- Sugon, 7%
- Fujitsu, 6%
- Lenovo, 6%
- Inspur, 1%
- Others, 24%

Commercial

- Lenovo, 33%
- Sugon, 16%
- Cray, 1%
- HPE, 3%
- Atos, 3%
- IBM, 2%
- Fujitsu, 1%
- Others, 12%
VENDORS / PERFORMANCE SHARE

**Research**
- Fujitsu, 34%
- IBM, 23%
- Others, 19%
- Cray, 11%
- Atos, 5%
- HPE, 5%
- Sugon, 0%
- Lenovo, 3%
- Inspur, 0%
- Others, 19%

**Commercial**
- Lenovo, 23%
- Inspur, 19%
- Others, 31%
- Sugon, 10%
- HPE, 6%
- Atos, 3%
- Fujitsu, 1%
- IBM, 6%
CHIPS / SYSTEM SHARE

Research

- Intel, 54%
- Intel / NVIDIA, 17%
- Power, 2%
- Power / NVIDIA, 6%
- Intel Phi, 11%
- ARM, 2%
- Others, 3%

Commercial

- Intel, 51%
- Intel / NVIDIA, 44%
- AMD / NVIDIA, 1%
- ARM, 1%
- AMD, 5%
- Power, 2%
- Others, 1%
SC20 TOP500 HIGHLIGHTS

• Fugaku is the new #1 in the TOP500
• It measured at over 1 Exaflop on the HPL-AI in reduced precision
• TOP10 has four new systems
• Overall turn-over in the list is at a record low
• TOP100 Research System and Commercial Systems show very different markets