The Cray XC30
“Darter” System

Daniel Lucio
The Darter Supercomputer
Cray Supercomputing Systems

Cray XC30 Supercomputer Series
Cray XC30 and XC30-AC supercomputers deliver on Cray's commitment to an adaptive supercomputing architecture that provides both extreme scalability and sustained performance. The flexibility of the Cray XC30 platform ensures that users can configure the exact machine to meet their specific requirements today, and also remain confident they can upgrade and enhance their system to address the demands of the future.

Learn more

Cray CS300 Cluster Supercomputer Series
The Cray CS300 cluster supercomputer delivers modular and energy-efficient high performance computing. Featuring an air- or liquid-cooled architecture based on industry-standard building block platforms, the CS300 system offers flexible configurations using the latest processing technologies and cluster management tools while addressing a wide range of datacenter cooling requirements. In addition, the CS300 product family offers ready-to-go shared memory and large memory systems that are preconfigured to speed up parallel processing performance and complex modeling analysis.

Learn more

Cray XK7 Supercomputer
The Cray XK7 supercomputer is a trifecta of scalar, network and many-core innovation. It combines Cray's proven Gemini interconnect, AMD's leading multi-core scalar processors and NVidia's powerful many-core GPU processors to create a true, productive hybrid supercomputer.

Learn more

Cray XE6 and XE6m Supercomputers
The Cray XE6 supercomputer takes the proven Cray XT5 infrastructure and incorporates it with two innovative technologies: AMD's powerful multi-core processors and the award-winning Gemini interconnect. The result is a system that brings production petascale to a wider HPC community and fundamentally changes how Cray systems communicate.

Learn more
Facts from the top500 list

- 51 Cray systems listed
- 14 of them are XC30s

<table>
<thead>
<tr>
<th>Rank</th>
<th>Site</th>
<th>System</th>
<th>Cores</th>
<th>Rmax (TFlop/s)</th>
<th>Rpeak (TFlop/s)</th>
<th>Power (KW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>DOE/SC/Oak Ridge National Laboratory, United States</td>
<td>Titan - Cray XK7, Opteron 6274 16C, 2.20GHz, Cray Gemini interconnect, NVIDIA K20x</td>
<td>560,640</td>
<td>17,590.0</td>
<td>27,112.5</td>
<td>8,209</td>
</tr>
<tr>
<td>6</td>
<td>Swiss National Supercomputing Centre (CSCS), Switzerland</td>
<td>Piz Daint - Cray XC30, Xeon E5-2670 8C 2.60GHz, Aries interconnect , NVIDIA K20x</td>
<td>115,984</td>
<td>6,271.0</td>
<td>7,788.9</td>
<td>3,265</td>
</tr>
<tr>
<td>10</td>
<td>Government, United States</td>
<td>Cray XC30, Intel Xeon E5-2697v2 12C 2.7GHz, Aries interconnect</td>
<td>225,984</td>
<td>3,143.5</td>
<td>4,881.3</td>
<td>8,209</td>
</tr>
<tr>
<td>19</td>
<td>ECMWF, United Kingdom</td>
<td>Cray XC30, Intel Xeon E5-2695v2 12C 2.4GHz, Aries interconnect</td>
<td>133,824</td>
<td>1,654.7</td>
<td>2,569.4</td>
<td>1,796.3</td>
</tr>
<tr>
<td>20</td>
<td>ECMWF, United Kingdom</td>
<td>Cray XC30, Intel Xeon E5-2697v2 12C 2.7GHz, Aries interconnect</td>
<td>83,160</td>
<td>1,552.0</td>
<td>1,796.3</td>
<td>1,796.3</td>
</tr>
<tr>
<td>25</td>
<td>EPSRC/University of Edinburgh, United Kingdom</td>
<td>ARCHER - Cray XC30, Intel Xeon E5 v2 12C 2.70GHz, Aries interconnect</td>
<td>76,192</td>
<td>1,367.5</td>
<td>1,645.7</td>
<td>1,645.7</td>
</tr>
<tr>
<td>31</td>
<td>ERDC DSRC, United States</td>
<td>Garnet - Cray XE6, Opteron 16C 2.50GHz, Cray Gemini interconnect</td>
<td>150,528</td>
<td>1,167.0</td>
<td>1,505.3</td>
<td>1,505.3</td>
</tr>
<tr>
<td>32</td>
<td>DOE/NNSA/LANL/SNL, United States</td>
<td>Cleio - Cray XE6, Opteron 6136 8C 2.40GHz, Custom</td>
<td>142,272</td>
<td>1,110.0</td>
<td>1,365.8</td>
<td>3,980</td>
</tr>
<tr>
<td>34</td>
<td>DOE/SC/LBNL/NERSC, United States</td>
<td>Hopper - Cray XE6, Opteron 6172 12C 2.10GHz, Custom</td>
<td>153,408</td>
<td>1,054.0</td>
<td>1,288.6</td>
<td>2,910</td>
</tr>
<tr>
<td>44</td>
<td>HWW/Universitaet Stuttgart, Germany</td>
<td>HERMIT - Cray XE6, Opteron 6276 16C 2.30 GHz, Cray Gemini interconnect</td>
<td>113,472</td>
<td>831.4</td>
<td>1,043.9</td>
<td>1,043.9</td>
</tr>
<tr>
<td>47</td>
<td>Lawrence Livermore National Laboratory, United States</td>
<td>Zin - Xtreme-X GreenBlade GB512X, Xeon E5 (Sandy Bridge - EP) 8C 2.60GHz, Cray Gemini interconnect</td>
<td>46,208</td>
<td>773.7</td>
<td>961.1</td>
<td>924.2</td>
</tr>
</tbody>
</table>

#6, Piz Daint
Cray XC30 Series Supercomputers

The Cray XC30 family delivers on Cray's commitment to an adaptive supercomputing architecture that provides both extreme scalability and sustained performance. The flexibility of the Cray XC30 platform ensures that users can configure the exact machine to meet their specific requirements today, and also remain confident they can upgrade and enhance their system to address the demands of the future.

Previously codenamed "Cascade," Cray XC30 and XC30-AC supercomputers are enabled by a robust Intel® Xeon® processor road map, Aries high performance interconnect and flexible Dragonfly network topology, providing low latency and scalable global bandwidth to satisfy the most challenging multi-petaflop applications.

While the extreme scaling Cray XC30 supercomputer is a transverse air-flow liquid-cooled architecture, the Cray XC30-AC air-cooled family provides slightly smaller and less dense supercomputing cabinets with no requirement for liquid coolants or extra blower cabinets. A reduced network topology lowers costs and the systems are completely compatible with the compute technology, OS, ISV and software stack support of the high-end Cray XC30 systems.

Cray XC30 and XC30-AC Literature
The Darter Supercomputer

- Originally funded by the University of Tennessee to study cutting edge computing technologies
- Now funded by NSF and is part of the XSEDE program
- Has been available since April 2013
- It offers 250 TFlops of peak performance
- Uses Intel Xeon technology
- Has native support for shared libraries
Where is it?

Bldg 5700, ORNL, Oak Ridge, TN
Darter Specs

- Cray XC30 (Cascade)
- Cray Linux Environment 5.0 upo3
- 4 compute racks
- 23,936 compute cores w/hyper threading
- 24 TB of compute memory
- 360TB Sonexion parallel file system
- 1.3PB Medusa Lustre file system
- 748 compute nodes
- Cray Aries Interconnect
- HPSS for archiving

Each compute node has:
- Two 2.6 GHz eight-core Intel SandyBridge (Xeon E5-2670) processors
- 16 physical cores (32 w/hyper-threading)
- 32 GB of memory
- Cray Aries interconnect with 8GB/sec bandwidth
Darter features

- Home areas are the same across all NICS resources
- Latest software development tools available
- Native Shared libraries support
- Hyper-Threading is off by default. (Need to use aprun option ‘-j 2’ to turn it on)
- GSI access is supported.
- GridFTP is also available for fast file transfers
- No PGI Compiler available

http://www.nics.tennessee.edu/request-software-installation-nics
Darter Allocations

- Time available through the XSEDE program and JICS/NICS Discretionary Allocations.

- Access to UT academic community, Regional Education Partners and Industrial Partners.

<table>
<thead>
<tr>
<th></th>
<th>Research Allocation</th>
<th>Pilot Allocation</th>
<th>EOT Allocation per event</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Darter</strong></td>
<td>500K-1M</td>
<td>200K</td>
<td>5K</td>
</tr>
<tr>
<td>(core hours)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

http://www.nics.tennessee.edu/darter-allocations
# Darter vs Kraken facts

<table>
<thead>
<tr>
<th></th>
<th>Darter</th>
<th>Kraken</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Allocations</strong></td>
<td>XSEDE/NICS</td>
<td>XSEDE/NICS</td>
</tr>
<tr>
<td><strong>Processor</strong></td>
<td>Intel Xeon</td>
<td>AMD Istanbul</td>
</tr>
<tr>
<td><strong>Interconnect</strong></td>
<td>Cray Aries</td>
<td>Cray SeaStar</td>
</tr>
<tr>
<td><strong>Network Topology</strong></td>
<td>Dragongfly</td>
<td>3D-torus</td>
</tr>
<tr>
<td><strong>Shared Library support</strong></td>
<td>YES!</td>
<td>no</td>
</tr>
<tr>
<td><strong>HPSS access</strong></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Software Tree status</strong></td>
<td>Updated</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Default compiler</strong></td>
<td>Cray CCE</td>
<td>PGI</td>
</tr>
</tbody>
</table>
# Darter vs Kraken facts

<table>
<thead>
<tr>
<th></th>
<th>Darter</th>
<th>Kraken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory per node</td>
<td>32</td>
<td>16</td>
</tr>
<tr>
<td>#Cores per node</td>
<td>16(32)</td>
<td>12</td>
</tr>
<tr>
<td>Hyper-Threading</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Size for node Allocation</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

The size of allocation need to be a multiple of 16. This is because PBS allocates nodes per number of physical cores requested.
Naming conventions

Cray modules now start with ‘cray-’

- cray-ga/5.1.0.2 (default)
- cray-hdf5/1.8.11 (default)
- cray-hdf5-parallel/1.8.11 (default)
- cray-lgdb/2.2.1
- cray-libsci/12.1.01
- cray-mpich/6.1.0
- cray-mpich2/6.1.0
- cray-netcdf/4.3.0 (default)
- cray-netcdf-hdf5parallel/4.3.0 (default)
- cray-parallel-netcdf/1.3.1.1 (default)
- cray-petsc/3.4.2.0
- cray-petsc-complex/3.4.2.0
- cray-shmem/6.1.0
- cray-tpsl/1.3.04 (default)
- cray-trilinos/11.4.1.0

Note: FFTW library still called ‘fftw’
Darter Documentation

http://www.nics.tennessee.edu/computing-resources/darter
Where to go for help?

help@xsede.org

help@nics.utk.edu

External links:

http://www.cray.com/Products/Computing/XC/Resources.aspx
https://www.olcf.ornl.gov/support/system-user-guides/eos-user-guide/
http://www.nersc.gov/users/computational-systems/edison/
http://user.cscs.ch/hardware/piz_daint_cray_xc30/index.html