



OPEN
Compute Project



OCP U.S. SUMMIT 2017

Santa Clara, CA



Intel and OCP: Collaboration and Innovation

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Intel Fellow, CTO for HPC Ecosystem

Intel Corporation


OPEN HARDWARE.

OPEN SOFTWARE.

OPEN FUTURE.



Digital Transformation with


50B
Connected Devices
by 2020⁺



**Hyper-connected
World**



**Cloud Processing
and Analytics**



Intel

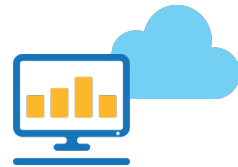
**5G Wireless and
Optical Networking**



Deluge of Data

Market Examples

Financial
Genomics
Government
Enterprise
Cloud



Infrastructure

Network
Storage
Compute



Applications

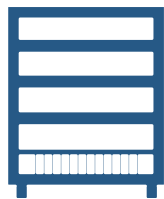
Security
Transcode
Video processing and analytics
Artificial Intelligence
Packet processing



Open Solutions accelerating the pace of innovation



AI: The next wave of computing



mainframes



Standard
s-based
servers



Cloud
computin
g

- ☑ Data deluge
- ☑ COMPUTE
- ☑ breakthrough

Artificial
intelligence
surge
ce

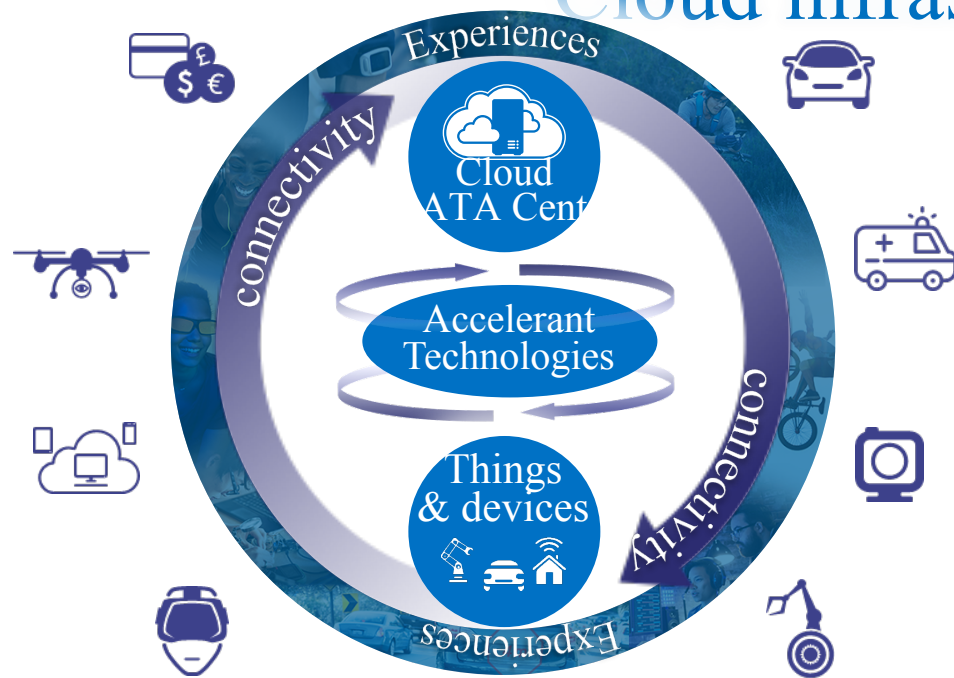
AI Compute Cycles will grow
by 2020 12X

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Artificial intelligence @ Intel Driving 12x growth in Cloud infrastructure



- ✓ MACHINE/DEEP LEARNING REASONING SYSTEMS
- ✓ Programmable solutions
- ✓ COMPUTER VISION TOOLS & STANDARDS
- ✓ Memory/storage
- ✓ Networking
- ✓ communications



Intel Driving Innovation and Collaboration in AI

Project Lightning



Lightning, NVMe JBOF



facebook

wiwynn

Microsemi

NVMe designed for OCP

- It scales
- It's open
- Flexible form factors
- Enables hot and warm storage

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Source:

<https://code.facebook.com/posts/989638804458007/introducing-lightning-a-flexible-nvme-jbof/>



Next Generation Intel® Xeon® Processor (Codename Skylake)



- Next-Generation Platform For Multi-Cloud Infrastructures
 - HW-Enhancements for great performance, security, & efficiency
-
- | | |
|--------------------------------------------------------------|--------------------------------------------------------------|
| ✓ Per core perf enhancements | ✓ Integrated Intel® Quick Assist Technology (crypto offload) |
| ✓ Intel® AVX-512 acceleration | ✓ Advanced RAS |
| ✓ Accelerated IO with Intel® Omni-Path Architecture (fabric) | ✓ Intel® Resource Director Technology |

Next generation of OCP designs based on Skylake and Intel World Wide Enabling Programs

OPEN HARDWARE.

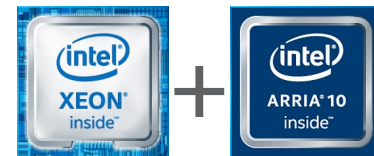
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OPEN FUTURE.

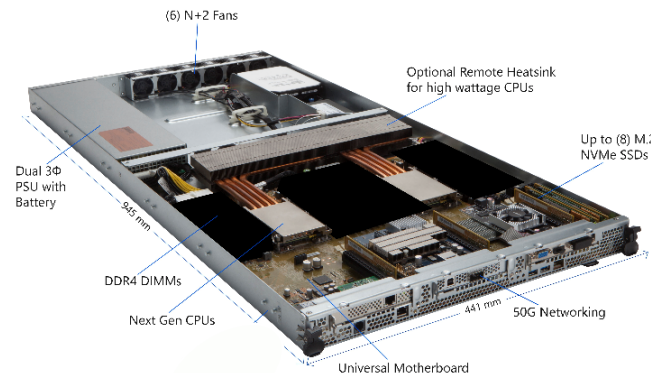


Microsoft* Project Olympus

Next generation Universal Motherboard for Hyperscale Cloud



- Based on next generation Intel® Xeon® processor, codename Skylake
 - Intel® AVX-512: Up to 2X FLOP/sec peak perf capability versus prior gen.¹
 - Integrated Intel® Quick Assist Technology (crypto offload)
- Supports Intel® Arria 10® FPGAs to provide a configurable framework
- Intel FPGAs accelerate network, encryption, compression & DNN functions



<https://azure.microsoft.com/en-us/blog/microsoft-reimagines-open-source-cloud-hardware/>

Standardized platform for various workloads
without compromising on performance

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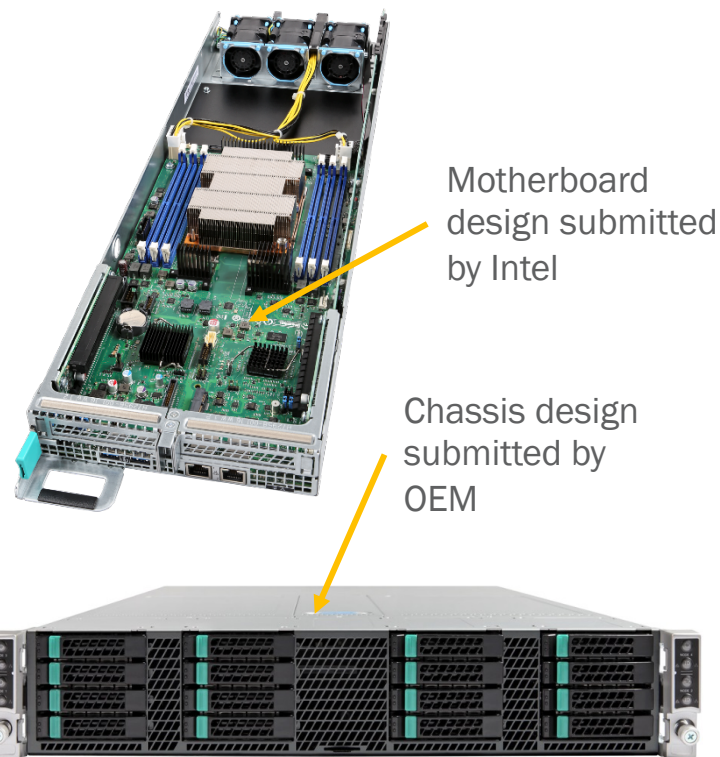
¹ Refer to <https://software.intel.com/en-us/blogs/2013/avx-512-instructions>

* Other names and brands are property of others.



Compute: Intel® Server Board S7200AP (Adams Pass)

- Specifically designed for highly parallelized workflows
- Support for Intel® Xeon® Phi™ processors with 6 DIMMs and optional support for Intel® Omni-Path Fabric Technology
- Customizable as a 2U, four node system
 - Submitted Adams Pass to the OCP Foundation
 - Enabled Penguin chassis submitted to OCP foundation



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OCP and RSD Ecosystem Fellow Travelers



*Other names and brands may be claimed as property of others

Intel® RSD - Revolutionizing the Datacenter

Laying the foundation for the modern scalable data center

Intel® RSD Vision:



Flexible



Manageable



Economic



Open

Becoming a reality...

1st Generation

2016: Established the standard, racks available

2nd Generation

2017: Era of pooling begins with storage
v2.1 released in February '17

Future

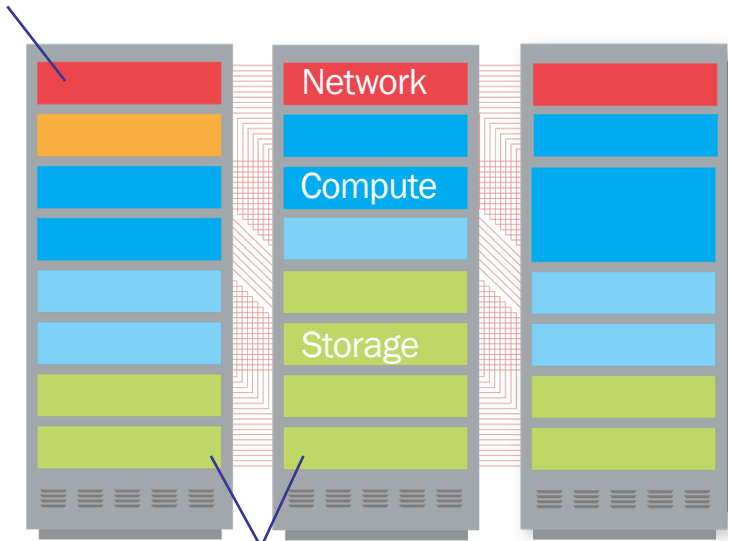
2017+

Intel® Rack Scale Design & OCP are complementary

Logical Architecture & Hardware Management Software

built on open industry standard Redfish™ API's

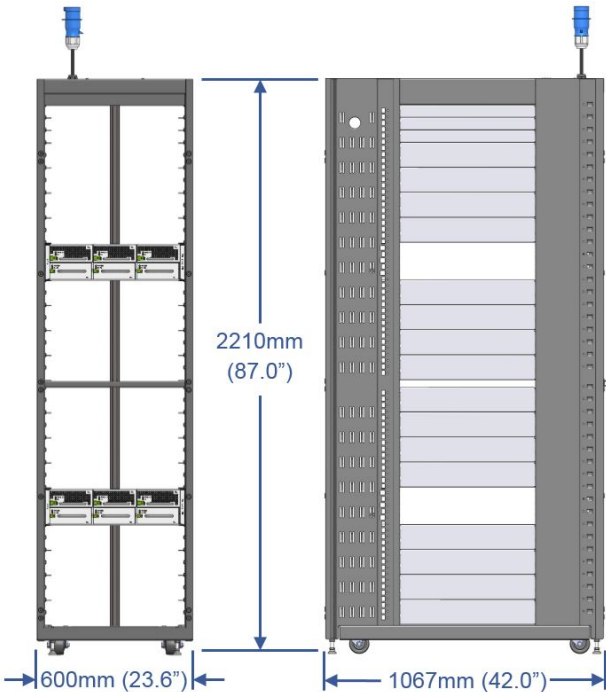
Network fabric ← **Pod-wide Management** →



Pod wide storage

Intel® RSD

Physical Architecture



Open Rack V2

OCP

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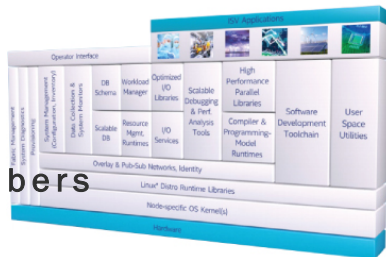
Datacenter Management SW



- Intel heavily invested in open source

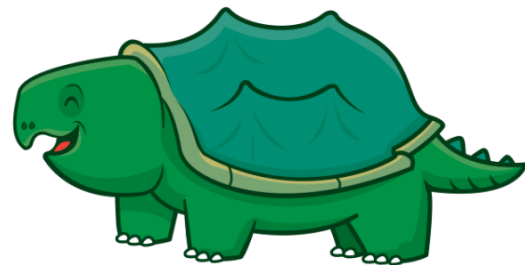
OpenHPC

A Linux Foundation
Community with 30 members



Snap

the open telemetry framework



- ✓ Over 60 Open Source components validated and integrated to ease High Performance Computing system installation, management and maintenance

<http://openhpc.community>

- ✓ Over 80 plugins w/ libraries for C++, Python, Go
<http://snap-telemetry.io>

OPEN HARDWARE.

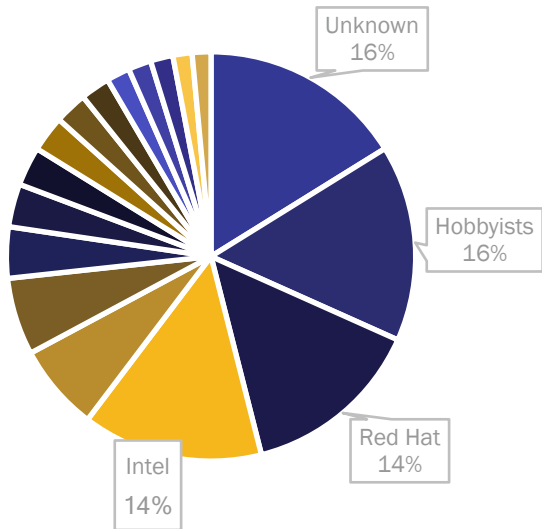
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Intel is a Major Linux Kernel Contributor

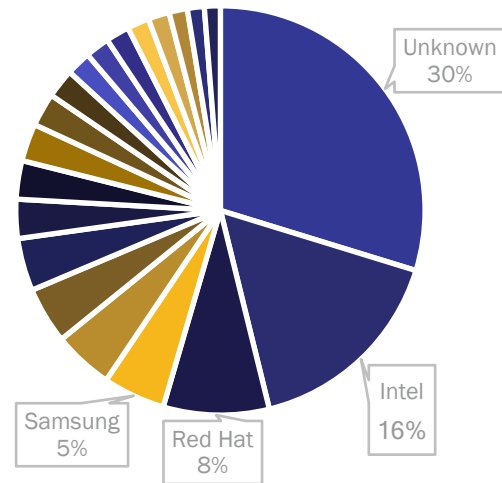
Contrib Since 2005



#4 Named contributor to Linux since 2005

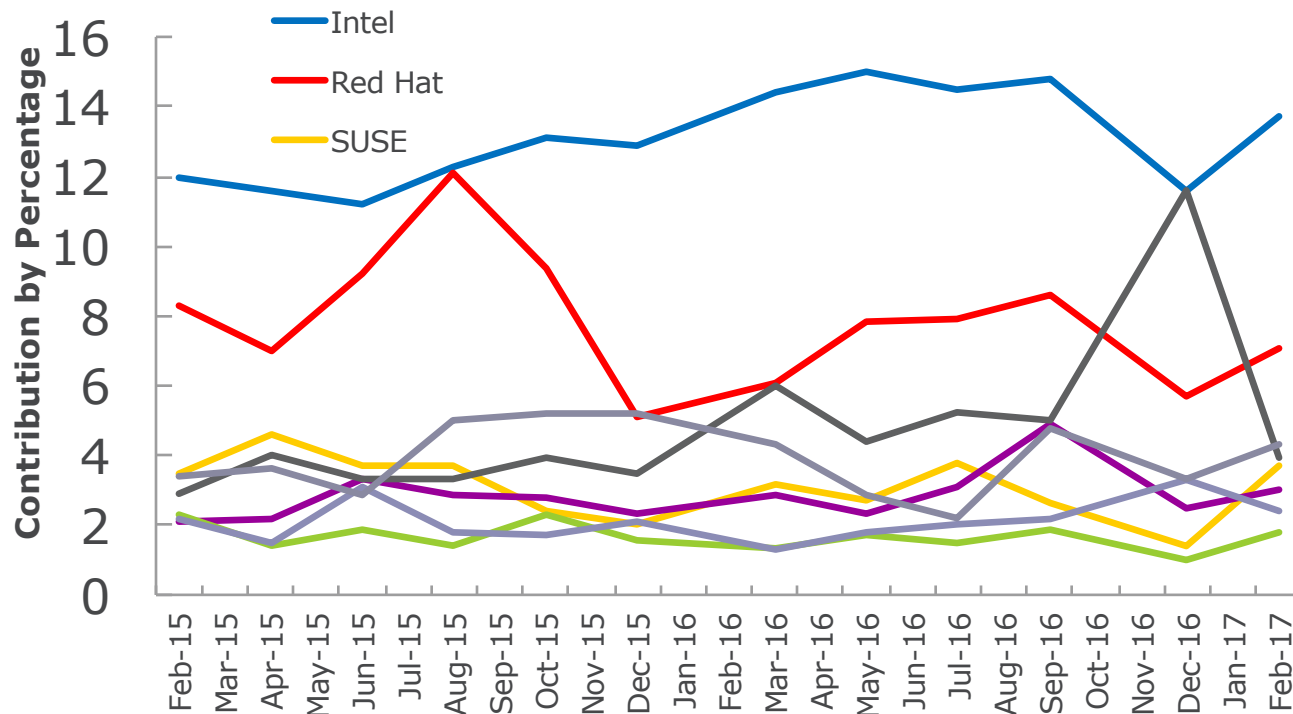
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Contributions 4.10



#1 Named contributor to Linux 4.10

Intel #1 in Linux Kernel Contributions



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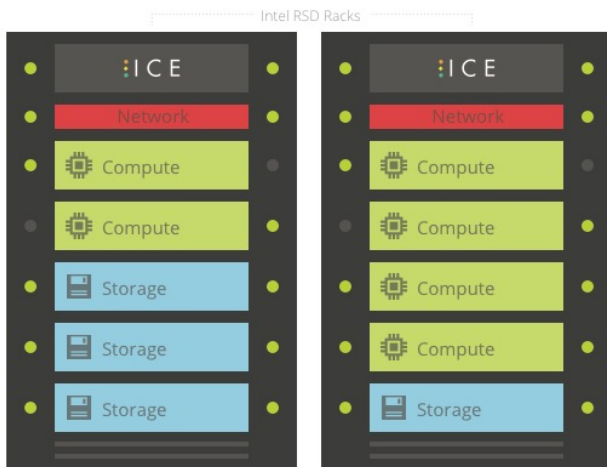
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Source: <http://lwn.net>



Software Define Power® Innovations



Peak Shaving

Utilize batteries to shave peaks and provide energy buffers for ride-throughs and multiple generations of growth



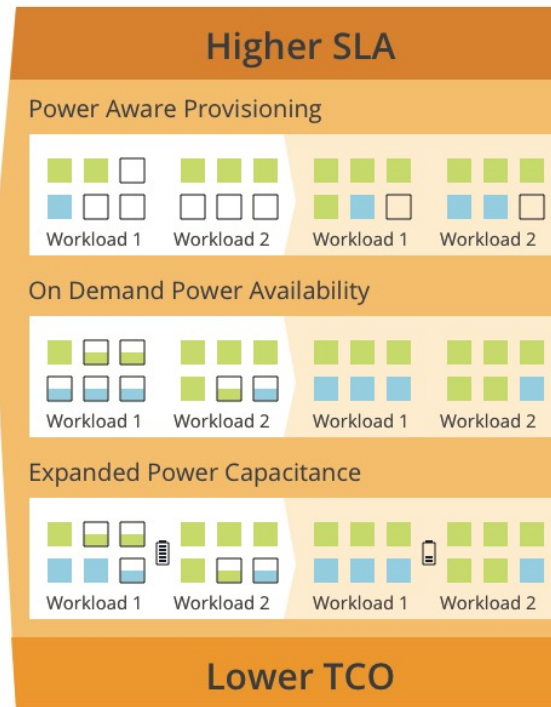
Dynamic Redundancy

Leverage unused redundant capacity for additional lower priority workloads



Workload Placement

Optimize energy utilization by dynamic placement and scheduling of workloads



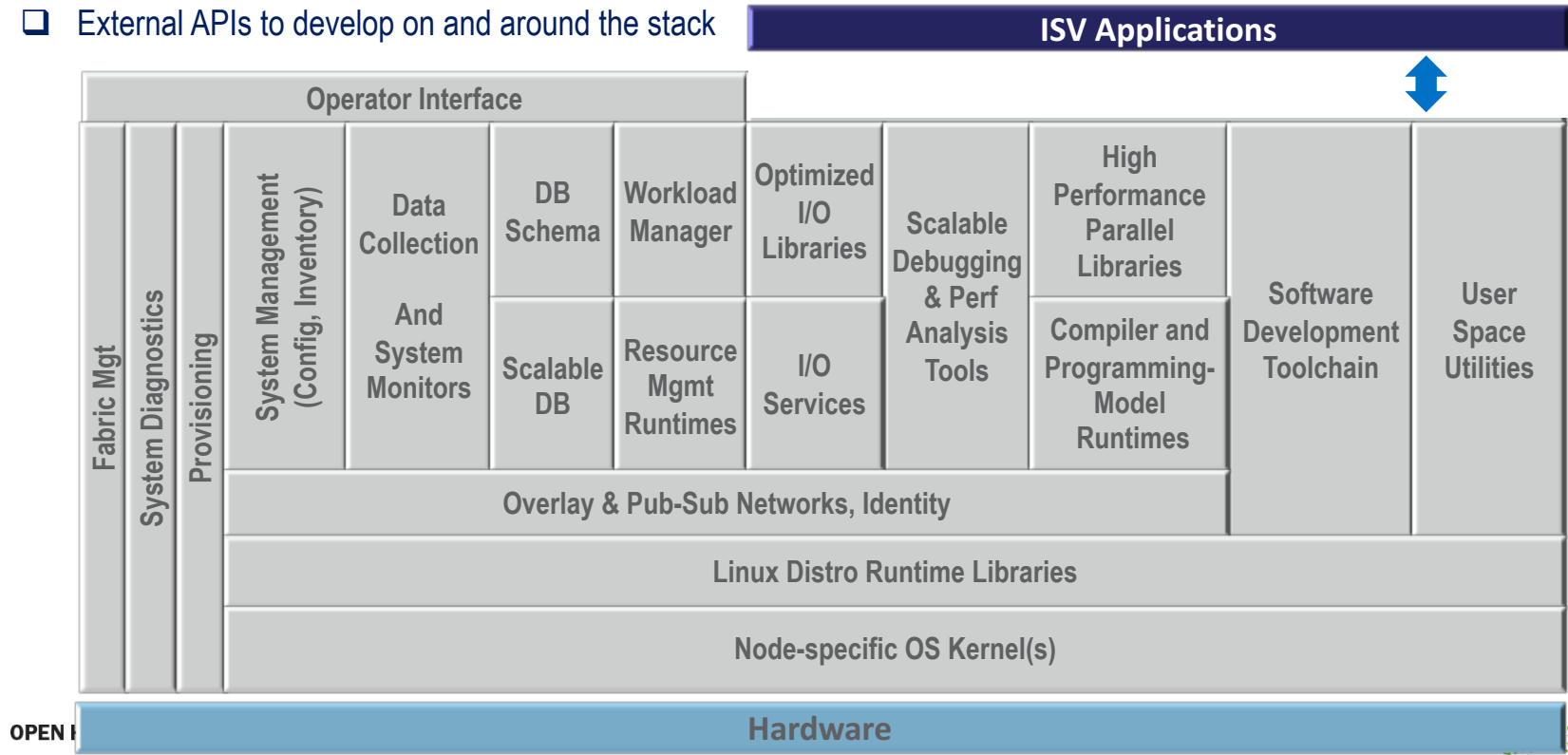
Provided by:  Virtual Power Systems

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HPC Stack Component View Enables collaboration and innovation

- ❑ Intra-stack APIs to allow for customization/differentiation
- ❑ External APIs to develop on and around the stack





OpenHPC Membership as of November 2016

💡 OpenHPC is a Linux Foundation* Project initiated by Intel and gained wide participation right away

💡 The goal is to collaboratively advance the state of the software ecosystem

Governing board is composed of Platinum members, Silver & Academic, Technical committee

30 Members

- Argonne National Laboratory

- Center for Research in Extreme Scale Technologies – Indiana University

- University of Cambridge

Courtesy of OpenHPC*

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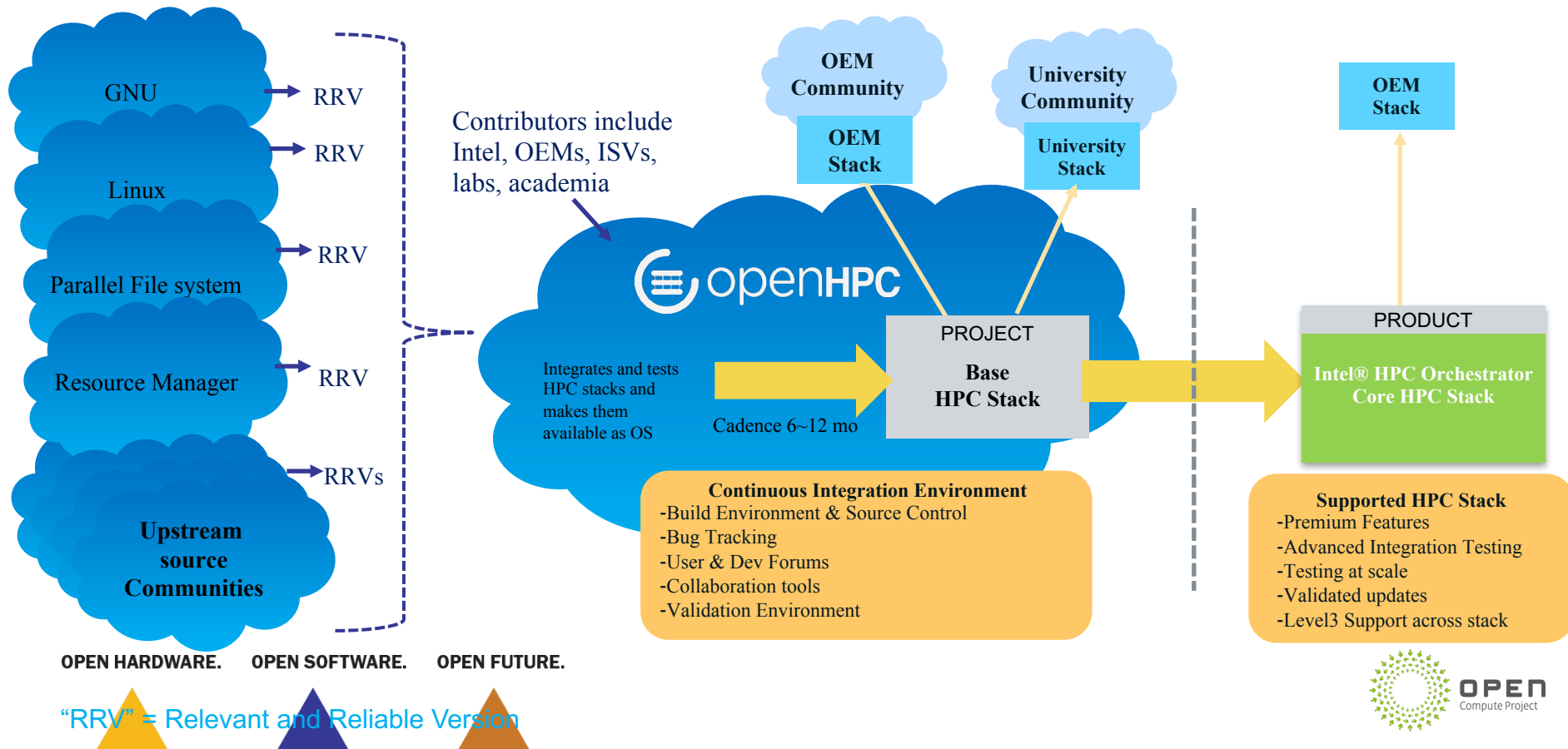
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WWW.OpenHPC.Community

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Intel® HPC Orchestrator Framework: OSS Project and Product



NUMPY & SCIPY OPTIMIZATIONS WITH INTEL® MKL

Configuration info: - Versions: Intel® Distribution for Python 2017 Beta, icc 15.0; Hardware: Intel® Xeon® CPU E5-2698 v3 @ 2.30GHz (2 sockets, 16 cores each, HT=OFF), 64 GB of RAM, 8 DIMMS of 8GB@2133MHz; Operating System: Ubuntu 14.04 LTS.

Linear Algebra

- BLAS
- LAPACK
- ScaLAPACK
- Sparse BLAS
- Sparse Solvers
 - Iterative
- PARDISO* SMP & Cluster

Up to
100x
faster

Fast Fourier Transforms

- Multidimensional
- FFTW interfaces
- Cluster FFT

Up to
10x
faster!

Vector Math

- Trigonometric
- Hyperbolic
- Exponential
- Log
- Power
- Root

Up to
10x
faster!

Vector RNGs

- Multiple BRNG
- Support methods for independent streams creation
- Support all key probability distributions

Up to
60x
faster!

Summary Statistics

- Kurtosis
- Variation coefficient
- Order statistics
- Min/max
- Variance-covariance

And More

- Splines
- Interpolation
- Trust Region
- Fast Poisson Solver

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INTEL® DISTRIBUTION FOR PYTHON* 2017

Advancing Python performance closer to native speeds

Easy, out-of-the-box access
to high performance Python

- Prebuilt, optimized for numerical computing, data analytics, HPC
- Drop in replacement for your existing Python. No code changes required

Drive performance with
multiple optimization
techniques

- Accelerated NumPy/SciPy/Scikit-Learn with Intel® Math Kernel Library
- Data analytics with pyDAAL, enhanced thread scheduling with TBB, Jupyter* Notebook interface, Numba, Cython
- Scale easily with optimized MPI4Py and Jupyter notebooks

Faster access to latest
optimizations for Intel
architecture

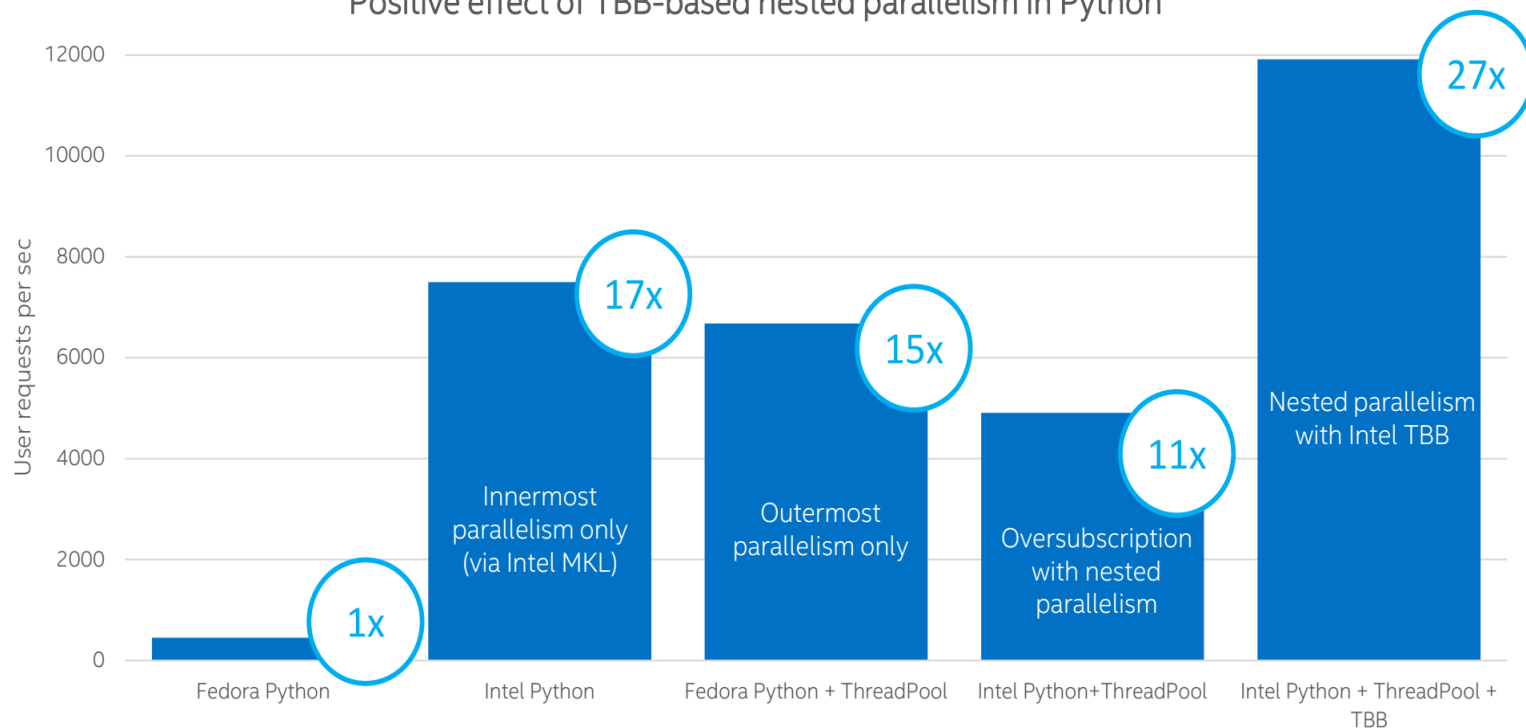
- Distribution and individual optimized packages available through conda and Anaconda Cloud
- Optimizations upstreamed back to main Python trunk

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Collaborative Filtering - Generation of User Recommendations

Positive effect of TBB-based nested parallelism in Python



Configuration Info: - Versions: Intel(R) Distribution for Python 2.7.11 2017, Beta (Mar 04, 2016), MKL version 11.3.2 for Intel Distribution for Python 2017, Beta, Fedora* built Python*: Python 2.7.10 (default, Sep 8 2015), NumPy 1.9.2, SciPy 0.14.1, multiprocessing 0.70a1 built with gcc 5.1.1; Hardware: 96 CPUs (HT ON), 4 sockets (12 cores/socket), 1 NUMA node, Intel(R) Xeon(R) E5-4657L v2@2.40GHz, RAM 64GB, Operating System: Fedora release 23 (Twenty Three)

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