Northeast Tier 2….2019, 2020,…

1.   Strategic Considerations
2.   Tactics for 2019…2020…

October 1, 2018

M.I.T. Plans College for Artificial Intelligence, Backed by $1 Billion

The Massachusetts Institute of Technology is taking a particularly ambitious step in preparing students to develop, and consider the implications of, artificial intelligence. It is creating a new college, backed by a planned investment of $1 billion.
Cody O'Loughlin for The New York Times

New York Times…*October 15, 2018*

Deals

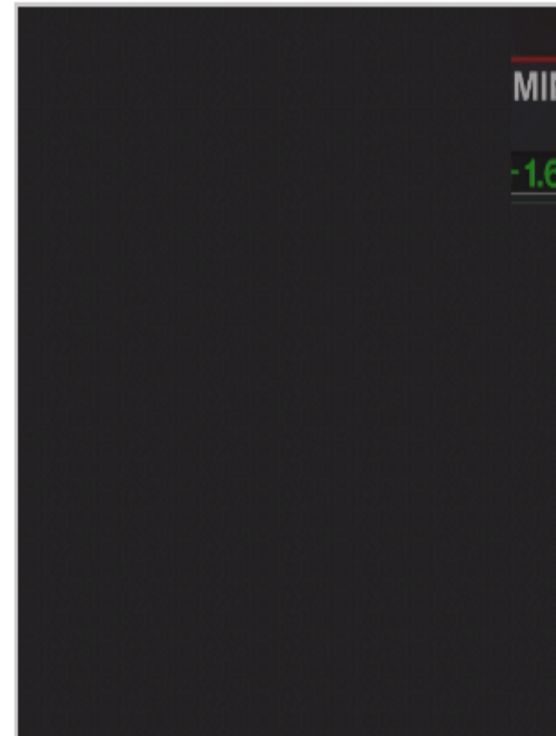# IBM to Acquire Linux Distributor Red Hat for $33.4 Billion

October 28, 2018

By Ed Hammond, Kiel Porter, and Alex Barinka
October 28, 2018, 1:54 PM EDT *Updated on October 28, 2018, 4:34 PM EDT*

▶ Computer-services giant to pay $190 a share for Red Hat

▶ Software maker will become a unit of IBM's Hybrid Cloud team

MI

-1.6

IBM's Been 'Reshaping' for This Moment, CEO Rometty Says

MGHPCC
Holyoke, Massachusetts
Near zero carbon footprint
>350,000 x86 cores now
Space/power/cooling for 785 racks
90,000 square feet of computer floor
Space for 2d building or pods

Consortium: BU, Harvard, MIT, NEU, UMASS,
Commonwealth of Massachusetts, DELL/EMC and Cisco

National compute & storage resources

Pittsburgh Supercomputing Center
- Bridges: 21056 CPUs
- Bridges GPU: 1344 processors
- Bridges large memory: 160 CPUs
- Bridges Pylon (storage): 10000 TB

● Compute Resources

● Storage Resources

San Diego Supercomputer Center:
- Comet: 46752 CPUs
- Comet GPU: 1728 processors
- Oasis (storage): 4000 TB

MGHPCC

Texas Advanced Computing Center:
- Stampede2: 368280 CPUs
- Wrangler: 2304 CPUs
- Ranch (storage): 61440 TB
- Wrangler (storage): 10000 TB

350,000 cores
~50000 TB storage

Northeast Tier 3

Boston University
Harvard University
UMASS/Amherst

- Operated by Wayne's group as part of NET2
- 56 Users
- Gradually growing
- Almost as many UMASS users as BU users
- Essentially no extra work for Augustine
- Use of Slack is extremely helpful
- UMASS bought in with three nodes
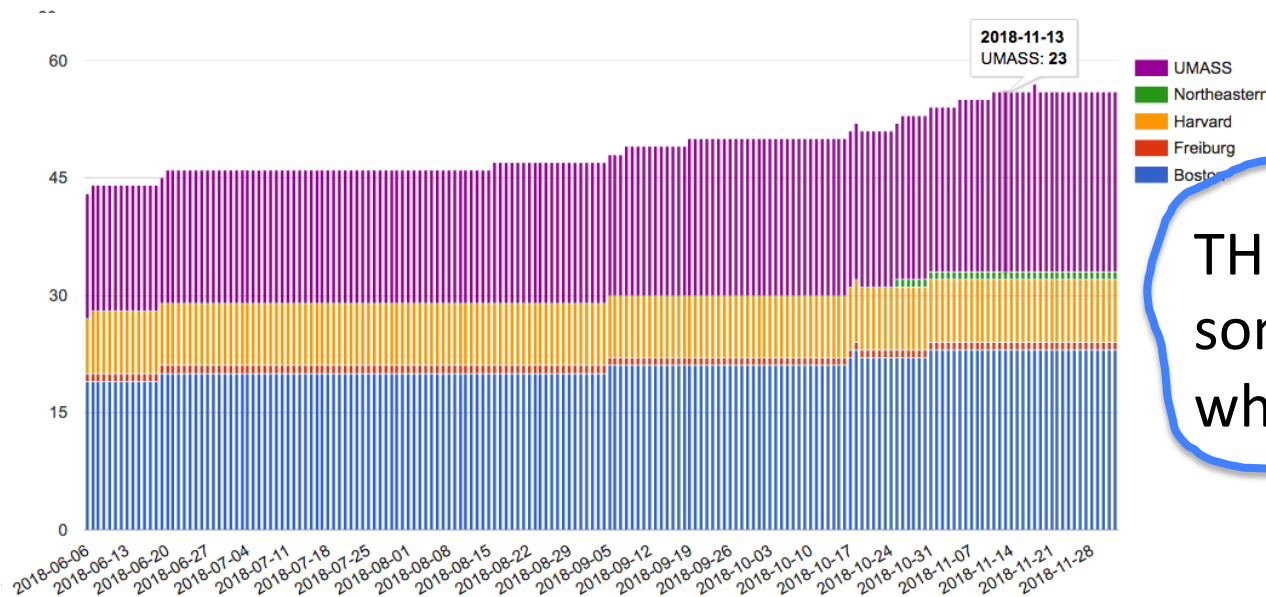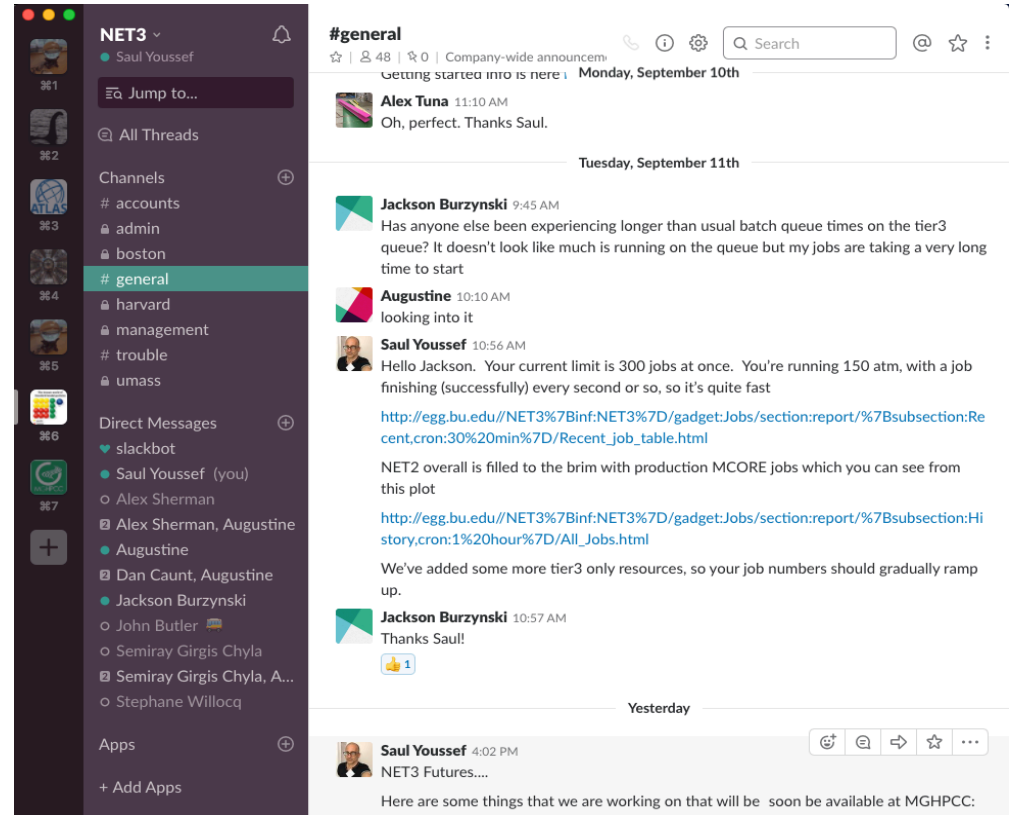
THEME: If you're good at something, do it for the whole consortium.

Internet2, Internet1
ESNet, LHCONE,…
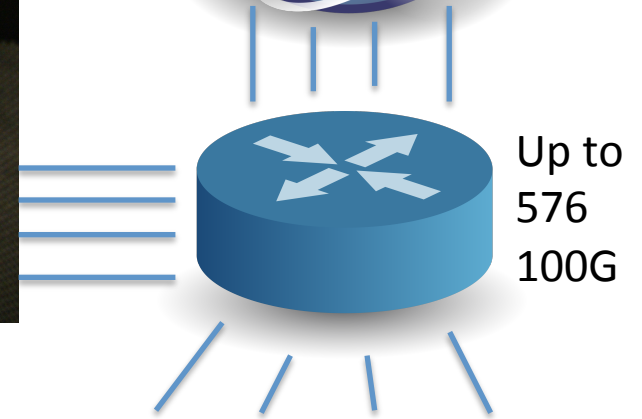
Up to
576
100G

CephFS/Posix   Globus   Gridftp   LHC Data   S3/Swift   Block storage

University buy-in, Project buy-in, NESE project funds, Inherited Equipment

8

MIT Supercloud

Education and Outreach

THEME: If you're good at something, do it for the whole consortium.

Search

- Home
- Requesting An Account
- Getting Started
- How To Use
- Jupyter Portal
- Online Courses
- Contact

Login using Touchstone

Systems and Software

This page lists information about the system and available software, languages, compilers, modules, etc. This is only a partial list, so if there is anything you are interested in that isn't listed here, please contact us.

MGHPCC TX–E1 Specifications

Summary	
Number of Nodes	56
Total CPU Cores	1348
Total GPUs	10
Distributed Storage	873 TB

CPU–Only Nodes				
Processor	Nodes	Cores	RAM	Local Disk
Intel Xeon	25	16	64 GB	16 TB
Intel Xeon	7	2 x 14	256 GB	12 TB
AMD Opteron*	20	2 x 16	192 GB	8 TB

GPU Nodes (Intel Xeon CPU)					
GPU Type	GPU Interconnect	Nodes	GPUs	CPU Cores	RAM	Local Disk
Volta V100	NVLink	1	4	2 x 14	500 GB	2 TB
Volta V100	PCIe	3	2	2 x 14	500 GB	2 TB

* Coming soon!

Mathematics of Big Data

Spreadsheets, Databases, Matrices, and Graphs

Jeremy Kepner and Hayden Jananthan

Foreword by Charles E. Leiserson

MIT LINCOLN LABORATORY SERIES

Jeremy Kepner

9

Hardware arrived, installed, OS deployed, Ceph testing beginning, ATLAS RSE testing coming soon.

R7-PB-C14: 2018-08-21 04:50:17 UTC

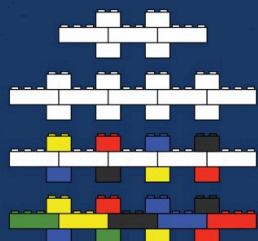|	loweredge ▼	type	vendor	anchor	model	nics	ST	drives							
1	44	MAN	DELL												
2	43	Cable Manager													
3	42	Cable Manager													
4	41	ADM	GDT												
5	40	TOR	DELL		S5048-ON	48x25G, 6x100G									
6	39	######			Air Gap										
7	38	TOR	DELL		S5048-ON	48x25G, 6x100G									
8	37	######			Air Gap										
9	36	MON	Microway		SYS-5019P-WTR	2x10G, 2x1G	32813	2x240G Micron SSD							
10	35	MON	Microway		SYS-5019P-WTR	2x10G, 2x1G		2x240G Micron SSD							
11	34	MDS	Microway		SYS-1029U-E1CRTP2	2x10G, 2x1G	32825	2x240G Micron SSD							
12	33	######			Buy-in OSD										
13	32	######			Buy-in OSD										
14	31	######			Buy-in OSD										
15	30	######			Buy-in OSD										
16	29	######			Buy-in OSD										
17	28	######			Buy-in OSD										
18	27	######			Buy-in OSD										
19	26	######			Buy-in OSD										
20	25	######			Buy-in OSD										
21	24	######			Buy-in OSD										
22	23	######			Buy-in OSD										
23	22	######			Buy-in OSD										
24	21	OSD	Microway		SSG-6019P-AC			SSD							
25	20	OSD	Microway		SSG-6019P-AC			SSD							
26	19	OSD	Microway		SSG-6019P-AC			SSD							
27	18	OSD	Microway		SSG-6019P-AC			SSD							
28	17	OSD	Microway		SSG-6019P-AC			SSD							
29	16	OSD	Microway		SSG-6019P-AC			SSD							
30	15	OSD	Microway		SSG-6019P-AC			SSD							
31	14	OSD	Microway		SSG-6019P-AC			SSD							
32	13	OSD	Microway		SSG-6019P-AC			SSD							
33	12	OSD	Microway		SSG-6019P-AC			SSD M							
34	11	OSD	Microway		SSG-6019P-AC			SSD M							
35	10	OSD	Microway		SSG-6019P-AC			SSD M							
36	9	OSD	Microway		SSG-6019P-AC			SSD M							
37	8	OSD	Microway		SSG-6019P-AC			SSD M							
38	7	OSD	Microway		SSG-6019P-AC			SSD M							
39	6	OSD	Microway		SSG-6019P-AC			SSD	Microway	8500446565	Jul 31, 2018, 12:00:00 AM	Jul 31, 2023, 12:00:00 AM	0	Boston University
40	5	OSD	Microway		SSG-6019P-AC			SSD	Microway	8500446565	Jul 31, 2018, 12:00:00 AM	Jul 31, 2023, 12:00:00 AM	0	Boston University
41	4	OSD	Microway		SSG-6019P-AC			SSD	Microway	8500446565	Jul 31, 2018, 12:00:00 AM	Jul 31, 2023, 12:00:00 AM	0	Boston University
42	3	OSD	Microway		SSG-6019P-ACR12L	2x10G, 2x1G	32956	12x10000G 7200rpm, 4x480G Micron SSD, 32G NVMe, 128G SSD	Microway	8500446565	Jul 31, 2018, 12:00:00 AM	Jul 31, 2023, 12:00:00 AM	0	Boston University
43	2	OSD	Microway		SSG-6019P-ACR12L	2x10G, 2x1G	32955	12x10000G 7200rpm, 4x480G Micron SSD, 32G NVMe, 128G SSD	Microway	8500446565	Jul 31, 2018, 12:00:00 AM	Jul 31, 2023, 12:00:00 AM	0	Boston University
44	1	OSD	Microway		SSG-6019P-ACR12L	2x10G, 2x1G	32954	12x10000G 7200rpm, 4x480G Micron SSD, 32G NVMe, 128G SSD	Microway	8500446565	Jul 31, 2018, 12:00:00 AM	Jul 31, 2023, 12:00:00 AM	0	Boston University
45	0	rack	EATON	rack											MGHPCC

2019…2020…Tactical

- Retire old HU nodes, absorb rest into BU pods
- Retire LSM in favor of rucio-mover
- RH7 upgrade => Singularity readiness
- New, small GPFS SSD system pool
- Networking upgrade including NET2<->NESE @200G
- Squid tune-up (re: John DeStephano, Nurcan)
- Harvester/single queue/SGE readiness
- Slate/k8 node acquisition & prep
- Creation of NESE, then MGHPCC-wide operations data co-op
- NESE ATLAS DDM endpoint creation & testing with gridFtp, xrootd,…(coordinate with Wei & Hiro)
- Technology evaluation for 2019..2020… NESE (learn from Xin re: tape carousels)

MIT "Supercloud" AI, Jupyter, Matlab, GPU-heavy

Operations
Data Co-op
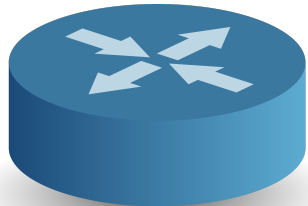
Pooled worker nodes, dynamically importable into HPC or Cloud environments

NESE Ceph

NESE Flash

NESE Carousel

Mass. Open Cloud, RH/IBM AI stacks, GPU-heavy

THEME: If you're good at something, do it for the whole consortium.

1st Deployment being cabled now. 12PB starter; 40+% buy-in already RedHat Partnership Going!

NESE: The Northeast Storage Exchange

Saul Youssef,[1] Scott Yockel,[2] Chris Hill,[3] John Goodhue,[4] Devesh Tiwari,[5] and Mike Zink[6]
Boston University,[1] Harvard University,[2] MIT,[3] MGHPCC,[4] Northeastern University,[5] University of Massachusetts[6]

Massachusetts Green High Performance Computing Center (MGHPCC)
- 15 megawatts, 785 racks, approx. 2/3 full now
- >350,000 x86 cores now
- Redundant 100Gb fiber ring to national research networks
- Secure, single use site
- Room for second building and/or expansion via pods

Context: The Consortium is comparable to the whole Pacific Research Platform in a single building:
- 5 Universities, 9 campuses including Harvard and MIT
- 17,000 researchers
- More than 100,000 students
- Five new Data Science initiatives or institutes
- Looking to expand membership

PROJECT ORGANIZATION
- Management, planning, outreach, science coordination, sustainability: *All PIs*
- Operations: *Scott Yockel*, Harvard FAS Research Computing, BU, RedHat
- Networking: *Jefferson Burson*, Harvard University IT
- Technology planning: *Devesh Tiwari*, Northeastern University
- Ocean apps and iRods: *Christopher Hill*, MIT
- Block storage for clouds, CloudLab: *Mike Zink*, UMass/Amherst
- NET2, LHC applications, federated LHC storage: *Saul Youssef*, Boston University
- Collaboration with RedHat, Mass. Open Cloud: *Orran Krieger*, Boston University
- Authentication and Globus: *Jim Culbert*, MGHPCC
- Education, Outreach, Open Storage Platform: *John Goodhue*, MGHPCC

For Data Science, location matters!

INTERVIEW: BU physicist on creating new, math-driven field of medicine

DATA SCIENCE
Every one of the five Consortium member universities have a new data science institute, initiative or program.

- Boston University Data Science Initiative
- Harvard Data Science Initiative
- MIT Institute for Data, Systems and Society
- Data Science at Northeastern University
- Center for Data Science, UMASS/Amherst

Every Consortium university will be able to create their own control room showing Northeast U.S. cyberinfrastructure operations including NESE. This would be great for
- Community building
- Student projects and training
- Inspiring new generations of operations software based on Data Science and AI

Amazon Says 900 Jobs Will Be Added At New Boston Office

RedHat
Intel
DELL/EMC
Google
NVIDIA
Amazon
Facebook
Microsoft
Wolfram Research
Mellanox
Cisco
General Electric
…

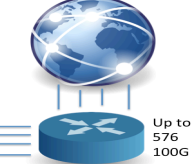Amazon to add 2,000 jobs in Boston

Partnership with RedHat
- Via BU/RedHat "Collaboratory"
- Design consultation…including with Sage Weil
- Installation help
- Embedded RedHat personnel
- Use of RedHat facilities in Boston
- Premium software Subscriptions

GOALS
- To meet the storage needs of the data revolution for science, engineering, education and technology.
- To be the start of a national cyberinfrastructure in the Northeast U.S.

STRATEGY
- Take advantage of the basic economics of storage.
- Use our unique consortium and the MGHPCC facility as a starting point.
- Organize the project for long term growth, with institutional responsibilities, community building, long term planning, integration with education, and long term technology tracking.
- Use our unique environment for partnerships with universities, technology companies, biotechs, hospitals, institutes, and new data science centers.

Internet2, Internet1 ESNet, LHCONE,…

Up to 576 100G

CephFS/Posix   Globus   Gridftp   LHC Data   S3/Swift   Block storage

University buy-in, Project buy-in, NESE project funds, Inherited Equipment

2 x 100Gb/s uplinks to 100Gb/s Fabric

3.9 PB raw per rack when filled
Space for more buy-ins

Start of Umass/Amherst buy-in

Basic Storage Unit
- 1U
- As dense as 60 bay JBOD
- 12 x 10TB 7200 rpm spinning Main storage
- 4 x 280GB Micron high endurance SSD Bluestore Ceph + CephFS
- 1 x 32GB NVMe
  - Ceph write-ahead log
- 2 x 10Gb/s
  - Matches drives i/o
- 1 x Single Socket Intel Xeon Skylake 2.2 Ghz (3.0 Ghz Turbo), 10C/20T with AVX-512 SIMD coprocessor

First Deployment
- Six racks at two sites
- 12 PB raw storage
- Small, flexible 120TB OSD
- Designed for all storage types: CephFS, Block storage, S3, Swift, Globus endpoint
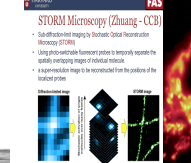- SSDs for Ceph Bluestore
- 100Gb/s networking

FIRST SCIENCE
- NESE storage for the U.S. ATLAS Northeast Tier 2 center (NET2, BU/Harvard) is one of the first production applications. 6PB and growing.
- Federating NESE storage with OSiRIS/(Also NSF-DIBBS) and with tape storage at Brookhaven National laboratory to produce a prototype national federation which can be scaled to the 1 EB needed in 2026 for the high luminosity LHC
- Ocean Modeling by Chris Hill's group at MIT uses data from ships, fixed stations, from space and from simulations.

Lichtman Lab at Harvard
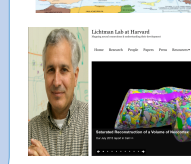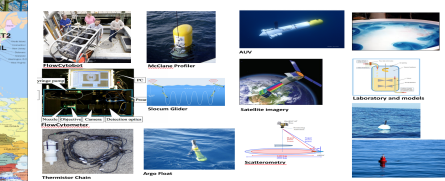
- Jeffrey Lichtman's lab at Harvard produces ~10 PB per year of electron microscopy images of mouse brains with the goal of mapping neuronal circuits and understanding brain function
- Mark Friedl of BU needs to to analyze 10s of PB of multi-spectral time-series satellite images of the Earth.

Astrophysics (Hernquist - CFA)

Remote Sensing & Geospatial Sciences

- Lars Hernquist's group at Harvard studies galaxy formation and cosmology with simulations which need 100s of TB for intermediate steps.
- A next-gen gene sequencing facility at Harvard needs to store and process tens of TB per day.

NextGen Sequencing

Core Facility

Illumina Instruments: NextSeq 500, HiSeq 2000 & 2500
- Rapid Reads (1x38) in 8 hrs: 9-11 Gb
  - 80-100 GB data to transfer
  - 320-400 GB data during processing
  - 3 instruments X 3 runs/day = 3.6 TB/day for processing
- High Output (2x250) in 6 days: 0.9-1.0 Tb
  - 8-9 TB data to transfer
  - 32-40 TB data during processing
  - 3 instruments / 6 days = 20 TB/day for processing

STORM Microscopy (Zhuang - CCB)

- Advanced microscopy at Harvard images mitochondria in single cells and produces approximately 1 PB of data per year.

CASA

- The CASA project at UMASS/Amherst aims to revolutionize rapid response to hazardous weather. Data currently at DFW metroplex.

INTERVIEW: BU physicist on creating new, math-driven field of medicine

- Network physiology is a new field invented by Plamen Ivanov at BU where unique medically important insights can be extracted from multi-source human physiology data with fast enough access for clinical response.
- These are only some of the first expected NESE applications to be discussed at meetings like HPC Futures.

HPC Futures

Results, ideas, and planning for computing at Boston area universities, institutes, hospitals and companies

Buy-ins done or planned from…
- Harvard FAS RC
- MIT
- UMASS/Amherst
- Boston University
- NET2 project
- *We already have 40% buy-in*