Project Report

Understanding the Cost of Computing in the Cloud

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This project is to find the cost breakdown of a private cloud, and compare that to what Amazon would charge. We need to estimate the cost of different configurations for 3 different set of requirements as below.

1. configuration 1: Hadoop/Spark Cluster with 32K-cores, 256TB memory, 50PB HDD, and 10Gb/s Ethernet Fat-Tree network (each VM should be equivalent to the d2.8xlarge instance); in addition to the compute resources, a 100PB distributed storage shared across the entire cloud should be procured, with enough capacity for 100GB/sec throughput.

d2.8xlarge (116 ECUs, 36 vCPUs, 2.4 GHz, Intel Xeon E52676v3, 244 GiB memory, 24 x 2048 GiB Storage Capacity)

	Description	Price per Item	Quantity	Total Price
Compute Servers(CPU, memory and server case)	INTEL XEON E5-2676 V3 2.40GHZ SOCKET 2011-3 LGA2011-3 HASWELL SERVER OEM CPU SR1Y5 CM8064401613101 (12 cores)	$2,197.00	3000	$6,591,000.00
	128GB (32GB x4) PC4-21300 DDR4-2666 Mhz Load Reduced ECC Quad Ranked 1.2V Major Brand	$1,959.99	3000	$5,879,970.00
	Acme RD-108TFA DP Xeon E5-2600v4 LGA2011-3 based 2.5 SATA*8 hot-swap 2x 10GbE 2x GbE IPMI 1U Server	$819.00	3000	$2,457,000.00

Network Switches	Mellanox Ethernet SwitchX®-2 based 48-port SFP+ 10GbE 12 port QSFP 40/56GbE 1U 1PS MSX1024B-1BRS	$14,187.00	95	$1,347,765.00
Network Cables	Mellanox MCP2M00-A001 Passive Copper Cable, ETH, up to 25Gb/s, SFP28, 1m	$19.00	3185	$60,515.00
Racks	Rack Enclosure Extension Frame Increases external depth of 42/48U cabinets by 8 inches to a total depth of 51 inches	$364.99	75	$27,374.25
Storage Servers (50PB HDD in cluster)	10TB Seagate ST10000NM0206 - SAS 4Kn HDD 10TB V.6 Enterprise Capacity SAS 12Gb/s 7200rpm 256MB 3.5-inch Bulk	$409.00	5000	$2,045,000.00
Storage Servers (100PB distributed storage: HDD disks and storage boxes)	10TB Seagate ST10000NM0206 - SAS 4Kn HDD 10TB V.6 Enterprise Capacity SAS 12Gb/s 7200rpm 256MB 3.5-inch Bulk	$409.00	10000	$4,090,000.00
	Promise VR2600FISUBA VessRAID 3U 16BAY FC8GX2+iSCSI1Gx4 6GB SAS/SATA 3xRedundant PSU Single-controller 2 redundant fans	$4,514.00	90	$406,260.00
Power Supply	CyberPower Smart-APP UPS PR2200LCDRT2U 2U 1600W 2170VA 120V 5-20P 5-20R RJ-45 USB Surge-Protected Black Retail	$682.99	3000	$2,048,970.00

Electric Power	nationwide average power price: 14.2 cents per kWh;	$9,711,403.48	5	$48,557,017.40
Cooling	Dynatron R17 cooler for CPU Intel Socket 2011-3 Xeon E5-2600 Series processor (square pitch)	$39.00	32000	$1,248,000.00
Administration	data center administrator	$61,554.00	15	$923,310.00
TOTAL	N/A	N/A	N/A	$75,682,181.65

Table 1: private cost for configuration 1

*Note:
1) Compute Servers(CPU, memory and motherboard): Since there is no server of Intel XEON E5-2676 V3 sold in market now, we build the server by ourseles.
12 cores contained by each processor, 32k cores needed, so quantity of the server here is 3000.
INTEL XEON E5-2676 V3 support memory type is DDR4. Here each server has 128GB, we have 384 TB memory. The requirement asks for 256 TB memroy, so the memory meet the requirement.
Here each server has 12 cores and 128GB memory, total we have 3000 servers.Cite: processor price website:
https://starmicroinc.net/intel-xeon-e5-2676-v3-2-40ghz-socket-2011-3-lga2011-3-haswell-server-oem-cpu-sr1y5-cm8064401613101/

2) Network Switches : Since we have 3000 servers, we can use 48 port switch to build a 3 layer fat tree network. Top layer has 1 switch(1 port to uplink, and 47 port to the second level). The second layer has 47 switches(with each switch has one port connecting to top level and 47 ports connecting to next level). The third we can just add 47 switches, they can all connect to the same switch on one of the second layer's switch.
Then we can connect 2209(47*47) servers to the last layer's switch; and adding 791 (3000-2209) servers and 90 storage boxes to the free ports in the second layer. We have totally 2162 free ports left in the second layer (46*47), so that's enough.
So totally we need 1+47+47=95 switches.
Here we use 10GBE switches, 48x 10GbE hosts port. It can ensure 10GB/s Ethernet.

3) Network Cables: To connect all the switches, we need 48+47=95 cables.
To connect all the switches with servers and storage boxes, we need 3090 cables. So quantity is 3185.
Here we use SFP 25Gb/s cable to ensure the network bandwidth.
Cite:

https://store.mellanox.com/products/mellanox-mc3309130-0a1-passive-copper-cable-ethernet-10gbe-10gb-s-sfp-1-5m.html?gclid=CjwKCAiArrrQBRBbEiwAH_6sNM0dCW2tIA8MXNIFrcjR0vyTkoGXJLQKgz2sLUWL77oqupTaEATPNxoC6DsQAvD_BwE

4) Racks: Each pod consists of 1 racks with 40 servers each, total 75 racks needed.
5) Storage Servers (50PB HDD in cluster): Each HDD has capacity 10TB,
50PB HDD needed, so quantity is 5000.
According to seagate website, each HDD has max transfer rate 254MB/s.
According to this formula:
I/O Operations Per-Sec = number of disks * Average I/O Operations on 1 disk per-sec/(
% of read workload + (Raid Factor * % of write workload)). 5000 HDD will ensure enough capacity for 100 GB/s throughput.
Cite:
https://www.seagate.com/www-content/datasheets/pdfs/ent-cap-3-5-hdd-10tb-channelDS1863-5C-1608US-en_US.pdf
http://blog.scoutapp.com/articles/2011/02/10/understanding-disk-i-o-when-should-you-be-worried
https://superuser.com/questions/1170362/what-is-storage-factor-in-total-raid-capacity-formula-given-by-wolframalpha

6) Storage Servers (100PB distributed storage: HDD disks and storage boxes): The distributed storage are HDD disks stored in storage boxes. With the storage boxes we chosen, each box can store 112 disks, so we need 90 storage boxes total. And as per professor's 11/20 lecture, with the storage box, we don't need extra storage servers, we just connect them to the top level switches.
Cite:
https://www.disctech.com/Promise-Technology-Vess-J2600S-VJ2600SZDUBA-3U-16-Bay-JBOD-Expansion-Chassis

7) Electric Powe: processor TDP 120W/unit; memory: 5.5W/unit max; server case: 800w/unit; switch(ATIS Weighted Power consumption): 74.7W/unit; stroage disk: 5.5W/unit; storage box: 500 w/unit; cooler: 3w/unit with 100% usage, power supplier: 1600w/unit
There are 8760 hours per year, so the total power consumption per year is:
(0.12*3000+0.0055*3000+0.8*3000+0.0747*95+0.0055*15000+0.5*90+0.003*32000+1.6*3000)*0.142*8760=9711403.48 dollars

8) Administration: According to glassdoor, average salary for 1 data center administrator is 61554 per year; We have 3000 servers, so 3 administrator needed, total we have 5 year lifetime, so the quantity is 15.
Cite:
https://www.glassdoor.com/Salaries/data-center-administrator-salary-SRCH_KO0,25.htm

2. Configuration 2: Support 1 million virtual machines (VM) where each VM requires 2-core, 15GB RAM, 32GB SSD storage, and 1Gb/s Fat-Tree network (each VM should be equivalent to the r3.large instances); in addition to the compute resources, a 10PB distributed storage shared across the entire cloud should be procured, with enough capacity for 10GB/sec throughput.

r3.large (6.5 ECUs, 2 vCPUs, 2.5 GHz, Intel Xeon E5-2670v2, 15 GiB memory, 1 x 32 GiB Storage Capacity)

A23:E2A23:E30	Description	Price per Item	Quantity	Total Price
Compute Servers(CPU, memory, and case)	Intel Xeon E5-2670 v3 Processor LGA2011-3 Haswell 12 Core 2.3GHz 30MB 9.6GT/s BX80644E52670V3 Box	$1,721.44	166667	$286,907,240.48
	16GB DDR3 PC3-12800 204-pin SODIMM DDR3-1600 Unbuffered Non-ECC 1.35 Main Brands	$179.99	1000000	$179,990,000.00
	Acme RD-108TFA DP Xeon E5-2600v4 LGA2011-3 based 2.5 SATA*8 hot-swap 2x 10GbE 2x GbE IPMI 1U Server	$819.00	166667	$136,500,273.00
Network Switches(1Gb core switch)	NETGEAR 48-port Gigabit Ethernet Rackmount Unmanaged Switch (GS348)	$297.99	4466	$1,330,823.34
Network Cables	Ethernet Cat6a Cable 3 feet RJ45 10Gb/1Gb	$6.80	171142	$1,163,765.60
Racks	Rack Enclosure Extension Frame Increases external depth of 42/48U cabinets by 8 inches to a total depth of 51 inches	$364.99	4166	$1,520,548.34
Storage Servers (32 GB SSD per VM)	Intel SATA 240GB Solid-State Drive SSDSCKKW240H6X1 540s Series SATA 6Gb/s M.2 2280 560MB/s Read	$117.99	166667	$19,665,039.33

Storage Servers (10PB distributed storage and storage boxes)	10TB Seagate ST10000NM0206 - SAS 4Kn HDD 10TB V.6 Enterprise Capacity SAS 12Gb/s 7200rpm 256MB 3.5-inch Bulk	$409.00	1000	$409,000.00
	Promise VR2600FISUBA VessRAID 3U 16BAY FC8GX2+iSCSI1Gx4 6GB SAS/SATA 3xRedundant PSU Single-controller 2 redundant fans	$4,514.00	9	$40,626.00
power supply	Intel FXX1100PCRPS/AXX1100PCRPS 1100W Redundant Power Supply Module for Servers G84027-007 S-1100ADU00-201	$259.00	166667	$43,166,753.00
Electric Power	nationwide average power price: 14.2 cents per kWh;	$429,169,059.20	5	$2,145,845,296.00
Cooling	Dynatron R17 cooler for CPU Intel Socket 2011-3 Xeon E5-2600 Series processor (square pitch)	$39.00	2000000	$78,000,000.00
Administration	data center administrator	$61,554.00	830	$51,089,820.00
TOTAL	N/A	N/A	N/A	$2,945,629,185.09

Table 2: private cost for configuration 2

*Note:
1) Compute Servers(CPU, memory and motherboard): Since there is no server of Intel XEON E5-2676 V3 sold in market now, we build the server by ourselves. 12 cores contained by each processor, 2 million cores needed, so quantity here is 166667, so we have 166667 servers. INTEL XEON E5-2676 V3 support memory type is DDR4 1600/1866/2133.
Cite:
https://ark.intel.com/products/81709/Intel-Xeon-Processor-E5-2670-v3-30M-Cache-2_30-GHz

2) Network Switches: Since we have 166,667 servers, we can use 48 port switch to build a 4 layer fat tree network. Top layer has 1 switch(1 port to uplink, and 47 port to the second level). The second layer has 47 switches(with each switch has one port connecting to top level and 47 ports connecting to next level). The third level has 47*47=2209 switches. The 4th layer we can just add another 2209 switches, they can connect to the first 47 switches in the third layer.

Then we can connect 62844 (47*47*47) servers to the last layer's switches; and adding 62844 (166667-103823) servers and 9 storage boxes to the free ports in the second layer. We have totally 101614 free ports left in the second third (46*47*47), so that's enough.
So totally we need 1+47+2209+2209=4466 switches.
Here we use 1GBE switches, 48x 1GbE hosts port. It can ensure 1GB/s Ethernet.
Cite:
https://www.newegg.com/Product/Product.aspx?Item=N82E16833122948&ignorebbr=1

3) Network Cables: To connect all the switches, we need 48+2209+2209+166667+9=171142cables.
Here we use 10Gb/1Gb cable to ensure the network bandwidth.

4) Racks: Each pod consists of 1 racks with 40 servers each, total 4166 racks needed.

5) Storage Servers (32 GB SSD per VM): Each SSD has capacity 32GB/VM, 1 million VMs total, so 32PB SSD total needed; each SSD has 240 GB/server, we have 166667 servers, so we have about 40PB SSD built, that's enough.
According to seagate website, each ssd has transfer rate 480MB/s.
According to this formula:
I/O Operations Per-Sec = number of disks * Average I/O Operations on 1 disk per-sec/(% of read workload + (Raid Factor * % of write workload)). 166,667 SSD will ensure enough capacity for 10 GB/s throughput.
Cite:
https://www.seagate.com/www-content/datasheets/pdfs/ent-cap-3-5-hdd-10tb-channelDS1863-5C-1608US-en_US.pdf
http://blog.scoutapp.com/articles/2011/02/10/understanding-disk-i-o-when-should-you-be-worried
https://superuser.com/questions/1170362/what-is-storage-factor-in-total-raid-capacity-formula-given-by-wolframalpha

6) Storage Servers (10PB distributed storage and storage boxes): The distributed storage are HDD disks stored in storage boxes. With the storage boxes we chosen, each box can store 112 disks, so we need 9 storage boxes total. And as per professor's 11/20 lecture, with the storage box, we don't need extra storage servers, we just connect them to the top level switches.

7) Electric Power: processor TDP 120W/unit; memory: 1.65W/unit max; server case: 145w/unit; switch: 23W/unit max; SSD stroage: 3.5W/unit active; distributed storage: 5.5W/unit; storage box: 500 w/unit; cooler: 3w/unit with 100% usage; power supply: 1100w/unit
There are 8760 hours per year, so the total power consumption per year is:
(0.12*166667+0.00165*1000000+0.8*166667+0.023*4466+0.0035*166667+0.0055*1000+0.5*9+0.003*2000000+1.1*166667)*0.142*8760=429169059.2 dollars

8) Administration: According to glassdoor, average salary for 1 data center administrator is 61554 per year; we have 166667 servers, so 166 administrator needed, total we have 5 year lifetime, so the quantity is 830.

- Configuration 3: Support deep learning with 1 exaflop of mixed precision performance (hint: each VM should be equivalent to p3.16xlarge instances; you will want to use the NVIDIA V100 GPUs (8 GPUs per node), and allocate 8-cores per GPU (64-cores per node) with 8GB of memory per core (512GB per node); the network to use is at least 10Gb/s per GPU (100Gb/s should work), and should be organized in a Fat-Tree network; in addition to the compute resources, a 1PB distributed storage shared across the entire cloud should be procured, with enough capacity for 10GB/sec throughput (for pricing comparison, see S3)

p3.16xlarge (8 GPUs, 64 vCPUs, 2.3 GHz, Intel Xeon E5-2686 v4 (Broadwell) , 488 GiB memory,128 GiB GPU memory, EBS only)

	Description	Price per Item	Quantity	Total Price
Compute Servers	NVIDIA DGX-1	$149,000.00	1000	$149,000,000.00
Network Switches(10Gb leaf switch)	JG243A - HP 5820-24XG -SFP + Taa-Compliant Switch. New Bulk Pack.	$2,650.00	365	$967,250.00
Network Cables	HP JD092B X130 10G SFP+ LC SR Transceiver 10 Gbps Gigabit Ethernet	$103.99	8396	$873,100.04
Rack	Rack Enclosure Extension Frame Increases external depth of 42/48U cabinets by 8 inches to a total depth of 51 inches	$364.99	63	$22,994.37
Storage Servers (1PB distributed storage and storage boxes)	Acme AS-444JB12 SAS3 4U 44 bays hot swap 12Gbps JBOD storage subsystem redundant power	$2,198.00	3	$6,594.00
	Seagate Enterprise Capacity 3.5" HDD 10TB (Helium) 7200 RPM SAS 12Gb/s 256MB Cache Standard Model 512e Internal Hard Drive ST10000NM0096	$364.99	100	$36,499.00
Electric Power	nationwide average power price: 14.2 cents per kWh;	$5,774,102.49	5	$28,870,512.46

Cooling	Tripp Lite Self-Contained Portable Air Conditioning Unit, 1250W, 120V, 60Hz, 12K BTU	$599.99	1000	$599,990.00
Administration	data center administrator	$61,554.00	5	$307,770.00
TOTAL				$180,684,709.87

Table 3: private cost for configuration 3

*Note:
1) Compute Servers:Each node performance is 1 petaFLOPS, we need 1 exaFLOPS (= 1000 petaFLOPS), so quantity is 1000/1 = 1000
cite:
https://www.nvidia.com/content/dam/en-zz/Solutions/Data-Center/dgx-1/NVIDIA-DGX-1-Volta-AI-Supercomputer-Datasheet.pdf

2) Network switches:note: with 24-port switch construct 3 layer fat-tree, each GPU connects 1 port, so each node connect 8 ports.
Because we have 3 additional storage boxes to connect switches, so 8000/(24-1) = 348 switches for 3rd layer, 348/(24-1) = 16 switches for 2nd layer, and 16/(24-1) = 1 switch for 1st layer
the quality is 1+16+348 = 365
cite:
https://www.allhdd.com/networking/switch/24-port/jg243a-hp-5820-24xg-sfp-taa-compliant-switch.-new-bulk-pack.-clone/?src=ggl&utm_source=google&utm_medium=cpc&adpos=1o18&scid=scplp167389&sc_intid=167389&gclid=EAIaIQobChMIs-7CtdvO1wIVyVuGCh3ghgbSEAkYEiABEgIuPvD_BwE

3) Network Cables:To connet switches and hosts, we need 23*(1+16+348)+1 cables. So quantity is 8396.
cite:
https://www.neweggbusiness.com/Product/Product.aspx?Item=9SIV0NR4MW8722&nm_mc=KNC-GoogleBizMKPL-PC&cm_mmc=KNC-GoogleBizMKPL-PC-_-pla-_-Network+-+Transceivers-_-9SIV0NR4MW8722&gclid=EAIaIQobChMIjfT4o9_O1wIVQ1gNCh0idQvbEAkYAyABEgLALPD_BwE

4) Rack:Each node is 3U, so each rack accomodates 48/3 = 16, the quality is 1000/16=63
cite:
http://www.dell.com/en-us/work/shop/accessories/apd/a7122352?cid=302824&st=&gclid=EAIaIQobChMIsPay1oLP1wIVwo-zCh3Gnwz2EAQYASABEgKGm_D_BwE&lid=5758064&VEN1=sFDN8vlXO,112781467989,901q5c14135,c,,A7122352&VEN2=,&dgc=st&dgseg=so&acd=12309152537501410&VEN3=811803470913021073

5) Storage Servers (1PB distributed storage and storage boxes): The distributed storage are HDD disks stored in storage boxes. With the storage boxes we chosen, each box can store 44 disks, so we need 3 storage boxes total.

6) Cooling: each node produces 3.2kw = 10924.8BTU, so one cooler can handle one node, the quality is 1*1000
cite:
https://www.connection.com/product/tripp-lite-self-contained-portable-air-conditioning-unit-1250w-120v-60hz-12k-btu-instant-rebate-save-25/srcool12k/10907491?cac=Result

	Configuration 1	Configuration 2	Configuration 3
Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage	378,939,787.20	7,523,993,815.00	1,078,319,101.00
Private Cloud cost over 5 years, 24/7 operation, with 100% usage	75,682,181.65	2,945,629,185.09	180,684,709.87
What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?	0.20	0.39	0.17

Table 4: Summary table comparing the 3 configurations between the public and private cloud

*Note:
1) Cite for AWS with config 1&2:
config1 .
https://calculator.s3.amazonaws.com/index.html#r=IAD&key=calc-A7FB0164-A85E-4342-8F94-C1417B5D6F20
config2.
https://calculator.s3.amazonaws.com/index.html#r=IAD&key=calc-142327EC-CE26-400F-AC7B-4E2E5C51BA2F

2) Since p3 instance doesn't show in AWS calculator, I refer p3.16xlarge price: $24.48/hr on AWS and use following two formula to get estimated price.
p3: $24.48*(5*12*30*24)*1000 = 1057536000
S3: 22583.50*12*5 = 1355010
AWS support: 323801.51*12*5 = 19428090.6
Total:1078319101

3)Regarding Accelerated Depreciation, we use Double-declining-balance(DDB) method, which sets salvage price to 0 as the professor mentioned in 11/20 lecture, then calculate each balance to the following formula:
DDB in year i = 2/n x (total acquisition cost - accumulated depreciation)
which n = 5 year

So finally we get 5 year amortization cost table for each configuration.

Year	Private Cloud Amortized cost	Public Cloud Amortized Cost
1st	$30,272,873.00	$75,787,957.44
2nd	$18,163,724.00	$75,787,957.44
3rd	$10,898,234.00	$75,787,957.44
4th	$6,538,940.00	$75,787,958.44
5th	$3,923,364.00	$75,787,957.44

Table 5: amortization cost for configuration 1

Year	Private Cloud Amortized cost	Public Cloud Amortized Cost
1st	$1,178,251,674.00	$1,504,798,763.00
2nd	$706,951,004.00	$1,504,798,763.00
3rd	$424,170,603.00	$1,504,798,763.00
4th	$254,502,362.00	$1,504,798,763.00
5th	$152,701,417.00	$1,504,798,763.00

Table 6: amortization cost for configuration 2

Year	Private Cloud Amortized cost	Public Cloud Amortized Cost
1st	$72,273,884.00	$215,663,820.20
2nd	$43,364,330.00	$215,663,820.20
3rd	$26,018,598.00	$215,663,820.20
4th	$15,611,159.00	$215,663,820.20
5th	$9,366,695.00	$215,663,820.20

Table 7: amortization cost for configuration 3

Conclusion:

1. From table 4, we can see that for configuration 1, the utilization should be 20% per year so that the private cloud option would be more attractive than the public option; for configuration 2, the utilization should be 39% per year so that the private cloud option would be more attractive than the public option; for configuration 3, the utilization should be 17% per year so that the private cloud option would be more attractive than the public option;
   So we can see due to the large amount of fixed cost of private cloud, we prefer use public cloud if the utilization is not so high; but if the utilization accesses some even point, we would prefer using private cloud.

2. From the amortized perspective, since the total cost of the private cloud are all less than the public option with 5 years' usage. We calculate the private cloud amortized cost by accelerated-depreciation methods, and the results are shown in table 5, 6 and 7. We can see for all configurations, the private option has less yearly amortized cost during all 5 years.

3. So with under the condition of high scalability, long year of usage, and high utilization, we would prefer building the private cloud; otherwise, we would prefer using public cloud.

4. For the private cloud here, we did not consider any maintenance fee and cost for rent the house or buy the land to build the data center. In reality, these could be a high cost. So the real cost of private cloud would be more expensive than our estimation.

*Note: For the shopping cart not listed on AcmeMicro (http://www.acmemicro.com), the quantity was set to 1 instead of actual quantity. B/C the websites except AcmeMicro do not allow buying the large quantity we need. For the actual quantity we need, please refer to the tables.

My Shopping Cart

Product	Product Code	Unit Price	Quantity	Sub Total
128GB (32GB x4) PC4-21300 DDR4-2666 Mhz Load Reduced ECC Quad Ranked 1.2V Major Brand  Remove Item	DR4-128G-LR21300EK4	$1,959.99	3000	$5,879,970
Mellanox Ethernet SwitchX®-2 based 48-port SFP+ 10GbE 12 port QSFP 40/56GbE 1U 1PS MSX1024B-1BRS  Remove Item	NW-ML-124B1BRS	$14,187	95	$1,347,765
10TB Seagate ST10000NM0206 - SAS 4Kn HDD 10TB V.6 Enterprise Capacity SAS 12Gb/s 7200rpm 256MB 3.5-inch Bulk  Remove Item	HD-ST-10000NM0206	$409.99	11000	$4,509,890
Promise VR2600FISUBA VessRAID 3U 16BAY FC8GX2+iSCSI1Gx4 6GB SAS/SATA 3xRedundant PSU Single-controller 2 redundant fans  Remove Item	SR-PM-VR2600FISUBA	$4,514	99	$446,886
Dynatron R17 cooler for CPU Intel Socket 2011-3 Xeon E5-2600 Series processor (square pitch)  Remove Item	FAN-DT-R17	$39	169667	$6,617,013
Intel Xeon E5-2670 v3 Processor LGA2011-3 Haswell 12 Core 2.3GHz 30MB 9.6GT/s BX80644E52670V3 Box  Remove Item	CP-IT-XE52670V3BOX	$1,721.44	166667	$286,907,240.48
16GB DDR3 PC3-12800 204-pin SODIMM DDR3-1600 Unbuffered Non-ECC 1.35 Main Brands	SO3-16G-12800	$179.99	100000	$179,990,000

 Remove Item				
Ethernet Cat6a Cable 3 feet RJ45 10Gb/1Gb  Remove Item	CAB-AC-RJ456A.3	$6.8	171142	$1,163,765.6
Intel SATA 240GB Solid-State Drive SSDSCKKW240H6X1 540s Series SATA 6Gb/s M.2 2280 560MB/s Read Remove Item	SSD-IT-SCKKW240H6X1	$117.99	166667	$19,665,039.33
Acme RD-108TFA DP Xeon E5-2600v4 LGA2011-3 based 2.5 SATA*8 hot-swap 2x 10GbE 2x GbE IPMI 1U Server  Remove Item	SY-AC-RD108TFA	$819	169667	$138,957,273
Intel FXX1100PCRPS/AXX1100PCRPS 1100W Redundant Power Supply Module for Servers G84027-007 S-1100ADU00-201  Remove Item	PS-IT-1100PCRPS	$259	166667	$43,166,753

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Expedited Process Order for only $3.99
What is this?

Tax Estimate:	N/A
Shipping Estimate:	N/A
Subtotal (2024671 items):	**$688,651,595.41**

Return Policy

Acme Micro System will accept returns on all products within seven days from the invoice date with a restocking fee of 25% exclude special order items and the manufactures listed. If it is after seven days, all returns must go through RMA process for repair or replacement.

Due to the manufacturer's return policy, products from Supermicro,

I agree with the Terms and RMA procedure..

Checkout

Servers | Workstations
Servers by Applications
Motherboards
CPUs
Memory
Hard Drive | SSD | SATADOM
Controller/flash Cards
Chassis | Cases
Networking
GPU | Xeon Phi Cards
Storage Boxes
Power Supplies
Software
Services and Warranty
Graphics Cards
Other Parts

ACME MICRO SOLUTIONS
Intel Xeon E5-2600v3
GPU Computing
High Density servers
Server Virtualization
Cluster supercomputer
Storage Solution
Server Customization

BRAND SOLUTIONS
Dell Systems
Xeon Phi Solution
Intel Solution Center
Huawei Solution
Open-E storage
Promise Media Solutions
HP Solution
Innodisk SATADOM

RMA Policy
Forms
Warranty
Shipping Policy
Dead on Arrival
Return Policy
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Clients
Partners
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Contact Info

3350 Scott Blvd. Building #45
Santa Clara, CA 95054
(408) 988-9888
(408) 988-9887
info@acmemicro.com

Stay Connected:

YOUR SHOPPING CART

The contents of your shopping cart have been updated.

CART ITEMS	QUANTITY	ITEM PRICE	ITEM TOTAL
 Intel Xeon E5-2676 v3 2.40GHz Socket 2011-3 LGA2011-3 Haswell Server OEM CPU SR1Y5 CM8064401613101	1	$2,197.00	$2,197.00

Subtotal: $2,197.00

Estimate Shipping & Tax

Grand Total: $2,197.00

UPDATE CART

COUPON CODE

REDEEM GIFT CERTIFICATE

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Security is a top priority at Newegg. When you

1 Item(s) in your shopping cart: $297.99

Select All | Remove Selected | Move Selected to Wish List | Update Qtys

Newegg Standard Shipping Service

Important Shipping Information

NETGEAR 48-port Gigabit Ethernet Rackmount Unmanaged Switch (GS348)

Extended Holiday Return Policy

1

IN STOCK

~~$309.99~~

$297.99

Save: 3.87%

PREMIER

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SquareTrade Protection Plan

- 3 year: $34.99
- 4 year: $54.99

Your Shopping Cart

Secure Checkout

Cart Items	Qty	Item Price	Item Total
 Mellanox MC3309130-0A1 Passive Copper Cable Ethernet 10GbE SFP+ 1.5m Ships same day	1 Remove	$19.00	*$19.00*

Subtotal: ***$19.00***

Estimate Shipping & Tax

Grand Total: **$19.00**

Update Cart

Continue Shopping

Secure Checkout

-- or use --

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All information is encrypted and transmitted without risk using a Secure Sockets Layer (SSL) protocol.

Payment Methods

https://www.dell.com/en-us/cart

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Black Friday starts now. Save up to 70% on select PCs for business and doorbusters every day.
Shop Now | Price Match Guarantee Call 1-877-302-3355 or Click to Chat

Cart

View saved carts.

Cart | Sign In | Shipping | Payment | Verify & Submit | Order Submitted

Item		Quantity	Price
	Rack Enclosure Extension Frame Increases external depth of 42/48U cabinets by 8 inches to a total depth of 51 inches less Save for later | Remove Estimated Ship Date 11/20/2017	1	$364.99

Cart Summary

1 Item

Subtotal $364.99

Shipping and taxes not included.

Checkout

Continue Shopping

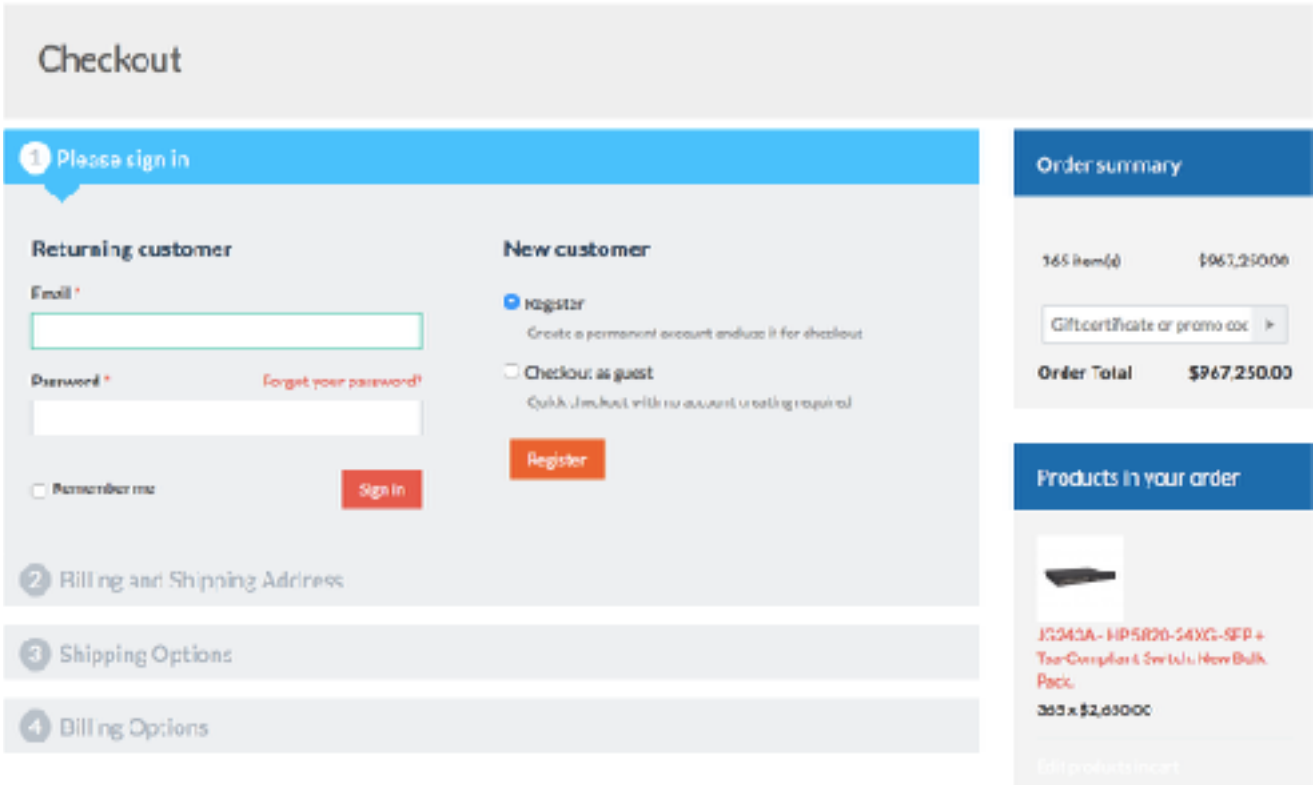
lsi-wp-databolt-pe....pdf | PA1 Hsueh Huang ....zip | Doc 17 Nov 2017, ...pdf | Doc 17 Nov 2017, ...pdf

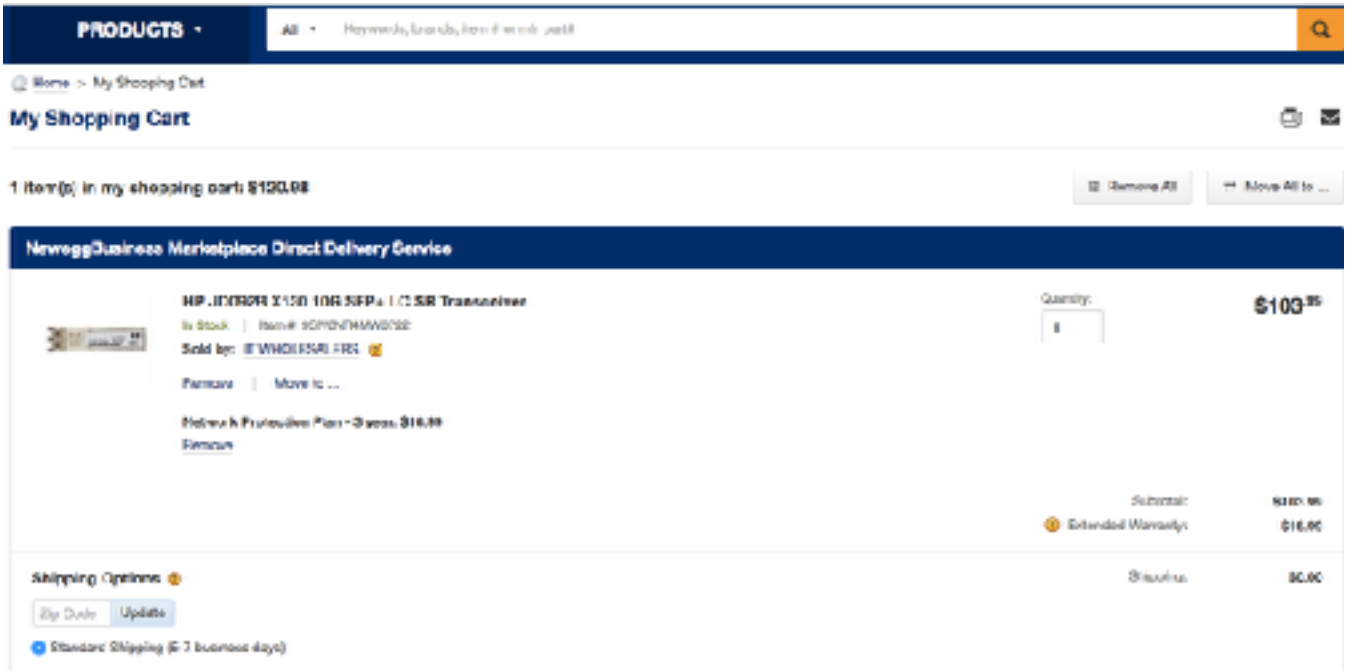
THE NVIDIA DGX-1 IS AVAILABLE FOR PURCHASE IN SELECT COUNTRIES

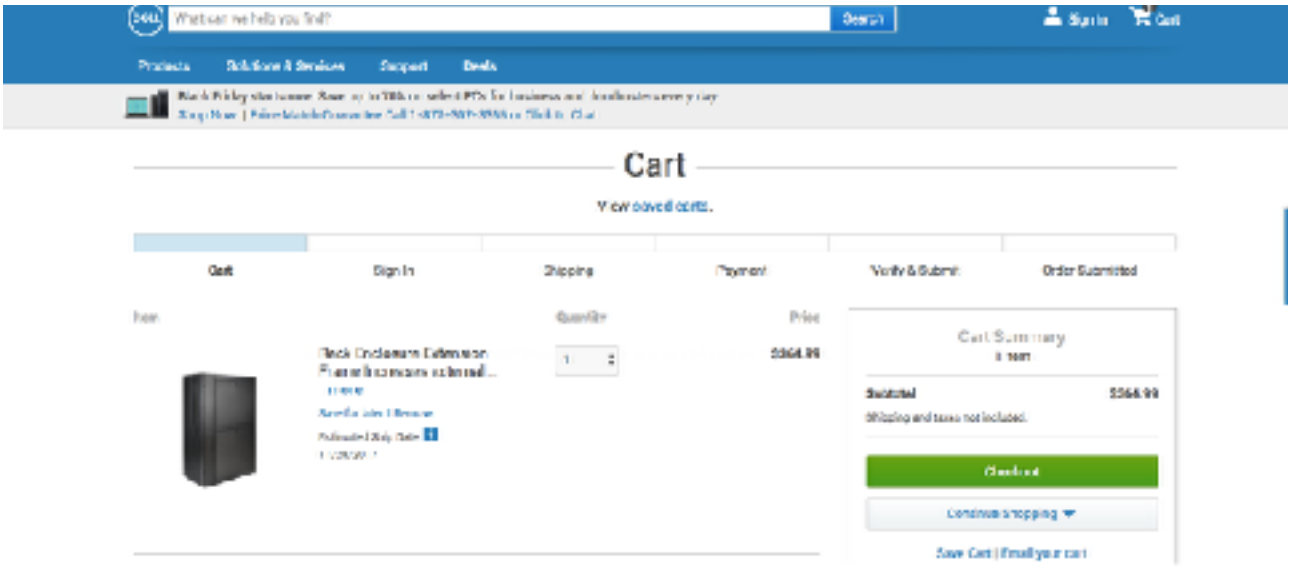
The NVIDIA DGX is available for purchase in select countries and is priced at:

- DGX with P100 at $129,000*
- DGX with V100 at $149,000*

When ordering DGX with V100, you can choose between getting DGX-1 with P100 now and receiving an upgrade to V100 as soon it's available, or getting a DGX with V100 when it starts shipping. DGX support plan is required and must be purchased separately.






Cart
View saved carts.
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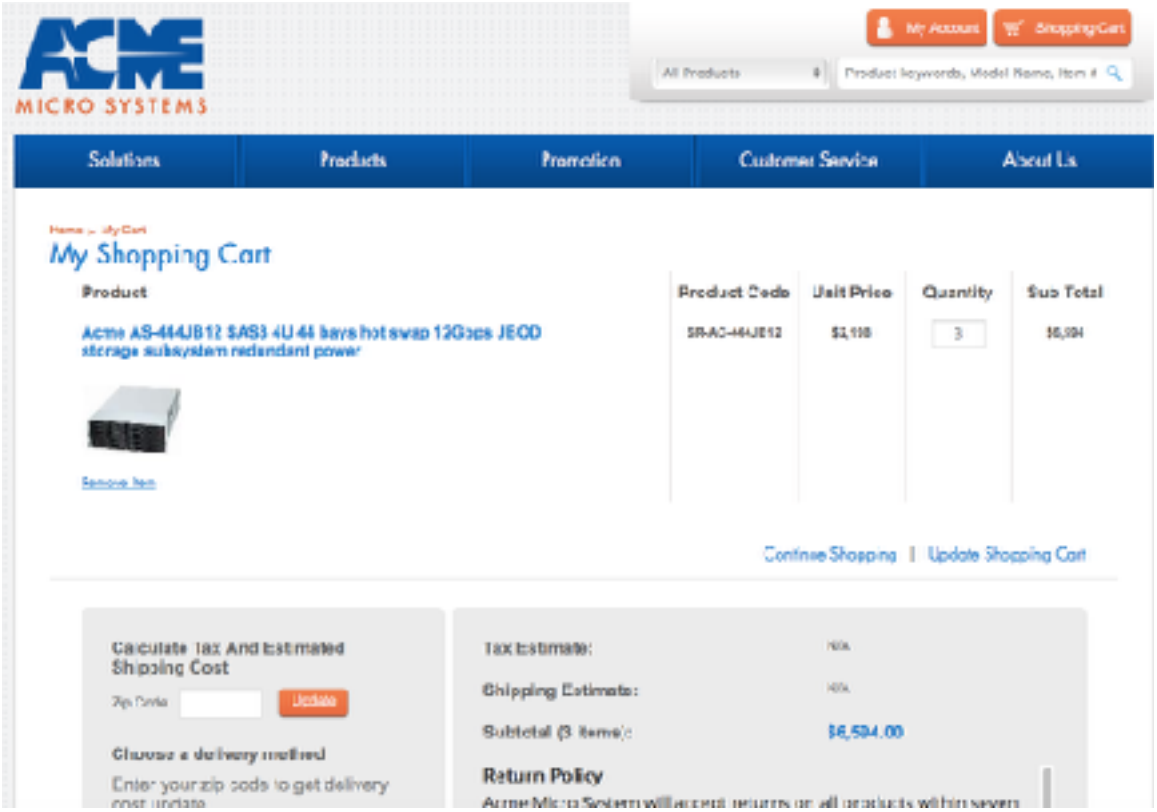
Shipping
Payment
Verify & Submit
Order Submitted
Price
Cart Summary
Subtotal
Shipping and taxes not included.
Checkout
Continue shopping
Save Cart | Email your cart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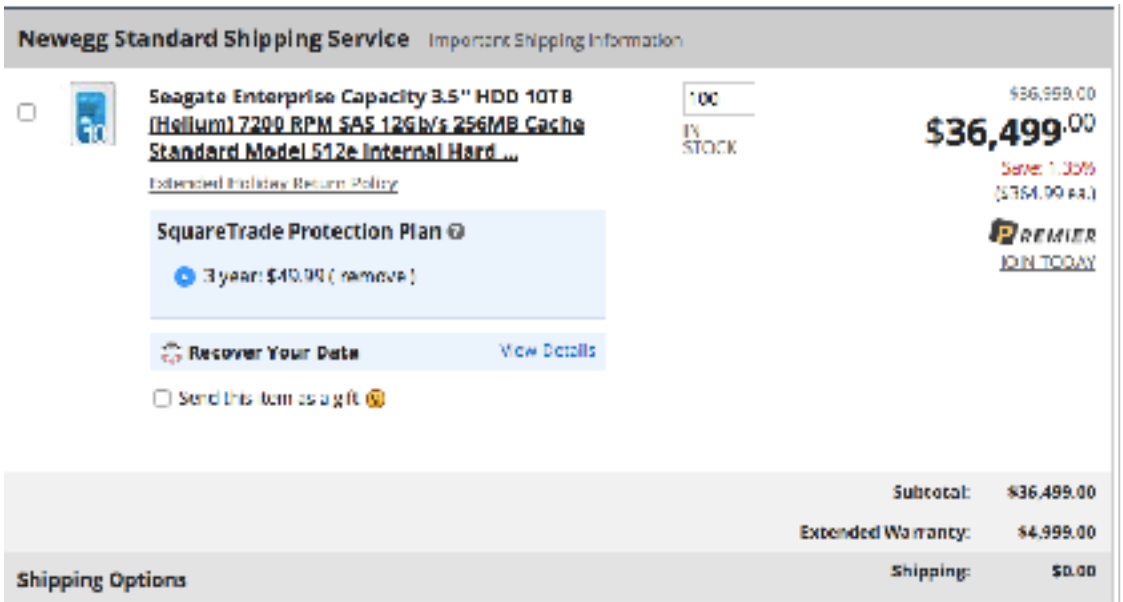
Acme AS-44JB12 SAS3 4U 44 bays hot swap 12Gbps JBOD storage subsystem redundant power
SR-AC-44JB12
$3,198
3
$9,594
Remove Item
Continue Shopping | Update Shopping Cart
Calculate Tax And Estimated Shipping Cost
Update
Choose a delivery method
Enter your zip code to get delivery cost update
Tax Estimate:
Shipping Estimate:
Subtotal (3 items):
$9,594.00
Return Policy


Newegg Standard Shipping Service
Important Shipping Information
Seagate Enterprise Capacity 3.5" HDD 10TB (Helium) 7200 RPM SAS 12Gb/s 256MB Cache Standard Model 512e Internal Hard ...
Extended Holiday Return Policy
SquareTrade Protection Plan
3 year: $49.99 (remove)
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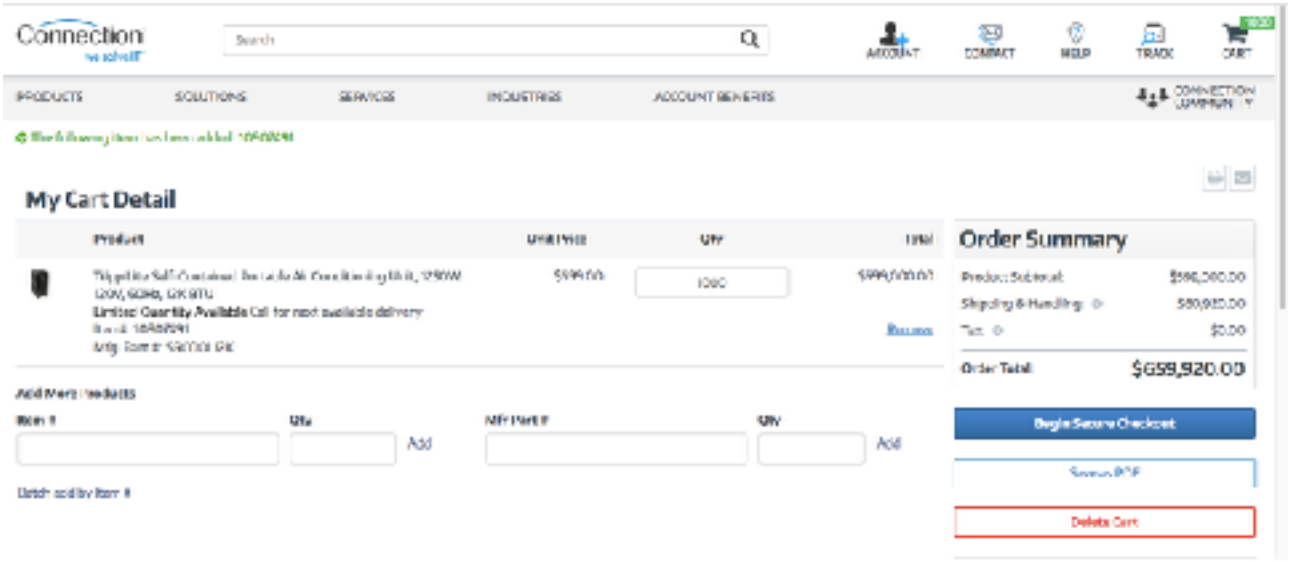
View Details
Send this item as a gift
100
IN STOCK
$36,999.00
$36,499.00
Save 1.35%
($364.99 ea.)
PREMIER
JOIN TODAY
Subtotal:
$36,499.00
Extended Warranty:
$4,999.00
Shipping Options
Shipping:
$0.00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Limited Quantity Available Call for next available delivery
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Order Summary
Product Subtotal:
Shipping & Handling:
Tax:
Order Total:
$659,920.00
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Delete Cart
Add
Add