

Understanding the Cost of Cloud Computing
Zhengcong Xiao: A20453141
Xuejian Zhou: A20451803
Jlaxin Dai: A20454885

Configuration1:

Hadoop/Spark Cluster with 256K-cores, 2PB memory, 400PB HDD, and 25Gb/s Ethernet Fat-Tree network (each VM should be equivalent to the d2.8xlarge instance); in addition to the compute resources, a 800PB distributed storage shared across the entire cloud should be procured, with enough capacity for 800GB/sec throughput (for pricing comparison, see S3)

The price of d2.8xlarge instance is \$5.52 per hour from Amazon EC2 price.

The price of S3 standard price is \$0.021 per GB if over 500 TB/Mont.

Suppose we have 1000 instances.

The cost of instances over 5 years = $5 \times 5.52 \times 1000 \times 365 \times 24 = \$241,776,000$

The cost of S3 standard cloud storage over 5 years =

$5 \times 12 \times 800 \times 1000 \times 1000 \times 0.021 = \$1,008,000,000$

Total cost of AWS service = $\$241,776,000 + \$1,008,000,000 = \$1,249,776,000$

Compute Server Configuration

	Description	Price per Item	Quantity	Total Price
Servers	Supermicro H11SSL-i - ATX - 16x SATA - 1x M.2 - Dual 1-Gigabit Ethernet	\$1984.00	8	\$15,872.00
CPU	AMD EPYC™ 7551 Processor 32-core 2.00GHz 64MB Cache (180W)	\$840.00	8	\$6,720.00
Memory	64GB PC4-25600 3200MHz DDR4 ECC RDIMM	\$320.00	32	\$10,240.00
Storage	Micron 5300 PRO Enterprise-Class SATA Solid State Drives 480GB Micron 5300 PRO Series 2.5" SATA 6.0Gb/s Solid State Drive	\$129.00	8	\$1,032.00
Network Adapter	Mellanox 25-Gigabit Ethernet Adapter	\$289.00	1	\$289.00

	ConnectX®-4 Lx EN MCX4121A (2x SFP28)			
			Total: \$34,153.00	

Each Rack server contains 8 computer servers, which is total in 256 cores, 3.84TB memory, 416TB Disk Memory.

$1000 \times 256 = 256,000$

$1000 \times 3.84\text{TB} = 3.84\text{PB}$

$1000 \times 416\text{TB} = 416\text{PB}$

Configuration 1 summary

Compute Servers	8 servers per rack		1000	\$34,153,000.00
Network Switches	Cisco Nexus 9372TX-E Managed L3 Switch - 48 10GBase-T Ports & 6 40-Gigabit QSFP+ Uplink Ports	\$2,250.00	22	\$49,500.00
Network Cables	CAT8 Ethernet RJ45 Cable 40Gbps 2000MHz High Speed Network Lan Internet Cable	\$16.00	1000	\$16,000.00
Racks	12U Portable Server Rack	\$360.00	1000	\$360,000.00
Storage Servers	Hitachi 400GB 7200 RPM 3.5" SATA 3 Gb/s Hard Drive - HDT725040VLA360 *1000	\$16,580.00	1000	\$16,580,000.00
Electric Power (12.19c/kWh)	2200kW			\$2,349,256.80
Cooling 9.83k/kWh	2200kW			\$1,894,437.60
Administration		\$150,000.00	1	\$150,000.00

Total		\$55,552,203.40
-------	--	-----------------

Configuration 2: Support 1M virtual machines (VM) where each VM requires 2-core, 16GB RAM, 75GB NVMe storage, and 10Gb/s Fat-Tree network (each VM should be equivalent to the r5d.large instances); in addition to the compute resources, a 10PB distributed storage shared across the entire cloud should be procured, with enough capacity for 100GB/sec throughput (for pricing comparison, see S3)

AWS:

The price of each r3.large instance is \$0.175 / hour per instance and s3 standard cloud storage costs \$0.021 per GB for a month.

Cost:

1000000 instances over 5years period = $5 \times 0.175 \times 1000000 \times 365 \times 24 = \$7,665,000,000$

S3 cloud storage for 10PB of data over 5 years = $5 \times 12 \times 10 \times 1000 \times 1000 \times 0.021 = \$12,600,000$

Total: AWS service = \$ 7,665,000,000 + \$12,600,000 = \$7,667,600,000

Private Cloud:

	Description		Price/Unit	Quantity	Total Price
Server	Supermicro SuperServer 5018R-M - 1U - 4x SATA - Intel C612 - 8x DDR4 - 350W	2 sockets	\$278	5	\$1390
CPU	Ten-Core Intel® Xeon® Processor E5-2640 v4 2.40GHz 25MB Cache (90W)	108ports	\$830	10	\$8300
Memory	Intel 16gb pc4-21300 2666MHZ DDR4 ECC RDIMM		\$120	25	\$3000
Storage	1.0TB SATA 6.0Gb/s 7200RPM - 3.5" - Ultrastar DC HA210(512)		\$89	50	\$4450

Network Adapter	Intel 10-Gigabit Ethernet Network Adapter x710-T2L(2X RJ45) - PCIe x8		\$327	10	\$3270
Total:			\$ 20,410		

Computer Servers	50 VMS per rack with total of 20000 servers		\$20410	20000	\$408,200,200
Network switches	Cisco Nexus 56128P - T - N5K-C56128P		\$10073	418	4210514
Network Cables	10G SFP+ Direct Attach Cable - 30 AWG Twinax / 1 Meters (1m / 3.3ft) - Beyondtech 10Gb Gigabit Ethernet Switch Network DAC Series		\$16.99	20500	348295
Rack	12U Portable Server Rack from racksolutions.com		\$ 360.00	20000	7,200,000
Storage Server	Hitachi 400GB 7200 RPM 3.5" SATA 3 Gb/s Hard Drive - HDT725040VLA360 *1000		\$16,580.00	1000	16,580,000
Electric Power (12.19c/kWh)	2200kW			20,010kw	44,022,000
Cooling 9.83k/kWh	2200kW			20,010kw	44,022,000

Administration Cost	Single admin per 1000 servers	5 years	\$80,000.00	20	8,000,000
Total: \$532,583,009					

Configuration 3:

Support deep learning with 1exaflop of double precision performance (hint: each VM should be equivalent to p3.16 xlarge 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 3Gb/s per GPU (25Gb/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)

The price of d3.16xlarge instance of 8 GPU-Tesla V100 is \$24.48 per hour from Amazon EC2 price.

The price of S3 standard price is \$0.021 per GB if over 500 TB/Mont.

The cost of instances over 5 years = $5 \times 24.48 \times 1000 \times 365 \times 24 = \$1,072,224,000$

The cost of S3 standard cloud storage over 5 years =
 $5 \times 12 \times 1 \times 1000 \times 1000 \times 0.021 = \$1,260,000$

Total cost of AWS service = $\$241,776,000 + \$1,008,000,000 = \$1,249,776,000$


	Description	Price per Item	Quantity	Total Price
Compute Servers	NVIDIA DGX-1	\$164,986.00	1000	\$164,986,000.00
Network Switches	MSB7800-ES2F MELLANOX 36-Port Qsfp28 EDR 1U Managed Infiniband Switch System	\$14,135.00	28	\$ 395,780
Network Cables	3-Meter SFP+ Cable, for Mellanox MC3309130-003	\$35.00	1027	\$ 35,945

	, 10Gbase-CU Direct Attach Copper Cable, Passive AWG30			
Racks	RackSolutions RACK-117-12U 12U Portable Server Rack	\$296.00	1000	\$ 296,000
Storage Servers	Hitachi 400GB 7200 RPM 3.5" SATA 3 Gb/s Hard Drive - HDT725040VLA360 *1000	\$16,580.00	1000	\$16,580,000.00
Electric Power	12.19c/kWh		3500kW	\$3,737,454.00
Cooling	9.83c/kWh		3500kW	\$3,013,878
Administration		\$150,000.00	1	\$150,000.00
Total				\$189,195,057.0

	Configuration 1	Configuration 2	Configuration 3
Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage	\$1,249,776,000	\$7,667,600,000	\$1,249,776,000
Private Cloud cost over 5 years, 24/7 operation, with 100% usage	\$55,552,203.40	\$532,583,009	\$189,195,057.0
What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?	4.4%	7%	15.1%

As shown above, the utilization of configuration 1 is 4.4%; the utilization of configuration 2 is 7% and the utilization of configuration 3 is 15.1%. It concluded that the private cloud setup is cheaper than the public one if it is with 100% utilization over 5 years.





Configuration 1: Your Order

Product	Unit Price	Quantity	Subtotal
 RAX-VM QS4-11E1 (My System April 13th, 4:07 pm EDT) Thinkmate Config ID 422102 <div><div>Supermicro H11SSL-i - ATX - 16x SATA - 1x M.2 - Dual 1-Gigabit Ethernet AMD EPYC™ 7551 Processor 32-core 2.00GHz 64MB Cache (180W) Supermicro SNK-P0062P - 1U Passive CPU Heat Sink for AMD Socket SP3 Processors 8 x 64GB PC4-25600 3200MHz DDR4 ECC RDIMM Thinkmate® RAX-1304-SH 1U Chassis - 4x Hot-Swap 3.5" SATA/SAS3 - 350W Single Power 480GB Micron 5300 PRO Series 2.5" SATA 6.0Gb/s Solid State Drive Supermicro MCP-120-00031-0N - Riser Card Bracket Air Shroud MCP-310-81305-0B for 813M Chassis and X11SPM H11SSL Thinkmate® 1U Riser Card - Left Slot - 1x PCIe 3.0 x16 Included Standard Rackmount Mounting Rails No vSphere Licensing No VMware vSphere Support Thinkmate® Update Manager (OOB Management Package) Thinkmate® ISO 9001 Certified Assembly, Testing, and Quality Control Thinkmate® System Badge - 1.75" x 0.4375" 3 Year Advanced Parts Replacement Warranty</div><div>Reconfigure</div></div>	\$5,690.00	<input type="text" value="1"/> <input type="checkbox"/> Remove	\$5,690.00

Update

\$5,690.00


Shopping Cart


 Mellanox ConnectX-4 Lx EN Network Adapter (MCX4121A-XCAT) In Stock Shipped from: Corsette Inc. Gift options not available. Learn more Qty: 1 <input type="button" value="Delete"/> <input type="button" value="Save for later"/> <input type="button" value="Compare with similar items"/> <div>This seller has a limit of 4 per customer. To see if more are available from another seller, go to the product detail page.</div>	<div>Price</div> <div>\$225.00</div> <div>Best Deal</div>
 Samsung 860 EVO SSD 1TB - M.2 SATA Internal Solid State Drive with V-NAND Technology (MZ-N6E1T0BW) In Stock Eligible for FREE Shipping This is a gift. Learn more Qty: 4 <input type="button" value="Delete"/> <input type="button" value="Save for later"/> <input type="button" value="Compare with similar items"/>	<div>5 Price Changes</div> <div>\$169.99</div>
 Brute Networks SNPP2MYXC/64G-BN - 64GB PC4-25600 DDR4-3200MHz 2Rx4 1.2v ECC Registered RDIMM (Equivalent to OEM PN # SNPP2MYXC/64G) In Stock Shipped from: Brute Networks Gift options not available. Learn more Qty: 8 <input type="button" value="Delete"/> <input type="button" value="Save for later"/> <input type="button" value="Compare with similar items"/>	<div>Best Deal</div> <div>Dropshot Error</div> <div>\$399.95</div>
 AMD EPYC 7551P 32 Core 2.00 GHz Processor Retail Pack Only 2 left in stock - order soon Shipped from: Eagle Computing and Accessories Gift options not available. Learn more Qty: 2 <input type="button" value="Delete"/> <input type="button" value="Save for later"/> <input type="button" value="Compare with similar items"/>	<div>1 Price Change</div> <div>\$1,290.00</div>
Subtotal (15 items): \$6,684.56	


This order contains a gift


Proceed to checkout

Best sellers in Kindle ebooks

**The Bad Seed**
by Jory John
★★★★★ 5,449
Kindle Edition
\$12.99

**The 7 Habits of Highly Effective People**
by Stephen R. Covey
★★★★★ 9,565
Kindle Edition
\$6.19

**The Girl Who Lived: A Year After**
by Christopher Greyson
★★★★★ 2,495
Kindle Edition
\$1.49

**The Girl Beneath the Sea**
by Andrew Mayne
★★★★★ 314
Kindle Edition
\$4.99

 This seller has only 1 of these available. To see if more are available from another seller, go to the [product detail page](#).




Qty: 1



Vivid CAT8 Ethernet Cable, Professional Network Patch Cable 40Gbps 2000Mhz S/FTP LAN Wires, High Speed Internet Cable Cord with RJ45 Gold Plated Connector for Router, Modem, Gaming, Xbox (15m/50ft)

Only 2 left in stock - order soon.

Eligible for FREE Shipping

 This is a gift [Learn more](#)

1 Price Change

Qty: 1 [Delete](#) [Save for later](#) [Compare with similar items](#)

 Best Deal

Qty: 1 [Delete](#) [Save for later](#) [Compare with similar items](#)

Subtotal (3 items): \$4,189.00

Price: \$14,135.75

60 day warranty included


- ☒ Select your Extended Warranty
- ☐ 2 Year Extended Warranty (+\$2120.36)
- ☐ 3 Year Extended Warranty (+\$2827.15)
- ☐ 4 Year Extended Warranty (+\$3533.94)
- ☐ 5 Year Extended Warranty (+\$4240.73)
- ☐ Life Time Warranty (+\$7067.88)



Configuration 2:

Reconfigure

Add A Spares Kit



SuperServer 5018R-M (My System April 13th, 4:09 pm EDT)

Thinkmate Config ID 422103

Supermicro SuperServer 5018R-MR - 1U - 4x SATA - Intel C612 - 8x DDR4 - 400W Redundant Ten-Core Intel® Xeon® Processor E5-2640 v4 2.40GHz 25MB Cache (90W)

4 x 16GB PC4-21300 2666MHz DDR4 ECC RDIMM

1.0TB SATA 6.0Gb/s 7200RPM - 3.5" - Ultrastar™ DC HA210 (512n)

Intel® 10-Gigabit Ethernet Network Adapter X710-T2L (2x RJ45) - PCIe x8

Supermicro Update Manager (SUM) (OOB Management Package)

No Operating System

System Assembly and Testing (Rackmount and Storage)

3 Year Depot Warranty (Return for Repair)

Reconfigure

Add A Spares Kit

\$3,211.00


1

Remove

\$3,211.00

Update

\$6,144.00



Cisco Nexus 56128P - T - N5K-C56128P

Only 15 left in stock - order soon.

Shipped from: [Get Better Trade](#)

Gift options not available. [Learn more](#)

Qty: 1

Delete


Save for later

Compare with similar items

\$10,073.00

Subtotal (1 item): \$10,073.00

Configuration3:



Mellanox Switch-IB 2 MSB7890 - switch - 36 ports - smart - rack-mountable

Gigabit Ethernet · Switches · 36 ethernet ports

Switch-IB 2 MSB7890 - Switch - smart - 36 x 100 Gigabit QSFP28 - ra mountable

See more details at [CDW »](#)

\$13,626.99

+\$1,396.77 tax and \$102.35 shipping

CDW



Mellanox MCP2M00-A002 Compatible 25G SFP28 Passive Twinax DAC Cable

\$28.00 [FS.COM](#) **97% positive** (514)

Mellanox compatible **SFP-H25G-CU2M** 25G SFP28 to SFP28 30AWG passive direct attach copper twinax **cable** provides reliable 25 ...

FS.COM · Ethernet



RackSolutions Rack

\$353.59 from 25+ stores

★★★★☆ 4 product reviews

The **RackSolutions 12U Portable Server Rack** is a **rack** mounting solution designed for users tha need their **racks** mobile in ...