

Configuration 1:

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)

Private cloud:

	Description	Price per item	Quantity	Total Price
Compute servers	8 x Intel® Xeon® Gold 5218 Processor 16-Core 2.3GHz 22MB Cache (125W) 64 x 32GB PC4-23400 2933MHz DDR4 ECC RDIMM 12 x 16.0TB SATA 6.0GB/s 7200RPM - 3.5" - Seagate Exos X16 Series FastFormat™ (512e/4Kn)	\$39,518.00	2000	\$173,806,250.00
Network Switches	4 x Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4111A (1x SFP28)			
Network cables				
Racks	2U			
Storage servers	64 x 2.0TB SAS 3.0 12.0Gb/s 7200RPM - 2.5" - Seagate Exos 7E2000 Series (512e)	\$27,809.00	6250	\$79,036,000.00
Electric power			2756	\$14,495.00
Cooling		12 cents/kwh	(24 * BTU/hr * 0.293)/1000	\$890,600.00
Administrator	System Administrator	82,625	2	\$82,625.00
TOTAL				\$253.8 million

* System Administrator salary is picked from indeed.com

Estimated Power and BTU/h for the above configuration from thinkmate

THINKMATE CONFIGURATOR

My System April 14th, 12:59 am EDT

SAVE

EMAIL

Estimated Power

1695.6 Watts - More

View/Print All Specs

BAREBONE

2U 4

2U 4

2U 4

Compare

Watts: 1695.6

Volt-Amps: 1738.0

BTU/h: 5785

Amps 110V: 15.41

Amps 208V: 8.15

12x SATA - 2200W R



12x SATA - LSI 300

12x SATA - LSI 3108

PROCESSOR

Thinkmate Cart for private cloud

Your Order

Product	Unit Price	Quantity	Subtotal
<div><div></div><div><div>STX-JB JD72-0420-SAS3 (My System April 14th, 12:57 am EDT)</div><div>Thinkmate Config ID 422264</div><div><div>Thinkmate® STX-4244 4U Chassis - 72x Hot-Swap 2.5" SATA/SAS - 12Gb/s SAS Dual Expander - 1200W Redundant Power</div><div>64 x 2.0TB SAS 3.0 12.0Gb/s 7200RPM - 2.5" - Seagate Exos 7E2000 Series (512e)</div><div>LSI MegaRAID 9380-8e SAS 12Gb/s PCIe 3.0 8-Port Controller with 1GB Cache</div><div>2 x 3-Meter External SAS Cable - 12Gb/s to 12Gb/s SAS - SFF-8644 to SFF-8644</div><div>2 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 6'</div><div>Thinkmate® ISO 9001 Certified Assembly, Testing, and Quality Control</div><div>5 Year Advanced Parts Replacement Warranty</div></div><div><div>Reconfigure</div><div>Add A Spares Kit</div></div></div></div> <div><div>\$27,809.00</div><div><div>6250</div><div>Remove</div></div><div>\$173,806,250.00</div></div>			
<div><div></div><div><div>HDX XS12-52S1 (My System April 14th, 12:59 am EDT)</div><div>Thinkmate Config ID 422266</div><div><div>2U 4-Node - Intel® C621 Chipset - 12x SATA - LSI 3008 12G SAS Controller - 2200W Redundant Power</div><div>8 x Intel® Xeon® Gold 5218 Processor 16-Core 2.3GHz 22MB Cache (125W)</div><div>64 x 32GB PC4-23400 2933MHz DDR4 ECC RDIMM</div><div>12 x 16.0TB SATA 6.0Gb/s 7200RPM - 3.5" - Seagate Exos X16 Series FastFormat™ (512e/4Kn)</div><div>4 x Supermicro SIOM 1-Gigabit Ethernet Adapter AOC-MGP-i2M (2x RJ45)</div><div>4 x Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx En MCX4111A (1x SFP28)</div><div>8 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 6'</div><div>4 x Thinkmate® Update Manager (OOB Management Package)</div><div>4 x No Operating System</div><div>Thinkmate® ISO 9001 Certified Assembly, Testing, and Quality Control</div><div>5 Year Advanced Parts Replacement Warranty</div></div><div><div>Reconfigure</div><div>Add A Spares Kit</div></div></div></div> <div><div>\$39,518.00</div><div><div>2000</div><div>Remove</div></div><div>\$79,036,000.00</div></div>			
<div>Update</div>			\$252,842,250.00

Public cloud AWS:

	Description	Price per item	Quantity	Total Price
Compute servers	d2.8xlarge HDD 24*200 GB 25GBit Network	\$140860 / 5years	7111	\$1,001,661,120.00
Network Switches	NA			
Network cables	NA			
Racks	NA			
Storage servers	Amazon S3 Storage Classes	\$8602163.20 / Month	60	\$516,129,792.00
Electric power	NA			
Cooling	NA			
Administrator	AWS support based on enterprise support policy pricing	\$541330/ year	5	\$2,706,652.00
TOTAL				1520.4 million

▼ Show calculations

Unit conversions

S3 Standard storage: 400000 TB per month x 1024 GB in a TB = 409600000 GB per month

Pricing calculations

Tiered price for: 409600000 GB

51200 GB x 0.0230000000 USD = 1177.60 USD

460800 GB x 0.0220000000 USD = 10137.60 USD

409088000 GB x 0.0210000000 USD = 8590848.00 USD

Total tier cost: 1177.60 USD + 10137.60 USD + 8590848.00 USD = 8602163.20 USD (S3 Standard storage cost)

S3 Standard cost (monthly): 8,602,163.20 USD

▼ Show calculations

Unit conversions

EC2 Instance Savings Plans rate for d2.8xlarge in the US East (Ohio) for 1 Year term and No Upfront is 3.216 USD

Hours in the commitment: 365 days * 24 hours * 1 year = 8760.0000 hours

Total Commitment: 3.216 USD * 8760 hours = 28172.1600 USD

Upfront: No Upfront (0% of 28172.16) = 0.0000 USD

Hourly cost for EC2 Instance Savings Plans = (Total Commitment - Upfront cost)/Hours in the term: (28172.16 - 0.0000)/8760 = 3.2160 USD

*Please note that you will pay an hourly commitment for Savings Plans and your EC2 usage will be accrued at a discounted rate against this commitment.

Pricing calculations

7,111 instances x 3.216 USD x 730 hours in month = 16,694,352.48 USD (monthly instance savings cost)

Amazon EC2 Instance Savings Plans instances (monthly): 16,694,352.48 USD

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)

Private cloud

Compute servers	8 x Intel® Xeon® Gold 6148 Processor 20-core 2.40GHz 27.50MB Cache (150W) 48 x 32GB PC4-23400 2933MHz DDR4 ECC RDIMM 20 x 300GB SAS3 12.0Gb/s 15000RPM - 2.5" - Seagate Exos 15E900 Series (512n)	\$53,579.00	12500	\$669,737,500.00
Network Switches	4 x Mellanox 10-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4111A (1x SFP28)			
Network cables				
Racks	2U HDX XT24-52S1			
Storage servers				
Electric power		12cents/kwh	1830	\$9,625.00
Cooling	6247 BTU/hr	12cents/kwh	(24 * BTU/hr * 0.293)/1000	\$962,023.00
Administrator	System Administrator	\$82,625.00	1	\$82,625.00
TOTAL				670.79 million

Estimated Power and BTU/h for the above configuration from thinkmate

THINKMATE CONFIGURATOR

My System April 9th, 3:49 pm EDT

SAVE

EMAIL

Estimated Power

1830.8 Watts - More

View/Print All Specs

PROCESSOR

1st Generation Intel® Xeon® Gold Processors

8 x 100W Intel® Xeon® Gold 6148 Processor 20-core 2.40GHz 27.50MB Cache (150W)

8 x 100W Intel® Xeon® Gold 6148 Processor 20-core 2.40GHz 27.50MB Cache (150W)

1st Generation Intel® Xeon® Silver Processors

Watts:

1830.8

Volt-Amps:

1876.6

BTU/h:

6247

Amps 110V:


16.64

Amps 208V:

8.80

Thinkmate Cart for private cloud

Your Order

Product	Unit Price	Quantity	Subtotal
<div><div></div><div><div>HDX XT24-52S1 (My System April 9th, 3:49 pm EDT)</div><div>Thinkmate Config ID 421304</div><div><div>2U 4-Node - Intel® C621 Chipset - 24x SATA - LSI 3108 12G SAS Controller - 2200W Redundant Power</div><div>8 x Intel® Xeon® Gold 6148 Processor 20-core 2.40GHz 27.50MB Cache (150W)</div><div>48 x 32GB PC4-23400 2933MHz DDR4 ECC RDIMM</div><div>20 x 300GB SAS3 12.0Gb/s 15000RPM - 2.5" - Seagate Exos 15E900 Series (512n)</div><div>4 x Supermicro S10M 25-Gigabit Ethernet Adapter AOC-M25G-i2SM (2x SFP28)</div><div>4 x Mellanox 10-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4111A (1x SFP28)</div><div>2 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 6'</div><div>8 x No vSphere Licensing</div><div>8 x No VMware vSphere Support</div><div>4 x Thinkmate® Update Manager (OOB Management Package)</div><div>Thinkmate® ISO 9001 Certified Assembly, Testing, and Quality Control</div><div>Thinkmate® System Badge - 1.75" x 0.4375"</div><div>5 Year Advanced Parts Replacement Warranty</div></div></div></div> <div><div>\$53,579.00</div><div>1250C</div><div>\$669,737,500.00</div></div> <div><div><input type="checkbox"/> Remove</div><div>Reconfigure</div></div>			
<div>Update</div>			\$669,737,500.00

Public cloud AWS:

	Description	Price per item	Quantity	Total Price
Compute servers	r5d.large instance 75GB SSD	\$4435.7 / 5years	1000000	\$4,435,700,000.00
Network Switches	NA			
Network cables	NA			
Racks	NA			
Storage servers	Amazon S3 Storage Classes + Amazon Block Storage	290603 / year	60	\$17,436,180.00
Electric power	NA			
Cooling	NA			
Administrator	AWS support	\$264000 / year	5	\$1,320,000.00
TOTAL				4454 million

▼ Show calculations

Unit conversions

S3 Standard storage: 10000 TB per month x 1024 GB in a TB = 10240000 GB per month

Pricing calculations

Tiered price for: 10240000 GB

51200 GB x 0.0230000000 USD = 1177.60 USD

460800 GB x 0.0220000000 USD = 10137.60 USD

9728000 GB x 0.0210000000 USD = 204288.00 USD

Total tier cost: 1177.60 USD + 10137.60 USD + 204288.00 USD = 215603.20 USD (S3 Standard storage cost)

S3 Standard cost (monthly): 215,603.20 USD

First 12 months total		Total upfront	Total monthly
889,747,238.40 USD		0.00 USD	74,145,603.20 USD
Services (2)			
Amazon EC2 Region: US East (Ohio)		Edit Action ▼	
Quick estimate <small>Operating system (Linux), Quantity (1000000), Storage for each EC2 instance (General Purpose SSD (gp2)), Storage amount (75 GB), Instance type (r5d.large)</small>		Monthly: 73,930,000.00 USD	
Amazon Simple Storage Service (S3)		Edit Action ▼	
S3 Standard storage (10000 TB per month)		Monthly: 215,603.20 USD	
Data Transfer			

Amazon Elastic Block Storage (EBS) [Info](#)

Attach persistent block storage volumes for your Amazon EC2 instances.

Storage per instance

Storage for each EC2 instance

General Purpose SSD (gp2) ▼

Storage amount

75 GB ▼

▼ Show calculations

75 GB x 0.10 USD x 1,000,000 instances = 7,500,000.00 USD (EBS Storage Cost)

Amazon Elastic Block Storage (EBS) pricing (monthly): 7,500,000.00 USD

Configuration 3:

Support deep learning with 1 exaflop of double 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 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)

Private cloud

	Description	Price per item	Quantity	Total Price
Compute servers	2 x Intel® Xeon® Gold 5218T Processor 16-Core 2.1GHz 22MB Cache (105W) 12 x 64GB PC4-23400 2933MHz DDR4 ECC RDIMM	\$94,515.00	1000	\$94,515,000.00
Network Switches	Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4121A (2x SFP28)			
Network cables				
Racks	4U			
Storage servers	50 x 2.0TB SAS 3.0 12.0Gb/s 7200RPM - 2.5" - Seagate Exos 7E2000 Series (512e)	\$22,999.00	10	\$229,990.00
Electric power		12 cents/kwh	2756	\$14,495.00
Cooling		12 cents/kwh	(24 * BTU/hr * 0.293)/1000	\$1,448,376.58
Administrator	System Administrator	82,625	1	\$82,625.00
TOTAL				96.2 million

Estimated Power and BTU/h for the above configuration from thinkmate

THINKMATE CONFIGURATOR

My System April 13th, 8:15 pm EDT

SAVE


EMAIL

Estimated Power

2756.4 Watts - More

View/Print All Specs

BAREBONE



Compare

Intel

/100 GPU Server -

Watts:

2756.4

Volt-Amps:

2825.3

BTU/h:

9405

Amps 110V:



25.06

Amps 208V:

13.25

Think mate cart for private cloud

Your Order

Product	Unit Price	Quantity	Subtotal
<div><div></div><div><div>GPX XT16-24S1-8NVLINK (My System April 13th, 8:15 pm EDT)</div><div>Thinkmate Config ID 422181</div><div><div>Intel® C621 Chipset - 4U SXM2 V100 GPU Server - 16x SATA - Dual 10-Gigabit Ethernet - 2000W Redundant Power Supply</div><div>2 x Intel® Xeon® Gold 5218T Processor 16-Core 2.1GHz 22MB Cache (105W)</div><div>12 x 64GB PC4-23400 2933MHz DDR4 ECC RDIMM</div><div>8 x NVIDIA® Tesla™ V100 GPU Computing Accelerator - 32GB HBM2 - SXM2 NVLink</div><div>Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4121A (2x SFP28)</div><div>2 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 1'</div><div>Thinkmate® Update Manager (OOB Management Package)</div><div>No Operating System</div><div>Thinkmate® ISO 9001 Certified Assembly, Testing, and Quality Control</div><div>5 Year Advanced Parts Replacement Warranty</div></div></div></div> <div><div>Reconfigure</div><div>Add A Spares Kit</div></div> <div><div>\$94,515.00</div><div><div>1000</div><div>Remove</div></div><div>\$94,515,000.00</div></div>			
<div><div></div><div><div>STX-JB JD72-0420-SAS3 (My System April 9th, 2:53 pm EDT)</div><div>Thinkmate Config ID 421288</div><div><div>Thinkmate® STX-4244 4U Chassis - 72x Hot-Swap 2.5" SATA/SAS - 12Gb/s SAS Dual Expander - 1200W Redundant Power</div><div>50 x 2.0TB SAS 3.0 12.0Gb/s 7200RPM - 2.5" - Seagate Exos 7E2000 Series (512e)</div><div>LSI MegaRAID 9380-8e SAS 12Gb/s PCIe 3.0 8-Port Controller with 1GB Cache</div><div>2 x 3-Meter External SAS Cable - 12Gb/s to 6Gb/s SAS - SFF-8644 to SFF-8088</div><div>2 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 6'</div><div>Thinkmate® ISO 9001 Certified Assembly, Testing, and Quality Control</div><div>5 Year Advanced Parts Replacement Warranty</div></div></div></div> <div><div>Reconfigure</div><div>Add A Spares Kit</div></div> <div><div>\$22,999.00</div><div><div>10</div><div>Remove</div></div><div>\$229,990.00</div></div>			
<div>Update</div>			\$94,744,990.00

Public cloud AWS:

	Description	Price per item	Quantity	Total Price
Compute servers	p3.16xlarge instance 64vCPU 8 nvidia tesla v100 GPU	\$731820 / 5 years	1000	\$731,820,000.00
Network Switches	NA			
Network cables	NA			
Racks	NA			
Storage servers	Amazon S3 Storage + AWS Block storage	\$264804 / year	5	\$1,324,020.00
Electric power	NA			
Cooling	NA			
Administrator	AWS support	5244878 / year	5	\$26,224,392.00
TOTAL				759 million

<div> <div> <p>Q p3.16xlarge</p> </div> <div> <p>X</p> </div> </div>			
<div> <div> <p>p3.16xlarge</p> </div> <div> <p>On-Demand hourly cost</p> <p>24.48</p> <p>1YR Std reserved hourly cost</p> <p>16.708</p> </div> <div> <p>vCPUs</p> <p>64</p> <p>Memory (GiB)</p> <p>488 GiB</p> </div> <div> <p>GPUs</p> <p>8</p> <p>Network performance</p> <p>25 Gigabit</p> </div> </div>			
<div> <div> <p>Quantity</p> <p>Enter the number of Amazon EC2 instances that you need.</p> </div> <div> <p>1000</p> </div> </div>			

Amazon Elastic Block Storage (EBS) [info](#)

Attach persistent block storage volumes for your Amazon EC2 instances.

Storage per instance

Storage for each EC2 instance

General Purpose SSD (gp2)

Storage amount

2

GB

▼ Show calculations

2 GB x 0.10 USD x 1,000 instances = 200.00 USD (EBS Storage Cost)

Amazon Elastic Block Storage (EBS) pricing (monthly): 200.00 USD

Unit conversions

S3 Standard storage: 1000 TB per month x 1024 GB in a TB = 1024000 GB per month

Pricing calculations

Tiered price for: 1024000 GB

51200 GB x 0.0230000000 USD = 1177.60 USD

460800 GB x 0.0220000000 USD = 10137.60 USD

512000 GB x 0.0210000000 USD = 10752.00 USD

Total tier cost: 1177.60 USD + 10137.60 USD + 10752.00 USD = 22067.20 USD (S3 Standard storage cost)

S3 Standard cost (monthly): 22,067.20 USD

First 12 months total		Total upfront	Total monthly
146,629,286.40 USD		0.00 USD	12,219,107.20 USD
Services (2)			
Amazon Simple Storage Service (S3)			Edit Action ▼
S3 Standard storage (1000 TB per month)			Monthly: 22,067.20 USD
Data Transfer			
Amazon EC2			Edit Action ▼
Region: US East (Ohio)			
Quick estimate			
Operating system (Linux), Quantity (1000), Storage for each EC2 instance (General Purpose SSD (gp2)), Storage amount (2 GB), Instance type (p3.16xlarge)			Monthly: 12,197,040.00 USD

Table 2:

	Configuration 1	Configuration 2	Configuration 3
Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage	1520.4 million	4454 million	759 million
Private Cloud cost over 5 years, 24/7 operation, with 100% usage	253.8 million	670.79 million	96.2 million
What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?	16.60%	15%	12.60%
Summary	Private clouds costs only 16.6% of AWS. AWS cost is less if it used for small projects below 10 months	Private clouds costs only 15% of AWS. AWS cost is less if it used for small projects below 9 months	Private clouds costs only 12.6% of AWS. AWS cost is less if it used for small projects below 8 months

Cloud services can be really more expensive than running on private data centers. While the savings on infrastructure costs may look more appealing, over a period of time it will result in a negative ROI.