# **Configuration 1:**

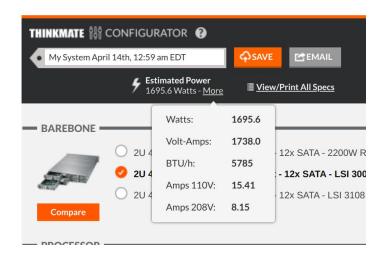
Hadoop/Spark Cluster with 256K-cores, 2PB memory, 400PB HDD, and 25Gb/s Ethernet Fat-Tree network (each VM should be equivalent to the d2.8xlarge instance); in addition to the compute resources, a 800PB distributed storage shared across the entire cloud should be procured, with enough capacity for 800GB/sec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

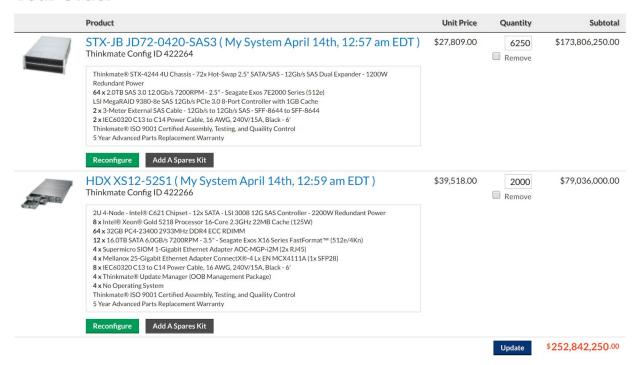
<sup>\*</sup> System Administrator salary is picked from indeed.com

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



### Thinkmate Cart for private cloud

# **Your Order**



### **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

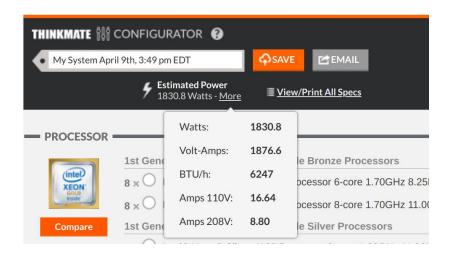
# **Configuration 2:**

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

	8 x Intel® Xeon® Gold 6148 Processor 20-core 2.40GHz 27.50MB Cache (150W) 48 x 32GB PC4-23400 2933MHz DDR4 ECC RDIMM			
Compute servers	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 Cart for private cloud

# **Your Order**



## **Public cloud AWS:**

	Description	Price per item	Quantity	Total Price
		\$4435.7 /		\$4,435,700,000.
Compute servers	r5d.large instance 75GB SSD	5years	1000000	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

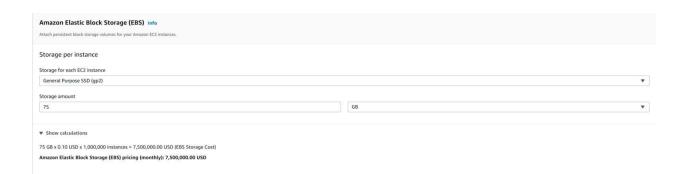
Tiered price for: 10240000 GB

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 889,747,238.40 USD	Total upfront 0.00 USD	Total m <b>74,145,60</b> 3	
Services (2)  Amazon EC2 Region: US East (Ohio)			Edit Action ▼
Quick estimate  Operating system (Linux), Quantity (1000000), Storage for each EC2 instance (General Purpose SSD (gp2)), Storage amount (75 GB), Instance type (rSd.large)		Monthly:	73,930,000.00 USD
Amazon Simple Storage Service (53) S3 Standard storage (10000 TB per month) Data Transfer		Monthly:	Edit Action ▼ 215,603.20 USD



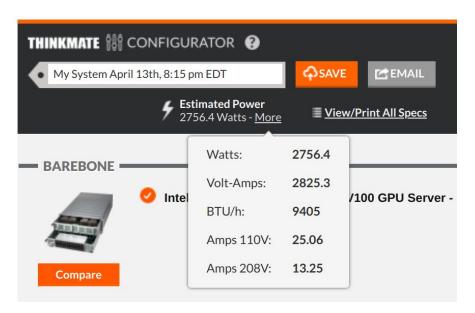
# **Configuration 3:**

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

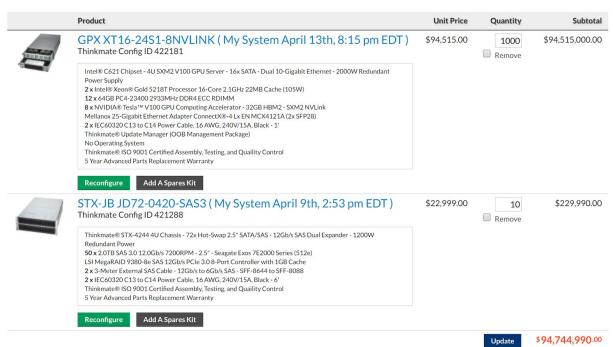
	Description	Price per item	Quantity	Total Price
	2 x Intel® Xeon® Gold 5218T Processor 16-Core 2.1GHz 22MB Cache (105W)			
Compute servers	12 x 64GB PC4-23400 2933MHz DDR4 ECC RDIMM	\$94,515.00	1000	\$94,515,000.00
Network Switches	Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4121A (2x SFP28)			
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



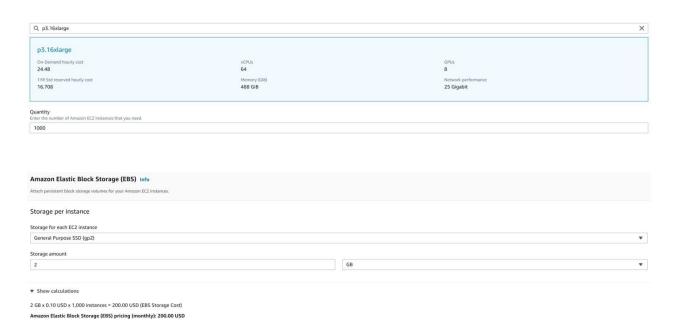
### Think mate cart for private cloud

# **Your Order**



# **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



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

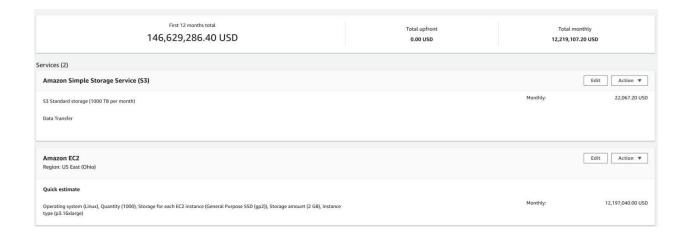


Table 2:

	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.