Understanding the Cost of Cloud Computing

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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*5.52*1000*365*24 = $241,776,000
The cost of S3 standard cloud storage over 5 years =
5*12*800*1000*1000*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<br>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*256 = 256,000
1000*3.84TB = 3.84PB
1000*416TB = 416PB

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*0.175*1000000*365*24 = $7,665,000,000
S3 cloud storage for 10PB of data over 5 years = 5*12*10*1000*1000*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<br>*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*24.48*1000*365*24 = $1,072,224,000
The cost of S3 standard cloud storage over 5 years =
5*12*1*1000*1000*0.021= $1,260,000

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

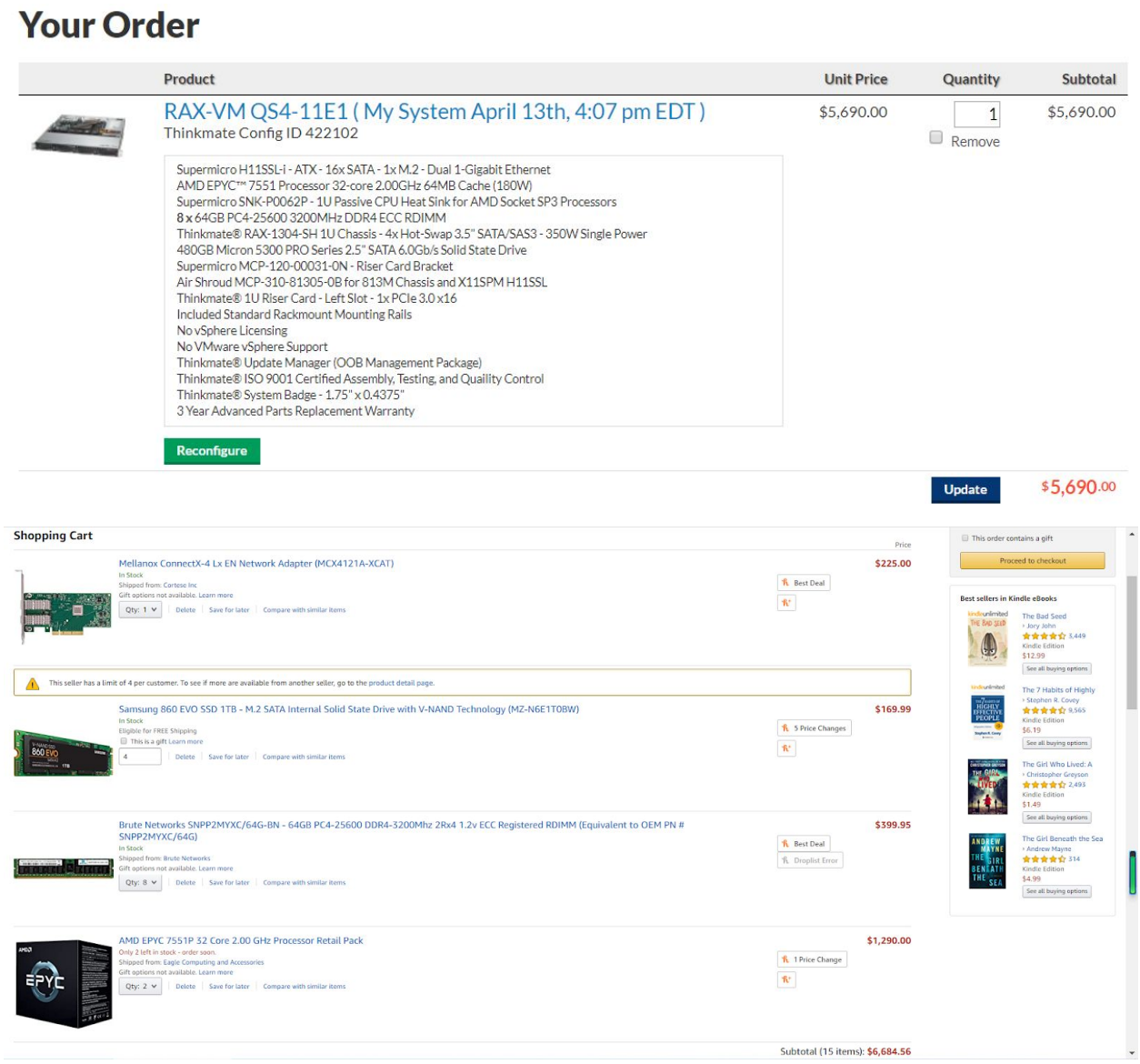
| | Description | Price per Item | Quantity | Total Price |
|---|---|---|---|---|
| Compute Servers | NVIDIA DGX-1 | $164,986.00 | 1000 | $164,986,000.00 |
| Network Switches | MSB7800-ES2F MELLANOX 36-Port Qsfp28 EDR 1U Managed Infiniband Switch System | $14,135.00 | 28 | $ 395,780 |
| Network Cables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

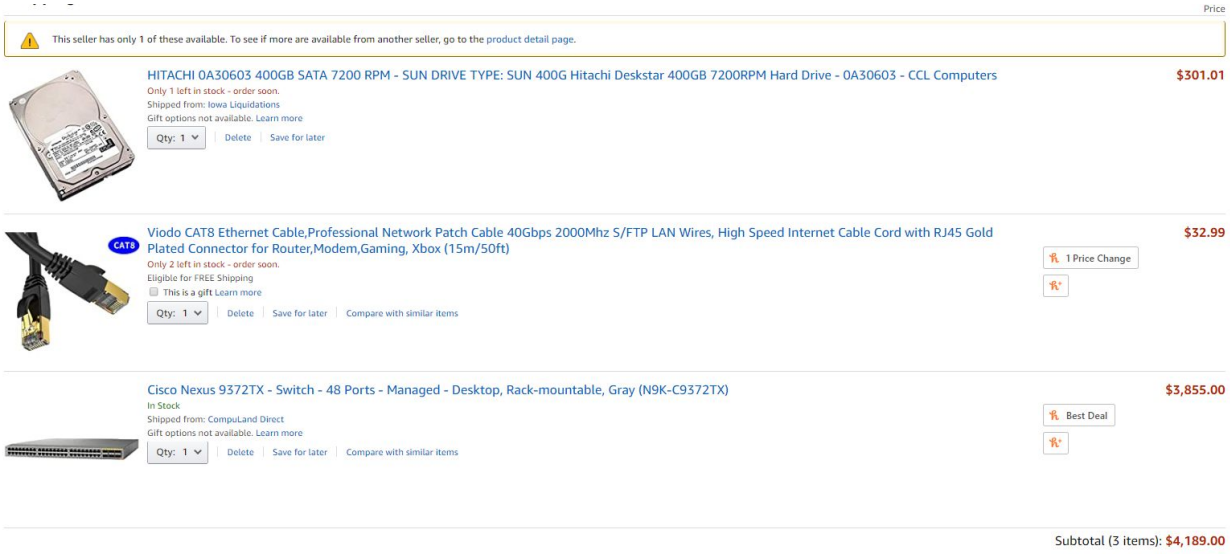
| | | | | |
|---|---|---|---|---|
| | , 10Gbase-CU Direct Attach Copper Cable, Passive AWG30 | | | |
| Racks | RackSolutions RACK-117-12U 12U Portable Server Rack | $296.00 | 1000 | $ 296,000 |
| Storage Servers | Hitachi 400GB 7200 RPM 3.5" SATA 3 Gb/s Hard Drive - HDT725040VLA360 *1000 | $16,580.00 | 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 1is 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:






**MSB7800-ES2F - Msb7800-es2f Mellanox 36-port Qsfp28 Edr 1u Managed Infiniband Switch System With A Non-blocking Switching Capacity Of 7tb-s 2ps, Standard Depth, P2c Airflow,rohs-6**

Price: $14,135.75

***Manufacturer Part Number : MSB7800-ES2F***

**60 day warranty included**

**Optional Extended Warranty**

- (•) 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)

**Machine Serial Number**

Configuration 2:

Reconfigure | Add A Spares Kit

SuperServer 5018R-M ( My System April 13th, 4:09 pm EDT )
Thinkmate Config ID 422103

$3,211.00 | 1 | Remove | $3,211.00

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

Update $6,144.00

Cisco Nexus 56128P - T - N5K-C56128P

$10,073.00

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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 »

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

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

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