# Homework4 Report

**Team-25**
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# Table 1: Summary configuration 1

| | Description | Price per Item | Quantity | Total Price |
|---|---|---|---|---|
| Compute Servers | RAX XT24-4480V4-10 G | 23863 | 8334 | 198874242 |
| Network Switches | S5850-24T16B | 3500 | 580 | 2030000 |
| Network Cables | (includes in the servers) | -- | -- | -- |
| Racks | Great Lakes GL910ENT-3242-FK(48U) | 2747 | 1158 | 3181026 |
| Storage Servers | STX-JB JD72-0420-SAS3 | 28053 | 5556 | 155862468 |
| Electric Power | 946.7 w/per compute server 1200w/ per storage server | $0.15 per KWH | -- | 95639476 |
| Cooling | Assume 30% of total datacenter power consumption * | -- | -- | 40988347 |
| Administration | System administrator average salary is used here ** | $65,000/year/person | 5years 14 administrator | 4550000 |
| TOTAL | | | | $501,125,559 |

*: https://www.dataspan.com/blog/data-center-cooling-costs/
**:
https://www.glassdoor.com/Salaries/chicago-systems-administrator-salary-SRCH_IL.0,7_IM167_KO8,29.htm

# Shopping Cart:

**RAX XT24-4480V4-10G ( My System April 13th, 8:59 pm EDT )**
Thinkmate Config ID 422200

$23,863.00 | 1 | Remove | $23,863.00

Intel® C602J Chipset - 96x DDR4 - Dual 10-Gigabit Ethernet - 1620W Redundant Power Supply
**4 x** Eight-Core Intel® Xeon® Processor E7-4809 v4 2.10GHz 20MB Cache (115W)
**32 x** 8GB PC4-19200 2400MHz DDR4 ECC RDIMM
**24 x** 2.0TB SATA 6.0Gb/s 7200RPM - 2.5" - Seagate Exos 7E2000 Series (512e)
No Optical Drive Support
**3 x** Supermicro AOC-S3108L-H8iR SAS 3.0 12Gb/s 8-Port RAID Controller with 2GB Cache
Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4111A (1x SFP28)
Thinkmate® Update Manager (OOB Management Package)
No Operating System
Thinkmate® ISO 9001 Certified Assembly, Testing, and Quaility Control
3 Year Depot Warranty (Return for Repair)

**STX-JB JD72-0420-SAS3 ( My System April 13th, 9:11 pm EDT )**
Thinkmate Config ID 422201

$28,053.00 | 1 | Remove | $28,053.00

Thinkmate® STX-4244 4U Chassis - 72x Hot-Swap 2.5" SATA/SAS - 12Gb/s SAS Dual Expander - 1200W Redundant Power
**72 x** 2.0TB SAS 3.0 12.0Gb/s 7200RPM - 2.5" - Seagate Exos 7E2000 Series (512e)
I have an existing Host Server or Adapter
0.5-Meter External SAS Cable - 12Gb/s to 6Gb/s SAS - SFF-8644 to SFF-8088
IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 1'
Thinkmate® ISO 9001 Certified Assembly, Testing, and Quaility Control
3 Year Depot Warranty (Return for Repair)

# Table 2: Summary configuration 2

| | Description | Price per Item | Quantity | Total Price |
|---|---|---|---|---|
| Compute Servers | HDX XN24-52S1 | 36402 | 10417 | 379199634 |
| Network Switches | S5850-24T16B | 3500 | 456 | 1596000 |
| Network Cables | (includes in the servers) | -- | -- | -- |
| Racks | Great Lakes GL910ENT-3242-FK(48U) | 2747 | 871 | 2392637 |
| Storage Servers | STX-JB JD72-0420-SAS3 | 28053 | 70 | 1963710 |
| Electric Power | 1200 W/per compute server 1200w/ per storage server | $0.15 per KWH | -- | 85722732 |
| Cooling | Assume 30% of total datacenter power consumption * | -- | -- | 36738314 |
| Administration | System administrator average salary is used here | $65,000/year/person | 5 years 11 administrators | 3575000 |
| TOTAL | | | | $511,188,027 |

# Shopping Cart:

## STX-JB JD72-0420-SAS3 ( My System April 13th, 9:11 pm EDT )

$28,053.00 | 1 | Remove | $28,053.00

Thinkmate Config ID 422201

Thinkmate® STX-4244 4U Chassis - 72x Hot-Swap 2.5" SATA/SAS - 12Gb/s SAS Dual Expander - 1200W Redundant Power
**72 x** 2.0TB SAS 3.0 12.0Gb/s 7200RPM - 2.5" - Seagate Exos 7E2000 Series (512e)
I have an existing Host Server or Adapter
0.5-Meter External SAS Cable - 12Gb/s to 6Gb/s SAS - SFF-8644 to SFF-8088
IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 1'
Thinkmate® ISO 9001 Certified Assembly, Testing, and Quaility Control
3 Year Depot Warranty (Return for Repair)

## HDX XN24-52S1 ( My System April 13th, 9:34 pm EDT )

$36,402.00 | 1 | Remove | $36,402.00

Thinkmate Config ID 422215

2U 4-Node - Intel® C621 Chipset - 24x NVMe - 2200W Redundant Power
**8 x** Intel® Xeon® Gold 5220R Processor 24-Core 2.2GHz 35.75MB Cache (150W)
**96 x** 16GB PC4-23400 2933MHz DDR4 ECC RDIMM
**12 x** 1.0TB Intel® SSD DC P4510 Series U.2 PCIe 3.1 x4 NVMe Solid State Drive
**4 x** Supermicro SIOM 1-Gigabit Ethernet Adapter AOC-MGP-i2M (2x RJ45)
**4 x** Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4111A (1x SFP28)
IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 1'
**4 x** Thinkmate® Update Manager (OOB Management Package)
**4 x** No Operating System
Thinkmate® ISO 9001 Certified Assembly, Testing, and Quaility Control
3 Year Advanced Parts Replacement Warranty

# Table 3: Summary configuration 3

| | Description | Price per Item | Quantity | Total Price |
|---|---|---|---|---|
| Compute Servers | GPX XT24-24S1-8GPU | 79521 | 17858 | 1420086018 |
| Network Switches | S5850-24T16B | 3500 | 776 | 2716000 |
| Network Cables | (includes in the servers) | -- | -- | -- |
| Racks | Great Lakes GL910ENT-3242-FK(48U) | 2747 | 1488 | 4087536 |
| Storage Servers | STX-JB JD72-0420-SAS3 | 28053 | 7 | 196371 |
| Electric Power | 2561.1 W/per compute server 1200w/ per storage server | $0.15 per KWH | -- | 300541521 |
| Cooling | Assume 30% of total datacenter power consumption * | -- | -- | 128803509 |
| Administration | System administrator average salary is used here | $65,000/year/person | 5 years, 20 administrators | 6500000 |
| TOTAL | | | | $1,862,930,955 |

# Shopping Cart:

## GPX XT24-24S1-8GPU ( My System April 13th, 10:56 pm EDT )

Thinkmate Config ID 422236

$79,521.00 | 1 | Remove | $79,521.00

Intel® C622 Chipset - 4U GPU Server - 24x SATA - Dual 10-Gigabit Ethernet - 2000W (2+2) Redundant Power Supply
**2 x** Intel® Xeon® Gold 6258R Processor 28-Core 2.7GHz 38.5MB Cache (205W)
**12 x** 64GB PC4-23400 2933MHz DDR4 ECC RDIMM
1.0TB SATA 6.0Gb/s 7200RPM - 2.5" - Seagate Exos 7E2000 Series (512e)
No Optical Drive Support
**8 x** NVIDIA® Tesla™ V100 GPU Computing Accelerator - 16GB HBM2 - PCIe 3.0 x16 - Passive Cooling
Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4111A (1x SFP28)
IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 1'
Thinkmate® Update Manager (OOB Management Package)
No Operating System
Thinkmate® ISO 9001 Certified Assembly, Testing, and Quaility Control
Thinkmate® System Badge - 2.1875" x 0.5625"
3 Year Advanced Parts Replacement Warranty

## STX-JB JD72-0420-SAS3 ( My System April 13th, 9:11 pm EDT )

Thinkmate Config ID 422201

$28,053.00 | 1 | Remove | $28,053.00

Thinkmate® STX-4244 4U Chassis - 72x Hot-Swap 2.5" SATA/SAS - 12Gb/s SAS Dual Expander - 1200W Redundant Power
**72 x** 2.0TB SAS 3.0 12.0Gb/s 7200RPM - 2.5" - Seagate Exos 7E2000 Series (512e)
I have an existing Host Server or Adapter
0.5-Meter External SAS Cable - 12Gb/s to 6Gb/s SAS - SFF-8644 to SFF-8088
IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 1'
Thinkmate® ISO 9001 Certified Assembly, Testing, and Quaility Control
3 Year Depot Warranty (Return for Repair)

# Table 4: Comparaison of the 3 configurations

| | Configuration 1 | Configuration 2 | Configuration 3 |
|---|---|---|---|
| Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage | EC2 Compute resources (r5.24xlarge) :<br><br>(256 000/96) instances * 6.048 hourly * 24 hours * 30 days * 12 months * 5 years = $696 816 691.2<br><br>Instance storage: 400 000 000 GB * 0.045 * 12 months * 5 years = $1 080 Million<br><br>S3 storage : 0.021 per GB per month * 800 000 000GB * 12 months * 5 years = $1 008 Million<br><br>Total: $2,784,816,691.2 | EC2 Compute resources (r5d.large) :<br><br>1 000 000 instances * 0.144 hourly * 24 hours * 30 days * 12 months * 5 years<br>= $6 220 800 000<br><br>S3 storage :<br><br>0.021 per GB per month * 10 000 000 GB * 12 months * 5 years<br>= $12 600 000<br><br>Total: $6,233,400,000 | 1 exaflop = 1000000 teraflops<br><br>Each p3.16xlarge instance gives 8*7 = 56 teraflops<br><br>Total number of p3.16xlarge instances needed = 1000000 / 56<br>=<br>17858<br>=> 17858*$24.48per hour<br>= $437142 per hour<br>= $19 146 857 140 per 5 years<br><br>S3 storage :<br>0.021 per GB per month * 1 000 000 GB * 12 months * 5 years<br>= $1 260 000<br><br>Total: $19,148,117,140 |
| Private Cloud cost over 5 years, 24/7 operation, with 100% usage | $501,125,559 | $511,188,027 | $1,862,930,955 |

Q: What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?

In our estimation, the private cloud is significantly cheaper than the public cloud if we are able to achieve 100% usage. For config 1, if the usage of the cloud is more than ~18%, the cost of the public cloud exceeds the overall cost of the private cloud. Similarly, for config 2 and 3, it is ~8.2% and ~9.7%. Although the public cloud provides flexibility and is easy to scale up, our calculation shows that having private hardware ready for computation does provide some merits, mainly on reducing overall costs.