Homework 4

-__Team__

Varun Gunda

Ayelet Bendor

Chandu Chinta

Configuration 1:

Server used : **HDX XS12-52S1**

	Description	Price per Item	Quantity	Total Price
Compute Servers	**HDX XS12-52S1, STX-JB JE12 -0220-SAS3**	$35,145, $4,304	1778	$70,140,322
Network Switches	Mellanox, FS – N8000	$16,673, $4,000	256, 1024	$8,364,288
Network Cables	Mellanox MCP2M00	$60	16896	$1013760
Racks	iStarUSA	$714.95	564	$28598
Storage Servers	STX-NL XE36 – 24S1-10G	$17,888	3290	$58,851,520
Electric Power	Assumption as per HW2	$0.15 per KWH	5509.6KW/year	$36198072
Cooling	Assumption as per HW2	$0.15 per KWH	5509.6KW/year	$36198072
Administration	Assumption as per HW2	$100K per year	5	$2500000
TOTAL	N/A	N/A	N/A	$213,294,632

Mellanox - Core switches:
https://store.mellanox.com/products/mellanox-msn2700-bs2fo-spectrum-based-40gbe-1u-open-ethernet-switch-with-onie-32-qsfp28-ports-2-power-supplies-ac-standard-depth-x86-cpu-p2c-airflow-rail-kit-rohs6.html

Aggregate and Edge switches:
https://www.fs.com/products/69227.html

Ethernet cables:
https://store.mellanox.com/products/mellanox-mcp2m00-a02ae30l-passive-copper-cable-eth-up-to-25gb-s-sfp28-2-5m-black-30awg-ca-l.html

Racks:
https://www.newegg.com/istarusa-wng3210-dwr4cm2ub-rack-mount-cabinet/p/N82E16816215910?Description=rack%20u4&cm_re=rack_u4-_-16-215-910-_-Product

POWER CONSUMPTION:
Compute node Power cost per server (4 Nodes) : 1668W   [As per Thinkmate]
Total power consumption for compute nodes   : Number of servers * 1668W
                                                                          : 1778*1668
                                                                          : 2965.7KW
Storage per server power consumption   : 668.2W
Total power consumption for Storage nodes   : 3290 * 668.2
                                                                          : 2198.3KW

Switch power consumption   : 300W (For aggregate and Edge switches) &
                                                                            150W (For Core switches)
Total power consumption for switches   : 1024 * 300W + 256 * 150W
                                                                          : 345.6KW

Total power cost for 5 Years   : (2965.7 + 2198.3 + 345.6) * 24 * 365 * 5 * 0.15$
                                                                          : 5509.6 * 24 * 365 * 5 * 0.15$

| | : $36198072 |
| Cooling cost | : $36198072 [Equal to the power cost] |

Administrator cost [For 5 years]	: (Total servers / 1000) * $100,000 * 5 years
(1 Admin for 1000 servers at $100K per Year)	: {(1778 + 3290) /1000 } * 100,000 * 5
	: ~$2.5Million

Rack Cost:

Compute Node rack (2U per server)	: (1778 * 2 / 32) = 111.125 ~112 racks
	: 112 * $714.95
	: $80080
Storage Node rack (4U per server)	: (3290 * 4 / 32) = 411.25 racks ~ 412 racks
	: 412 * $714.95
	: $294560
Switches (1U per server)	: (1024 + 256 /32) = 40 racks
	: 40 * $714.95
	: $28598

Ethernet cables cost	: Number of cables * $60
	: (16896 * 60)
	: $1013760

Calculations for the number of Ethernet cables for Fat tree network:

Number of ports (k) = 32

Number of Ethernets for ->

Core to Aggregate connection requires	: (Number of core switches) * k
	: $(k/2)^2 * k = k^3 /4$
Aggregate to Edge connection requires	: (Number of aggregate switches) * k
	: $(k/2) * k = k^2 /4$
Edge to Server connection requires	: (Number of servers)
	: $k^3 /4$

Total Ethernet cables	: $(k^3 /4) + (k^2 /4) + (k^3 /4)$
	: $k^2 (k+1)/2$
Total Number of Ethernet cables	: 16896
(Using k = 32)	

Configuration 2:

	Description	Price per Item	Quantity	Total Price
Compute Servers	HDX XN24-52S1	$32890	25000	$822250000
Network Switches	HPE Aruba 5406R zl2 - switch	$2,159	6845	$14778355
Network Cables	Mellanox MCP2M00	$60	205350	$12321000
Racks	iStarUSA WNG3210-DWR4CM2UB 32U 1000mm	$714.95	2471	$1766641.45
Storage Servers	STX-NL XE36 – 24S1-10G	$13254	412	$5460648
Electric Power	214 Watt per switch 478 Watt per storage server 1228 Watt per compute server	$0.15 per KWH		$44845045
Cooling	Assumption as per HW2	$0.15 per KWH		$44845045
Administration	Assumption as per HW2	$100K per year	26	$13000000
TOTAL	N/A	N/A	N/A	$959266734.5

Configuration 3:

	Description	**Price per Item**	**Quantity**	**Total Price**
Compute Servers	AMD EPYC™ 7002 Series - 2U GPU Server		129000	
	Processor - AMD EPYC™ 7662 Processor 64-core 2.00GHz 256MB Cache		16	
	Memory - 32GB PC4-23400 2933MHz DDR4 ECC RDIMM		16(512GB)	
	GPU - NVIDIA® Tesla™ V100- 16GB NVLink		64	$11,551,434,000
	HDD 240GB Samsung PM883 Series 2.5" SATA 6Gb/s SSD			
	Network - Mellanox 25-Gigabit Ethernet Adapter		1	
	Warranty - 5 Year		1	

Network Switches	HPE Aruba 5406R zl2 - switch + 5 year warranty	$7221.99	3363	$17,023,506
Network Cables	Mellanox MCP2M00	$60	137,842	$8270520
Racks	iStarUSA WNG3210-DWR4CM2UB 32U	$714.95	$12007	$8584404.65
Storage Servers	STX-NL XE36-2460V4-SAS3	$6124	$50	$306,200
Electric Power	215 Watt per switch 340.6 Watt per storage server 2200 Watt per compute server	$0.15 per KWH		$1,870,209,837
Cooling	Same as Electric power cost	$0.15 per KWH		$1,870,209,837
Administration	Assumption as per HW2	$100K per year	7	$3500000
TOTAL	N/A	N/A	N/A	$15329538304.65

Table 2:

	Configuration 1	Configuration 2	Configuration 3
Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage	$2865070902.6	$6528395218.2	$142861223127.6
Private Cloud cost over 5 years, 24/7 operation, with 100% usage	$213,294,632	$959266734.5	$15329538304.65
What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?	7.5%	14.6%	11%

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CONFIGURATION 1

Removed *STX-NS XE12-12S1-10G (My System April 13th, 5:28 pm EDT)* from your order.

Product	Unit Price	Quantity	Subtotal
STX-JB JE12-0220-SAS3 (My System April 13th, 3:33 pm EDT) Thinkmate Config ID 422116	$4,304.00	1 ☐ Remove	$4,304.00

Thinkmate® STX-2312 2U Chassis - 12x Hot-Swap 3.5" SAS3 - 12Gb/s SAS Dual Expander - 740W Redundant Power
3 x 14.0TB SAS 3.0 12.0Gb/s 7200RPM - 3.5" - Seagate Exos X16 Series FastFormat™ (512e/4Kn)
LSI SAS 9300-8e SAS 12Gb/s PCIe 3.0 8-Port Host Bus Adapter
3-Meter External SAS Cable - 12Gb/s to 12Gb/s SAS - SFF-8644 to SFF-8644
10 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 6'
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Product	Unit Price	Quantity	Subtotal
HDX XS12-52S1 (My System April 13th, 4:48 pm EDT) Thinkmate Config ID 422119	$35,145.00	1 ☐ Remove	$35,145.00

2U 4-Node - Intel® C621 Chipset - 12x SATA - LSI 3008 12G SAS Controller - 2200W Redundant Power
8 x Intel® Xeon® Gold 5220 Processor 18-Core 2.2GHz 25MB Cache (125W)
48 x 8GB PC4-23400 2933MHz DDR4 ECC RDIMM
12 x 16.0TB SAS 3.0 12.0Gb/s 7200RPM - 3.5" - Seagate Exos X16 Series FastFormat™ (512e/4Kn)
4 x Supermicro SIOM 25-Gigabit Ethernet Adapter AOC-MH25G-m2S2TM (2x SFP28, 2x RJ45)
4 x Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4121A (2x SFP28)
10 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 6'
4 x Thinkmate® Update Manager (OOB Management Package)
4 x No Operating System
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Product	Unit Price	Quantity	Subtotal
STX-NL XE36-24S1-10G (My System April 13th, 5:44 pm EDT) Thinkmate Config ID 422136	$17,888.00	1 ☐ Remove	$17,888.00

Intel® C622 Chipset - 10x SATA3 - 2x M.2 - Dual Intel® 10-Gigabit Ethernet (RJ45) - IPMI 2.0 with LAN
2 x Intel® Xeon® Gold 5220R Processor 24-Core 2.2GHz 35.75MB Cache (150W)
Thinkmate® 2U Datacenter Class Passive Heatsink
Supermicro SNK-P0068PSC Heatsink
16 x 16GB PC4-23400 2933MHz DDR4 ECC RDIMM
Thinkmate® STX-4336 4U Chassis - 36x Hot-Swap 3.5" SATA/SAS3 - 12Gb/s SAS Single Expander - 1280W Redundant Power
16 x 16.0TB SATA 6.0GB/s 7200RPM - 3.5" - Seagate Exos X16 Series FastFormat™ (512e/4Kn)
No Optical Drive Support
LSI MegaRAID 9361-8i SAS 12Gb/s PCIe 3.0 8-Port Controller with 1GB Cache
CacheVault Flash Cache Protection Module for 9361/9380 Series (CVM02) w/bracket
Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4121A (2x SFP28)
4 x Thinkmate® Certified 12Gb/s mini SAS HD Cable - SFF-8643 to SFF-8643 (80cm) (30AWG)
2 x Thinkmate® Certified 12Gb/s mini SAS HD Cable - SFF-8643 to SFF-8643 (50cm) (30AWG)
Supermicro AOM-SAS3-8I8E-LP - 2-Port Backplate - SFF-8643 to SFF-8644 (Low Profile)
STARTECH 12IN 4PIN FAN POWER SPLITTER CABLE MFG P/N FAN4SPLIT12
10 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 6'
Supermicro MCP-220-82616-0N - Dual 2.5" Hot-swap HDD tray
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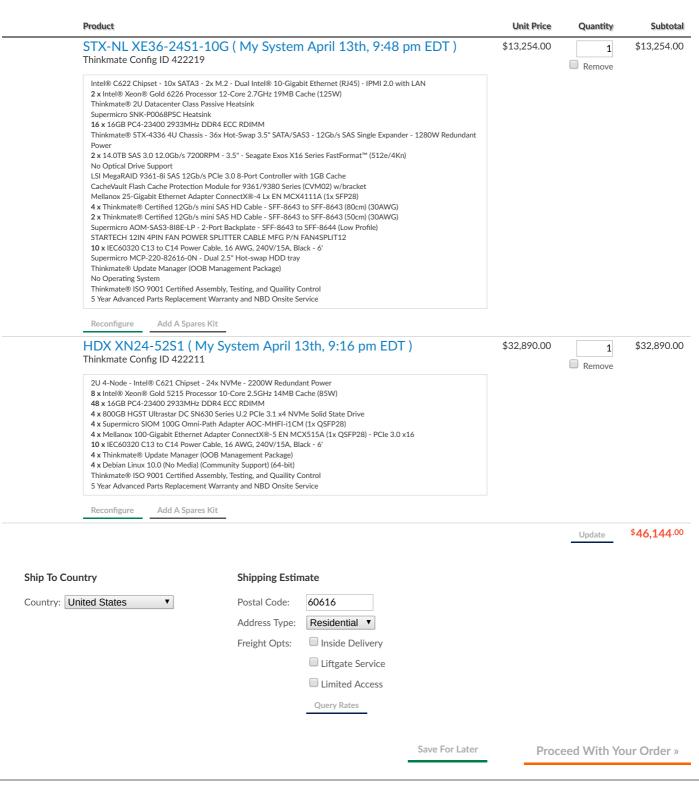**1-800-371-1212**
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CONFIGURATION 2

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Product	Unit Price	Quantity	Subtotal
STX-NL XE36-24S1-10G (My System April 13th, 9:48 pm EDT) Thinkmate Config ID 422219	$13,254.00	1 ☐ Remove	$13,254.00

Intel® C622 Chipset - 10x SATA3 - 2x M.2 - Dual Intel® 10-Gigabit Ethernet (RJ45) - IPMI 2.0 with LAN
2 x Intel® Xeon® Gold 6226 Processor 12-Core 2.7GHz 19MB Cache (125W)
Thinkmate® 2U Datacenter Class Passive Heatsink
Supermicro SNK-P0068PSC Heatsink
16 x 16GB PC4-23400 2933MHz DDR4 ECC RDIMM
Thinkmate® STX-4336 4U Chassis - 36x Hot-Swap 3.5" SATA/SAS3 - 12Gb/s SAS Single Expander - 1280W Redundant Power
2 x 14.0TB SAS 3.0 12.0Gb/s 7200RPM - 3.5" - Seagate Exos X16 Series FastFormat™ (512e/4Kn)
No Optical Drive Support
LSI MegaRAID 9361-8i SAS 12Gb/s PCIe 3.0 8-Port Controller with 1GB Cache
CacheVault Flash Cache Protection Module for 9361/9380 Series (CVM02) w/bracket
Mellanox 25-Gigabit Ethernet Adapter ConnectX®-4 Lx EN MCX4111A (1x SFP28)
4 x Thinkmate® Certified 12Gb/s mini SAS HD Cable - SFF-8643 to SFF-8643 (80cm) (30AWG)
2 x Thinkmate® Certified 12Gb/s mini SAS HD Cable - SFF-8643 to SFF-8643 (50cm) (30AWG)
Supermicro AOM-SAS3-8I8E-LP - 2-Port Backplate - SFF-8643 to SFF-8644 (Low Profile)
STARTECH 12IN 4PIN FAN POWER SPLITTER CABLE MFG P/N FAN4SPLIT12
10 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 6'
Supermicro MCP-220-82616-0N - Dual 2.5" Hot-swap HDD tray
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HDX XN24-52S1 (My System April 13th, 9:16 pm EDT) Thinkmate Config ID 422211	$32,890.00	1 ☐ Remove	$32,890.00

2U 4-Node - Intel® C621 Chipset - 24x NVMe - 2200W Redundant Power
8 x Intel® Xeon® Gold 5215 Processor 10-Core 2.5GHz 14MB Cache (85W)
48 x 16GB PC4-23400 2933MHz DDR4 ECC RDIMM
4 x 800GB HGST Ultrastar DC SN630 Series U.2 PCIe 3.1 x4 NVMe Solid State Drive
4 x Supermicro SIOM 100G Omni-Path Adapter AOC-MHFI-i1CM (1x QSFP28)
4 x Mellanox 100-Gigabit Ethernet Adapter ConnectX®-5 EN MCX515A (1x QSFP28) - PCIe 3.0 x16
10 x IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 6'
4 x Thinkmate® Update Manager (OOB Management Package)
4 x Debian Linux 10.0 (No Media) (Community Support) (64-bit)
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Thinkmate Config ID 422179

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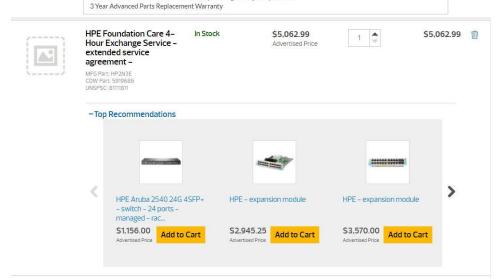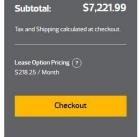☐ Remove

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IEC60320 C13 to C14 Power Cable, 16 AWG, 240V/15A, Black - 1'
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AMD EPYC™ 7002 Series - 2U GPU Server - 4x Hot-Swap 2.5" SAS3 - 4x Hot-Swap NVMe - Dual 10-Gigabit RJ45 - 2200W Redundant Power
2 x AMD EPYC™ 7662 Processor 64-core 2.00GHz 256MB Cache (225W)
16 x 32GB PC4-23400 2933MHz DDR4 ECC RDIMM
240GB Samsung PM883 Series 2.5" SATA 6Gb/s Solid State Drive
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)
2 x IEC320 C19 to NEMA 5-15P Power Cable, 14AWG, 125V/15A, Black - 3ft (TAA Compliant)
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