CS553 Cloud Computing

Project Report

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Configuration 1:

Public cloud:

Configuration details:

Instance name	d2.8xlarge
Cost/hr	$5.52
GFIOPS	1382.4
vCPU	36
RAM	244 GiB
Storage	256TB
Network	10Gbps
Storage 100 PB Monthly cost	$2202572.8

Calculation of number of instances and utilizations:

Configuration No	Instance Count	Instance cost/hr	Instance Utilization	Utilization GFIOPS	Storage(PB)
1	1050	5796	25%	345.6	100
2	1050	5796	50%	691.2	100
3	1050	5796	75%	1036.8	100
4	1050	5796	100%	1382.4	100

Continue:

Conf no	Storage cost/hr $	Cost/hr/GFIOPS $	Total AWS cost/ hr $ (based on utilization)	Total AWS cost/ 5 years $	Total AWS cost/ 5 years $
			(Comment: Storage cost is fixed)	(Comment: Storage cost is fixed)	Storage cost and instance cost based on utilization
1	2960.44	25.33	4409.44	193133792.3	95883098.06
2	2960.44	12.66	5858.44	256599992.3	191766196.1
3	2960.44	8.44	7307.44	320066192.3	287649294.2
4	2960.44	6.33	8756.44	383532392.3	383532392.3

5 Year cost 24*7 Utilization cost/hr/gfiops $	277439.5199
5 Year cost 24*7 Utilization cost $	383532392.3

Private cloud:

	Description	Price per item($)	Quantity	Total ($)	Comment
CPU	Intel Xeon e5-2676 v3 @ 2.40ghz (Haswell) processors	2197	3150	6920550	3 Processors for 1 VM
Memory	64GB PC4-21300 DDR4-2666Mhz Load Reduced ECC Quad Ranked 1.2V Major Brand	899.99	4200	3779958	4 Memory per vm
Disk	6TB Seagate ST6000NM0105 - SAS 4Kn HDD 6TB V.5 Enterprise Capacity SAS 12Gb/s 7200rpm 256MB 3.5-inch Bulk	248.99	6300	1568637	6 disk per vm
Motherboard	ASUS Z10PE-D16 WS LGA 2011-v3 Intel C612 PCH SATA 6Gb/s USB 3.0 SSI EEB Intel Motherboard	498.99	1051	524438.49	1050 vm and extra 1 for storage server
Network Switch	Mellanox SX1710 Ethernet SwitchX-2 based 36-port QSFP 40/56GbE 1U 36 QSFP ports 2 PS MSX1710-BS2F2	11323	31	351013	30 for vm and 1 for upperone
Network Adapter	Mellanox MCX415A-CCAT ConnectX-4 EN	758.24	31	23505.44	same as network switch

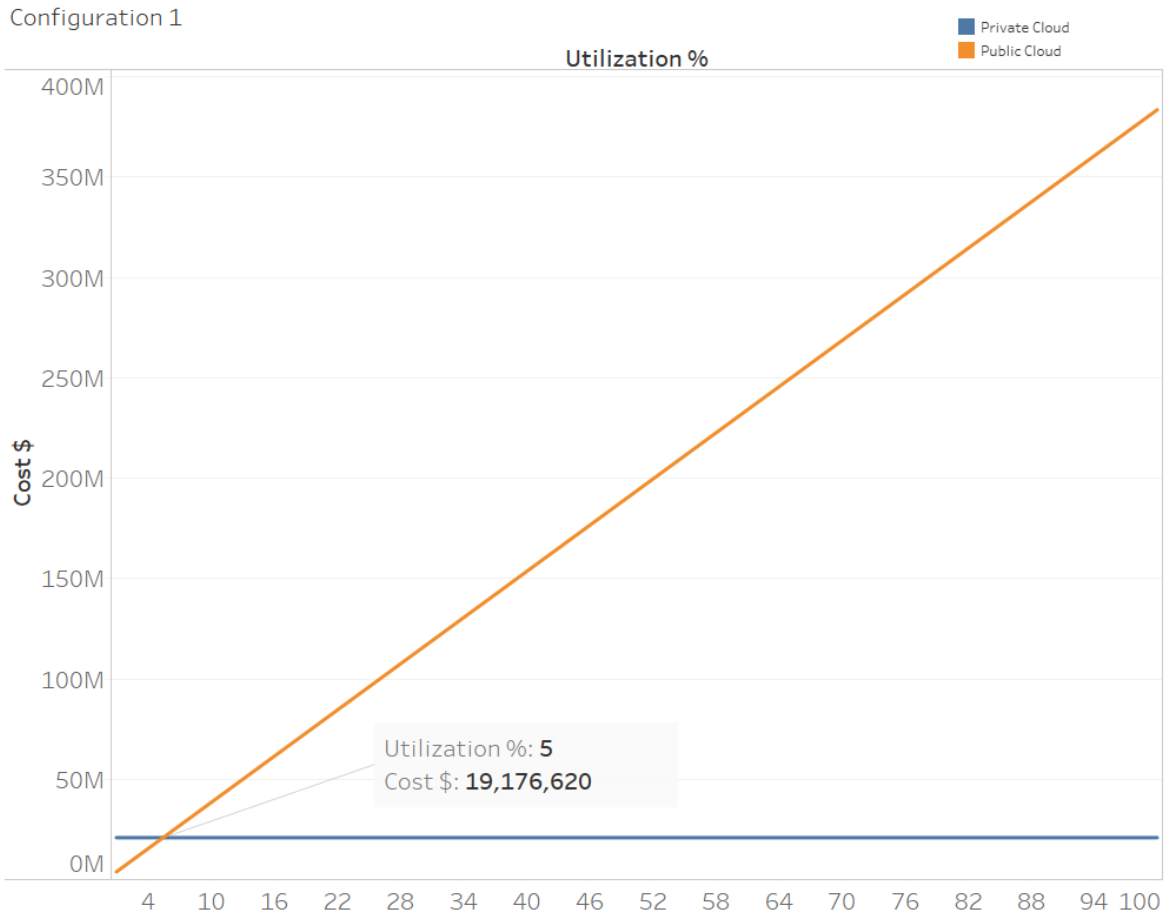
	network interface card, 100GbE single-port QSFP28, PCIe3.0 x16, tall bracket				
Network Cable	Belkin A3L791b14-BLU-S 14 ft. Cat 5E Blue Patch Cable	9.99	1085	10839.15	vm + switch + extra 4
Server Racks	iStarUSA WD-1045 10U 450mm Depth Simple Server Rack	228.99	105	24043.95	10vm per rack
Storage server	J4601S, HGST 4U 60 Bay JBOD with 60 * 12TB Helium SAS SSD (Kepler+)	44250	139	6150750	100PB/720TB
Electric Power	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 120 watts/hr			1182126.96	
Cooling	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 120 watts/hr			900748.4339	
Admin	70000 per year salary	70000	2	700000	
			TOTAL:	**20886060.42**	

Configuration No	Instance Count	Instance cost/hr	Instance Utilization	Utilization GFIOPS	Storage (PB)	Storage cost/hr	Cost/hr/GFIOPS
1	1050	84.105653	25%	345.6	100	140.4280	0.6496925
2	1050	168.21130	50%	691.2	100	140.4280	0.4465268
3	1050	252.31695	75%	1036.8	100	140.4280	0.3788050
4	1050	336.42261	100%	1382.4	100	140.4280	0.3449440

5 Year cost 24*7 Utilization cost/hr/gfiops $	15108.55065
5 Year cost 24*7 Utilization cost $	20886060.42

Analysis and Conclusion:

Compare AWS (Storage cost and instance cost based on utilization) and private cloud:



As per above, we can say that if our utilization is less than 5%, then public cloud(AWS) is the best choice. Otherwise private cloud is the best option in 5 years of time. We observed that public cloud price increase, with utilization. For less utilization, public cloud price is less. So it will be better to rent public cloud if the requirement is a short period of time, but for 5 years requirement it will grate to buy own private cloud.

Configuration 2:

Public cloud:

Configuration details:

Instance name	r3.large
Cost/hr	$0.166
GFIOPS	40
vCPU	2
RAM	15.25GB
Storage	32GB
Network	Moderate
Storage 10 PB Monthly cost	$220764.16

Calculation of number of instances and utilizations:

Configuration No	Instance Count	Instance cost/hr $	Instance Utilization	Utilization GFIOPS	Storage(PB)
1	1000000	166000	25%	10	10
2	1000000	166000	50%	20	10
3	1000000	166000	75%	30	10
4	1000000	166000	100%	40	10

Continue:

Conf. No.	Storage cost/hr $	Cost/hr/GFIOPS	Total AWS cost/ hr $ (based on utilization)	Total AWS cost/ 5 years $	Total AWS cost/ 5 years $
			(Comment: Storage cost is fixed)	(Comment: Storage cost is fixed)	Storage cost and instance cost based on utilization
1	296.7260215	16629.6726	41796.72602	1830696600	1820949150
2	296.7260215	8314.836301	83296.72602	3648396600	3641898300
3	296.7260215	5543.224201	124796.726	5466096600	5462847450
4	296.7260215	4157.418151	166296.726	7283796600	7283796600

5 Year cost 24*7 Utilization cost/hr/gfiops $	182094915
5 Year cost 24*7 Utilization cost $	7283796600

Private cloud:

	Description	Price per item($)	Quantity	Total($)	Comment
CPU	Intel Xeon E5-2670 v2 Ivy Bridge-EP 2.5 GHz 25MB L3 Cache LGA 2011 115W BX80635E52670V2 Server Processor	1550	1000000	1550000000	1 cpu per vm
Memory	16GB PC4-19200 DDR4-2400Mhz Registered ECC DIMM 1.2V Major Brand	210.99	1000000	210990000	1 Memory per vm
Disk	Intel 32GB MEMPEK1W032GAXT Optane Memory Series NVMe PCIe M.2 2280 1350MB/sec Read 20nm 3D Xpoint, Retail	96.99	1000000	96990000	1 disk per vm
Motherboard	ASUS Z10PE-D16 WS LGA 2011-v3 Intel C612 PCH SATA 6Gb/s USB 3.0 SSI EEB Intel Motherboard	498.99	1000001	498990499	1 million vm and extra 1 for storage server
Network Switch	Mellanox SX1710 Ethernet SwitchX-2 based 36-port QSFP 40/56GbE 1U 36 QSFP ports 2 PS MSX1710-BS2F2	11323	28573	323532079	1million/35 for vm and 1 for upperone
Network Adapter	Mellanox MCX415A-CCAT ConnectX-4 EN network interface card, 100GbE single-port QSFP28, PCIe3.0 x16, tall bracket	758.24	28573	21665191.52	same as network switch
Network Cable	Belkin A3L791b14-BLU-S 14 ft. Cat 5E Blue Patch Cable	9.99	1028580	10275514.2	vm + switch + extra 7
Server Racks	iStarUSA WD-1045 10U 450mm Depth Simple Server Rack	228.99	100000	22899000	10vm per rack
Storage server	J4601S, HGST 4U 60 Bay JBOD with 60 * 12TB Helium SAS SSD (Kepler+)	44250	14	619500	10PB/720TB
Electric Power	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 202 watts/hr			110759.25	

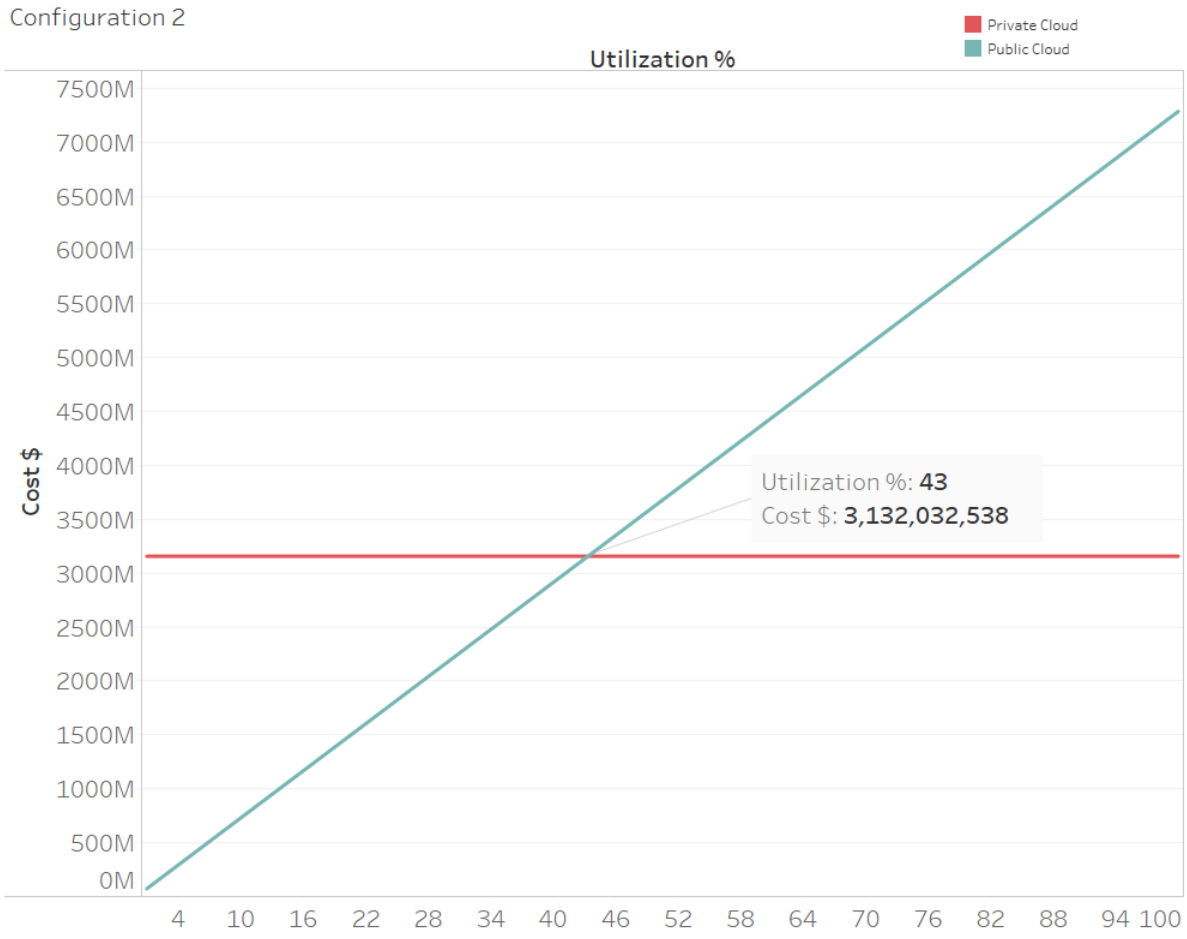
Cooling	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 202 watts/hr			71320000	
Admin	70000 per year salary	70000	1000	350000000	
			Total:	3157392543	

Configuration No	Instance Count	Instance cost/hr	Instance Utilization	Utilization GFIOPS	Storage(PB)	Storage cost/hr	Cost/hr/GFIOPS
1	1050	18018.11098	25%	10	100	14.14383562	1803.225481
2	1050	36036.22195	50%	20	100	14.14383562	1802.518289
3	1050	54054.33293	75%	30	100	14.14383562	1802.282559
4	1050	72072.4439	100%	40	100	14.14383562	1802.164693

5 Year cost 24*7 Utilization cost/hr/gfiops $	78934813.57
5 Year cost 24*7 Utilization cost $	3157392543

Analysis and Conclusion:

Compare AWS (Storage cost and instance cost based on utilization) and private cloud:



As per above, we can say that if our utilization is less than 43%, then public cloud(AWS) is the best choice. Otherwise private cloud is the best option in 5 years of time. We observed that public cloud price increase, with utilization. For less utilization, public cloud price is less. So it will be better to rent public cloud if the requirement is a short period of time, but for 5 years requirement it will grate to buy own private cloud.

Configuration 3:

Public cloud:

Configuration details:

Instance name	p3.16xLarge
Cost/hr	$24.48
TeraFIOPS	1000
vCPU	64
GPU	8
RAM	488GB
GPU Memory	128GB
Storage	32GB
Network	25
Storage 1 PB Monthly cost	$22583.3

Calculation of number of instances and utilizations:

Configuration No	Instance Count	Instance cost/hr	Instance Utilization	Utilization TeraFIOPS	Storage(PB)
1	1000	24480	25%	250	1
2	1000	24480	50%	500	1
3	1000	24480	75%	750	1
4	1000	24480	100%	1000	1

Continue:

Conf. No.	Storage cost/hr $	Cost/hr/TeraFIOPS $	Total AWS cost/ hr $ (based on utilization)	Total AWS cost/ 5 years $	Total AWS cost/ 5 years $
			(Comment: Storage cost is fixed)	(Comment: Storage cost is fixed)	Storage cost and instance cost based on utilization
1	30.35389785	98.04141559	6150.353898	269385500.7	268388375.2
2	30.35389785	49.0207078	12270.3539	537441500.7	536776750.4
3	30.35389785	32.68047186	18390.3539	805497500.7	805165125.5
4	30.35389785	24.5103539	24510.3539	1073553501	1073553501

5 Year cost 24*7 Utilization cost/hr/TeraFiops $	1073553.501
5 Year cost 24*7 Utilization cost $	1073553501

Private cloud:

	Description	Price per item($)	Quantity	Total($)	Comment
CPU	Intel Xeon E5 2686 V4 SR2K8 18Core 2.3Ghz 45MB LGA2011-3 145W 14nm Processor CPU	1119	4000	4476000	4 per vm
Memory	64GB PC4-21300 DDR4-2666Mhz Load Reduced ECC Quad Ranked 1.2V Major Brand	899.99	8000	7199920	8 Memory per vm
Disk	Intel 32GB MEMPEK1W032GAXT Optane Memory Series NVMe PCIe M.2 2280 1350MB/sec Read 20nm 3D Xpoint, Retail	96.99	1000	96990	1 disk per vm
GPU	NVIDIA TESLA V100 PCIE 16GB MODULE	18650	8000	149200000	8 GPU per vm
Motherboard	ASUS Z10PE-D16 WS LGA 2011-v3 Intel C612 PCH SATA 6Gb/s USB 3.0 SSI EEB Intel Motherboard	498.99	1001	499488.99	1000 vm and extra 1 for storage server
Network Switch	Mellanox SX1710 Ethernet SwitchX-2 based 36-port QSFP 40/56GbE 1U 36 QSFP ports 2 PS MSX1710-BS2F2	11323	30	339690	1000/35 for vm and 1 for upperone
Network Adapter	Mellanox MCX415A-CCAT ConnectX-4 EN network interface card, 100GbE single-port QSFP28, PCIe3.0 x16, tall bracket	758.24	30	22747.2	same as network switch
Network Cable	Belkin A3L791b14-BLU-S 14 ft. Cat 5E Blue Patch Cable	9.99	1035	10339.65	vm + switch + extra 5
Server Racks	iStarUSA WD-1045 10U 450mm Depth Simple Server Rack	228.99	100	22899	10vm per rack
Storage server	J4601S, HGST 4U 60 Bay JBOD with 60 * 6TB Helium SAS SSD (Kepler+)	26024.27	3	78072.81	10PB/720TB
Electric Power	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 120 watts/hr			938196	

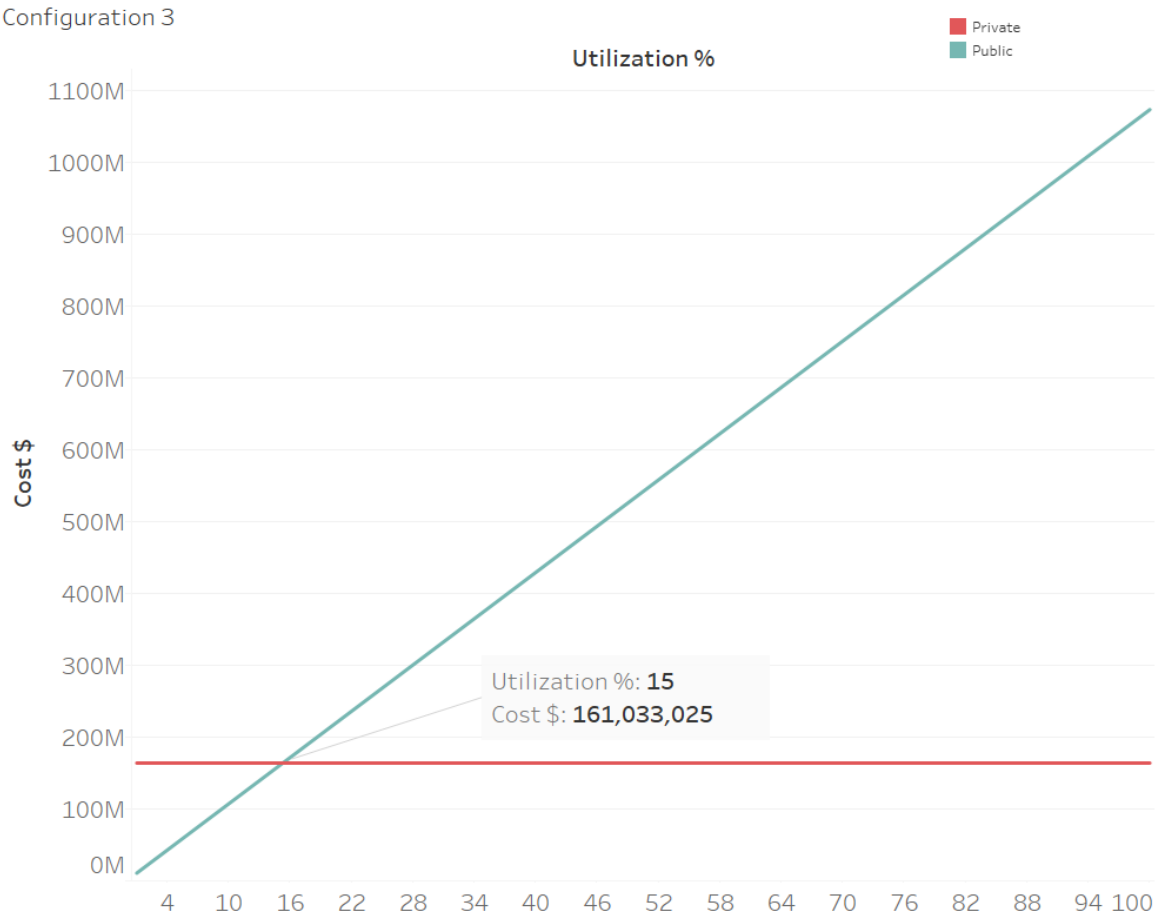
Cooling	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 120 watts/hr			714878.5455	
Admin	70000 per year salary	70000	1	350000	
				163949222.2	

Configuration No	Instance Count	Instance cost/hr $	Instance Utilization	Utilization TeraFIOPS	Storage(PB)	Storage cost/hr $	Cost/hr/TeraFIOPS
1	1050	935.3376106	25%	250	100	1.782484247	3.74848038
2	1050	1870.675221	50%	500	100	1.782484247	3.744915411
3	1050	2806.012832	75%	750	100	1.782484247	3.743727088
4	1050	3741.350443	100%	1000	100	1.782484247	3.743132927

5 Year cost 24*7 Utilization cost/hr/gfiops $	163949.2222
5 Year cost 24*7 Utilization cost $	163949222.2

Analysis and Conclusion:

Compare AWS (Storage cost and instance cost based on utilization) and private cloud:



As per above, we can say that if our utilization is less than 15%, then public cloud(AWS) is the best choice. Otherwise private cloud is the best option in 5 years of time. We observed that public cloud price increase, with utilization. For less utilization, public cloud price is less. So it will be better to rent public cloud if the requirement is a short period of time, but for 5 years requirement it will grate to buy own private cloud.

Summary Table:

	Configuration 1	Configuration 2	Configuration 3
Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage $	383532392.3	7283796600	1073553501
Private Cloud cost over 5 years, 24/7 operation, with 100% usage $	20886060.42	3157392543	163949222.2
What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?	After 5% utilization, private cloud option more attractive and cost effective than public cloud.	After 43% utilization, private cloud option more attractive and cost effective than public cloud.	After 15% utilization, private cloud option more attractive and cost effective than public cloud.

Conclusion:

Using above analysis, we conclude that for a short period of time public cloud is better and for a longer period of time like 5 years' private cloud is better. Cost is the most important factor for startup companies. If startup company plan for long period of development, then it's better to buy their own private cloud instead of rent public cloud on-demand. For configuration 1, 2 and 3, it would be better for startup companies to maintain utilization more than 5%, 43% and 15% respectively.

Shopping cart:

CPU:

NTEL XEON E5-2676 V3 2.40GHZ

INTEL XEON E5-2676 V3 2.40GHZ SOCKET 2011-3 LGA2011-3 HASWELL SERVER OEM CPU SR1Y5 CM8064401613101

INTEL

$2,197.00

SKU:
E5-2676v3

Quantity
1

ADD TO CART ADD TO WISHLIST

Save

Memory:

64GB PC4-21300 DDR4-2666Mhz Load Reduced ECC Quad Ranked 1.2V Major Brand

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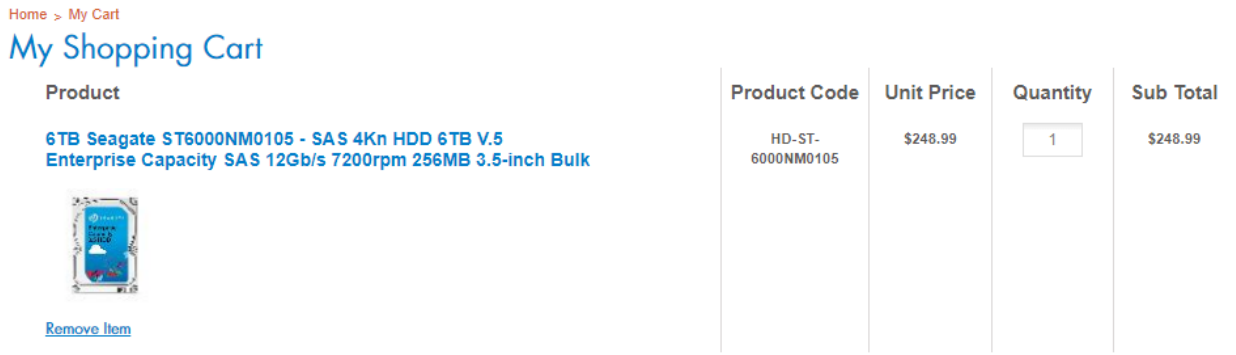
Product	Product Code	Unit Price	Quantity	Sub Total
64GB PC4-21300 DDR4-2666Mhz Load Reduced ECC Quad Ranked 1.2V Major Brand  Remove Item	DR4-64G-LR21300E	$899.99	1	$899.99

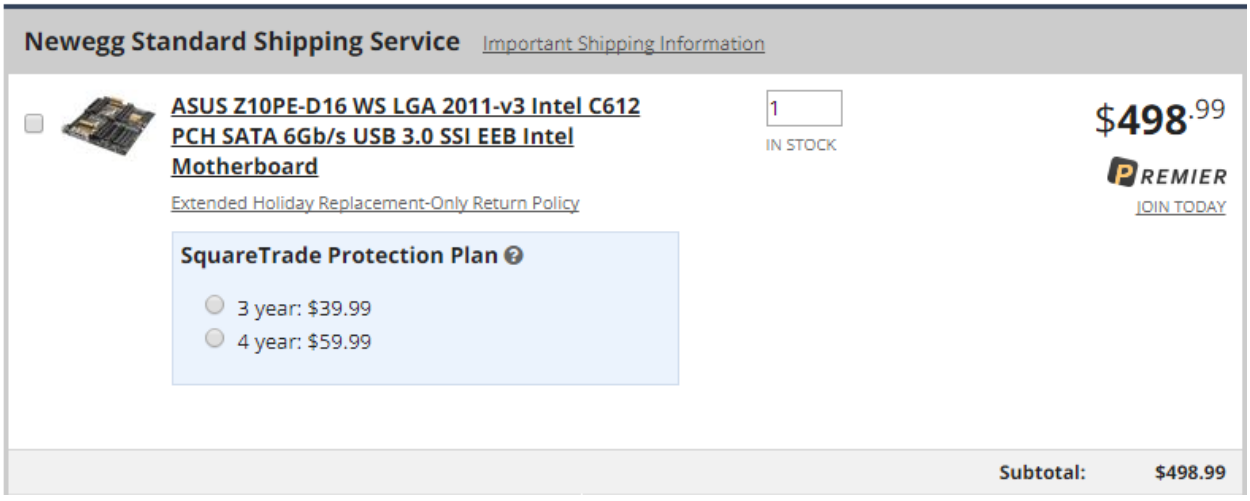
Disk:

6TB Seagate ST6000NM0105 - SAS 4Kn HDD 6TB V.5 Enterprise Capacity SAS 12Gb/s 7200rpm 256MB 3.5-inch Bulk



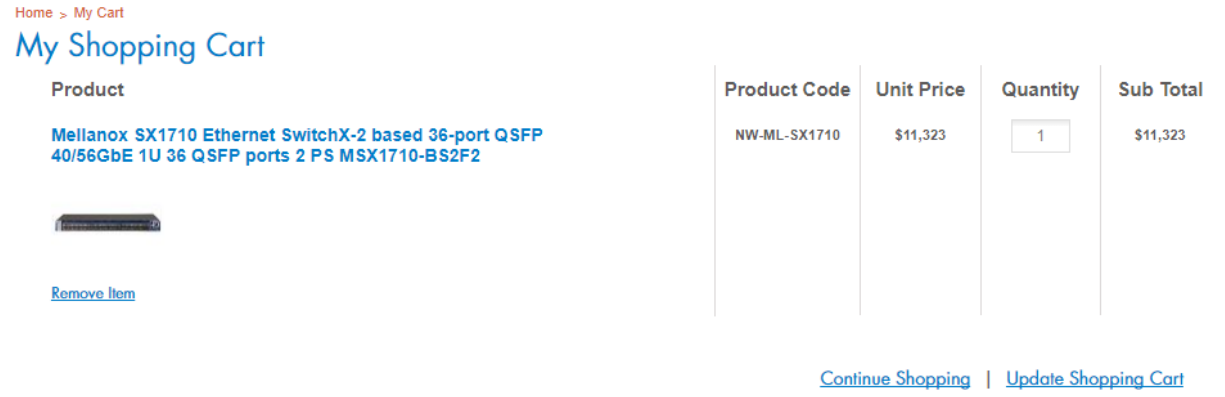
Motherboard:

ASUS Z10PE-D16 WS LGA 2011-v3 Intel C612 PCH SATA 6Gb/s USB 3.0 SSI EEB Intel Motherboard



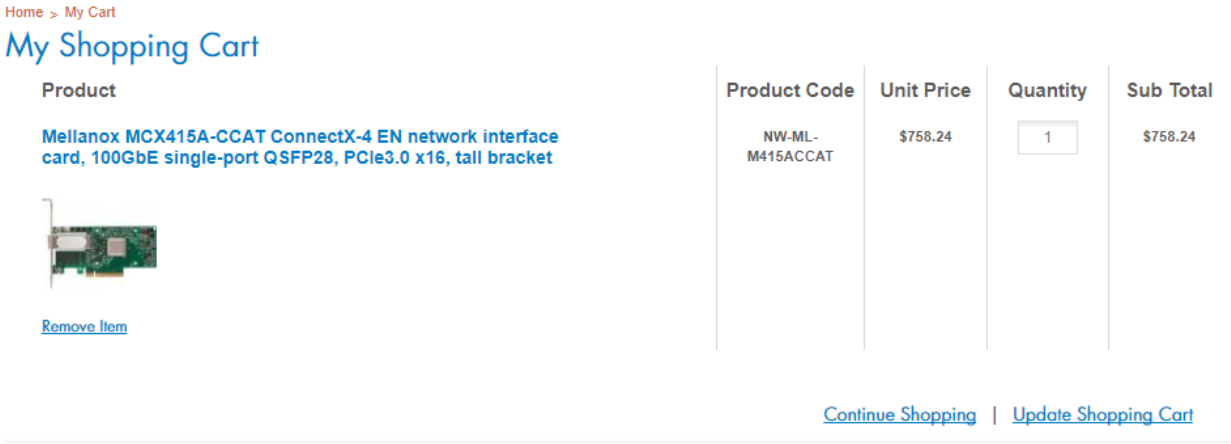
Network Switch:

Mellanox SX1710 Ethernet SwitchX-2 based 36-port QSFP 40/56GbE 1U 36 QSFP ports 2 PS MSX1710-BS2F2



Network Adapter:

Mellanox MCX415A-CCAT ConnectX-4 EN network interface card, 100GbE single-port QSFP28, PCIe3.0 x16, tall bracket



Network cable:

[Belkin A3L791b14-BLU-S 14 ft. Cat 5E Blue Patch Cable]

Newegg Standard Shipping Service Important Shipping Information

Belkin A3L791b14-BLU-S 14 ft. Cat 5E Blue Patch Cable

Extended Holiday Return Policy

1 IN STOCK

$9.99

Subtotal: **$9.99**

Server Rack:

[iStarUSA WD-1045 10U 450mm Depth Simple Server Rack]

Newegg Standard Shipping Service Important Shipping Information

iStarUSA WD-1045 10U 450mm Depth Simple Server Rack

Extended Holiday Return Policy

1 IN STOCK

~~$238.99~~

$228.99

Save: 4.18%

Subtotal: **$228.99**

Storage server:

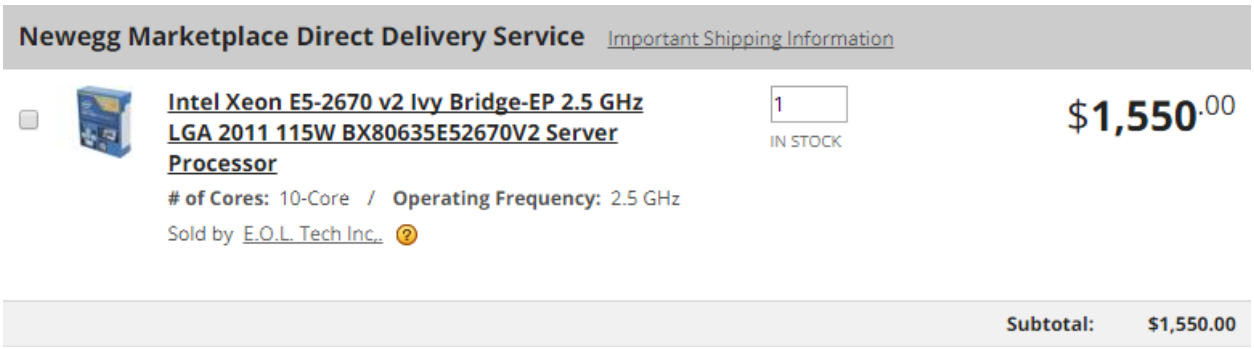
J4601S, HGST 4U 60 Bay JBOD with 60 * 12TB Helium SAS SSD (Kepler+)

Shopping Cart

Qty	System	Description			
1	J4601S	view components	$44,249.96	$44,249.96	Edit System Delete System
Create Quote from Webcart Why create a quote?			Total	$44,249.96	Checkout

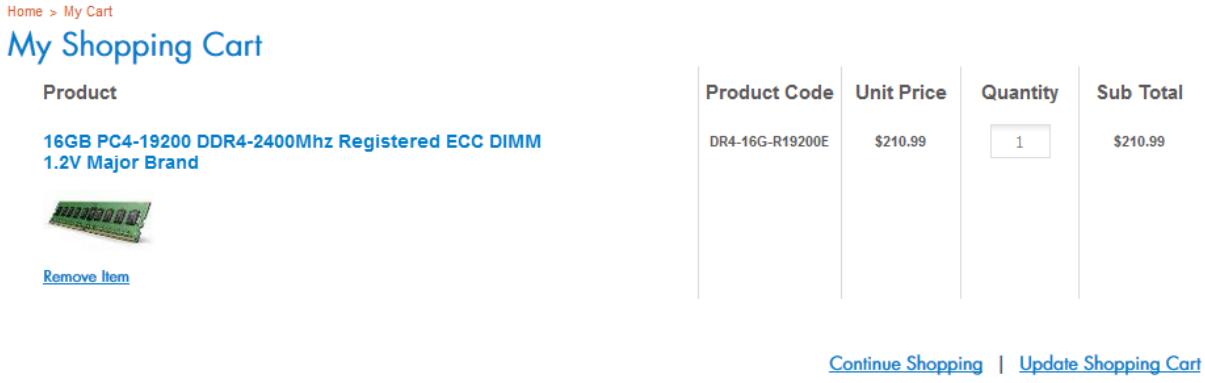
CPU:

Intel Xeon E5-2670 v2 Ivy Bridge-EP 2.5 GHz 25MB L3 Cache LGA 2011 115W BX80635E52670V2 Server Processor



Memory:

[16GB PC4-19200 DDR4-2400Mhz Registered ECC DIMM 1.2V Major Brand]



Disk:

[Intel 32GB MEMPEK1W032GAXT Optane Memory Series NVMe PCIe M.2 2280 1350MB/sec Read 20nm 3D Xpoint, Retail]

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Product	Product Code	Unit Price	Quantity	Sub Total
Intel 32GB MEMPEK1W032GAXT Optane Memory Series NVMe PCIe M.2 2280 1350MB/sec Read 20nm 3D Xpoint, Retail  Remove Item	SSD-IT-PEK1W032GAXT	$96.99	1	$96.99

CPU:

[Intel Xeon E5 2686 V4 SR2K8 18Core 2.3Ghz 45MB LGA2011-3 145W 14nm Processor CPU]

Seller hwtrade-e (7405★) Request total from seller

Intel Xeon E5 2686 V4 SR2K8 18Core 2.3Ghz 45MB LGA2011-3 145W 14nm Processor CPU
Condition: Used

Quantity: 1 $1,099.00

Standard Int'l Shipping (8-20 business days) + $20.00
Standard Shipping from China/Hong Kong/Taiwan to worldwide

Remove | Save for later

Subtotal (1 item):	$1,099.00
Shipping to US	$20.00
Total:	**$1,119.00**

Continue shopping | Proceed to checkout

Storage:

J4601S，HGST 4U 60 Bay JBOD with 60 * 6TB Helium SAS SSD (Kepler+)

Shopping Cart

Qty	System	Description			
1	J4601S	view components	$26,024.27	$26,024.27	Edit System Delete System
Storage Options: 1x HGST 4U 60 Bay JBOD with 60 x 6TB SAS HDD (Kepler) **3 Meter SAS Cable:** 1x Patch Cable SFF-8644 to SFF-8644 External JBOD 3M **Warranty and Support:** 1x Return to Depot Warranty (5 Year Hardware Warranty with Standard Advance Parts Replacement)					close
Create Quote from Webcart Why create a quote?			Total	$26,024.27	Checkout

GPU:

NVIDIA TESLA V100 PCIE 16GB MODULE

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HP HPE NVIDIA TESLA V100 PCIE 16GB MODULE
Part Number: Q2N68A, Item #: 2782569
$2,051.53/unit for Hot Swap Warranty
$18,650.27
1 Remove

US$ Sub-Total: $18,650.27

Select a Destination Country: United States
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