Group:

Rohan Borde.

Sagar Mane.

Shruti Gupta.

Configuration 1:

Public cloud:

Configuration details:

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

Calculation of number of instances and utilizations:

Configuration No	**Instance Count**	**Instance cost/hr**	**Instance Utilization**	**Utilization GFLOPS**	**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/GFLOPS**	**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	2960.447312	25.33694245	4409.447312	***193133792.3***	***95883098.06***
2	2960.447312	12.66847123	5858.447312	***256599992.3***	***191766196.1***
3	2960.447312	8.445647484	7307.447312	***320066192.3***	***287649294.2***
4	2960.447312	6.334235613	8756.447312	***383532392.3***	***383532392.3***

5 Year cost 24*7 Utilization cost/hr/gflops	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	5400	1050	5670000	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	11323	31	351013	30 for vm and 1 for upperone

	MSX1710-BS2F2				
Network Adapter	Mellanox MCX415A-CCAT ConnectX-4 EN network interface card, 100GbE single-port QSFP28, PCIe3.0 x16, tall bracket	758.24	31	23505.44	same as network switch
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	

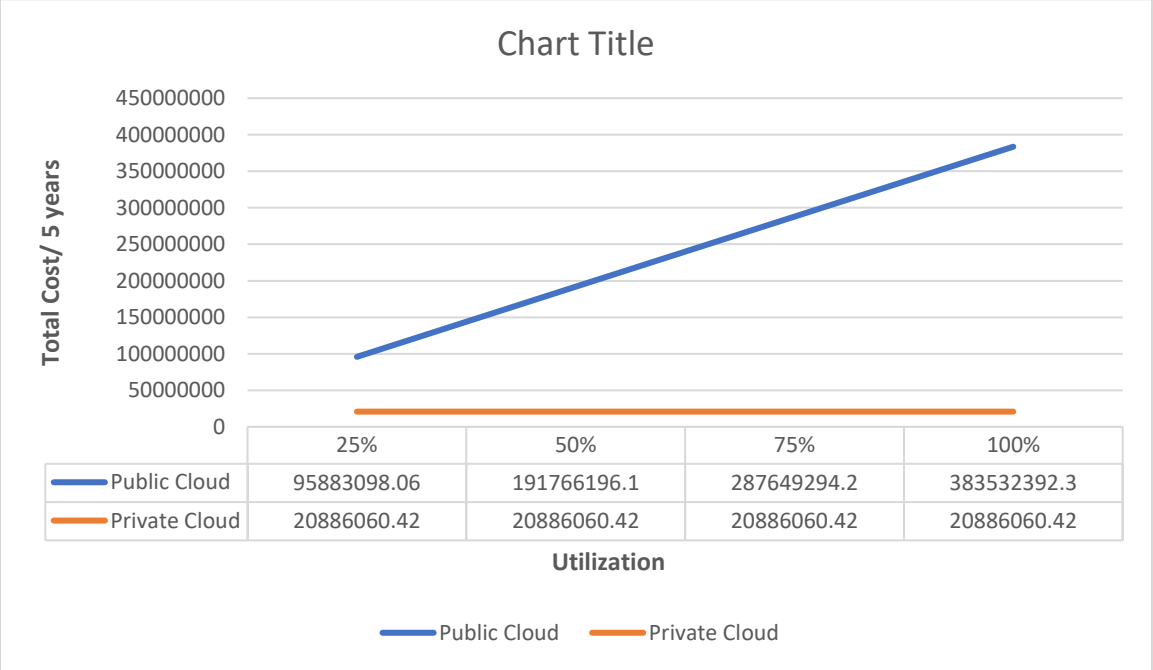
TOTAL: ***20886060.42***

Configuration No	Instance Count	Instance cost/hr	Instance Utilization	Utilization GFLOPS	Storage(PB)	Storage cost/hr	Cost/hr/GFLOPS
1	1050	84.1056531	25%	345.6	100	140.4280822	0.649692521
2	1050	168.2113062	50%	691.2	100	140.4280822	0.446526893
3	1050	252.3169593	75%	1036.8	100	140.4280822	0.378805017
4	1050	336.4226124	100%	1382.4	100	140.4280822	0.344944079

5 Year cost 24*7 Utilization cost/hr/gflops	15108.55065
5 Year cost 24*7 Utilization cost	20886060.42

So, based on above analysis we have plotted graphs as follows:

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



As per above, we can say that private cloud is the best option in 5 years of time.

Configuration 2:

Public cloud:

Configuration details:

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

Calculation of number of instances and utilizations:

Configuration No	Instance Count	Instance cost/hr	Instance Utilization	Utilization GFLOPS	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/GFLOPS	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/gflops	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	
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

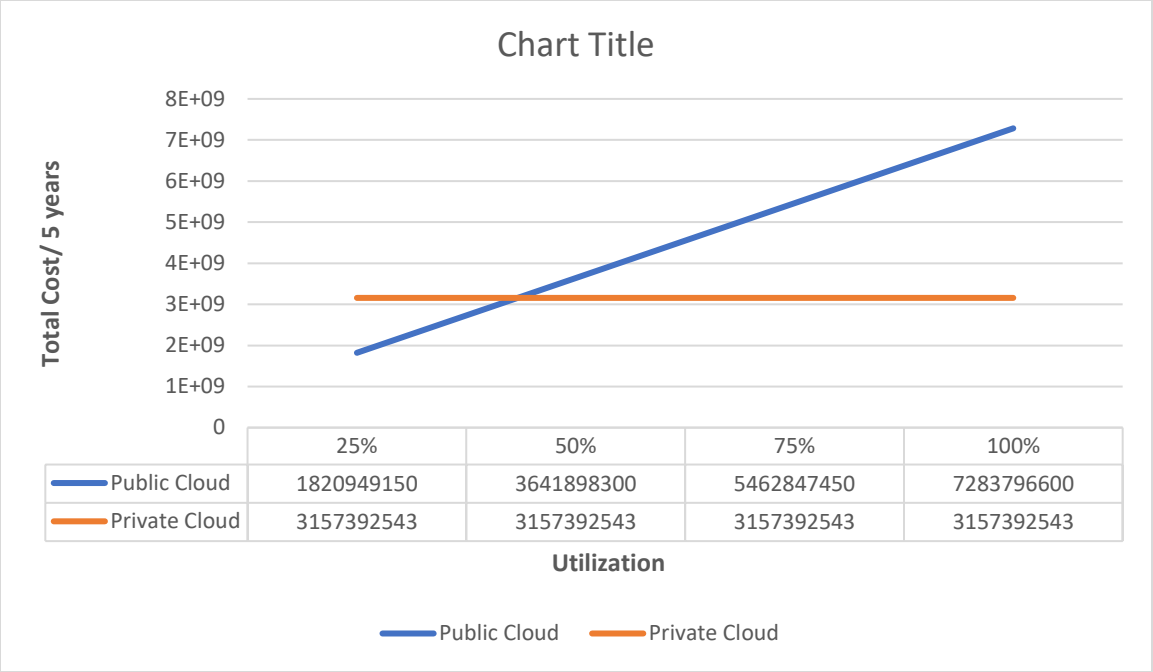
Electric Power	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 202 watts/hr			110759.25	
Cooling	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 202 watts/hr			71320000	
Admin	70000 per year salary	70000	1000	350000000	
				3157392543	

Configuration No	**Instance Count**	**Instance cost/hr**	**Instance Utilization**	**Utilization GFLOPS**	**Storage(PB)**	**Storage cost/hr**	**Cost/hr/GFLOPS**
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/gflops	78934813.57
5 Year cost 24*7 Utilization cost	3157392543

So, based on above analysis we have plotted graphs as follows:

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 45% then public cloud(AWS) is the best choice. Otherwise private cloud is the best option in 5 years of time.

Configuration 3:

Public cloud:

Configuration details:

Instance name	p3.16xLarge
Cost/hr	24.48
TeraFLOPS	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 TeraFLOPS**	**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/TeraFLOPS**	**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

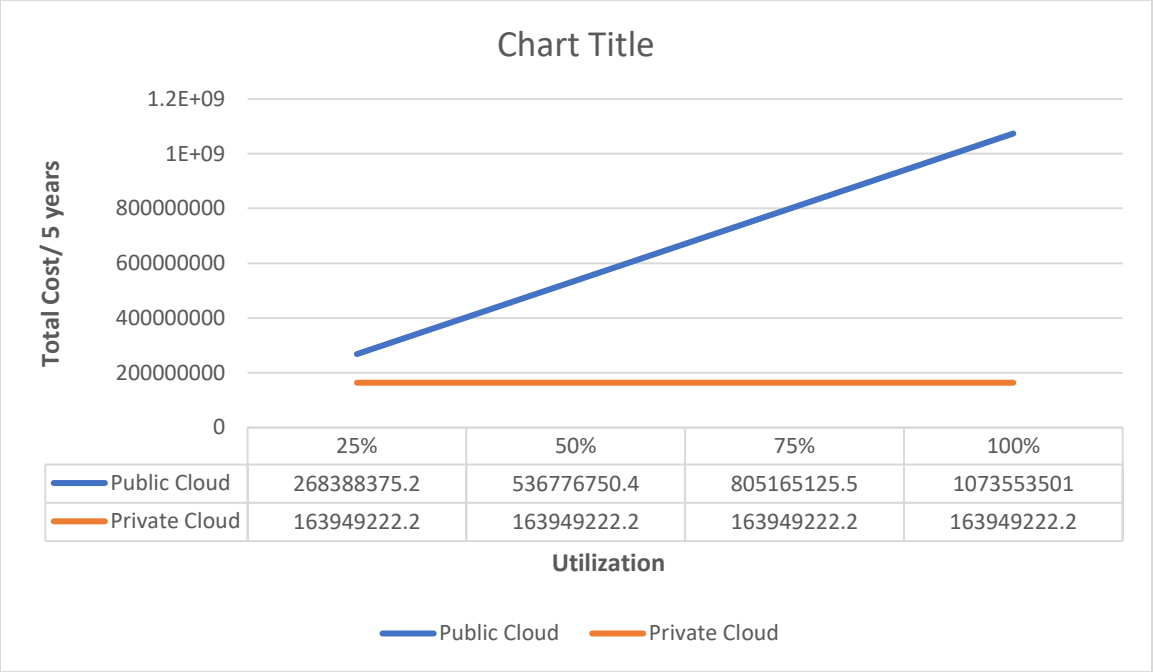
Electric Power	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 120 watts/hr			938196	
Cooling	Chicago Electricity cost 7.15 per kWh. Power consumed per cpu: 120 watts/hr			714878.5455	
Admin	70000 per year salary	70000	1	350000	
				163949222.2	

Configuration No	**Instance Count**	**Instance cost/hr**	**Instance Utilization**	**Utilization TeraFLOPS**	**Storage(PB)**	**Storage cost/hr**	**Cost/hr/TeraFLOPS**
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/gflops	163949.2222
5 Year cost 24*7 Utilization cost	163949222.2

So, based on above analysis we have plotted graphs as follows:

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



As per above, we can say that private cloud is the best option in 5 years of time.

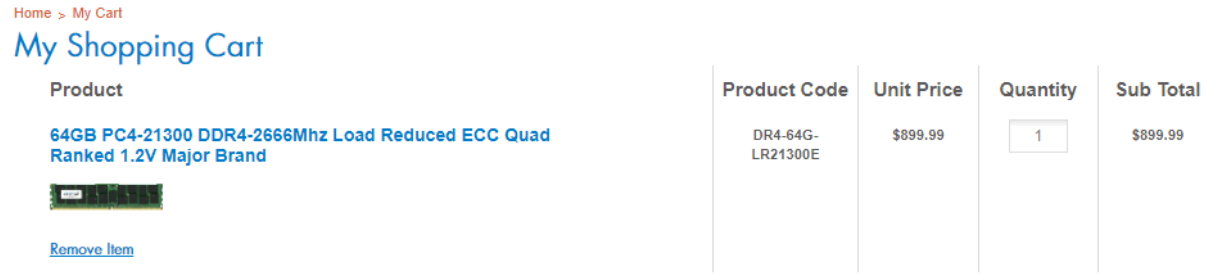
Summary Table:

	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?	Private cloud more efficient.	Utilization around 45%.	Private cloud more efficient.

Shopping cart:

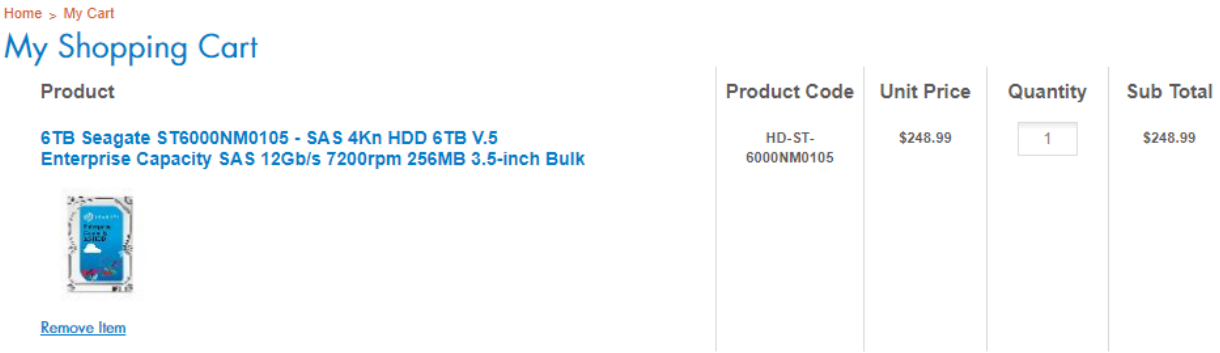
Memory:

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



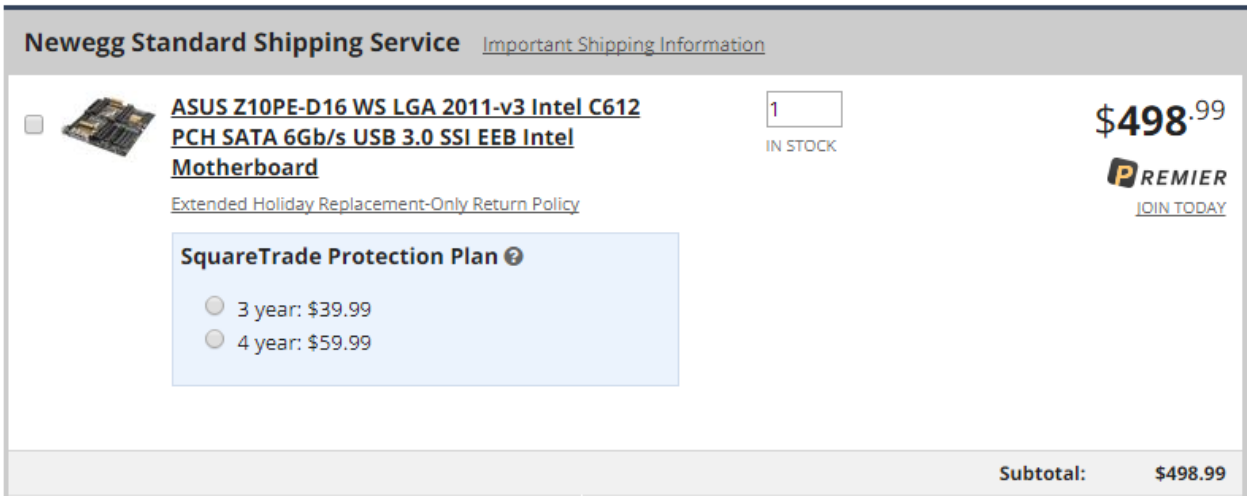
Disk:

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



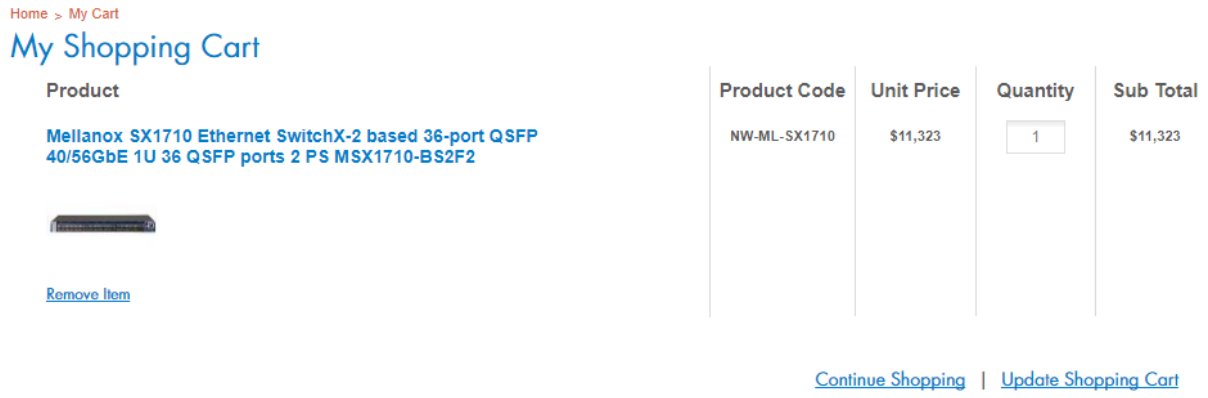
Motherboard:

[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

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My Shopping Cart

Product	Product Code	Unit Price	Quantity	Sub Total
Mellanox MCX415A-CCAT ConnectX-4 EN network interface card, 100GbE single-port QSFP28, PCIe3.0 x16, tall bracket  Remove Item	NW-ML-M415ACCAT	$758.24	1	$758.24

Continue Shopping | Update Shopping Cart

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

Configuration 2

CPU:

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

Newegg Marketplace Direct Delivery Service Important Shipping Information

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

# of Cores: 10-Core / **Operating Frequency:** 2.5 GHz

Sold by E.O.L. Tech Inc.

1 IN STOCK

$1,550.00

Subtotal: $1,550.00

Memory:

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

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Product	Product Code	Unit Price	Quantity	Sub Total
16GB PC4-19200 DDR4-2400Mhz Registered ECC DIMM 1.2V Major Brand	DR4-16G-R19200E	$210.99	1	$210.99

Remove Item

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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

Configuration 3

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
(Including Guam, US Territory)

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Sales tax will be collected for CA,MA,MD,TN,DC customers.
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