PROJECT- UNDERSTANDING THE COST OF COMPUTING IN THE CLOUD

Yash Agarwal - A20392372
Chitrarth Singh- A20387080

Introduction

This report is about cost of cloud computing, here the comparison have been made between public cloud AWS and the private configuration when they have a huge demand of cloud services.
As most of the industries now know the cost effectiveness and performance benefits that cloud can offer at the cost of very less actual investment, they obviously will have two questions in mind:

1. Whether to use existing public cloud services provide by reputed companies, like Amazon, Google, Microsoft, etc?
2. Or, build their own private cloud?

While making a choice, many factors are needed to be considered to conclude between both.
Following are the factors needs to be considered while deciding between private or public cloud.

1) Cost of computing
2) Demand/ Usage
3) Security
4) Maintenance
5) Compliance
6) Future usage
7) Scalability
8) Reliability

The problem statement is to identify whether the computing resources should be rented from a public cloud on-demand or whether a private cloud should be purchased. The task is to estimate the cost breakdown of a private cloud and compare it with Amazon on demand instances cost.

PUBLIC CLOUD CONFIGURATION(AWS)

Configuration 1

Core needed- 32 k , therefore number of VM's =889
Memory needed 256 TB, therefore number of VM's = 978
HDD needed 50PB, therefore number of VM's needed= 1042
Therefore, we need 1042 instances
According to the AWS Calculator the monthly cost for 1042 d2.8x large instances will be (including AWS Support for Business) : $ 4343557.29
So, the cost for the 5 years for d2.8xlarge instance will be:
$ 4343557.29 *12 * 5 = $ 260613437.4

For Distributed Storage:
For 100PB the total cost for per month which will be charged by AWS is $ 2275549.99(including AWS Business Support)
Therefore total cost for 5 years is
$2275549.99 *12*5 =$ 136532999.4

Therefore Total Public Cloud Cost for Configuration 1 is :
Cost of EC2 for 5 years + Cost of Storage for 5 years:
$ 260613437.4 + $ 136532999.4 = $ 397146436.8

Configuration 2

VM needed 1 million
According to AWS Calculator 1 million VM of r3.large instance will cost up $ 125172500.00 (including cost AWS Business support)
SO for 5 years the cost will be $ 125172500.00 *12*5 =$7510350000

Distributed Storage :
For 10PB the total cost for per month which will be charged by AWS is $ 233702.37 (including AWS Business Support)
Therefore total cost for 5 years is
$ 233702.37*12*5 =$ 14022142.2

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Therefore Total Public Cloud Cost for Configuration 2 is :
Cost of EC2 for 5 years + Cost of Storage for 5 years:
=$7510350000+ $ 14022142.2= $ 7524372142.2

Configuration 3:

EC2 per hour cost:$24.48 per Hour
We need 1000 VM's
According to AWS Calculator 1 VM of p3.16xlarge instance will cost up $ 24.48
So for 5 years the cost will be $ 24.48 *43800*1000 =$1072224000

Distributed Storage :
For 1PB the total cost for per month which will be charged by AWS is $ 233702.37 (including AWS Business Support)
Therefore total cost for 5 years is
$ 24464.01*12*5 =$ 1467840.6

Therefore Total Public Cloud Cost for Configuration 2 is :
Cost of EC2 for 5 years + Cost of Storage for 5 years:
=$1072224000+$ 1467840.6 =$1073691840.6

Configuration 1

Component		Description	Quantity	Price/Unit	Total Price	Power(Watts)/ Unit	Total Watt/hour	
Computer Servers	Processor	INTEL XEON E5-2676 V3 2.40GHZ SOCKET 2011-3 LGA2011-3 HASWELL SERVER OEM CPU SR1Y5 CM8064401613101	2668	$2,197	$5,861,596.00	120	320160	https://starmicroinc.net/intel-xeon-e5-2676-v3-2-40ghz-socket-2011-3-lga2011-3-haswell-server-oem-cpu-sr1y5-cm8064401613101/
	Rackmount	SUPERMICRO SYS-4028GR-TRT2 4U Rackmountable Server - Barebone Dual LGA 2011 Intel C612 2400 / 2133 / 1866 / 1600 MHz ECC DDR4 SDRAM 72-bit	1334	$4,837	$6,452,558.00	2000	2668000	https://www.newegg.com/Product/Product.aspx?Item=9SIA3AR59H9718
	Internal Storage	Seagate IronWolf ST12000VN0007 12TB 7200 RPM 256MB Cache SATA 6.0Gb/s 3.5" Internal Hard Drive	4167	$400	$1,666,800.00			https://www.newegg.com/Product/Product.aspx?Item=N82E16822172025&ignorebbr=1
	Memory	Samsung M386A8K40BM1-CPB 64GB DDR4-2133 4Rx4 LP ECC LRDIMM Server Memory	4000	$850.00	$3,400,000.00			https://www.newegg.com/Product/Product.aspx?Item=9SIA5EM3G36302&cm_re=memory_server-_-1WK-002G-00022-_-Product
Network Switches		Lenovo RackSwitch G8272 Layer 3 Switch	34	$7,823	$265,982.00	230	7820	https://www.newegg.com/Product/Product.aspx?Item=9SIA91N5SB8508

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								&ignorebbr=1&nm_mc=KNC-GoogleMKP-PC&cm_mmc=KNC-GoogleMKP-PC-_-pla-_-Network+-+Switches-_-9SIA91N5SB8508&gclid=Cj0KCQiA6enQBRDUARIsAGs1YQhh12T-dkPpmJV30MuxP88R2FEp-uX4OuchW_H5IlCTWfkZ-IhFOZ4aAu-BEALw_wcB&gclsrc=aw.ds
Rack & Shelf	shelf	4U 7" Vented Rack Shelf	1507	$86	$128,999.20			https://www.newegg.com/Product/Product.aspx?Item=9SIA00Y1Y94194&cm_re=4u_rack_shelf-_-9SIA00Y1Y94194-_-Product
	Rack	42U 4 Post Open Frame Server Rack 19" Adjustable Depth 25"-37" Aluminum.	170	$199	$33,830.00			https://www.newegg.com/Product/Product.aspx?Item=9SIAA053V29199&ignorebbr=1
Network Cable		Dell Networking, Cable, SFP+ to SFP+, 10GbE, Active Optical (Optics included) Cable,3 Meter, Customer Kit	2494	$170	$423,980.00			http://www.dell.com/en-us/shop/accessories/apd/470-ablz?ref=p13n_ena_pdp_vv&c=us&cs=04&l=en&s=bsd
Storage Servers		J4601S-Storage Options: 1x HGST 4U 60 Bay JBOD with 60 x 12TB Helium SAS HDD (Kepler +) 3 Meter SAS Cable: 4x 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)	139	$44,475.85	$6,182,143.15	3300	458700	
Electric Power					17737598.4			

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Cooling		Tripp Lite SRCOOL24K SmartRack 24,000 BTU 208 / 240V Portable Air Conditioning Unit	85	2,582	219469.15	7000	595000	https://www.newegg.com/Product/Product.aspx?Item=N82E16816228213&cm_re=SRCOOL24K-_-16-228-213-_-Product&nm_mc=AFC-C8Junction&cm_mmc=AFC-C8Junction-_-na-_-na-_-na&cm_sp=&AID=11552995&PID=1796839&SID=285945163
Administration			2	$1,000,000	$2,000,000.00			
Total					$44,372,955.90			
Electricity:	4049680	177375984000	177375984	17737598.4				

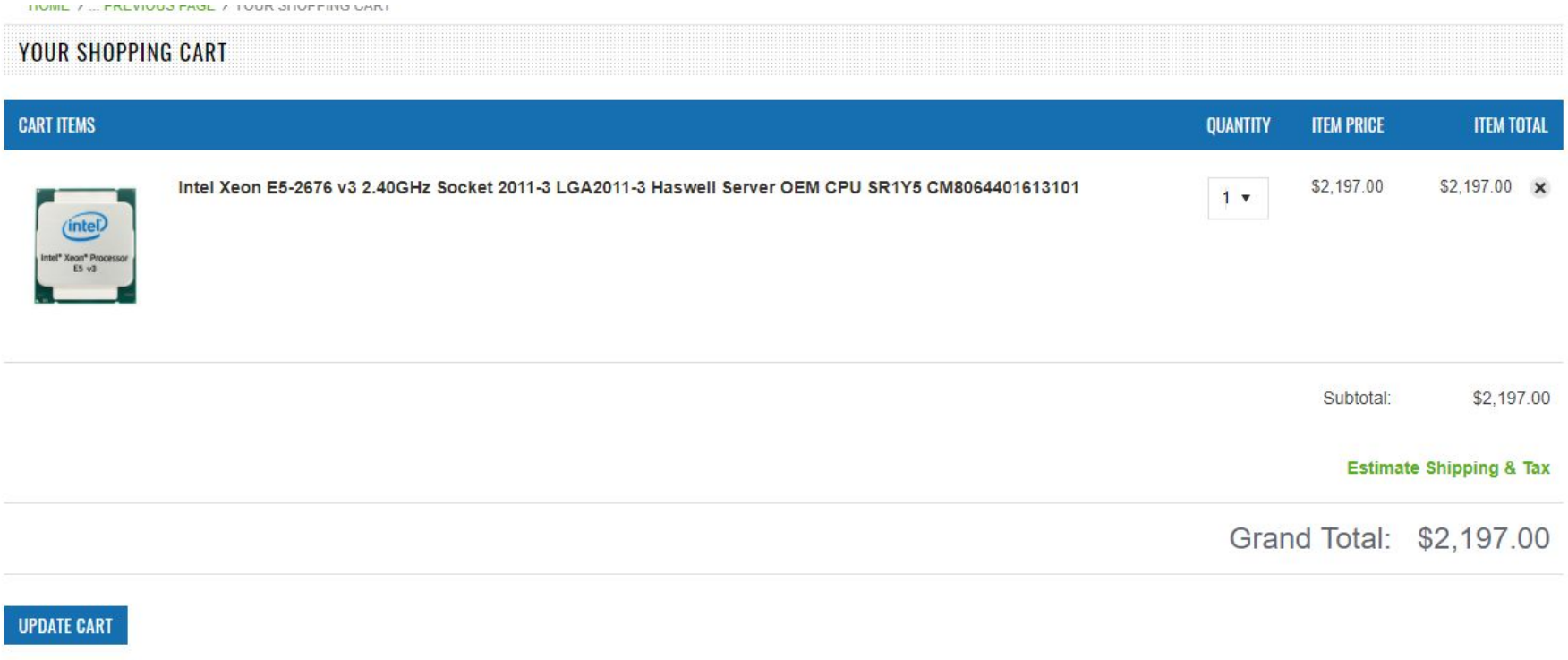
Assuming total power(watt)/hr we now calculate the power for five years :
Total Power **=** 3454680
Five years = 3454680 * 365 *24* 5 = 151314984000
Converting this power to KWatt = 151314984000 / 1000 = 151314984
Assuming the power cost ar $0.1 = 151314984 * 0.1 = 107433638.6

Screenshots:

Configuration 1:

Compute Servers

- Processor



- Rackmount

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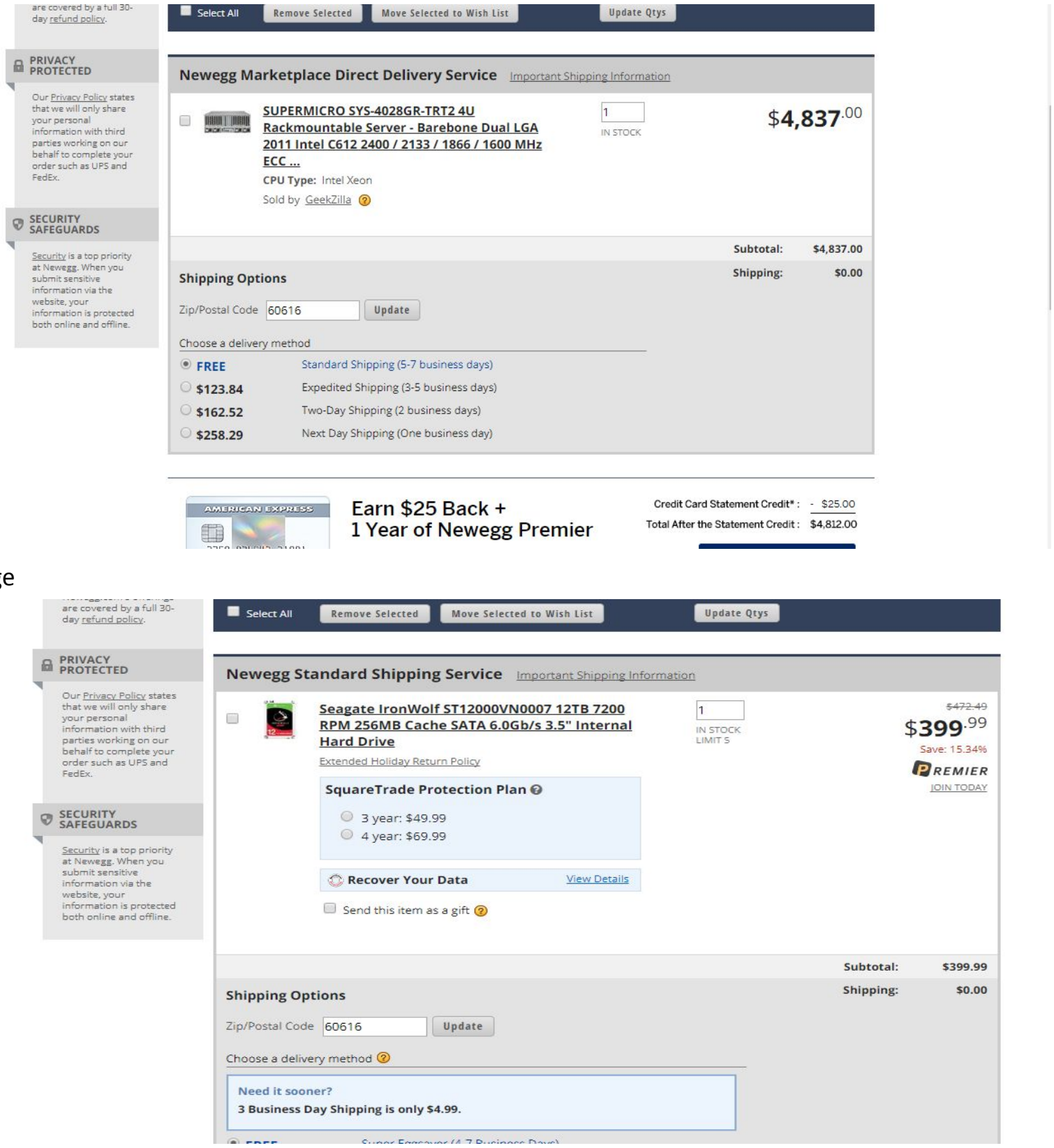
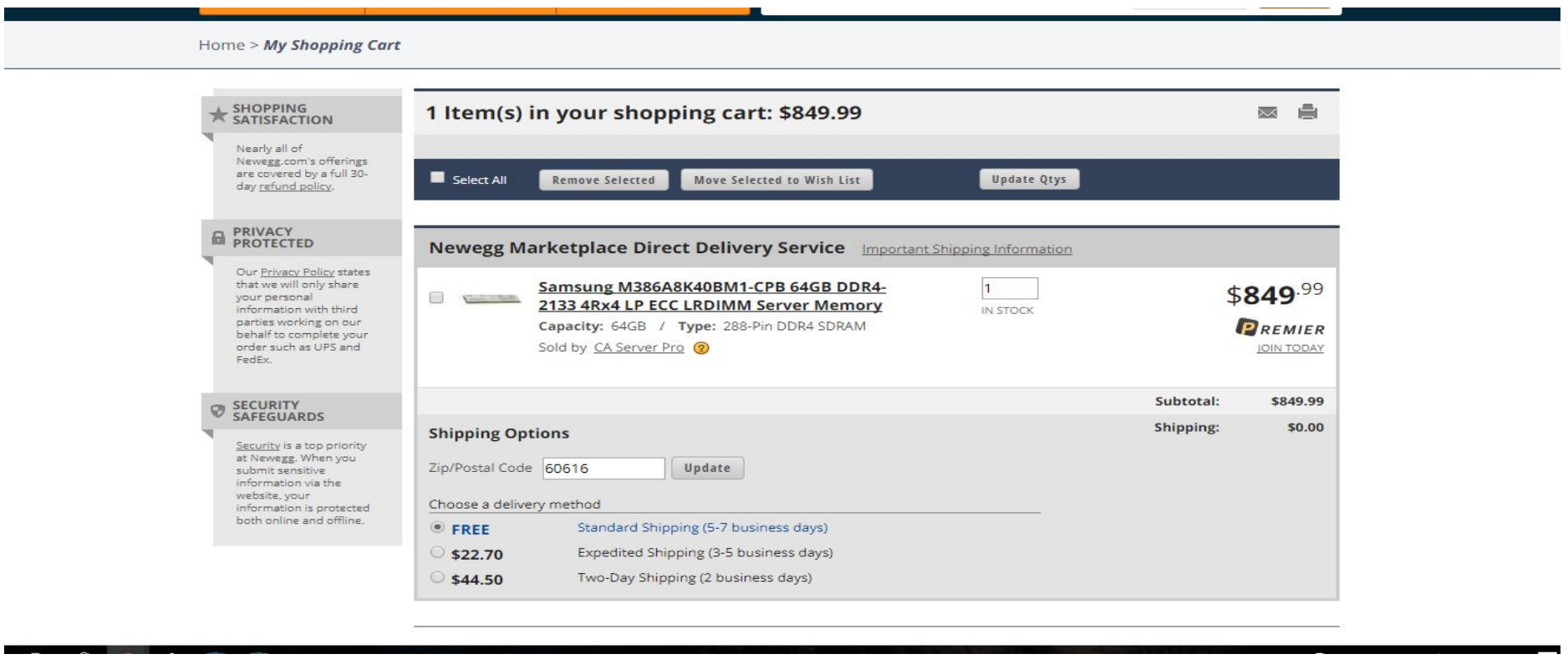


- Internal Storage

- Memory



Network Switches

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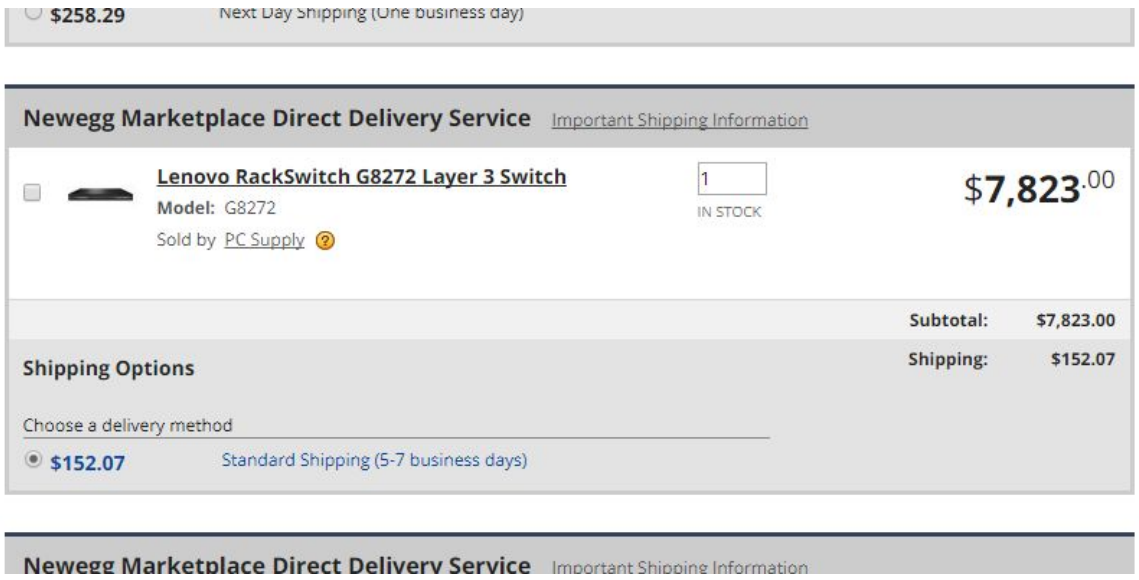
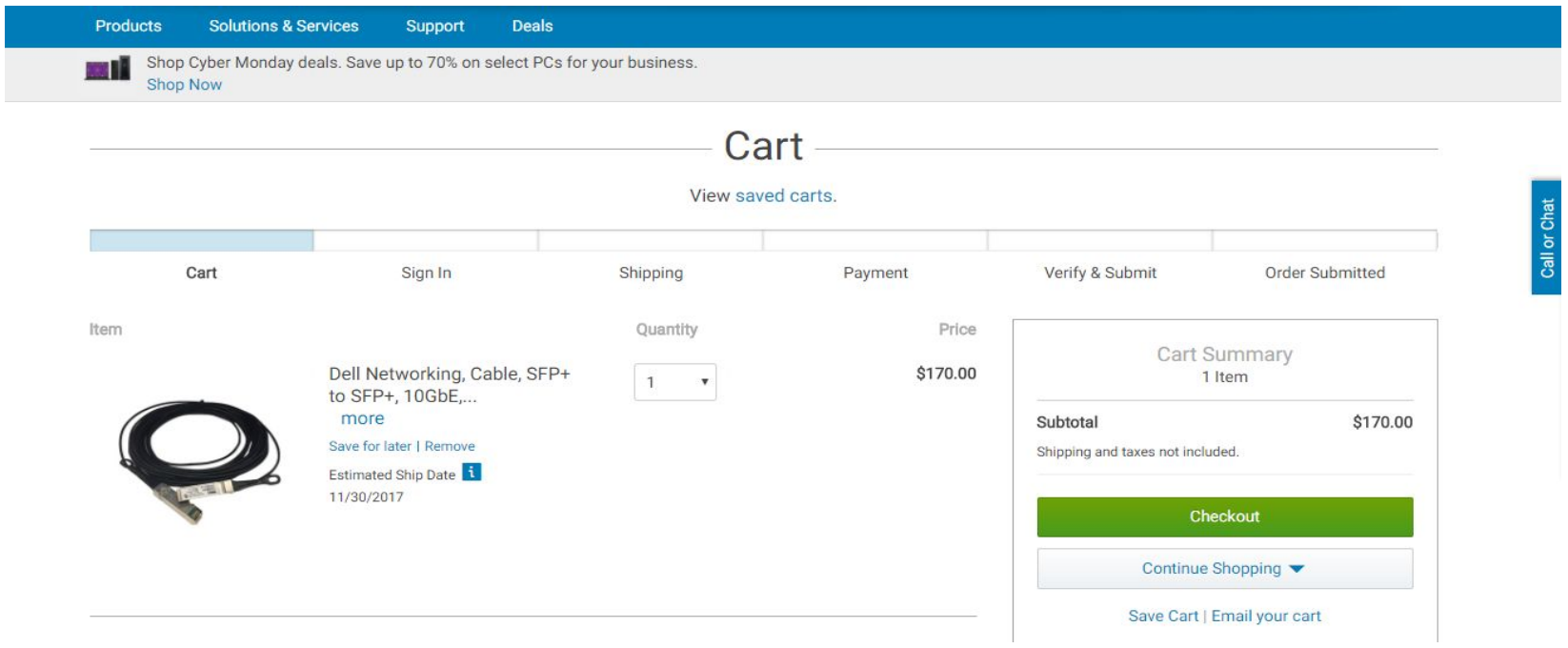
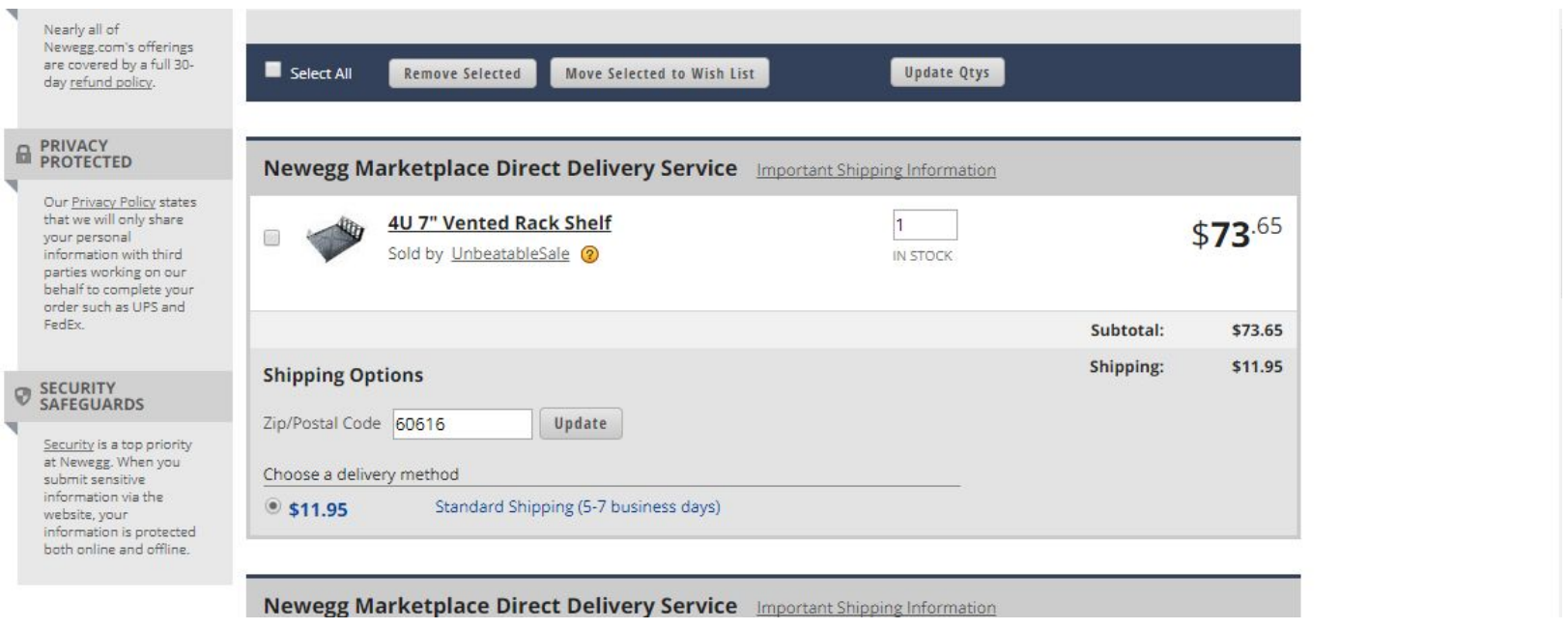


Network Cables



Racks and Shelf

- Shelf



- Rack

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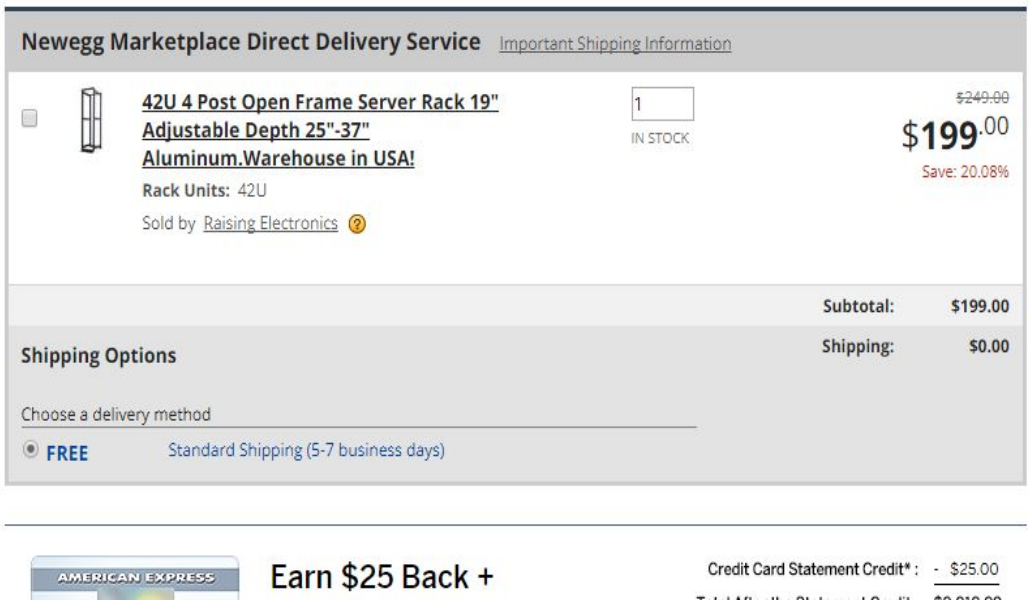
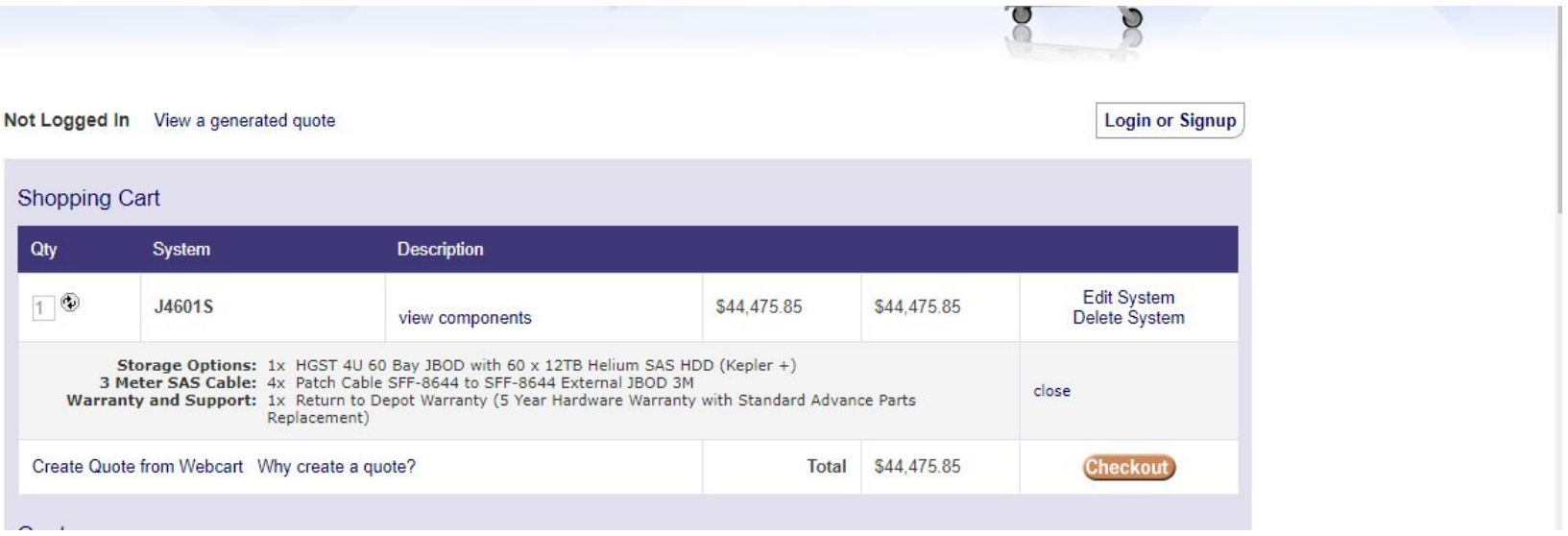
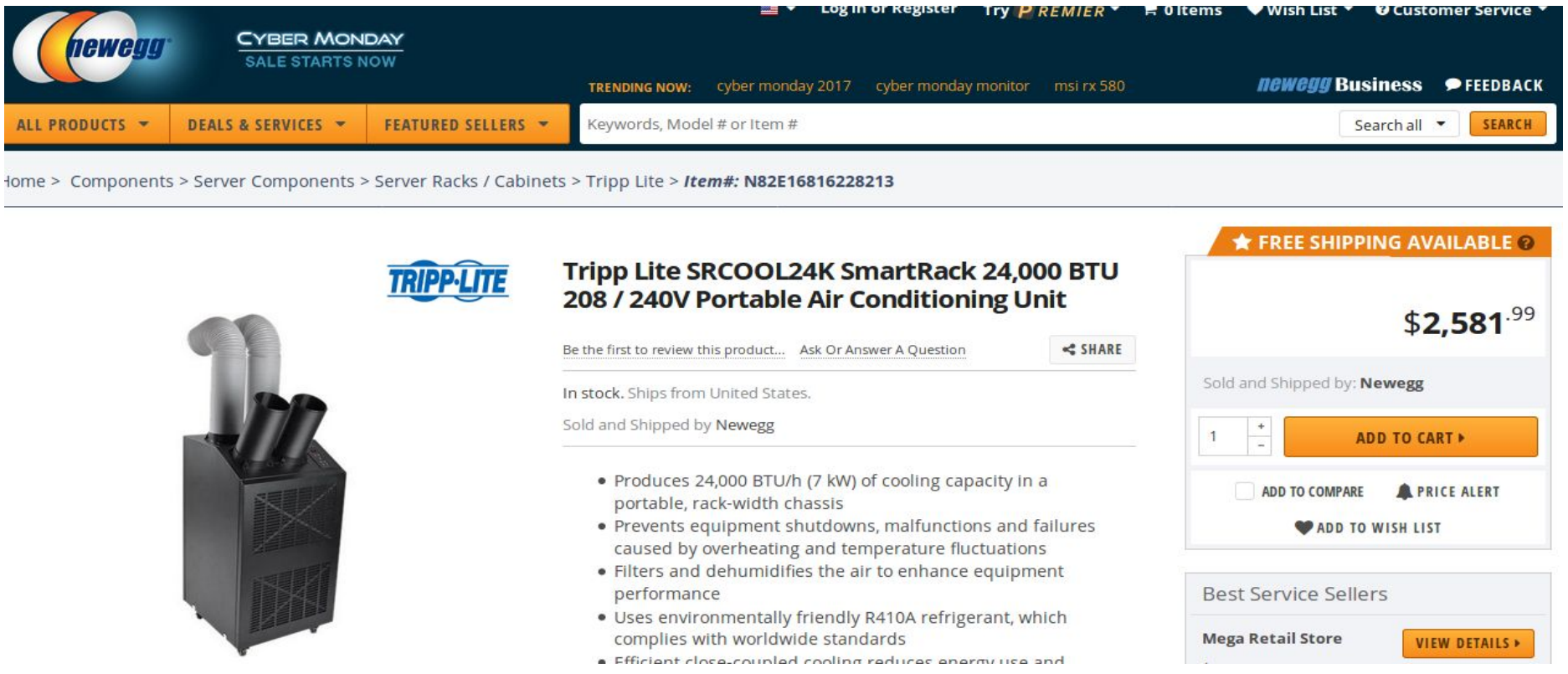


Storage Servers



Cooling



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Configuration 2:

Component		Description	Quantity	Price/Unit	Total Price	Power(Watts)/Unit	Total Power(watt)/hour		
Computer Servers	Processor	Intel Xeon E5-2670 v2 Ivy Bridge-EP 2.5 GHz 25MB L3 Cache LGA 2011 115W BX80635E52670V2 Server Processor	200000	$1,550	$310,000,000.00	115	23000000	https://www.newegg.com/Product/Product.aspx?Item=9SIAAEE5739794&ignorebbr=1	
	Rackmount	SUPERMICRO SYS-4028GR-TRT2 4U Rackmountable Server - Barebone Dual LGA 2011 Intel C612 2400 / 2133 / 1866 / 1600 MHz ECC DDR4 SDRAM 72-bit	100000	$4,837	$483,700,000.00	2000	200000000	https://www.newegg.com/Product/Product.aspx?Item=9SIA3AR59H9718	
	Internal Storage	Intel 535 Series 2.5" 360GB SATA III MLC SSDSC2BW360H6R5	100000	$150	$15,000,000			https://www.newegg.com/Product/Product.aspx?Item=9SIA99455A0964&cm_re=ssd_storage-_-9SI	

Yash Agarwal - A20392372
Chitrarth Singh- A20387080

								A99455A0964-_-Product	
	Memory	SAMSUNG 16GB 288-Pin DDR4 SDRAM Registered DDR4 2400 (PC4 19200) Memory (Server Memory) Model M393A2K40BB1-CRC	200000	$200	$40,000,000			https://www.newegg.com/Product/Product.aspx?Item=N82E16820147575	
		Samsung M386A8K40BM1-CPB 64GB DDR4-2133 4Rx4 LP ECC LRDIMM Server Memory	200000	$850.00	$170,000,000			https://www.newegg.com/Product/Product.aspx?Item=9SIA5EM3G36302&cm_re=memory_server-_-1WK-002G-00022-_-Product	
Network Switches		Cisco Catalyst 2960-Plus 48TC-L 48-Port Fast Ethernet Switch	2181	$1,789	$3,901,787.19	30.6	66738.6	https://www.cdw.com/shop/products/Cisco-Catalyst-2960-Plus-48TC-L-48-Port-Fast-Ethernet-Switch/3156751.aspx	
Rack& Shelf	Shelf	4U 7" Vented Rack Shelf	102174	$86	$8,746,094.40			https://www.newegg.com/Product/Product.aspx?Item=9SIA00Y1Y9	

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								4194&cm_re=4u_rack_shelf-_-9SIA00Y1Y94194-_-Product	
	Rack	45U Open Frame aluminium Server Network Rack 1000MM Deep 4 Post With 3 Pairs of L-Rails	10221	$199	$2,033,979			https://www.newegg.com/Product/Product.aspx?Item=9SIAAA054SF5010&cm_re=rack_45u-_-9SIAAA054SF5010-_-Product	
Network Cable		Dell Networking, Cable, SFP+ to SFP+, 10GbE, Active Optical (Optics included) Cable,3 Meter, Customer Kit	104688	$170	$17,796,960.00			http://www.dell.com/en-us/shop/accessories/apd/470-ablz?ref=p13n_ena_pdp_vv&c=us&cs=04&l=en&s=bsd	

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Storage Servers		J4601S-Storage Options: 1x HGST 4U 60 Bay JBOD with 60 x 12TB Helium SAS HDD (Kepler +) 3 Meter SAS Cable: 4x 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)	14	$44,475.85	$622,661.90	3300	46200		
Electric Power					1133937931				
Cooling		Tripp Lite SRCOOL24K SmartRack 24,000 BTU 208 / 240V Portable Air Conditioning Unit	5111	2,582	13196550.89	7000	35777000	https://www.newegg.com/Product/Product.aspx?Item=N82E16816228213&cm_re=SRCOOL24K-_-16-228-213-_-Product&nm_mc=AFC-C8Junction&cm_mmc=AFC-C8Junction-_-na-_-na-_-na&cm_sp=&AID=11552995&PID=1	

Yash Agarwal - A20392372
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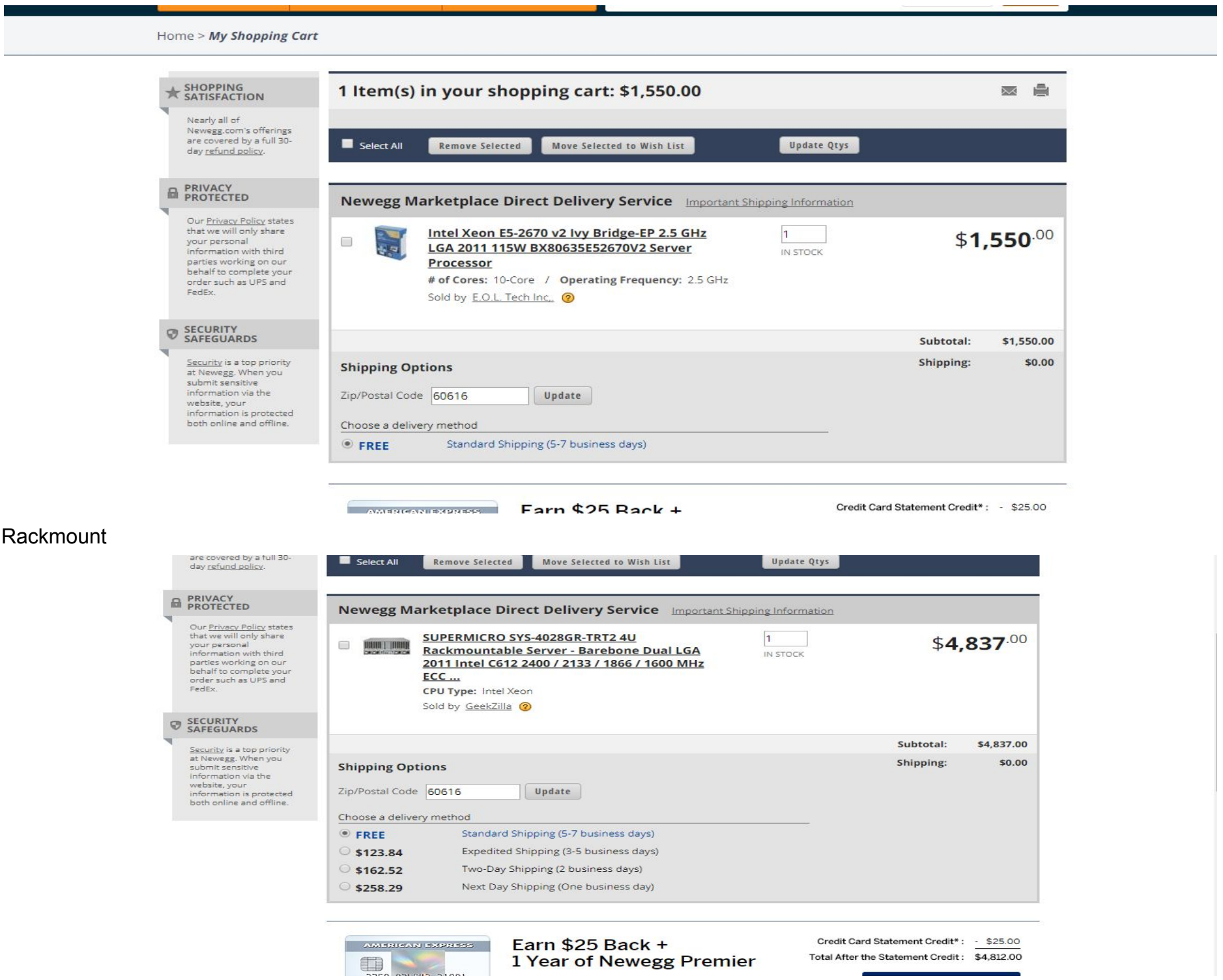
								796839&SID=285950899	
Administration			100	$1,000,000	$100,000,000.00				
Total					$2,298,935,964.45				
Electricity:	258889938.6	1133937931068 0	1133937931 1	1133937931					

Compute Servers

- Processor



- Rackmount

- Internal Storage

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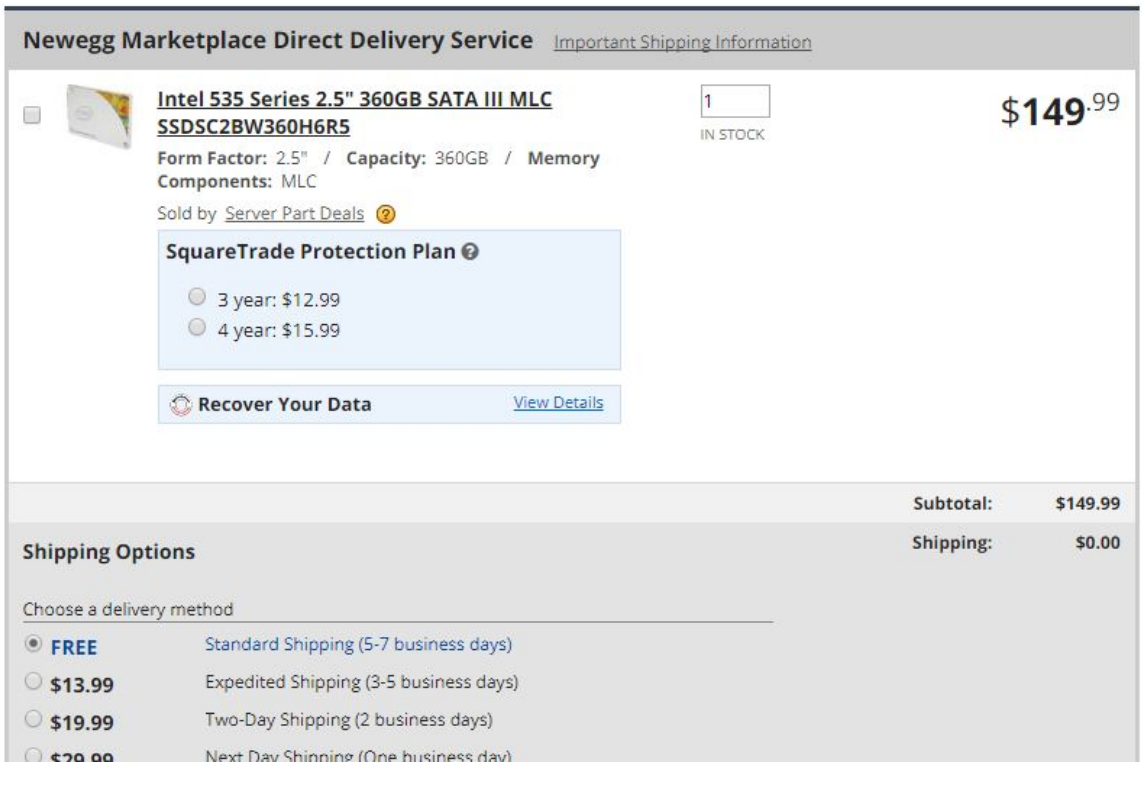
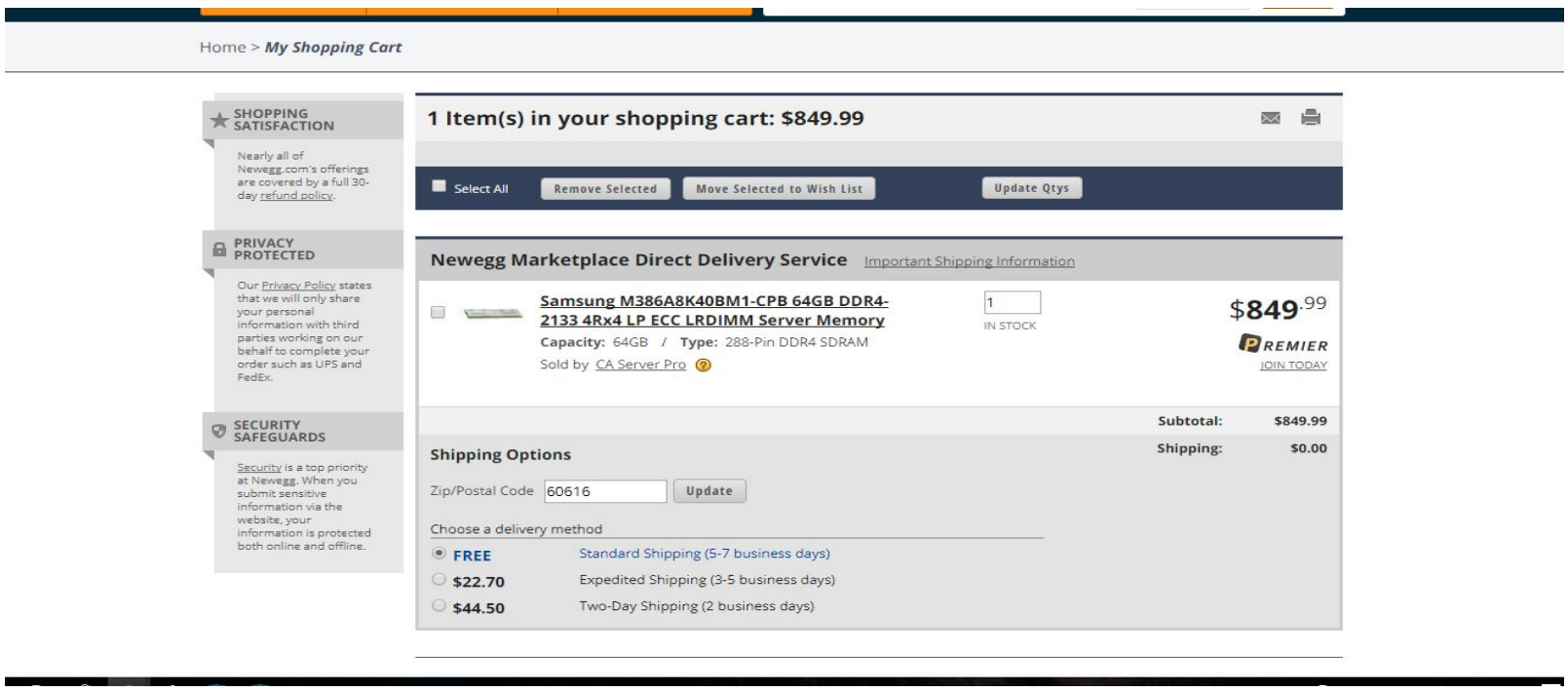
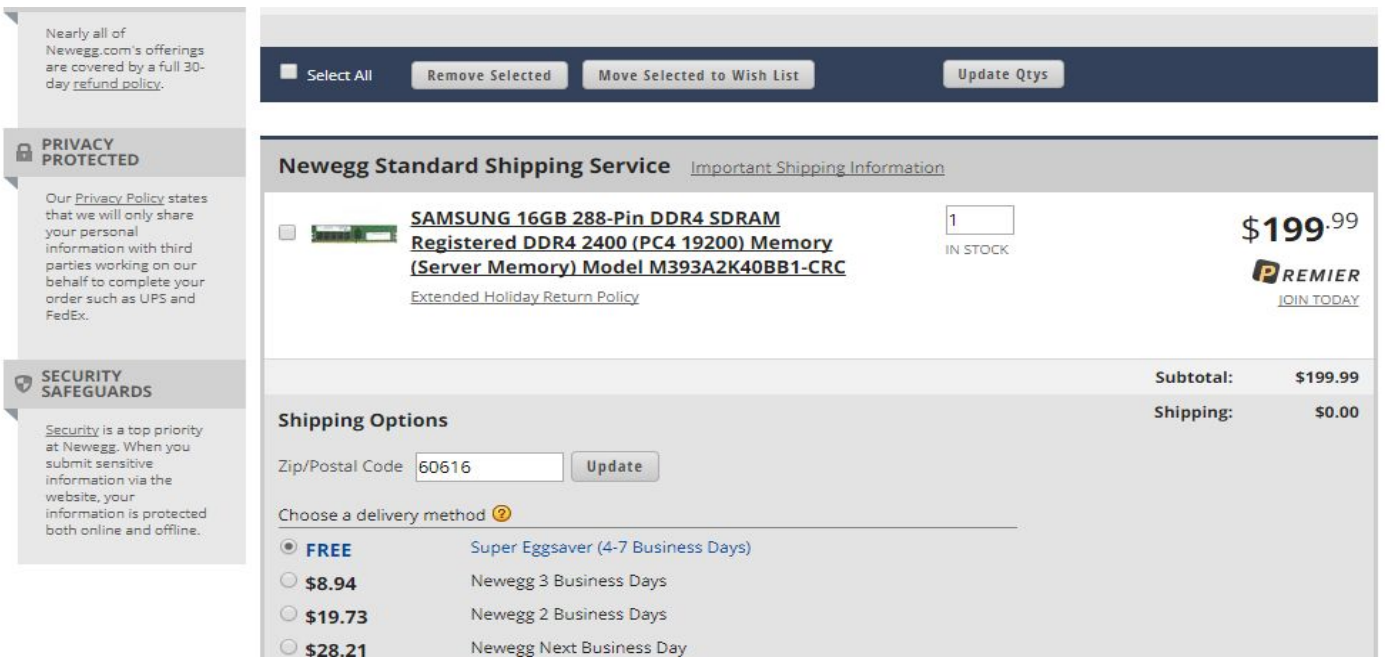


- Memory





Network Switches

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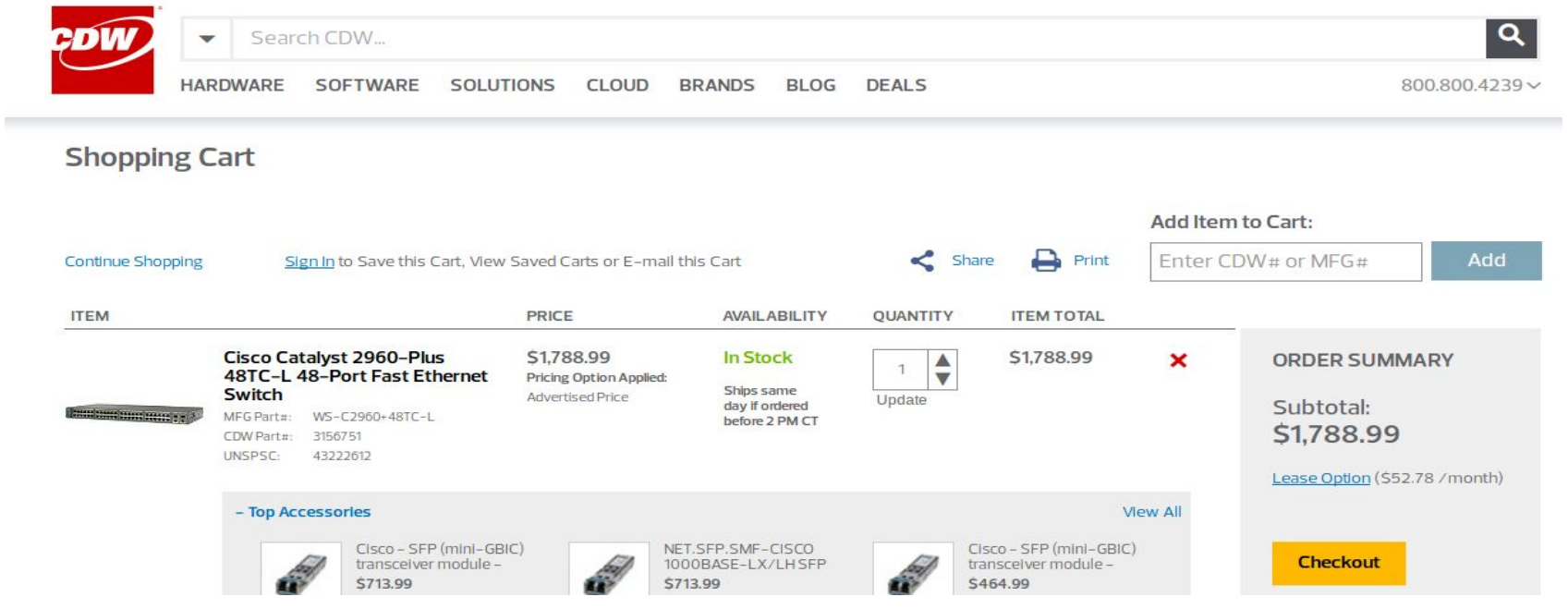
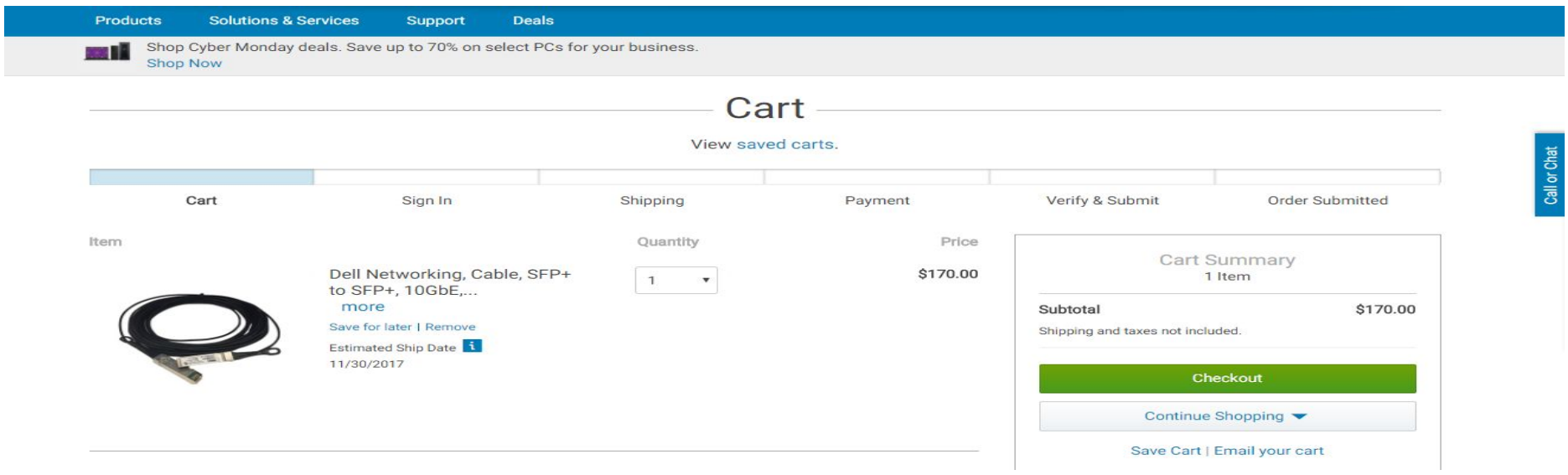
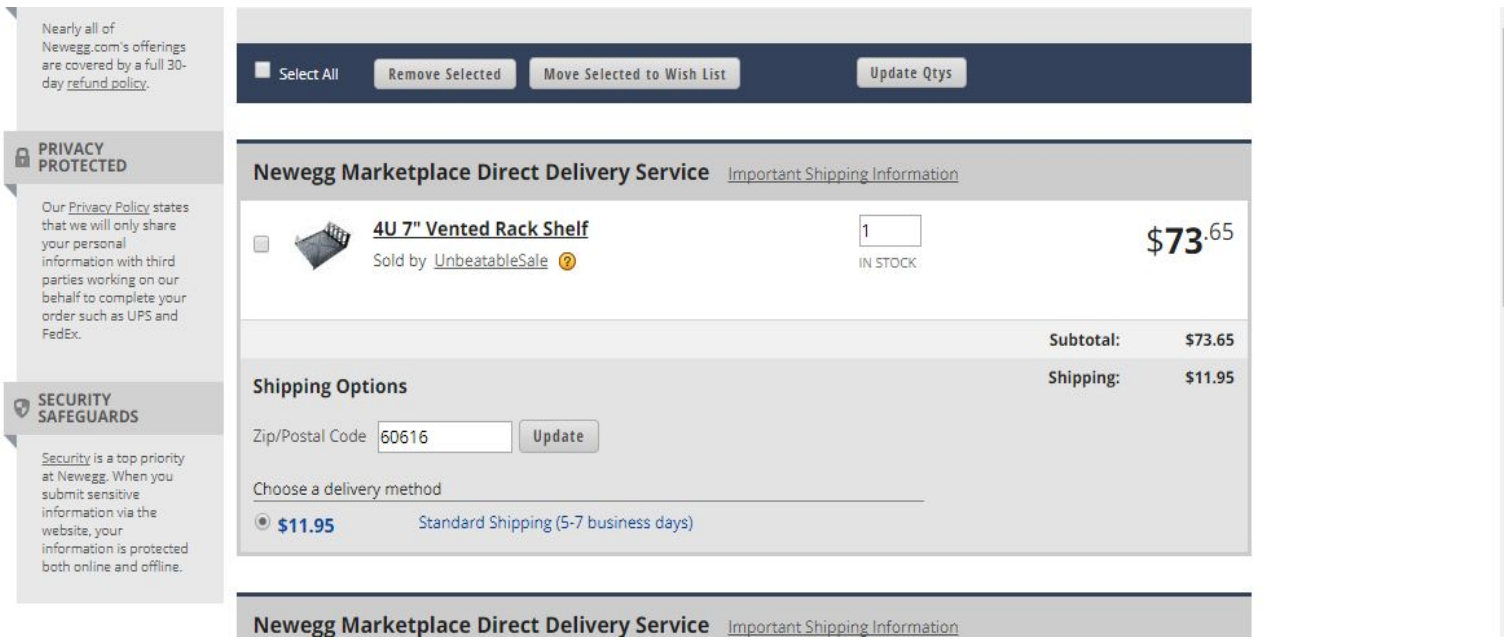


Network Cables



Racks and Shelf

- Shelf



- Rack

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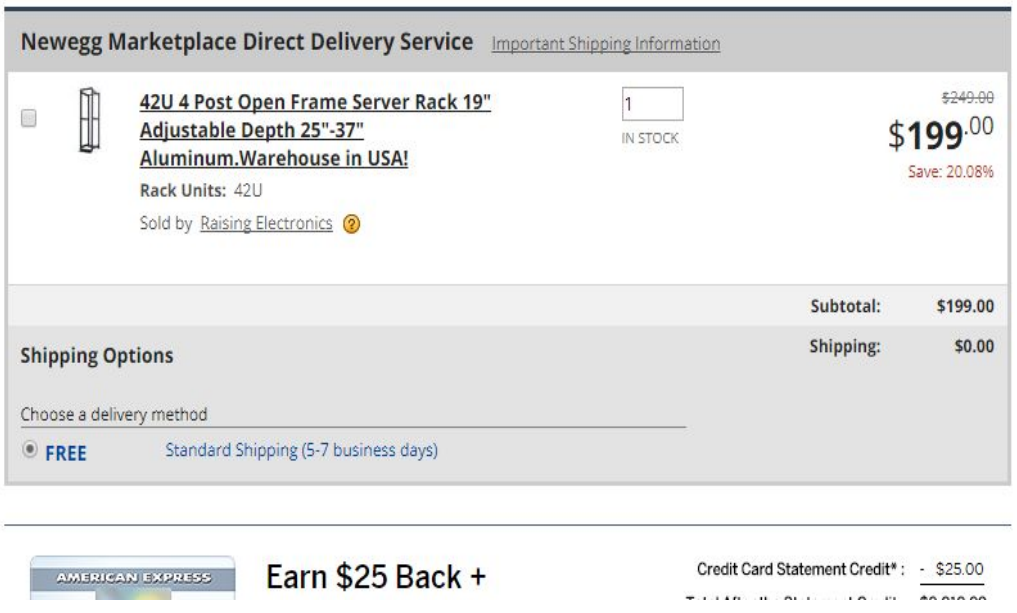
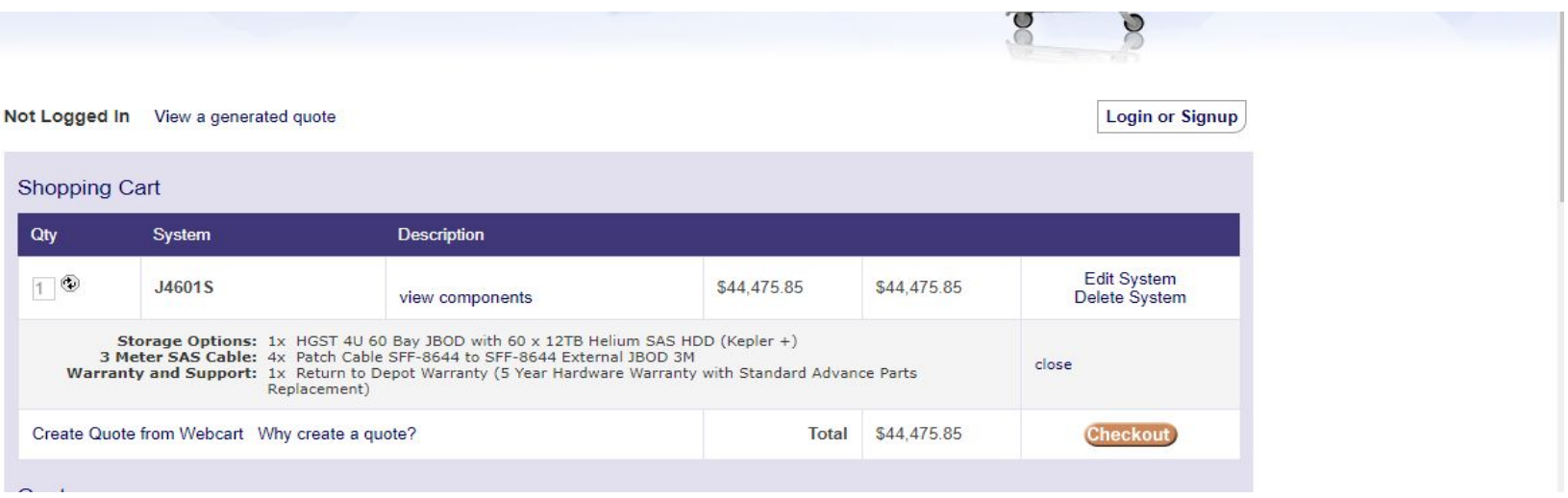
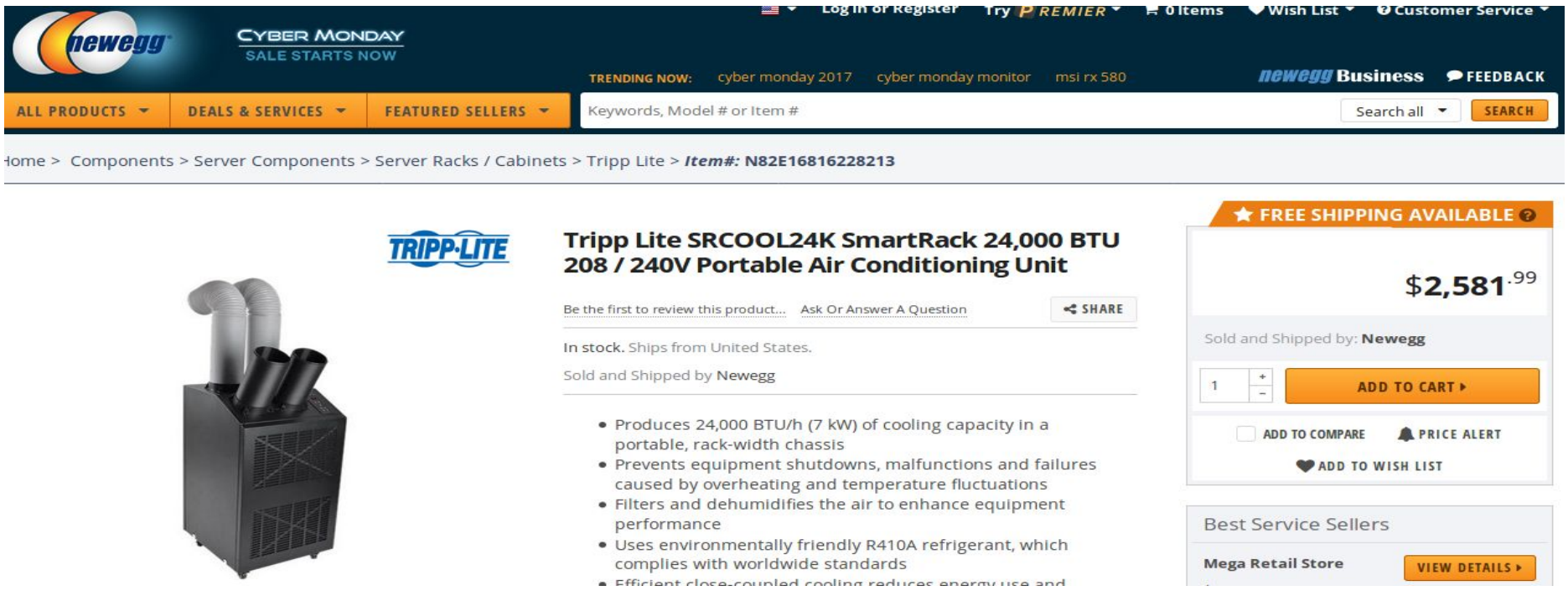


Storage Servers



Cooling



Configuration 3

Component		Description	Quantity	Price/Unit	Total Price	Power(Watts)/ Unit	Total Watt/hour	
Computer Servers	GPU	NVIDIA CORP 8-GPU/512GB DGX-1 DL WITH V100	1000	$154,766	$154,766,060.00	120	120000	http://www.nextwarehouse.com/item/?2707240_g10e
Network		Lenovo RackSwitch	23	$7,823	$179,929.00	230	5290	https://www.newegg.com/

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Switches		G8272 Layer 3 Switch						Product/Product.aspx?Item=9SIA91N5SB8508&ignorebbr=1&nm_mc=KNC-GoogleMKP-PC&cm_mmc=KNC-GoogleMKP-PC-_-pla-_-Network+-+Switches-_-9SIA91N5SB8508&gclid=Cj0KCQiA6enQBRDUARIsAGs1YQhh12T-dkPpmJV30MuxP88R2FEp-uX4OuchW_H5IlCTWfkZ-IhFOZ4aAu-BEALw_wcB&gclsrc=aw.ds
Rack & Shelf	shelf	4U 7" Vented Rack Shelf	1025	$86	$87,740.00			https://www.newegg.com/Product/Product.aspx?Item=9SIA00Y1Y94194&cm_re=4u_rack_shelf-_-9SIA00Y1Y94194-_-Product
	Rack	42U 4 Post Open Frame Server Rack 19" Adjustable Depth 25"-37" Aluminum.	102	$199	$20,298.00			https://www.newegg.com/Product/Product.aspx?Item=9SIAA053V29199&ignorebbr=1
Network Cable		Dell Networking, Cable, SFP+ to SFP+, 10GbE, Active Optical (Optics included) Cable,3 Meter, Customer Kit	1039	$170	$176,630.00			http://www.dell.com/en-us/shop/accessories/apd/470-ablz?ref=p13n_ena_pdp_vv&c=us&cs=04&l=en&s=bsd
Storage Servers		J4601S-Storage Options: 1x HGST 4U 60 Bay JBOD with 60 x 10TB Helium SAS HDD (Kepler +) 3 Meter SAS Cable: 4x 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)	2	$39,244.15	$78,488.30	3300	6600	
Electric Power					2141338.2			
Cooling		Tripp Lite SRCOOL24K SmartRack 24,000 BTU 208 / 240V	51	2,582	131681.49	7000	357000	https://www.newegg.com/Product/Product.aspx?Item=N82E168162

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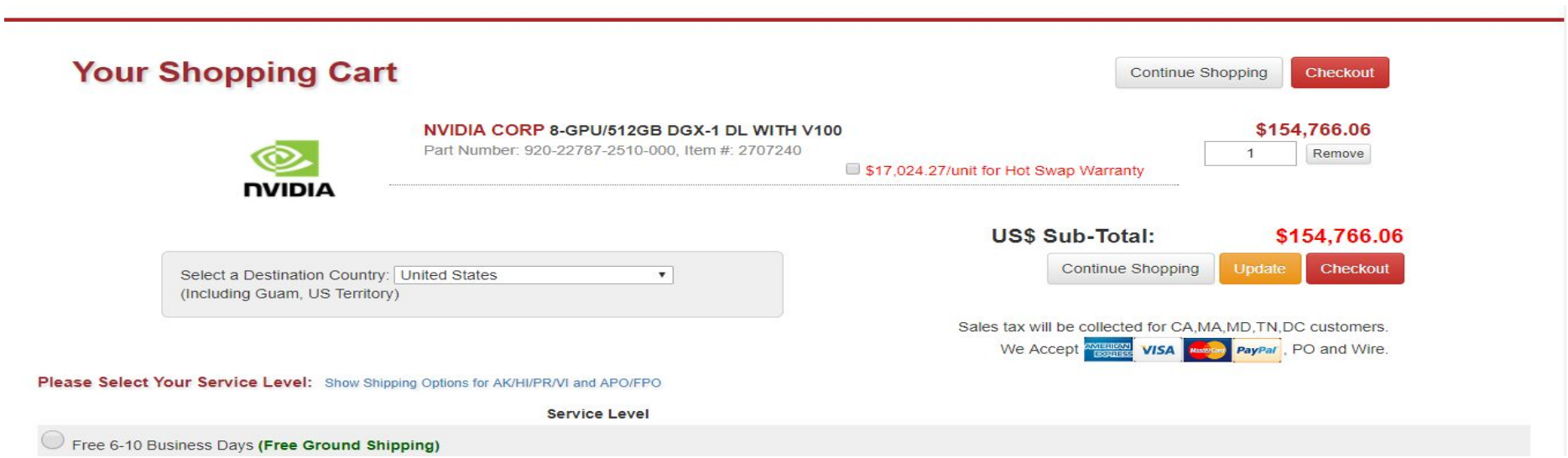
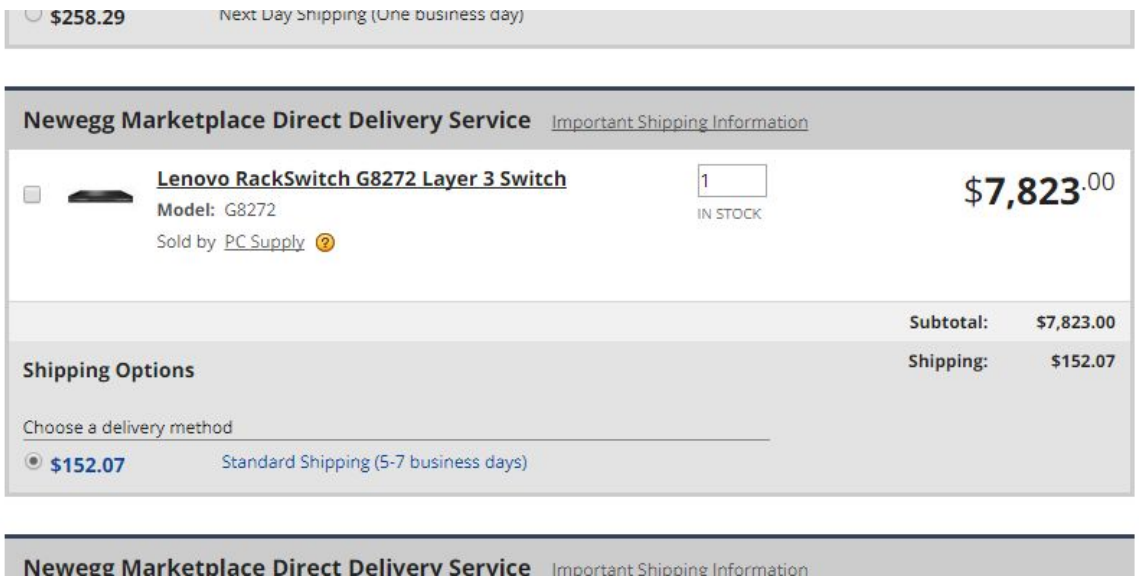
		Portable Air Conditioning Unit						28213&cm_re=SRCOOL24K-_-16-228-213-_-Product&nm_mc=AFC-C8Junction&cm_mmc=AFC-C8Junction-_-na-_-na-_-na&cm_sp=&AID=11552995&PID=1796839&SID=285950899
Administration			1	$1,000,000	$1,000,000.00			
Total					$158,582,164.99			
Electricity:	488890	21413382000	21413382	2141338.2				

Compute Servers

- GPU



Network Switches



Network Cables

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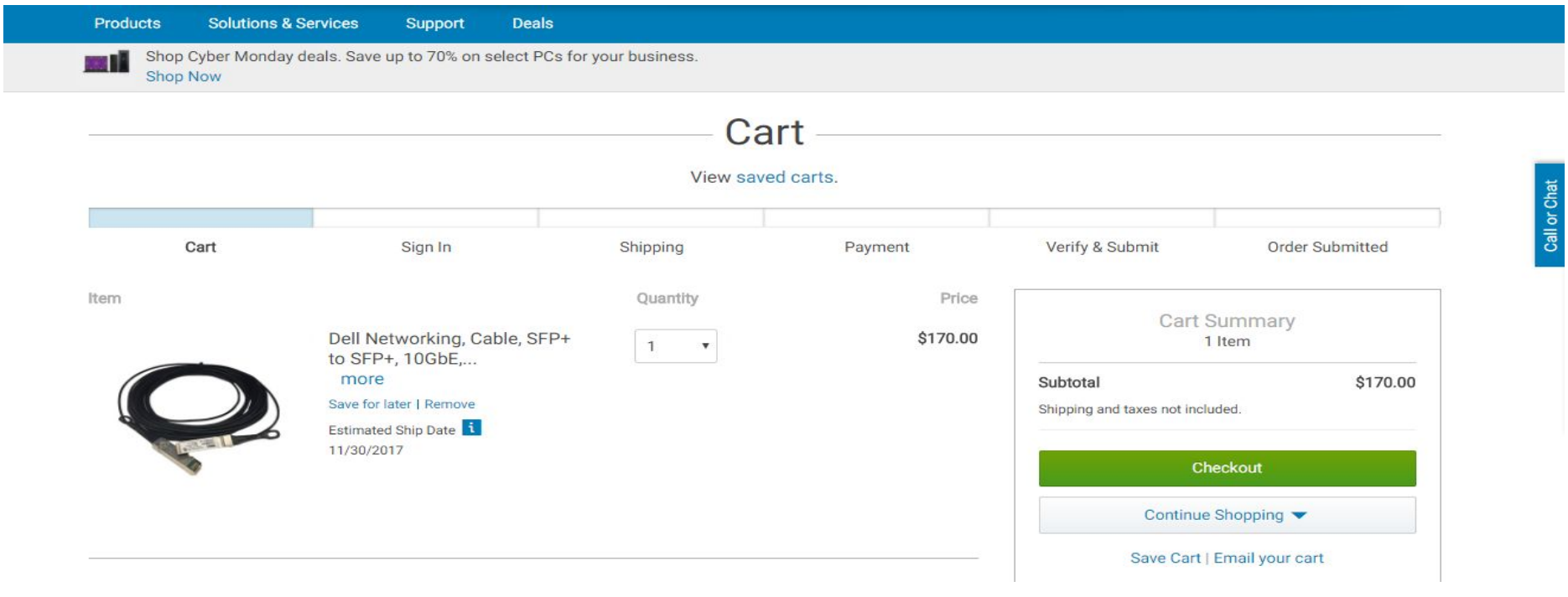
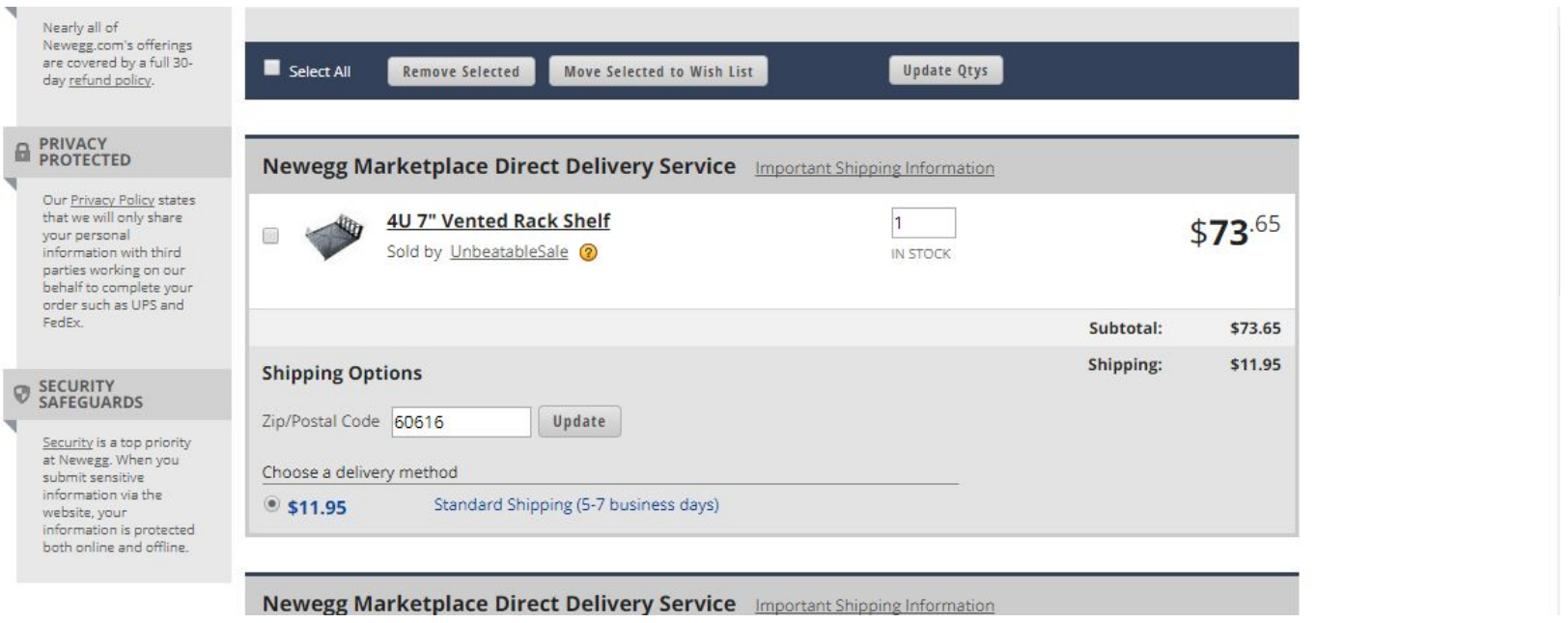
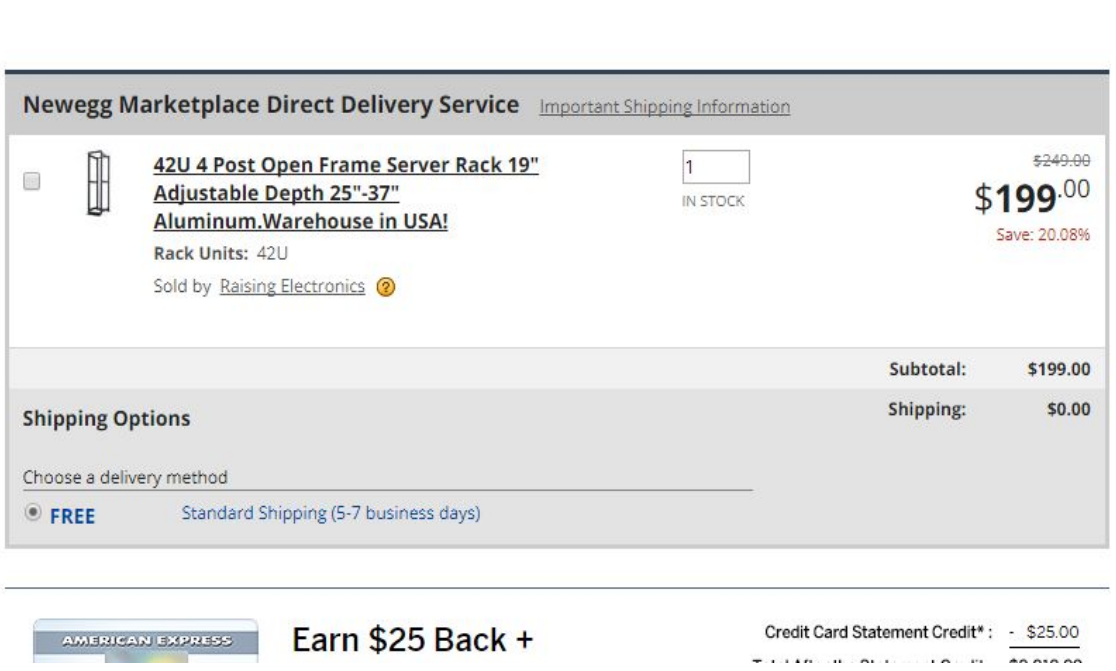


Racks

- Shelf



- Rack



Storage Servers

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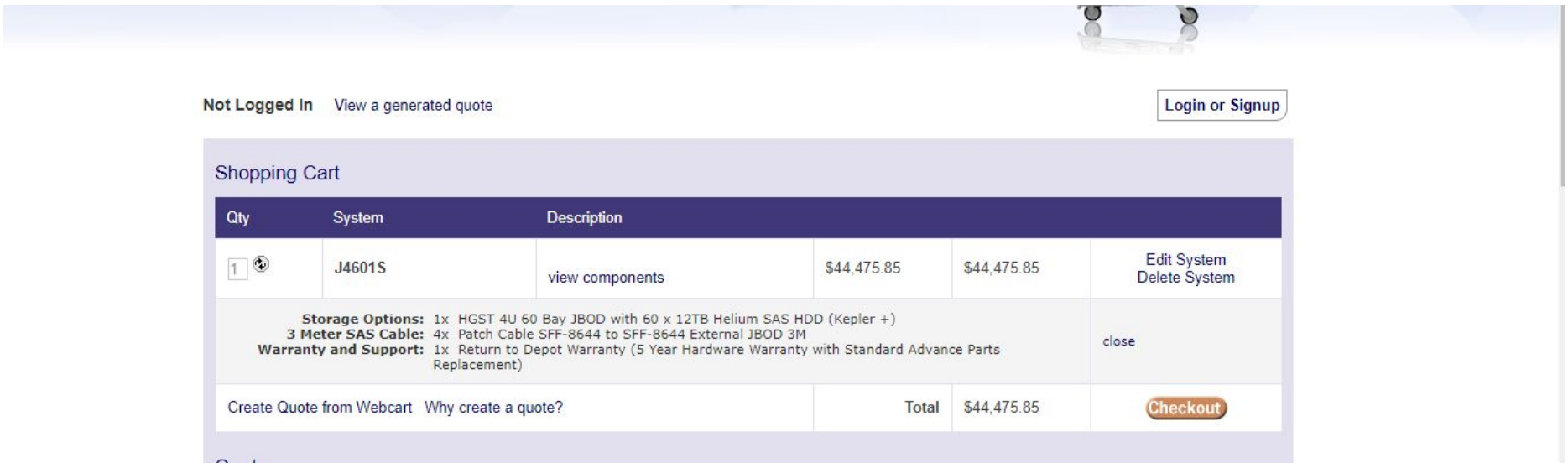
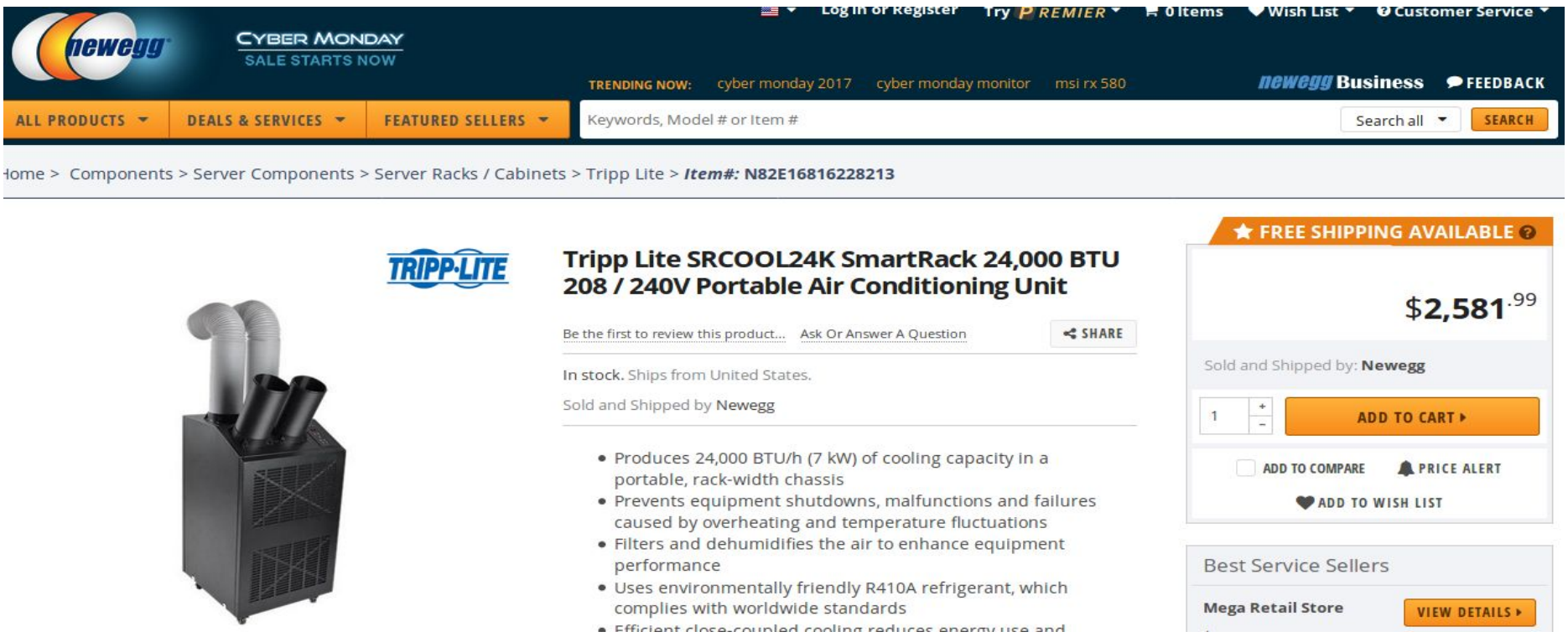


Cooling



Conclusion:

	Configuration 1	Configuration 2	Configuration 3
Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage	$ 397,146,436.8	$ 7,524,372,142.2	$1,073,691,840.6
Private Cloud cost over 5 years, 24/7 operation, with 100% usage	$44,372,955.90	$2,298,935,964.45	$158,582,164.99
What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?	10%	15.9%	17.2%

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Assumption: AWS Business Support is included in public cloud cost.

Utilization:

For configuration 1

At **11%** utilization it costs us **$39,714,643.68** for Public and **$4,437,295.59** for the Private cloud.

For configuration 2

At 15.9% utilization it costs us **$1,196,375,170.6** for Public Cloud and **$3,65,530,818.2** for Private Cloud

For configuration 3

At 17.2% utilization it costs **$184,674,996.58** for Public Cloud and **$27,104,132.378** for Private Cloud

In the above observations, if we decrease the utilization rates than above utilization rates then it will make the private cloud more expensive than that of the public cost. Because only the cost for electricity for the private cloud will get decrease, but for the public cloud it's not the same.