A Project Report on Understanding the Cost of Computing in Cloud

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Public Clouds

- Cost estimation of different configuration for three different set of requirements:
  - **Configuration I**:

    Hadoop/Spark Cluster with 32K-cores, 256TB memory, 50PB HDD, and 10Gb/s Ethernet Fat-Tree network (each VM should be equivalent to the d2.8xlarge instance); in addition to the compute resources, a 100PB distributed storage shared across the entire cloud should be procured, with enough capacity for 100GB/sec throughput.

    - Instance type: **d2.8xlarge**
    - vCPU: 36
    - Memory (GiB): 244
    - Instance Storage (GB): 24 * 2000 GB = 48 TB.
    - Network: 10Gb/s Ethernet Fat-Tree network.
  - Cost estimation for Public cloud as provided by Amazon AWS for On-Demand Linux instance:
    - Instance: d2.8xlarge
    - Price per instance: $5.52/hr
    - Total cost for 5 years (assuming 365 days in a year): 5.22 * 24 * 365 * 5 = $241776
  - In order to match our configuration requirement,
    - For 32k cores,
      - Total d2.8xlarge instances required = 32000/36 = 889 instances.
    - For 256 TB memory requirements,
      - Total d2.8xlarge instances required = 256TB/244GiB = 1050 instance
    - For 50 PB HDD requirement,
      - Total d2.8xlarge instances required = 50PB/48TB = 1043 instances.
  - From above 3 number of instances required, we need the one which has maximum value to meet all our needs. So, we need to take **1050 instances**.
  - Hence total cost to rent 1050 instances for 5 years will be
    = 1050 * $241776
    = $**253,864,800**
  - In addition to the above 1050 d2.8xlarge instances, we also need 100PB distributed storage shared across entire cloud.
    - We will use amazon S3 storage specification and pricing for this:
      - Amazon Storage = S3
      - Cost per GB (assuming pricing for over 500TB/month) = $0.021
      - Cost for 100PB/Month = 0.021 * 5,00,000 * 200 = $2,100,000
      - Cost for 5 years = 5 * 12 * 2,100,000 = $**126,000,000**

- Hence total cost for Compute server and storage server comes out to:
  Total cost = cost for AWS instance + cost for S3 storage
  = $**253,864,800 + $126,000,000**
  = $**379,864,800**

- **<u>Configuration II:</u>**

  Support 1 million virtual machines (VM) where each VM requires 2-core, 15GB RAM, 32GB SSD storage, and 1Gb/s Fat-Tree network (each VM should be equivalent to the r3.large instances); in addition to the compute resources, a 10PB distributed storage shared across the entire cloud should be procured, with enough capacity for 10GB/sec throughput.

  - Configuration as per Amazon AWS instance r3.large
    - Instance type: **r3.large**
    - vCPU: 2
    - Memory (GiB): 15
    - Instance Storage (GB): 32 GB (SSD)
    - Network: 1Gb/s Ethernet Fat-Tree network.
  - Cost estimation for Public cloud as provided by Amazon AWS for On-Demand Linux instance:
    - Instance: **r3.large**
    - Price per instance: $0.166/hr
    - Total cost for 5 years (assuming 365 days in a year): 0.166 * 24 * 365 * 5
      = $7,270.8
  - In order to match our configuration requirement,
    - For 1 million Virtual Machines, total cost will be,
      Total cost = $7,270.8 * 1,000,000
      = $**7,270,800,000**
  - In addition to the above, we also need 10PB distributed storage, shared across entire cloud.
    - We will use amazon S3 storage specification and pricing for this:
      - Amazon Storage = S3
      - Cost per GB (assuming pricing for over 500TB/month) = $0.021
      - Cost for 10PB/Month = 0.021 * 5,00,000 * 20 = $2,100,00
      - Cost for 5 years = 5 * 12 * 2,100,00 = $**12,600,000**
  - Hence total cost for Compute server and storage server comes out to:
    Total cost = cost for AWS instance + cost for S3 storage
    = $**7,270,800,000 + $12,600,000**
    = $**7,283,400,000**

- **Configuration III:**

  Support deep learning with 1 exaflop of mixed precision performance (hint: each VM should be equivalent to p3.16xlarge instances; you will want to use the NVIDIA V100 GPUs (8 GPUs per node), and allocate 8-cores per GPU (64-cores per node) with 8GB of memory per core (512GB per node); the network to use is at least 10Gb/s per GPU (100Gb/s should work), and should be organized in a Fat-Tree network; in addition to the compute resources, a 1PB distributed storage shared across the entire cloud should be procured, with enough capacity for 10GB/sec throughput

  - Configuration as per Amazon AWS instance p3.16xlarge
    - Instance type: **p3.16xlarge**
    - vCPU: 64
    - CPU Memory (GiB): 488
    - GPU Memory(GiB): 128
    - Network: 25Gb/s Ethernet Fat-Tree network.
    - For Deep learning: NVIDIA Tesla Teraflops (125 TFlops).
  - Since we have 8 GPU and each GPU supports 125 TFlops,
    Total TFlops = 8 * 125 = 1000 TFlops = **1 pflops**.
  - In order to match 1 exaflop requirement, we will need
    = 1 exaflop/ 1 pflop
    = **1000** instances.
  - Cost estimation for Public cloud as provided by Amazon AWS for On-Demand Linux instance:
    - Instance: **p3.16xlarge**
    - Price per instance: $24.48
    - Total cost for 5 years (assuming 365 days in a year): 24.48 * 24 * 365 * 5
      = $1072224
  - Hence for 1000 instances, the total cost will be,
    = 1072224 * 1000
    = $**1,072,224,000**
  - In addition to the above, we also need 1PB distributed storage, shared across entire cloud.
    - We will use amazon S3 storage specification and pricing for this:
      - Amazon Storage = S3
      - Cost per GB (assuming pricing for over 500TB/month) = $0.021
      - Cost for 10PB/Month = 0.021 * 5,00,000 * 2 = $21,000
      - **Cost for 5 years** = 5 * 12 * 21000 = $**1,260,000**
  - Hence total cost for Compute server and storage server comes out to:
    Total cost = cost for AWS instance + cost for S3 storage
    = $**1,072,224,000 + $1,260,000**
    = $**1,073,484,000**

Private Clouds

- Cost estimation of different configuration for three different set of requirements:
  - **Configuration I**:

	Description	Price per Item	Quantity	Total Price
Compute Servers	CPU: 1x Intel Xeon E5-2603v4 6C 1.7GHz 15MB Cache Memory: 1x 256GB DDR4 ECC Reg 2133MHz (4 x 64GB) Hard Drives: 1x HGST Ultrastar HE12 12TB 7200RPM SATA 6Gb/s RAID Controller: 1x LSI MegaRAID SAS 9361-4i 12Gb/s SAS Controller PCI Express Expansion: 1x Intel I350-T2 Dual Port Gigabit Ethernet Adapter GPU Options: 1x Nvidia Tesla K20 5GB GDDR5 PCI-E Active Cooling Operating System: 1x No Operating System. Include testing and customer OS preference in notes. RAID Level: 1x Custom RAID Configuration - Add instructions to system notes Warranty and Support: 1x Return to Depot Warranty (3 Year Hardware Warranty with Standard Advance Parts Replacement)	9,807.11	4,167.00	40,866,227.37
Network Switches	NETGEAR 48-Port 10 Gigabit Ethernet Smart Managed Pro Switch, L2+/Layer 3 Lite, 10 SFP+, ProSAFE Lifetime Protection (XS748T)	3,642.72	54	196,706.88
Network Cables	2m (7ft) Dell Force10 CBL-10GSFP-DAC-2M Compatible 10G SFP+ Passive Direct Attach Copper Twinax Cable	13.00	4,221.00	54,873.00
Racks	42u Cruxial 4 Post Server Rack w/ Angle Brackets	464.99	100	46,499.00
Storage Servers	CPU: 1x Intel Xeon E5-2603v4 6C 1.7GHz 15MB Cache Memory: 1x 8GB DDR4 ECC Reg 2400MHz (2 x 4GB) Rear-mounted OS Disks: 1x Intel S4500 Series 240GB 3D1 TLC SATA SSD 6Gb/s Data HDD: **36** x HGST Ultrastar HE12 12TB 7200RPM SATA 6Gb/s Operating System: 1x No Operating System. Include testing and customer OS preference in notes. RAID Level: 1x Custom RAID Configuration - Add instructions to system notes Warranty and Support: 1x Return to Depot Warranty	20,841.20	232	4,835,158.40

	(3 Year Hardware Warranty with Standard Advance Parts Replacement)			
Electric Power	ComEd Price	0.07195	102,279,570.00	7,359,015.06
Cooling	One AC per rack	698	100	69,800.00
Administration	One administrator per 1000 servers	60,000	25	1,500,000
Total	N/A	N/A	N/A	**$54,928,279.71**

- As per the mentioned requirements, I have used **Iris 1181-2GPU** compute server which is a 22 core Intel Xeon E5-2603v4 6C 1.7GHz 15MB Cache CPU and I took 4167 instances to match the exact requirement (here to match HDD).
- In order to create FAT-Tree network for our configuration, I have used 48 port network switches and to connect all of the 4167 servers, I would require 54 such switches which includes 1 port of switch, which is connected to external network.
- In order to connect servers with switches, we would require 4221 cables, which are "10G SFP+ Passive Direct Attach Copper Twinax Cable", which matches perfectly with my network interface card.
- I used 100 42u Cruxial 4 Post Server Rack w/ Angle Brackets to mount our compute servers and switches on the racks.
- For extra storage of 100PB, I have used **Iris 418-36** storage server where each server has 36 * 12TB of capacity and hence we would need 232 such instances.
- The Electric power consumption is calculated for compute server, switches and storage server
  - For Compute server,
    - Power consumed by each server = 500 W/hr
    - Total power consumed over 5 years by 4167 instances
      = 500 * 24 * 365 * 5 * 4167 = 91257300000 WH
      = 91257300 KWH
    - Hence, Total cost = 0.07195 * 91257300
      = $6565962.735
  - For Network Switch,
    - Power consumed by each switch = 75 W/hr
    - Total power consumed by 54 switches for 5 years
      = 75 * 24 * 365 * 5 * 54 = 177390000 WH = 177390 KWH

- Hence, Total cost = 0.07195 * 177390 = $12763.2105

- I have used 1 Air Conditioner per rack and hence total number of AC's would be 100.
  - Power consumed per AC = 1200 W/hr
  - Hence, total power consumed by 100 AC's over 5 years is:
    Total energy = 1200 * 24 * 365 * 5 * 100 = 5256000000 WH
    = 5256000 KWH
  - Hence, Total cost = 0.07195 * 5256000 = $378169.2
- For Storage Server,
  - Power consumed by each server = 550 W/hr
  - Total power consumed by 232 servers over 5 years
    = 550 * 24 * 365 * 5 * 232 = 5588880000WH = 5588880 KWH
  - Therefore, Total cost = 0.07195 * 5588880 = $402119.916

- For Cooling,
  - I have used 1 Air Conditioner per rack and hence total number of AC's would be 100.
    - Cost of one AC = 698 W/hr
    - Hence, Total cost = 100 * 698 = $69800
- For Administration cost,
  - I have considered 1 system admin per 1000 servers.
  - The salary for 1 system admin has been taken from Glassdoor for Illinois and it is considered as $60,000/year.
  - So, for 4167 compute servers and 232 storage servers, we would require 5 system administrators for 5 years and hence the total cost would come out to 1,500,000

- **Configuration II**:

	Description	Price per Item	Quantity	Total Price
Compute Servers (Iris 1298-ER4T)	CPU: 2x Intel Xeon Gold 6152 22C 2.1GHz 30.25MB Cache Memory: 1x 384GB DDR4 2666MHz ECC Reg (24 x 16GB) OS DOM: 1x 64GB Internal SATA DOM HDD: 1x Intel S4500 Series 960GB 3D1 TLC SATA SSD 6Gb/s Operating System: 1x No Operating System. Include testing and customer OS preference in notes. RAID Level: 1x Custom RAID Configuration - Add instructions to system notes Warranty and Support: 1x Return to Depot Warranty (3 Year Hardware Warranty with Standard Advance Parts Replacement)	16,637.65	45,455.00	756,264,380.75
Network Switches	NETGEAR 48-Port 10 Gigabit Ethernet Smart Managed Pro Switch, L2+/Layer 3 Lite, 10 SFP+, ProSAFE Lifetime Protection (XS748T)	3,642.72	947	3,449,655.84
Network Cables	2m (7ft) Dell Force10 CBL-10GSFP-DAC-2M Compatible 10G SFP+ Passive Direct Attach Copper Twinax Cable	13.00	46,402.00	603,226.00
Racks	42u Cruxial 4 Post Server Rack w/ Angle Brackets	464.99	1083	503,584.17
Storage Servers (Iris 418-36)	CPU: 1x Intel Xeon E5-2603v4 6C 1.7GHz 15MB Cache Memory: 1x 8GB DDR4 ECC Reg 2400MHz (2 x 4GB) Rear-mounted OS Disks: 1x Intel S4500 Series 240GB 3D1 TLC SATA SSD 6Gb/s Data HDD: 36x HGST Ultrastar HE12 12TB 7200RPM SATA 6Gb/s Operating System: 1x No Operating System. Include testing and customer OS preference in notes. RAID Level: 1x Custom RAID Configuration - Add instructions to system notes Warranty and Support: 1x Return to Depot Warranty (3 Year Hardware Warranty with Standard Advance Parts Replacement)	20,841.20	24	500,188.80
Electric Power	ComEd Price	0.07195	1,056,076,035.00	75,984,670.72
Cooling	Air Conditioners, one per rack	698	1083	755,934.00
Administration	One administrator per 1000 servers	60,000	230	13,800,000.00
Total	N/A	N/A	N/A	**$851,861,640.28**

- As per the mentioned requirements, I have used **Iris 418-36** compute server which is a 22 core Intel Xeon Gold 6152 2.1GHz 30.25MB Cache CPU and I took 45455 instances to match the exact requirement (here to match 1 million VM's).
- In order to create FAT-Tree network for our configuration, I have used 48 port network switches and to connect all of the 45455 servers, I would require 947 such switches which includes 1 port of switch, which is connected to external network.
- In order to connect servers with switches, we would require 46,402 cables, which are "10G SFP+ Passive Direct Attach Copper Twinax Cable", which matches perfectly with my network interface card.
- I used 1083 42u Cruxial 4 Post Server Rack w/ Angle Brackets to mount our compute servers and switches on the racks.
- For extra storage of 10PB, I have used **Iris 418-36** storage server where each server has 36 * 12TB of capacity and hence we would need 24 such instances.
- The Electric power consumption is calculated for compute server, switches and storage server
    - For Compute server,
        - Power consumed by each server = 500 W/hr
        - Total power consumed over 5 years by 45,455 instances
          = 500 * 24 * 365 * 5 * 45455 = 995464500000 WH
          = 995464500 KWH
        - Hence, Total cost = 0.07195 * 995464500
          = $71623670.775

- For Network Switch,
    - Power consumed by each switch = 75 W/hr
    - Total power consumed by 947 switches for 5 years
      = 75 * 24 * 365 * 5 * 947 = 3110895000 WH = 3110895 KWH
    - Hence, Total cost = 0.07195 * 3110895 = $223828.89525
- For Cooling,
    - I have used 1 Air Conditioner per rack and hence total number of AC's would be 1083.
        - Power consumed per AC = 1200 W/hr
        - Hence, total power consumed by 1083 AC's over 5 years is:
          Total energy = 1200 * 24 * 365 * 5 * 1083 = 56922480000 WH
          = 56922480 KWH
        - Hence, Total cost = 0.07195 * 56922480 = $4095572.436
- For Storage Server,
    - Power consumed by each server = 550 W/hr
    - Total power consumed by 24 servers over 5 years
      = 550 * 24 * 365 * 5 * 24 = 578160000 WH= 578160 KWH

- Therefore, Total cost = 0.07195 * 578160 = $41598.612

- For Cooling,
  - I have used 1 Air Conditioner per rack and hence total number of AC's would be 1083.
    - Cost of one AC = 698 W/hr
    - Hence, Total cost = 1083 * 698 = $ 755,934.00
- For Administration cost,
  - I have considered 1 system admin per 1000 servers.
  - The salary for 1 system admin has been taken from Glassdoor for Illinois and it is considered as $60,000/year.
  - So, for 45455 compute servers and 24 storage servers, we would require 46 system administrators for 5 years and hence the total cost would come out to 13800000

- **Configuration III:**

	Description	**Price per Item**	**Quantity**	**Total Price**
Compute Servers	NVIDIA CORP 8-GPU/512GB DGX-1 DL WITH V100 Mfg Part Number: 920-22787-2510-000	164,986.46	1,000.00	164,986,460.00
Network Switches	Mellanox Certified Refurbished MSB7780-ES2F Switch-IB Based EDR InfiniBand 1U Router 36 QSFP28 Ports 2 Power Supplies (AC) x86 dual core Standard Depth P2C Airflow Rail Kit R	13,139.95	28	367,918.60
Network Cables	Mellanox MCP1600-C001 Passive Copper Cable Ethernet 100GbE QSFP PVC 1m 30AWG	76.00	1,028.00	78,128.00
Racks	42u Cruxial 4 Post Server Rack w/ Angle Brackets	464.99	25	11,624.75
Storage Servers (Iris 418-36)	CPU: 1x Intel Xeon E5-2603v4 6C 1.7GHz 15MB Cache Memory: 1x 8GB DDR4 ECC Reg 2400MHz (2 x 4GB) Rear-mounted OS Disks: 1x Intel S4500 Series 240GB 3D1 TLC SATA SSD 6Gb/s Data HDD: 36x HGST Ultrastar HE12 12TB 7200RPM SATA 6Gb/s Operating System: 1x No Operating System. Include testing and customer OS preference in notes. RAID Level: 1x Custom RAID Configuration - Add instructions to system notes Warranty and Support: 1x Return to Depot Warranty (3 Year Hardware Warranty with Standard Advance Parts Replacement)	20,841.20	3	62,523.60
Electric Power	ComEd Price	0.07195	40,919,098.80	2,944,129.16
Cooling	Air Conditioners, one per rack	698	25	17,450.00

Administration	One administrator per 1000 servers	60,000	2	600,000.00
Total	N/A	N/A	N/A	**$169,068,234.11**

- As per the mentioned requirements, I have used **NVIDIA CORP** compute server which is 8-GPU/512GB DGX-1 DL WITH V100 server and I took 1000 instances to match the exact requirement which is to support deep learning with 1 exaflop of mixed precision performance.
- In order to create FAT-Tree network for our configuration, I have used 36 port network switches and to connect all of the 1000 servers, I would require 28 such switches which includes 1 port of switch per rack, which is connected to external network. The switch would support speed up to 100Gb/s.
- In order to connect servers with switches, we would require 1028 cables, which are "Mellanox MCP1600-C001 Passive Copper Cable Ethernet 100GbE QSFP PVC 1m 30AWG", which matches perfectly with my network interface card.
- I used 1083 42u Cruxial 4 Post Server Rack w/ Angle Brackets to mount our compute servers and switches on the racks. So, we would need 25 racks to mount compute servers, switches and storage servers.
- For extra storage of 1PB, I have used **Iris 418-36** storage server where each server has 36 * 12TB of capacity and hence we would need 3 such instances.
- The Electric power consumption is calculated for compute server, switches, Air Conditioner and storage server
    - For Compute server,
        - Power consumed by each server = 900 W/hr
        - Total power consumed over 5 years by 1000 instances
          = 900 * 24 * 365 * 5 * 1000 = 39420000000 WH
          = 39420000 KWH
        - Hence, Total cost = 0.07195 * 39420000
          = $2836269

- For Network Switch,
    - Power consumed by each switch = 92 W/hr
    - Total power consumed by 28 switches for 5 years
      = 92 * 24 * 365 * 5 * 28 = 112828800 WH = 112828.8 KWH
    - Hence, Total cost = 0.07195 * 112828.8 = $8118.03216
- For Cooling,
    - Use of 1 AC per rack.
    - Power consumed by each AC = 1200 W/hr
    - Total power consumed by 25 AC's for 5 years
      = 1200 * 24 * 365 * 5 * 25 = 1314000000 WH = 1314000 KWH
    - Hence, Total cost = 0.07195 * 1314000 = $94542.3

- For Storage Server,
    - Power consumed by each server = 550 W/hr
    - Total power consumed by 3 servers over 5 years
      = 550 * 24 * 365 * 5 * 3 = 72270000 WH= 72270 KWH
    - Therefore, Total cost = 0.07195 * 72270 = $5199.8265

- For Cooling,
    - I have used 1 Air Conditioner per rack and hence total number of AC's would be 25.
        - Cost of one AC = 698 W/hr
        - Hence, Total cost = 25 * 698 = $17,450
- For Administration cost,
    - I have considered 1 system admin per 1000 servers.
    - The salary for 1 system admin has been taken from Glassdoor for Illinois and it is considered as $60,000/year.
    - So, for 1000 compute servers and 3 storage servers, we would require 2 system administrators for 5 years and hence the total cost would come out to 600,000.00.

Summary

.	**Configuration 1**	**Configuration 2**	**Configuration 3**
Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage	379,864,800	7,283,400,000	1,073,484,000
Private Cloud cost over 5 years, 24/7 operation, with 100% usage	54,928,279.71	851,861,640.28	169,068,234.11
What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?	The private cloud should be utilized for **14.46%** in order to match the public cloud. So, out of 5 years, it should be used for **264** days or **6334** hours.	The private cloud should be utilized for **11.70%** in order to match the public cloud. So, out of 5 years, it should be used for **214** days or **5123** hours.	The private cloud should be utilized for **15.75%** in order to match the public cloud. So, out of 5 years, it should be used for **288** days or **6899** hours.

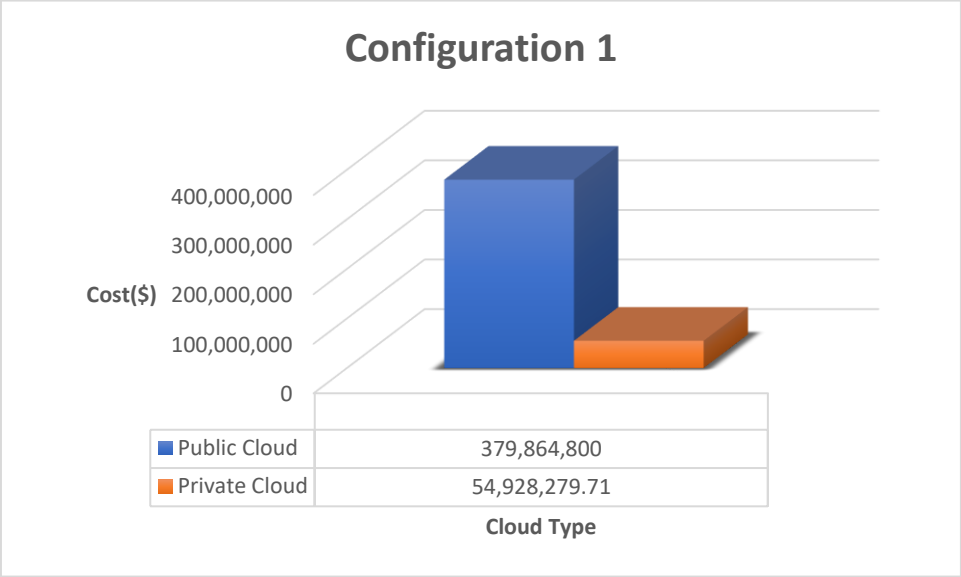
- As per me, the effectiveness of public cloud and private cloud depends on the usage that your application has, because considering all the above factors, the private cloud will have many add on costs like maintenance cost, administration cost, electricity cost and other such things.
- On the other hand, if your application has very high utilization and it is for long term use than Private cloud will be handy and cost effective as compared to public cloud.
- The utilization for 5 years is calculated by using formula

$$\boldsymbol{Utilization}\ (\%) = \left(\frac{\boldsymbol{cost\ of\ private\ cloud}}{\boldsymbol{cost\ of\ public\ cloud}}\right) * \mathbf{100}$$

$$\boldsymbol{Number\ of\ days} = \left(\frac{\boldsymbol{cost\ of\ private\ cloud}}{\boldsymbol{cost\ of\ public\ cloud}}\right) * \mathbf{365} * \mathbf{5}$$

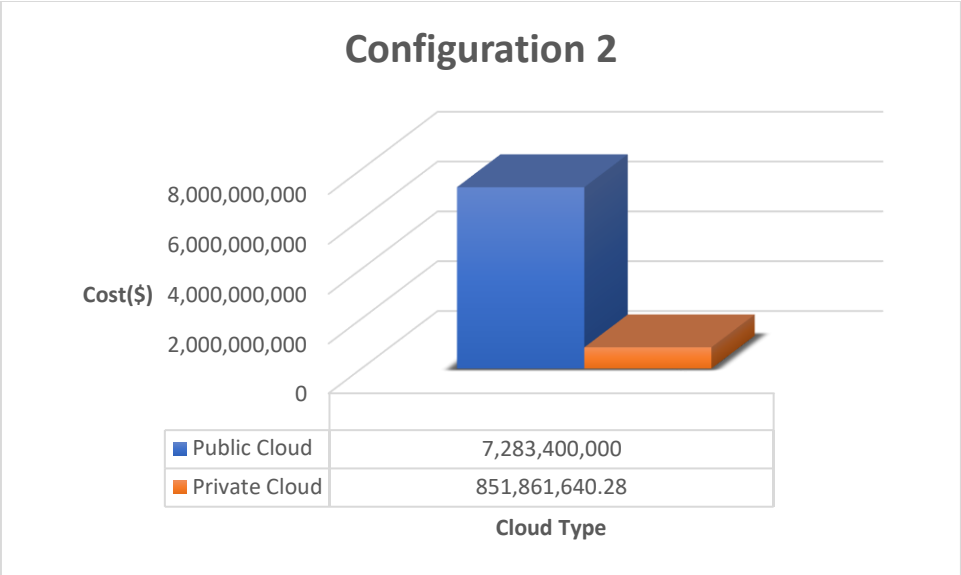
-
- If you plan to install private cloud over public cloud than minimum utilization that you should maintain for various configuration varies as below:
    - **Config 1:** 264 days or 6334 hours of utilization.
    - **Config 2**: 214 days or 5123 hours of utilization.
    - **Config 3**: 288 days or 6899 hours of utilization.
- If your application has usage above this numbers than private cloud will be cost effective as compared to public cloud over a duration of 5 years.

Graphical Visualization



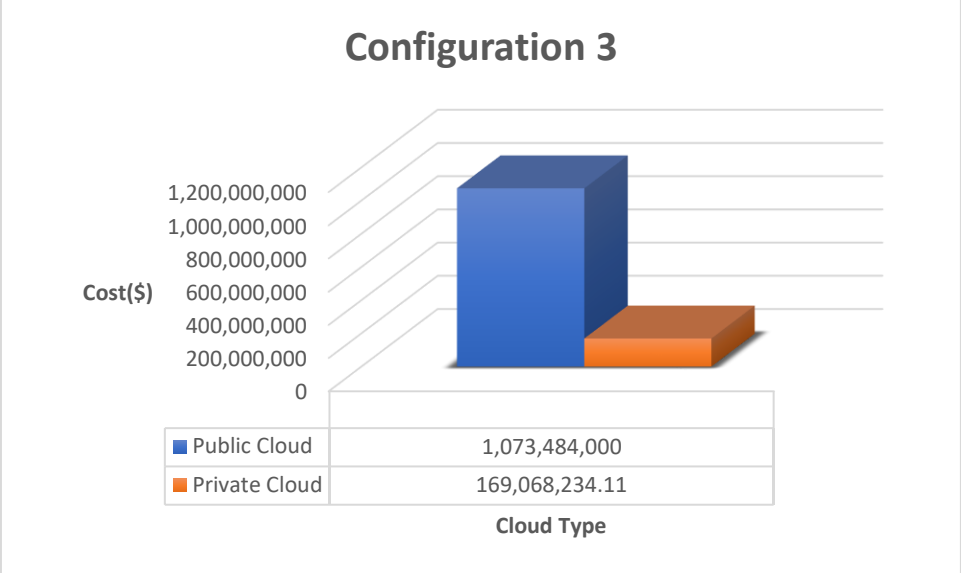
Public vs Private cloud: Price comparison over 5 years

- From the above graph, it is very clear that Private cloud costs very less as compared to Public cloud over utilization period of 5 years.
- For private cloud, there is one time investment of purchasing servers, Netwrok switches, HDD, RAM, Network cables and server racks.
- After certain utilization is achieved, private cloud costs less as compared to public cloud.



Public vs Private cloud: Price comparison over 5 years

- For configuration 2, and from the above graph, it is very clear that Private cloud costs very less as compared to Public cloud over utilization period of 5 years.
- The cost for public cloud increases exponentially for the requirement of 1M VM's.
- So, one time investment of purchasing private cloud is seen to be cheaper as compared to the public cloud when the utilization is made over **11.70%** over the course of 5 years.
- After certain utilization is achieved, private cloud costs less as compared to public cloud.



Public vs Private cloud: Price comparison over 5 years

- Configuration 3 requires very high investment at initial stage to meet the GPU requirements, wherein NVIDIA GPU is bought which supports 8 GPU's per node and 8 cores per GPU, which in total has 64 cores per node.
- The cost of public cloud is low when the utilization is low or the time period is less but the private cloud gets cheaper as the utilization increases because private cloud has only one time investment whereas public cloud needs year-on-year investment.

Screenshots

1. Configuration I:

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Qty	System	Description			
1	Atlas 223-12	view components	$5,525.93	$5,525.93	Edit System Delete System
1	Iris 1181-2GPU	view components	$9,807.11	$9,807.11	Edit System Delete System

CPU: 1x Intel Xeon E5-2603v4 6C 1.7GHz 15MB Cache
Memory: 1x 256GB DDR4 ECC Reg 2133MHz (4 x 64GB)
Hard Drives: 1x HGST Ultrastar HE12 12TB 7200RPM SATA 6Gb/s
RAID Controller: 1x LSI MegaRAID SAS 9361-4i 12Gb/s SAS Controller
PCI Express Expansion: 1x Intel I350-T2 Dual Port Gigabit Ethernet Adapter
GPU Options: 1x Nvidia Tesla K20 5GB GDDR5 PCI-E Active Cooling
Operating System: 1x No Operating System. Include testing and customer OS preference in notes.
RAID Level: 1x Custom RAID Configuration - Add instructions to system notes
Warranty and Support: 1x Return to Depot Warranty (3 Year Hardware Warranty with Standard Advance Parts Replacement)

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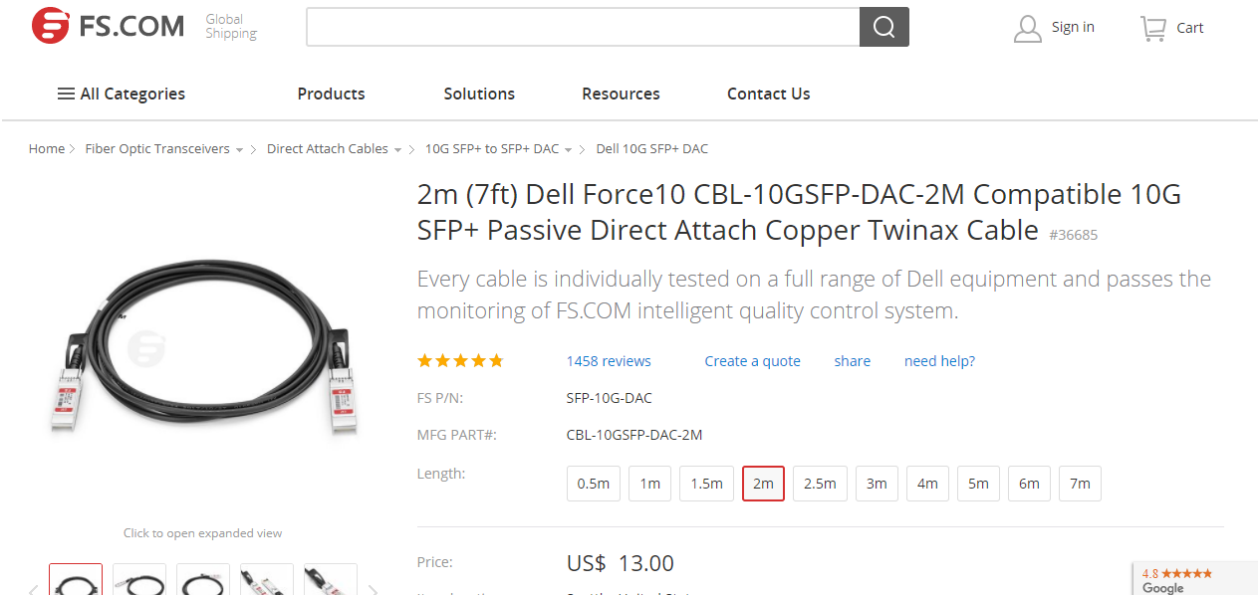
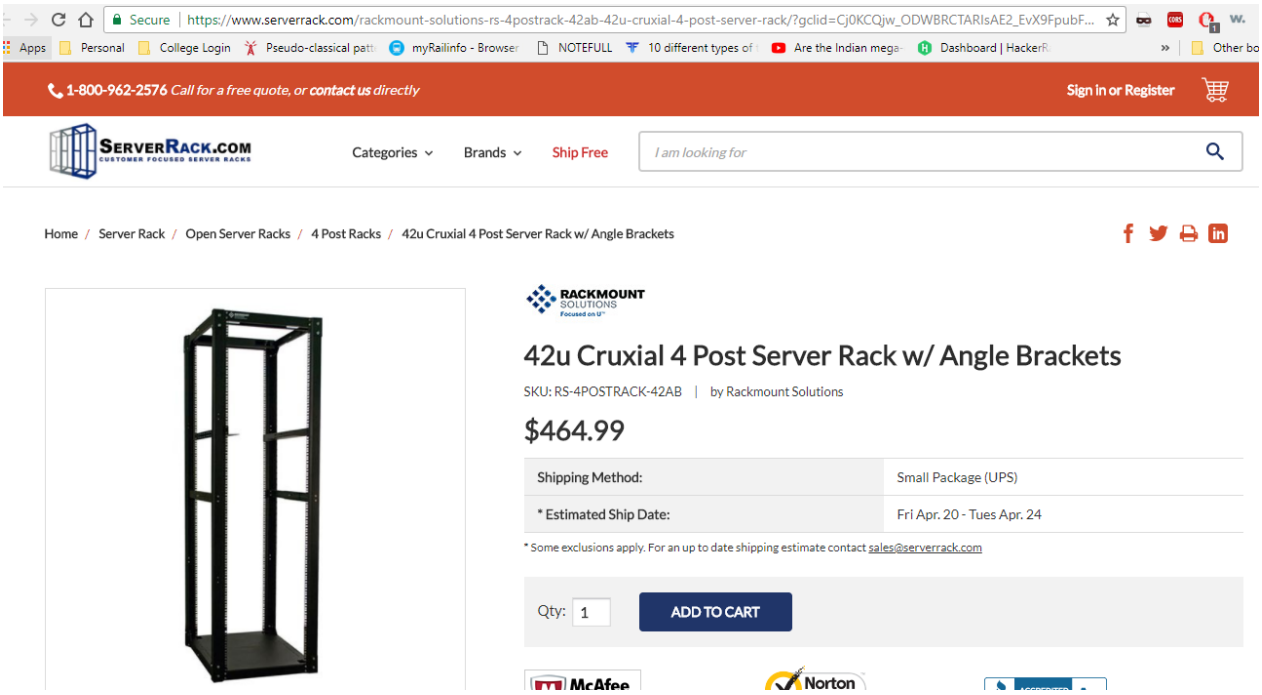
Compute Server

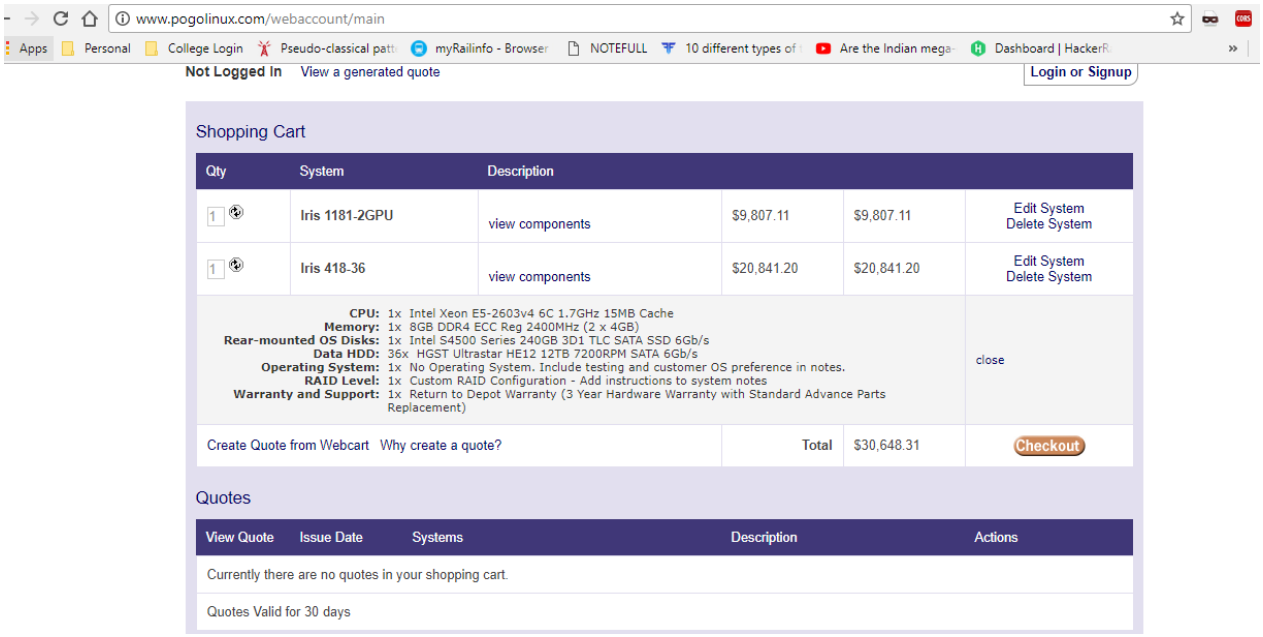
Network Switch



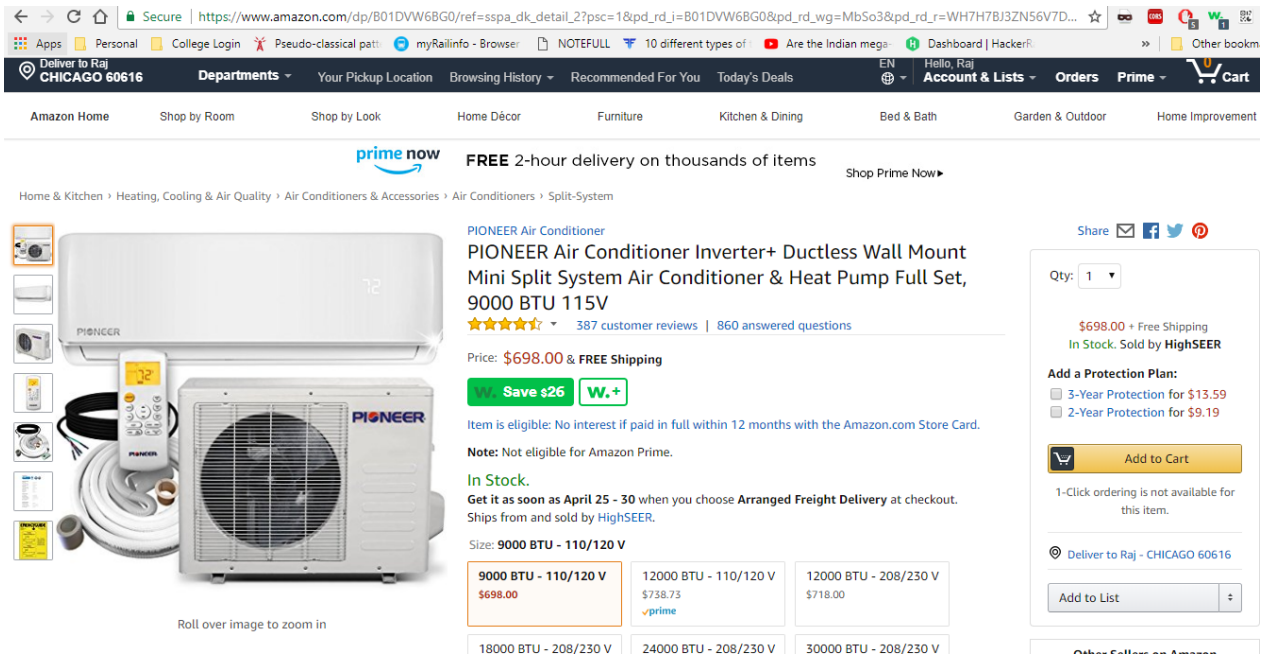
Network Cables



Server Racks

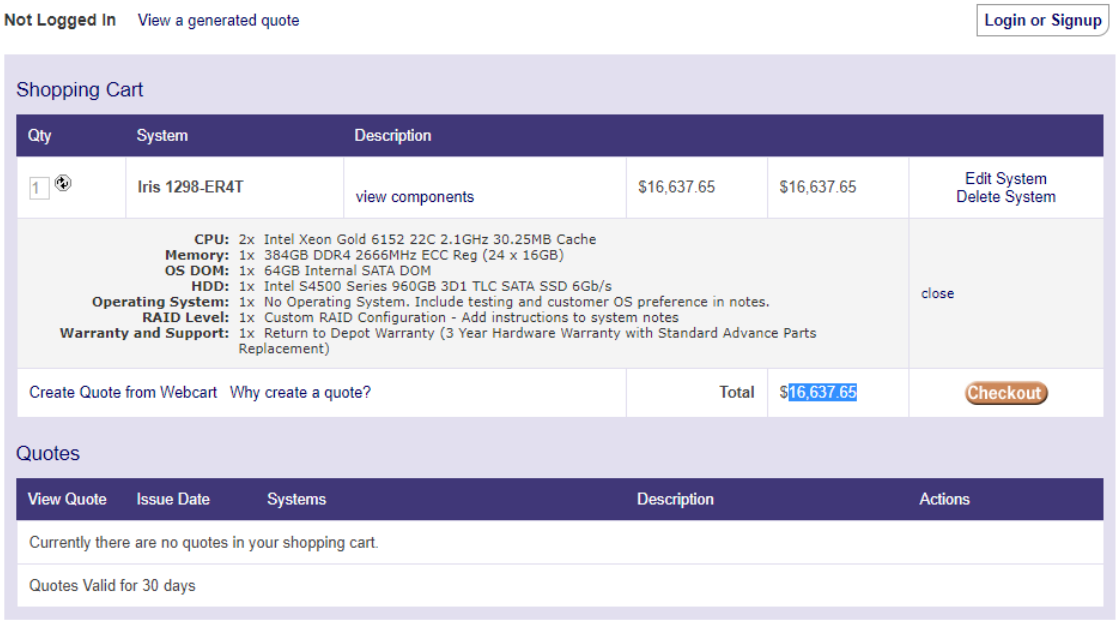


Storage Server



Air Conditioner

2. Configuration II:



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Shopping Cart

Qty	System	Description			
1	Iris 1298-ER4T	view components	$16,637.65	$16,637.65	Edit System Delete System

CPU: 2x Intel Xeon Gold 6152 22C 2.1GHz 30.25MB Cache
Memory: 1x 384GB DDR4 2666MHz ECC Reg (24 x 16GB)
OS DOM: 1x 64GB Internal SATA DOM
HDD: 1x Intel S4500 Series 960GB 3D1 TLC SATA SSD 6Gb/s
Operating System: 1x No Operating System. Include testing and customer OS preference in notes.
RAID Level: 1x Custom RAID Configuration - Add instructions to system notes
Warranty and Support: 1x Return to Depot Warranty (3 Year Hardware Warranty with Standard Advance Parts Replacement)

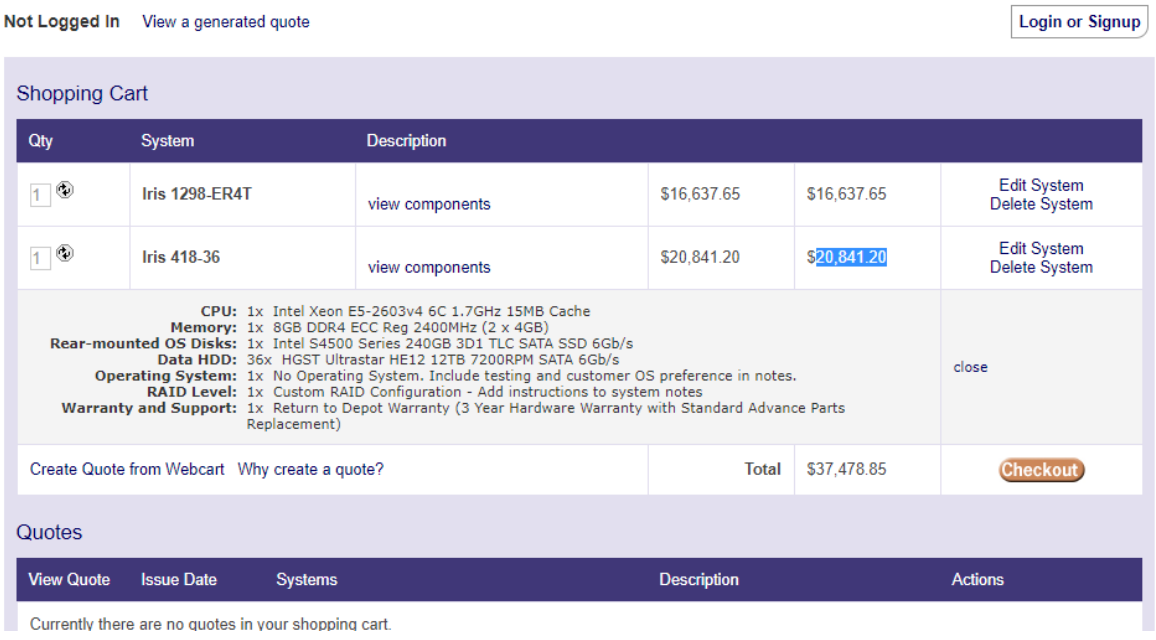
close

Create Quote from Webcart Why create a quote? Total $16,637.65 Checkout

Quotes

View Quote	Issue Date	Systems	Description	Actions
Currently there are no quotes in your shopping cart.				
Quotes Valid for 30 days				

Compute Server



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Shopping Cart

Qty	System	Description			
1	Iris 1298-ER4T	view components	$16,637.65	$16,637.65	Edit System Delete System
1	Iris 418-36	view components	$20,841.20	$20,841.20	Edit System Delete System

CPU: 1x Intel Xeon E5-2603v4 6C 1.7GHz 15MB Cache
Memory: 1x 8GB DDR4 ECC Reg 2400MHz (2 x 4GB)
Rear-mounted OS Disks: 1x Intel S4500 Series 240GB 3D1 TLC SATA SSD 6Gb/s
Data HDD: 36x HGST Ultrastar HE12 12TB 7200RPM SATA 6Gb/s
Operating System: 1x No Operating System. Include testing and customer OS preference in notes.
RAID Level: 1x Custom RAID Configuration - Add instructions to system notes
Warranty and Support: 1x Return to Depot Warranty (3 Year Hardware Warranty with Standard Advance Parts Replacement)

close

Create Quote from Webcart Why create a quote? Total $37,478.85 Checkout

Quotes

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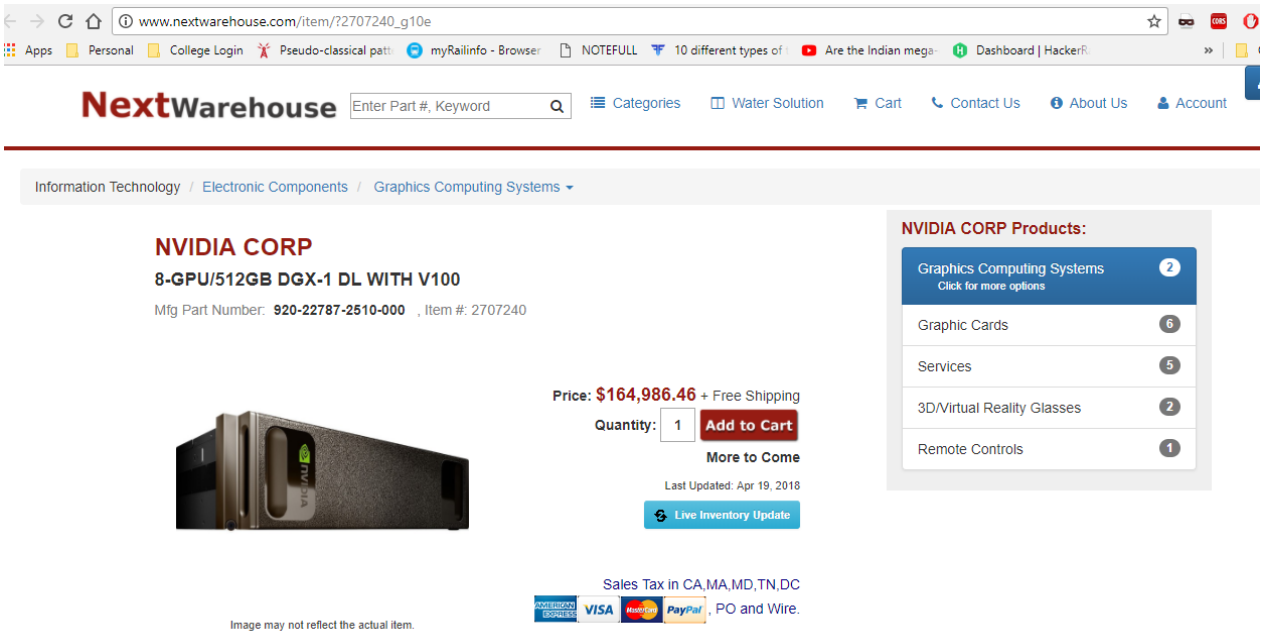
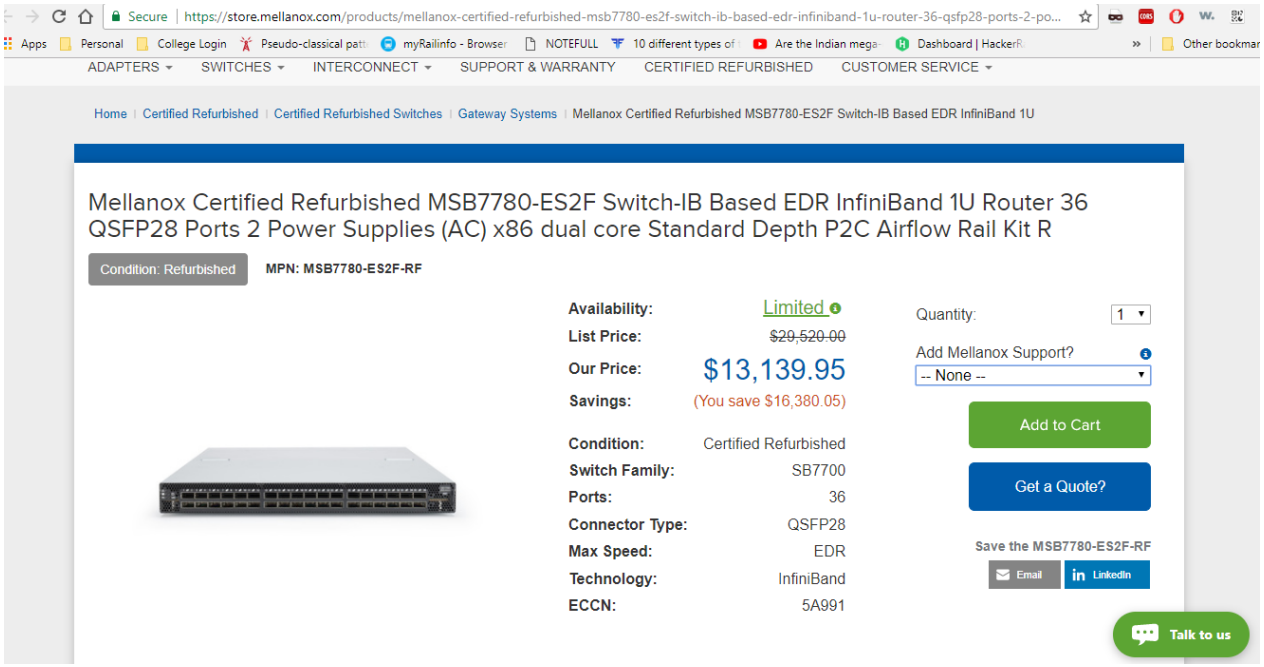
Currently there are no quotes in your shopping cart.				

Storage Server

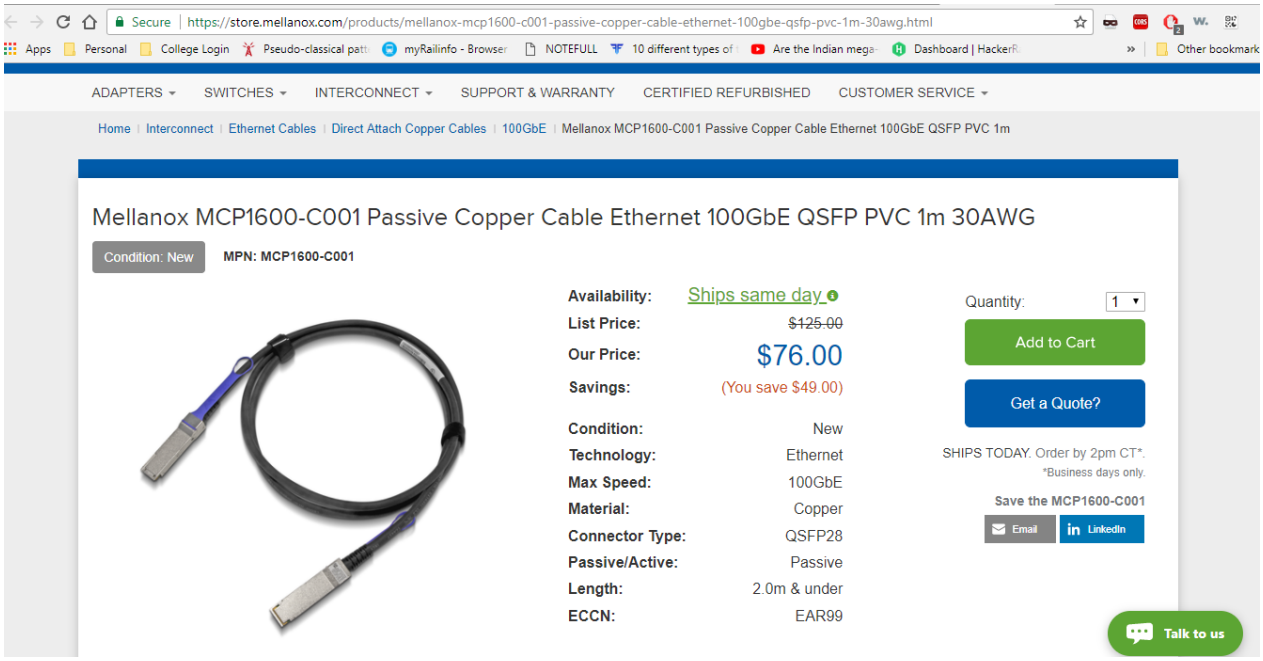
3. Configuration III:



Compute Server



Network Switch


Secure | https://store.mellanox.com/products/mellanox-mcp1600-c001-passive-copper-cable-ethernet-100gbe-qsfp-pvc-1m-30awg.html
ADAPTERS
SWITCHES
INTERCONNECT
SUPPORT & WARRANTY
CERTIFIED REFURBISHED
CUSTOMER SERVICE
Home | Interconnect | Ethernet Cables | Direct Attach Copper Cables | 100GbE | Mellanox MCP1600-C001 Passive Copper Cable Ethernet 100GbE QSFP PVC 1m
Mellanox MCP1600-C001 Passive Copper Cable Ethernet 100GbE QSFP PVC 1m 30AWG
Condition: New
MPN: MCP1600-C001
Availability: Ships same day
List Price: $125.00
Our Price: $76.00
Savings: (You save $49.00)
Condition: New
Technology: Ethernet
Max Speed: 100GbE
Material: Copper
Connector Type: QSFP28
Passive/Active: Passive
Length: 2.0m & under
ECCN: EAR99
Quantity: 1
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References

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