Understanding the Cost of Computing in the Cloud

Introduction:

This report consists of cloud computing report to find the cost breakdown of a private cloud, and compare that to what Amazon would charge for renting the public cloud.

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 like 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.

This report gives a detail description of comparison between public and private cloud as per the given three configurations. 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: Hadoop/Spark Cluster

- Number of Cores needed for the cluster=32 k, this implies number of VM's =889.
- Memory needed for the cluster=256 TB, this implies number of VM's = 978.
- HDD needed for the cluster=50PB, this implies number of VM's needed= 1042.
- 10Gb/s Ethernet Fat-Tree network for the cluster.
- **S3** Standard cloud storage costs at $0.021 per GB for a month

Therefore, we need 1042 **d2.8xlarge** instances.

According to the AWS Calculator the monthly cost for 1042 **d2.8x large** instances will be: **$ 4069785.6**. So, the cost for the 5 years for d2.8xlarge instance will be: $ **4069785.6**. ***12 * 5** = **$ 244187136**
For Distributed Storage:

For 100PB the total cost for per month which will be charged by AWS is **$ 2202009.6**. Therefore, total cost for 5 years is **$2202009.6 *12*5 =$ 132120576.**

Therefore, Total Public Cloud Cost for **Configuration 1** is:

Cost of EC2 for 5 years + Cost of Storage for 5 years: **$ 244187136** + **$132120576** = **$ 376307712.**

Configuration 2: Virtual Machines Required 1 million

- Each **r3.large** instance has a on demand price of **$ 0.175**.
- **S3** Standard cloud storage costs at $0.021 per GB for a month.

According to the AWS Calculator the monthly cost for 1Million **r3.large** instances will be: **$ 0.175*24*30*1000000**= **$ 126000000**
So, for 5 years the cost will be **$ 126000000*12*5 =$ 7560000000.00.**

For Distributed Storage:

For 10PB the total cost for per month which will be charged by AWS: **$ 10*1000*1000*0.021=$ 210000**.
Therefore, total cost for 5 years will be **$ 210000*12*5 =$ 1260000.00**
Therefore, Total Public Cloud Cost for **Configuration 2** is:
Cost of EC2 for 5 years + Cost of Storage for 5 years: **$ 7560000000.00** + **$1260000.00**= **$ 7561260000.**

Configuration 3: AWS p3.16x large instance consists of 8 Tesla V100 GPU's with 64 cores per GPU and 125 TFlops per GPU

- Each **p3.16xlarge** instance has on-demand price of $24.48 per hour per instance
- **S3** Standard cloud storage costs at $0.021 per GB for a month.

We need 1000 VM's
According to the AWS Calculator the monthly cost for **1000 r3.large** instance will be: $
24.48*24*30*1000=$ 17625600
So, for 5 years the cost will be **$ 17625600*12*5 =$ 1057536000**

For Distributed Storage:

For 1PB the total cost for per month which will be charged by AWS: **$ 1*1000*1000*0.021 =$ 21000**
Therefore, total cost for 5 years is $ **21000*12*5 =$ 1260000**

Therefore, Total Public Cloud Cost for **Configuration 3** is:
Cost of EC2 for 5 years + Cost of Storage for 5 years:
$ **1057536000** + $ **1260000**= **$ 1058796000**

PRIVATE CLOUD CONFIGURATION

Configuration 1: Hadoop/Spark Cluster

		Description	Price/Item	Quantity	Total Price
Compute Servers	Processor	INTEL XEON E5-2676 V3 2.40GHZ SOCKET 2011-3 LGA2011-3 HASWELL SERVER OEM CPU SR1Y5 CM8064401613101	$2,197	2669	$5,863793
	Rackmount	SUPERMICRO SYS-4028GR-TRT2 4U Rack mountable Server - Barebone Dual LGA 2011 Intel C612 2400 / 2133 / 1866 / 1600 MHz ECC DDR4 SDRAM 72-bit	$4,837	1336	$6,462232
	Internal Storage	Seagate Iron Wolf ST12000VN0007 12TB 7200 RPM 256MB Cache SATA 6.0Gb/s 3.5" Internal Hard Drive	$400	4169	$1,667600
	Memory	Samsung M386A8K40BM1-CPB 64GB DDR4-2133 4Rx4 LP ECC LRDIMM Server Memory	$850.00	4000	$3,400,000
Network Switches		Lenovo Rack Switch G8272 Layer 3 Switch	$7,823	35	$273805
Network Cables		Dell Networking, Cable, SFP+ to SFP+, 10GbE, Active Optical (Optics included) Cable,3 Meter, Customer Kit	$170	2495	$ 424150
Racks	Shelf	4U 7" Vented Rack Shelf	$86	1507	$128,999
	Rack	42U 4 Post Open Frame Server Rack 19" Adjustable Depth 25"-37" Aluminum.	$199	170	$33,830
Storage Servers		J4601S-Storage Options: 1x HGST 4U 60 Bay JBOD with 60 x 12TB Helium SAS HDD (Kepler +)			$6,182,143

	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)			
Electric Power				$ 17737598
Cooling	Tripp Lite SRCOOL24K SmartRack 24,000 BTU 208 / 240V Portable Air Conditioning Unit	$2,582	25	$ 219469
Administration		$1,000,000	2	$2,000,000
TOTAL:				**$44,393,619**

Processors:

RackMount:

Internal storage:

Memory:

Network Switches:

Network Cables:

Rack and Self:

Storage Servers:

Cooling:

Configuration 2: Virtual Machines Required 1 million

		Description	Price/Item	Quantity	Total Price
Compute Servers	Processor	Intel Xeon E5-2670 v2 Ivy Bridge-EP 2.5 GHz 25MB L3 Cache LGA 2011 115W BX80635E52670V2	$1,550	200000	$310,000,000

		Server Processor			
	Rackmount	SUPERMICRO SYS-4028GR-TRT2 4U Rackmountable Server - Barebone Dual LGA 2011 Intel C612 2400 / 2133 / 1866 / 1600 MHz ECC DDR4 SDRAM 72-bit	$4,837	100000	$483,700,000
	Internal Storage	Intel 535 Series 2.5" 360GB SATA III MLC SSDSC2BW360H6R5	$150	100000	$15,000,000
	Memory	SAMSUNG 16GB 288-Pin DDR4 SDRAM Registered DDR4 2400 (PC4 19200) Memory (Server Memory) Model M393A2K40BB1-CRC	$200	200000	$40,000,000
		Samsung M386A8K40BM 1-CPB 64GB DDR4-2133 4Rx4 LP ECC LRDIMM Server Memory	$850.00	200000	$170,000,000
Network Switches			$1,789	2184	$3,907,176
Network Cables		Dell Networking, Cable, SFP+ to SFP+, 10GbE, Active Optical (Optics included) Cable,3 Meter, Customer Kit	$170	104690	$17,797,300
Racks	Racks	45U Open Frame aluminium Server Network Rack 1000MM Deep 4 Post With 3 Pairs of L-Rails	$199	10222	$2,034,178
	Shelf	4U 7" Vented Rack Shelf	$86	102175	$8,787,050
Storage Servers		J4601S-Storage Options: 1x HGST 4U 60 Bay JBOD with 60 x 12TB Helium SAS HDD (Kepler +)	$44,475.85	15	$667137.75

	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)			
Electric Power				$ 1133937931
Cooling	Tripp Lite SRCOOL24K SmartRack 24,000 BTU 208 / 240V Portable Air Conditioning Unit	$ 2,582	$ 5111	$ 13196550.89
Administration		$1,000,000	50	$100,000,000
TOTAL:				**$829,902,730**

Processors:

Rackmount:

Select All   Remove Selected   Move Selected to Wish List   Update Qtys

Newegg Marketplace Direct Delivery Service   Important Shipping Information

SUPERMICRO SYS-4028GR-TRT2 4U Rackmountable Server - Barebone Dual LGA 2011 Intel C612 2400 / 2133 / 1866 / 1600 MHz ECC ...
CPU Type: Intel Xeon
Sold by GeekZilla

1   IN STOCK   **$4,837**.00

Subtotal:	$4,837.00
Shipping:	$0.00

Shipping Options

Zip/Postal Code 00010 [Update]

Choose a delivery method

- ⦿ FREE   Standard Shipping (5-7 business days)
- ○ $123.84   Expedited Shipping (3-5 business days)
- ○ $162.52   Two-Day Shipping (2 business days)
- ○ $258.29   Next Day Shipping (One business day)

Internal Storage:

Newegg Marketplace Direct Delivery Service   Important Shipping Information

Intel 535 Series 2.5" 360GB SATA III MLC SSDSC2BW360H6R5
Form Factor: 2.5" / Capacity: 360GB / Memory Components: MLC
Sold by Server Part Deals

SquareTrade Protection Plan ⓘ

- ○ 3 year: $12.99
- ○ 4 year: $15.99

🔄 **Recover Your Data**   View Details

1   IN STOCK   **$149**.99

Subtotal:	$149.99
Shipping:	$0.00

Shipping Options

Choose a delivery method

- ⦿ FREE   Standard Shipping (5-7 business days)
- ○ $13.99   Expedited Shipping (3-5 business days)
- ○ $19.99   Two-Day Shipping (2 business days)
- ○ $20.99   Next Day Shipping (One business day)

Memory:

Home > My Shopping Cart

1 Item(s) in your shopping cart: $849.99

Select All   Remove Selected   Move Selected to Wish List   Update Qtys

Newegg Marketplace Direct Delivery Service   Important Shipping Information

Samsung M386A8K40BM1-CPB 64GB DDR4-2133 4Rx4 LP ECC LRDIMM Server Memory
Capacity: 64GB / Type: 288-Pin DDR4 SDRAM
Sold by CA Server Pro

1   IN STOCK   **$849**.99
PREMIER JOIN TODAY

Subtotal:	$849.99
Shipping:	$0.00

Shipping Options

Zip/Postal Code 60616 [Update]

Choose a delivery method

- ⦿ FREE   Standard Shipping (5-7 business days)
- ○ $22.70   Expedited Shipping (3-5 business days)
- ○ $44.50   Two-Day Shipping (2 business days)

Network Switches:

Network Cables:

Shelf:

■ Select All   Remove Selected   Move Selected to Wish List   Update Qtys

Newegg Marketplace Direct Delivery Service   Important Shipping Information

☐   **4U 7" Vented Rack Shelf**   [1] $73.⁶⁵
     Sold by UnbeatableSale ?   IN STOCK

Subtotal: $73.65

Shipping: $11.95

Shipping Options

Zip/Postal Code 60616   Update

Choose a delivery method

● **$11.95**   Standard Shipping (5-7 business days)

Newegg Marketplace Direct Delivery Service   Important Shipping Information

Rack:

Newegg Marketplace Direct Delivery Service   Important Shipping Information

☐   **42U 4 Post Open Frame Server Rack 19"**   [1] $349.00
     Adjustable Depth 25"-37"   IN STOCK $199.⁰⁰
     Aluminum.Warehouse in USA!   Save: 20.08%
     Rack Units: 42U
     Sold by Raising Electronics ?

Subtotal: $199.00

Shipping: $0.00

Shipping Options

Choose a delivery method

● **FREE**   Standard Shipping (5-7 business days)

Storage Server:

Not Logged In   View a generated quote   Login or Signup

Shopping Cart

Qty	System	Description			
1 ⊕	J4601S	view components	$44,475.85	$44,475.85	Edit System Delete System

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)

close

Create Quote from Webcart Why create a quote?   Total $44,475.85   Checkout

Cooling:

Configuration 3: AWS p3.16x large instance consists of 8 Tesla V100 GPU's with 64 cores per GPU and 125 TFlops per GPU

		Description	Price/Item	Quantity	Total Price
Compute Servers	GPU	NVIDIA CORP 8-GPU/512GB DGX-1 DL WITH V100	$154,766	1000	$154,766,060
Network Switches		Lenovo Rack Switch G8272 Layer 3 Switch	$7,823	25	$195,575.
Network Cables		Dell Networking, Cable, SFP+ to SFP+, 10GbE, Active Optical (Optics included) Cable,3 Meter, Customer Kit	$170	1040	$ 176,800.
Racks	Rack	42U 4 Post Open Frame Server Rack 19" Adjustable Depth 25"-37" Aluminum.	$199	103	$20,497
	Shelf	4U 7" Vented Rack Shelf	$86	1025	$87,740
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	$39,244.15	2	$78,488.30

	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)			
Electric Power				$ 2141338.2
Cooling	Tripp Lite SRCOOL24K Smart Rack 24,000 BTU 208 / 240V	2,582	51	$ 131681.49
Administration		$1,000,000	1	$1,000,000
TOTAL				**$158,598,180**

GPU:

Network Switches:

Network Cables:

Shelf:

Racks:

Storage Server:

Cooling:

	Configuration 1	Configuration 2	Configuration 3
Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage	$ 376,307,712.	$ 7,561,260,000.	$ 1,058,796,000.

Private Cloud cost over 5 years, 24/7 operation, with 100% usage	$44,393,619	$829,902,730	$158,598,180
What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?	12%	10.9%	15%

Conclusion:

Utilization:
For **configuration 1:** At 12% utilization it costs us $ 376,307,712 for Public and $44,393,619 for the Private cloud.

For **configuration 2**: At 10.9% utilization it costs us $ 7,561,260,000 for Public Cloud and $829,902,730 for Private Cloud.
For **configuration 3:** At 15%utilization it costs $ 1,058,796,000 for Public Cloud and $158,598,180 for Private Cloud

The observation we get from above while comparing public and private cloud is that if we decrease the utilization rates than above utilization rates for all the three configurations then the public cloud will be more expensive that private cloud.

Finally, we can deduce or conclude that form the calculated results that it would be wise to build a private cloud than renting public cloud if we need 100% utilization for over 5 years as renting public cloud will be expensive than private cloud.

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