Understanding the Cost Computing in the cloud

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In this project, we are going to compare own created private cloud instances with public (Amazon EC2) cloud instances.
A public cloud consists of a service or set of services that are purchased by a business or organization and delivered via the Internet by a third-party provider.
A private cloud is essentially an extension of an enterprise's traditional datacenter that is optimized to provide storage capacity and processor power for a variety of functions.
Here, we have to find cost break down of private cloud and compare it with public (Amazon EC2) cloud. In this project, we did some experiment on different instances and found that private clouds are best to scale for larger data scale, while public clouds are best for small amount of data.

Public Cloud Instances GFLOPS(Amazon EC2)

In first bullet, we assumed 1 EC2 instance is 4.4 GFLOPs and accordingly we have to derive graph for GFLOPs versus Cost per hour for different instances of amazon EC2.

This is how we had calculated GFLOPs.

GFLOPs = ECU*4.4

And then we have cost per hour for each instance. So to find the value for 1 GFLOPs, we divided cost per hour to GFLOPs.

Table 1 depicts the value of cost per hour as given and GFLOPs are being calculated for each EC2 instances.

Instance Type	vCPU	Memory (GiB)	Storage (GB)	ECU	GFLOPS	Cost per hour ($)
t2.small	1	2	EBS	1	4.4	0.026
m3.large	2	7.5	1X32 SSD	6.5	28.6	0.14
c3.8xlarge	32	60	2X320 SSD	108	475.2	1.68
g2.2xlarge	8	15	60 SSD	26	114.4	0.65
r3.4xlrge	16	122	1x320 SSD	52	228.8	1.4
i2.8xlarge	32	244	8X800 SSD	104	457.6	6.82
hs1.8xlarge	16	117	24X2048	35	154	4.6

Table 1 Comparison between Amazon EC2 instances

Private Instances Requirements:

1. t2.small:

Device	Details	Cost
Chases	700 W- 2U Rackmount Server Case with Power Supply	$565
CPU	Intel Xeon E5-2670 v2 Ivy Bridge-EP 2.5GHz ,10 cores	$1534
Memory	Kingston 48GB (3 x 16GB) DDR3	$590
HDD	300 GB SSD	$393
Motherboard	Motherboard LGA 2011 Intel C604 DDR3 1600	$351
System Admin	120k * 5	$600000
System Power	700W	$4967
Cooling Power	115W	$816
Rack	25 u rack	$275
Network Switch	24LC-S Managed Switch	$436
Total Cost (5years)	100 GFLOPS	$ 609927
Unit Cost	Per Instance/hour	$13.92527201

2. m3.large :

Device	Details	Cost
Chases	700 W- 2U Rackmount Server Case with Power Supply	$565
CPU	Intel Xeon E5-2670 v2 Ivy Bridge-EP 2.5GHz , 10 cores	$1534
Memory	Kingston 24GB (3 x 8GB) DDR3	$354
HDD	100 GB SATA	$190
Motherboard	Motherboard LGA 2011 Intel C604 DDR3 1600	$351
System Admin	120k * 5	$600000
System Power	700W	$4967
Cooling Power	115W	$816
Rack	25 u rack	$275
Network Switch	24LC-S Managed Switch	$436
Total Cost (5years)	100 GFLOPS	$ 609488
Unit Cost	Per Instance/hour	$13.91524918

3. c3.8xlarge :

Device	Details	Cost
Chases	700 W- 2U Rackmount Server Case with Power Supply	$565
CPU	Intel Xeon E5- 2695 v3 14-Core Processor 2.3 GHz	$2340
Memory	Crucial 64GB (2 x 32GB) 240-Pin DDR3	$1084
HDD	320GB*2 SSD	$2500
Motherboard	Server Motherboard LGA 2011 R3	$270
System Admin	120k * 5	$600000
System Power	700W	$4967
Cooling Power	135W	$957.906
Rack	25 u rack	$275
Network Switch	24LC-S Managed Switch	$436
Total Cost (5years)	515.2 GFLOPS	$ 613394.82
Unit Cost	Per Instance/hour	$14.00444808

4. g2.2xlarge :

Device	Details	Cost
Chases	700 W- 2U Rackmount Server Case with Power Supply	$565
CPU	Intel Xeon E5-2670 v2 Ivy Bridge-EP 2.5GHz , 10 cores	$1534
GPU	NVIDIA Quadro K5000 4GB	$1700
Memory	Crucial 96GB (3 x 32GB) 240-Pin DDR3	$5100
HDD	600GB*2 SSD	$2500
Motherboard	Motherboard LGA 2011 Intel C604 DDR3 1600	$351
System Admin	120k * 5	$600000
System Power	822W	$5832
Cooling Power	115W	$816
Rack	25 u rack	$275
Network Switch	24LC-S Managed Switch	$436
Total Cost (5years)	2200 GFLOPS	$ 617669.5772
Unit Cost	Per Instance/hour	$14.10204514

5. r3.4xlarge :

Device	Details	Cost
Chases	700 W- 2U Rackmount Server Case with Power Supply	$565
CPU	Intel Xeon E5- 2695 v3 14-Core Processor 2.3 GHz	$2340
Memory	Crucial 128GB (4 x 32GB) DDR3	$4600
HDD	320GB*2 SSD	$2500
Motherboard	Server Motherboard LGA 2011 R3	$270
System Admin	120k * 5	$600000
System Power	700W	$4967
Cooling Power	135W	$957.906
Rack	25 u rack	$275
Network Switch	24LC-S Managed Switch	$436
Total Cost (5years)	515.2 GFLOPS	$ 616910.826
Unit Cost	Per Instance/hour	$14.08472205

6. i2.8xlarge :

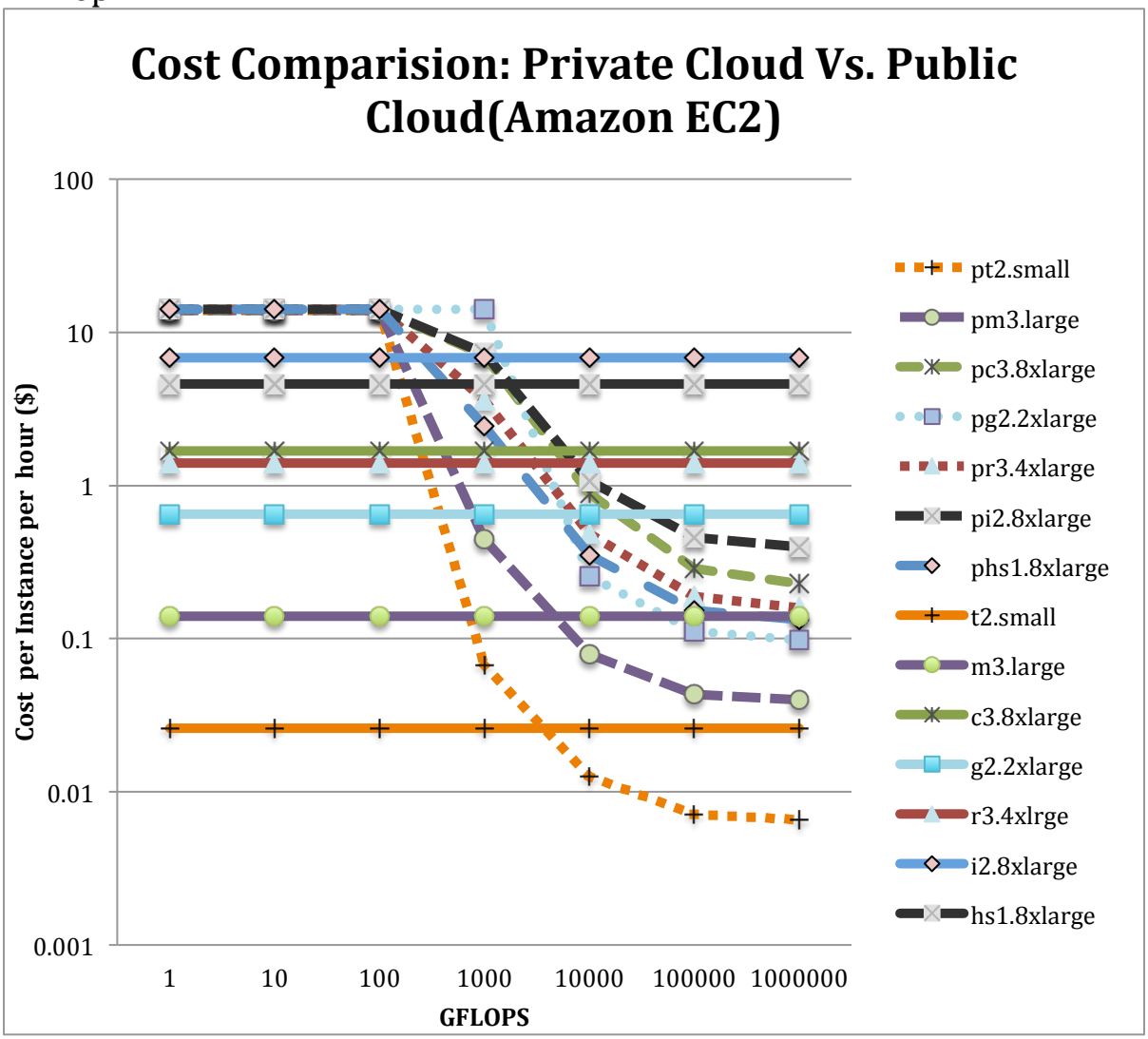
Device	Details	Cost
Chases	700 W- 2U Rackmount Server Case with Power Supply	$565
CPU	Intel Xeon E5- 2695 v3 14-Core Processor 2.3 GHz	$2340
Memory	Crucial 128GB (4 x 32GB) DDR3	$4600
HDD	800GB*8 SSD	$6424
Motherboard	Server Motherboard LGA 2011 R3	$270
System Admin	120k * 5	$600000
System Power	700W	$4967
Cooling Power	135W	$957.906
Rack	25 u rack	$275
Network Switch	24LC-S Managed Switch	$436
Total Cost (5years)	515.2 GFLOPS	$ 620834.826
Unit Cost	Per Instance/hour	$14.1743111

7. hs1.8xlarge :

Device	Details	Cost
Chases	700 W- 2U Rackmount Server Case with Power Supply	$565
CPU	Intel Xeon E5- 2695 v3 14-Core Processor 2.3 GHz	$2340
Memory	Crucial 128GB (4 x 32GB) DDR3	$6900
HDD	2048GB*24 HDD	$3120
Motherboard	Server Motherboard LGA 2011 R3	$270
System Admin	120k * 5	$600000
System Power	700W	$4967
Cooling Power	135W	$957.906
Rack	25 u rack	$275
Network Switch	24LC-S Managed Switch	$436
Total Cost (5years)	515.2 GFLOPS	$ 619830.826
Unit Cost	Per Instance/hour	$14.15138872

Plot #1 :

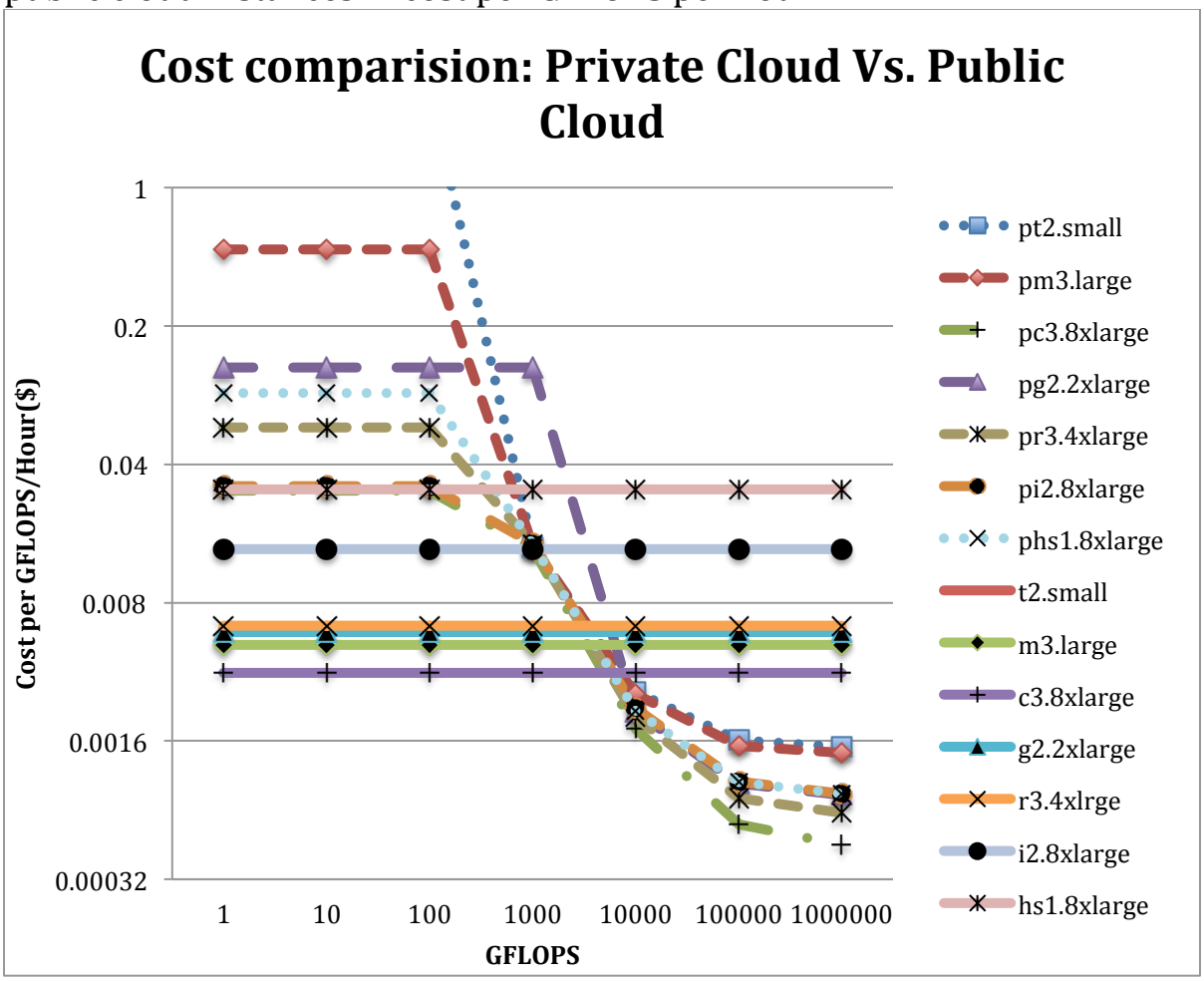
The graph shows the cost (in $) per instance per hour for 7 Amazon EC2 instance types vs. 7 private cloud equivalent instance types from 1GFlop to 1PFlop.



Plot1-A : Cost Comparison between Private Cloud and Public Cloud Instances(Cost per instance/hour)

As per above plot, we can see that for higher computing power(GFLOPS) private cloud has low cost then public cloud which have constant cost.
As per hardware selected for private cloud instances up to 100GFLOPS every instances have nearer to same cost because of scaling in number of instances. After some specific number of GFLOPS every private instance's cost become lower then it's equivalent public cloud instance. Now when computing power becomes >100TFLOPS cost for private instances become constant at some specific value.

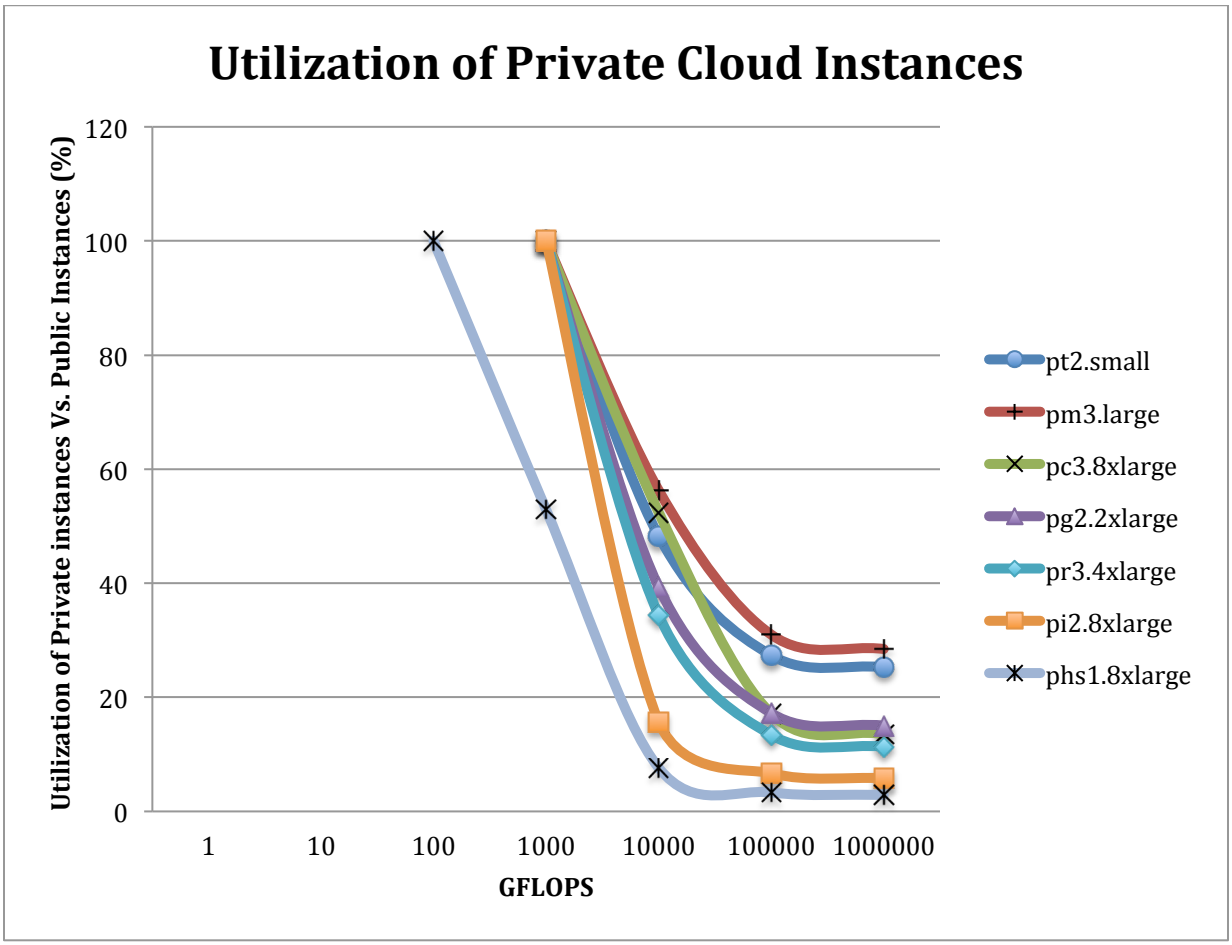
Another graph for cost comparison between private instances and public cloud instances in cost per GFLOPS per hour.



Plot1-B : Cost Comparison between Private Cloud and Public Cloud Instances(Cost per GFLOPS/hour)

Plot #2 :

The graph shows the utilization of private cloud from 1 GFLOPs to 1 PFLOPs.



Plot2 : Utilization of Private Cloud Instances (%)

As per above plot, we can define that for the private cloud cost utilization remains infinite up to when it cross cost of equivalent public cloud instance. At the point of meeting utilization becomes 100% . After whenever private instance's cost become lower it's utilization % also become less. Whenever it goes for higher computing power >100TFLOPS utilization becomes constant at some specific value.

Reference for Hardware :
[1] http://www.superbiiz.com/
[2] http://www.newegg.com/