Cost of Computing in the Cloud

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Please refer to "costcalc.xls" for formulas, calculations and references

1 Configuration 1: 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 (for pricing comparison, see S3)

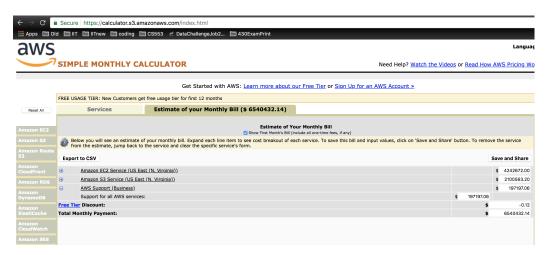
Cost of Private Cloud

	Description	Price per Item		Quantity	Tota	l Price(5Yrs)
Compute Servers	18 x 256KB L2 Cache 45MB L3 Cache LGA 2011-3 145W BX80660E52697V4 Server Processor	\$	10,878.20	1778.00	\$	19,341,439.60
Network Switches	(a) Mellanox Switch-IB 2 MSB7890 - switch - 36 ports - smart - rack-mountable(Qty 99) (b) Mellanox MSX6506-NR 108 port FDR capable modular chassis includes 4 fans and 2 (N+N) (Qty 18)	13959.99 , 21,435.00		99(36 Port), 18(108 port)	\$	1,767,869.01
Network Cables	7m (23ft) Cisco ONS-SC+-10G-CU7 Compatible 10G SFP+ Passive Direct Attach Copper Twinax Cable	\$	42.00	3560.00		\$149,520.00
Racks	Server Cabinet Enclosures, RACK-15, 42U,Adjustable mounting depth	\$	1,133.98	43	\$	48,761.14
Storage Servers	Dell 400-AJSC 600GB SAS Hard Drive Kit	\$	252.00	166667	\$	42,000,084.00
Electric Power	1400W High-efficiency AC power supply with Digital Switching Control & PMBus 1.2	9.47 cents/1kwh		1400 Watt	\$	10,331,958.00
Cooling	A server package rated at 1400 watts running at maximum would theoretically generate 4480 BTU/hr.	9.47 cents/1kwh		(OperatingHour* BTU per hour*0.293)/100 0	\$	3,025,181.96
Administration	Data Center Administrator(Lead , 2 senior , Associate)	\$	54,925.00	4	\$	1,098,500.00
TOTAL	N/A	N/A		N/A	77.76	4 Million

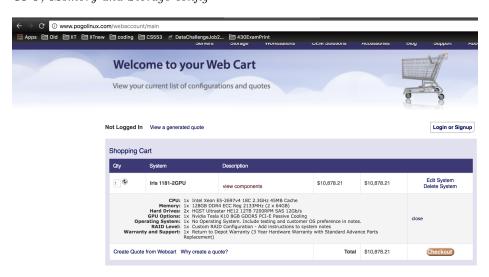
Cost of Public Cloud

	Description	Price per Item(Per month)	Quantity	Cost Per month	Total Price(5 Yrs)
Compute Servers	d2.8xlarge 36 244.0 HDD 24 x 2000 10 Gigabit	\$ 4,040.64	1050	\$ 4,242,672.00	\$ 254,560,320.00
Network Switches	N/A	N/A	N/A	N/A	N/A
Network Cables	N/A	N/A	N/A	N/A	N/A
Racks	N/A	N/A	N/A	N/A	N/A
Storage Servers	Amazon S3 Storage Classes	First 50 TB/ month \$0.023 / GB	100000000.00	\$ 2,100,563.20	\$ 126,033,792.000
Electric Power	N/A	N/A	N/A	N/A	N/A
Cooling	N/A	N/A	N/A	N/A	N/A
Administration	AWS Support Business			\$ 197,197.00	\$ 11,831,820.00
TOTAL	N/A	N/A	N/A		392.425932 Million

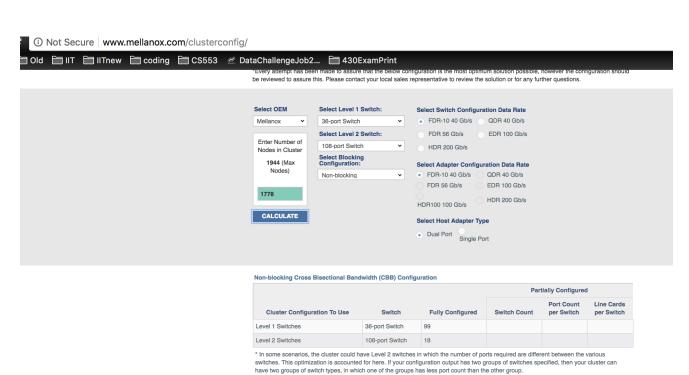
$AWS \ cost$



CPU, Memory and Storage config



Fat-Tree network Infiniband



Cables Required

Node to Level 1 Switch Cables 1778

Level 1 Switch to Level 2 Switch Cables 1782

Cable Media Type
Copper Optical/Fiber Both

List Cable Lengths (in meters)

All Selected

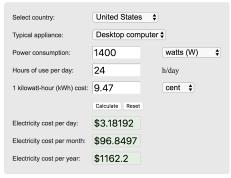


$Power\ usage$

Home > Calculators > Electrical Calculators > Electricity bill calculator

Electricity Bill Calculator

Electricity bill cost calculator. Electricity usage consumption calculator.



2 Configuration 2: 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 (for pricing comparison, see S3)

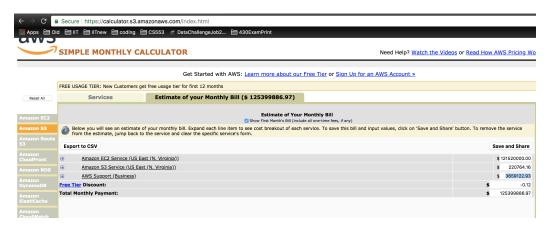
Cost of Private Cloud

	Description	Price per Item		Quantity	Total Price(5Yrs)
Compute Servers	Intel Xeon E5-2600 v4 Series Processor • Up to 512GB DDR4 2400MHz ECC Registered Memory • Dual Port Gigabit Ethernet • Supports 2x Double Width GPU's		.920.00	125000.00	\$ 1,115,000,000.00
	(a) Mellanox Switch-IB 2 MSB7890 - switch - 36 ports - smart - rack-mountable (b) Mellanox MCS7500 130Tb/s 648-port EDR InfiniBand chassis switch includes 20 fans and 10 power supplies (N+N) RoHS R6	13959.99 , 108,335.00		556*12.5(36 Port), 18*12.5(648 port) (Network can max support 10000 nodes	\$ 121,397,305.50
Network Cables	7m (23ft) Cisco ONS-SC+-10G-CU7 Compatible 10G SFP+ Passive Direct Attach Copper Twinax Cable	\$	42.00	250100.00	\$10,504,200.00
Racks	Server Cabinet Enclosures, RACK-15, 42U,Adjustable mounting depth	\$ 1,	,133.98	2977	\$ 3,375,858.46
Storage Servers	Dell 400-AJSC 600GB SAS Hard Drive Kit	\$	252.00	16667	\$ 4,200,084.00
Electric Power	1400W High-efficiency AC power supply with Digital Switching Control & PMBus 1.2	9.47 cents/1kwh		1400 Watt	\$ 726,375,000.00
Cooling	A server package rated at 1400 watts running at maximum would theoretically generate 4480 BTU/hr.	9.47 cents/1kwh		(OperatingHo ur*BTU per hour*0.293)/1 000	\$ 212,681,521.50
Administration	Data Center Administrator(Lead , 2 senior , Associate)	\$ 54,	,925.00	125	\$ 34,328,125.00
TOTAL	N/A	N/A		N/A	2.228 Billions

Cost of Public Cloud

Network Switches N/A N/A N/A N/A N/A Network Cables N/A N/A N/A N/A N/A N/A N/A Racks N/A N/A N/A N/A N/A N/A	291,200,000.00
Network Cables N/A N/A N/A N/A N/A Racks N/A N/A N/A N/A N/A	
Racks N/A N/A N/A N/A N/A	
Storage Servers Amazon S3 Storage Classes First 50 TB/ month \$0.023 / GB 10000000.00 \$ 220,764.16 \$ 3.00	
	13,245,849.600
Electric Power N/A N/A N/A N/A N/A	
Cooling N/A N/A N/A N/A N/A	
Administration AWS Support Business \$ 3,659,122.93 \$	219,547,375.80
TOTAL N/A N/A N/A 7.524 E	Billion

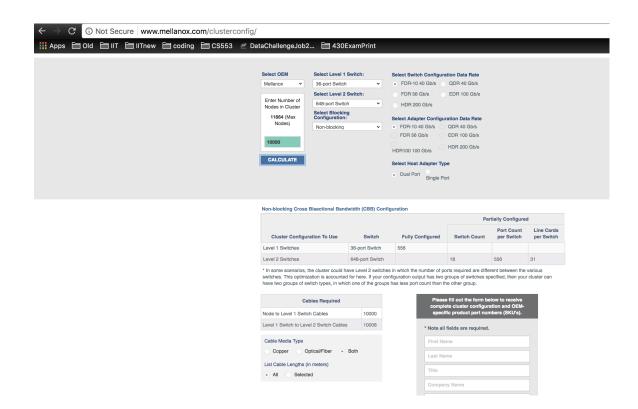
$AWS\ cost$



CPU, Memory and Storage config

Qty	Description	Unit Amount	Extended Amount
1	Iris 1181-2GPU	\$8,920.00	\$8,920.00
1 1 1 1 1	Intel Xeon E5-2600 v4 Series Processor Up to 5126B DDR4 2400MHz ECC Registered Memory Dual Port Gigabit Ethernet Supports 2x Double Width GPU's 3 x 3.5" Hot-swap Drive Trays Integrated IPMI 2.0-KVM with Dedicated LAN 1400W High Efficiency Power Supply Intel Xeon E5-2683v4 16C 2.1 GHz 40MB Cache 128GB DDR4 ECC Reg 2133MHz (2 x 64GB) Samsung 850 Pro 256GB 3D MLC SATA SSD 6Gb/s Nvidia Tesla K10 8GB GDDR5 PCI-E Passive Cooling No Operating System. Include testing and customer OS preference in notes. Custom RAID Configuration - Add instructions to system notes Return to Depot Warranty (3 Year Hardware Warranty with Standard Advance Parts Replacement)		
Total			
		Subtotal: Tax: Shipping Total:	TBD

 ${\it Fat-Tree\ network\ Infiniband}$

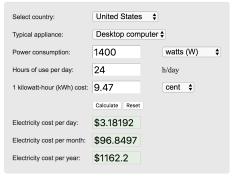


$Power\ usage$

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Electricity Bill Calculator

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Configuration 3: 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 (for pricing comparison, see S3)

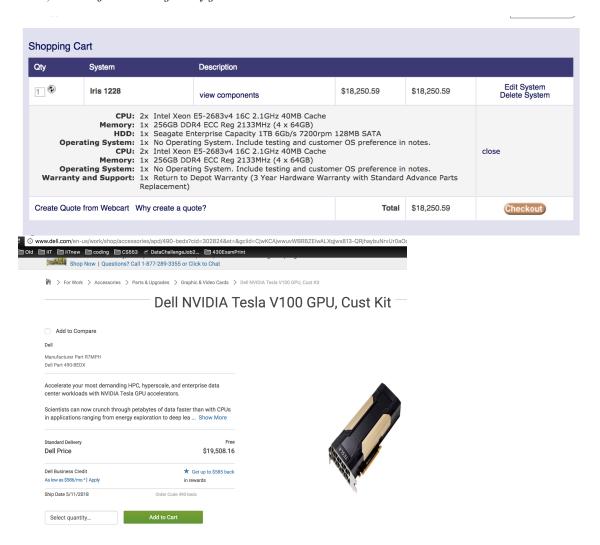
Cost of Private Cloud

	Description	Price per Item	Quantity	Total Price(5Yrs)
	Twin Node Server (1U) Each Node config	-		
	(CPU: 2x Intel Xeon E5-2683v4 16C 2.1GHz			
	40MB Cache , Memory: 1x 256GB DDR4 ECC			
	Reg 2133MHz (4 x 64GB)+Dell NVIDIA Tesla			
Compute Servers	V100 GPU, Cust Kit)	\$ 174,315.87	999.00	\$ 174,141,554.13
	(a) Mellanox Switch-IB 2 MSB7890 - switch -			
	36 ports - smart - rack-mountable(Qty 56) (b)			
	Mellanox MSX6506-NR 108 port FDR capable			
	modular chassis includes 4 fans and 2 (N+N)		56(36 Port),	
Network Switches	(Qty 18)	13959.99 , 21,435.00	18(108 port)	\$ 1,167,589.44
	7m (23ft) Cisco ONS-SC+-10G-CU7 Compatible			
	10G SFP+ Passive Direct Attach Copper			
Network Cables	Twinax Cable	\$ 42.00	2008.00	\$84,336.00
	Server Cabinet Enclosures, RACK-15,			
Racks	42U,Adjustable mounting depth	\$ 1,133.98	48	\$ 54,431.04
Storage Servers	Dell 400-AJSC 600GB SAS Hard Drive Kit	\$ 252.00	1667	\$ 420,084.00
	1400W High-efficiency AC power supply with			
Electric Power	Digital Switching Control & PMBus 1.2	9.47 cents/1kwh	1400+1400 Watt	\$ 11,610,328.05
	A server package rated at 1400 watts running		(OperatingHour*	
	at maximum would theoretically generate		BTU per	
	4480 BTU/hr.		hour*0.293)/100	
Cooling	4480 B10/III.	9.47 cents/1kwh	0	\$ 3,399,501.44
	Data Center Administrator(Lead , 2 senior ,			
Administration	Associate)	\$ 54,925.00	4	\$ 1,098,500.00
TOTAL	N/A	N/A	N/A	191.977 Million

 $Cost\ of\ Public\ Cloud$

	Description	Price per Item(Per month)	Quantity	Cost Per month	Total Price(5 Yrs)
Compute Servers	r3.large 2 15.2 SSD 1 x 32 Moderate	\$ 17,919.36	999	\$ 17,901,440.64	\$ 1,074,086,438.40
Network Switches	N/A	N/A	N/A	N/A	N/A
Network Cables	N/A	N/A	N/A	N/A	N/A
Racks	N/A	N/A	N/A	N/A	N/A
Storage Servers	Amazon S3 Storage Classes	First 50 TB/ month \$0.023 / GB	1000000.00	\$ 22,583.30	\$ 1,354,998.000
Electric Power	N/A	N/A	N/A	N/A	N/A
Cooling	N/A	N/A	N/A	N/A	N/A
Administration	AWS Support Business			\$ 544,620.72	\$ 32,677,243.20
TOTAL	N/A	N/A	N/A		1108.119 Million

CPU, Memory and Storage config

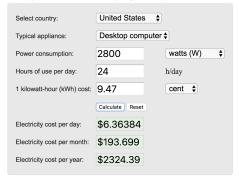


Fat-Tree network Infiniband

Select OEM	Select Level 1 Switch:		Select Switch Configu	uratio	n Data Rate		
Mellanox 🗸	36-port Switch	~	• FDR-10 40 Gb/s		QDR 40 Gb/s		
	Select Level 2 Switch:		FDR 56 Gb/s		EDR 100 Gb/s		
Enter Number of Nodes in Cluster	108-port Switch	~	HDR 200 Gb/s				
1944 (Max Nodes)	Select Blocking Configu	ration:					
, , , , , , , , , , , , , , , , , , , ,	Non-blocking	~	Select Adapter Config	guratio			
1000			• FDR-10 40 Gb/s FDR 56 Gb/s		QDR 40 Gb/s EDR 100 Gb/s		
			HDR100 100 Gb/s		HDR 200 Gb/s		
CALCULATE			HDH 100 100 Gb/s		HDH 200 Gb/s		
			Select Host Adapter 1	Гуре			
			Dual Port S	Single F	ort		
					Partially Configured		
Cluster Configu	ration To Use	Switch	Fully Configured		Switch Count	Port Count per Switch	Line Cards per Switch
Level 1 Switches	36-port	Switch	56				
Level 2 Switches	108-por	Switch			18	56	4
	luster could have Level 2 switches t has two groups of switches speci		ster can have two groups	of switc	h types, in which one of t	he groups has less po	rt count than the other
	Cables Required				out the form below to re and OEM-specific produ		
Node to Level 1 Switch Ca	ables	1000					
Level 1 Switch to Level 2 S	Switch Cables	1008	* Note	all fiel	ds are required.		
			Firs	t Name			
Cable Media Type							
Copper Op	tical/Fiber Both		Last	t Name			
List Cable Lengths (in me	eters)		Title				
All Selected	i						
				npany l	Nama		

$Power\ usage$

Electricity bill cost calculator. Electricity usage consumption calculator.



Summary

	Configuration 1(Million)	Configuration 2 (Billion)	Configuration 3 (Million)
Public Cloud (including EC2 and S3) Cost			
over 5 years, 24/7 operation, with 100%			
usage.	\$ 392.43	7.524	1108.119
Private Cloud cost over 5 years, 24/7			
operation, with 100% usage	\$ 77.76	2.228	191.977
What utilization must be achieved with the			
private cloud to make the private cloud			
option more attractive than the public			
cloud?	19.82%	29.61%	17.32%
	Private cloud only costs 19.82% of	Private cloud only costs 29.62%	Private cloud only costs 17.33%
Summary	AWS, Or if we need the resources for	of AWS, Or if we need the	of AWS, Or if we need the
Summary	small projects less than 11.9 months	resources for small projects less	resources for small projects less
		than 17.8 months	than 10.4 months