



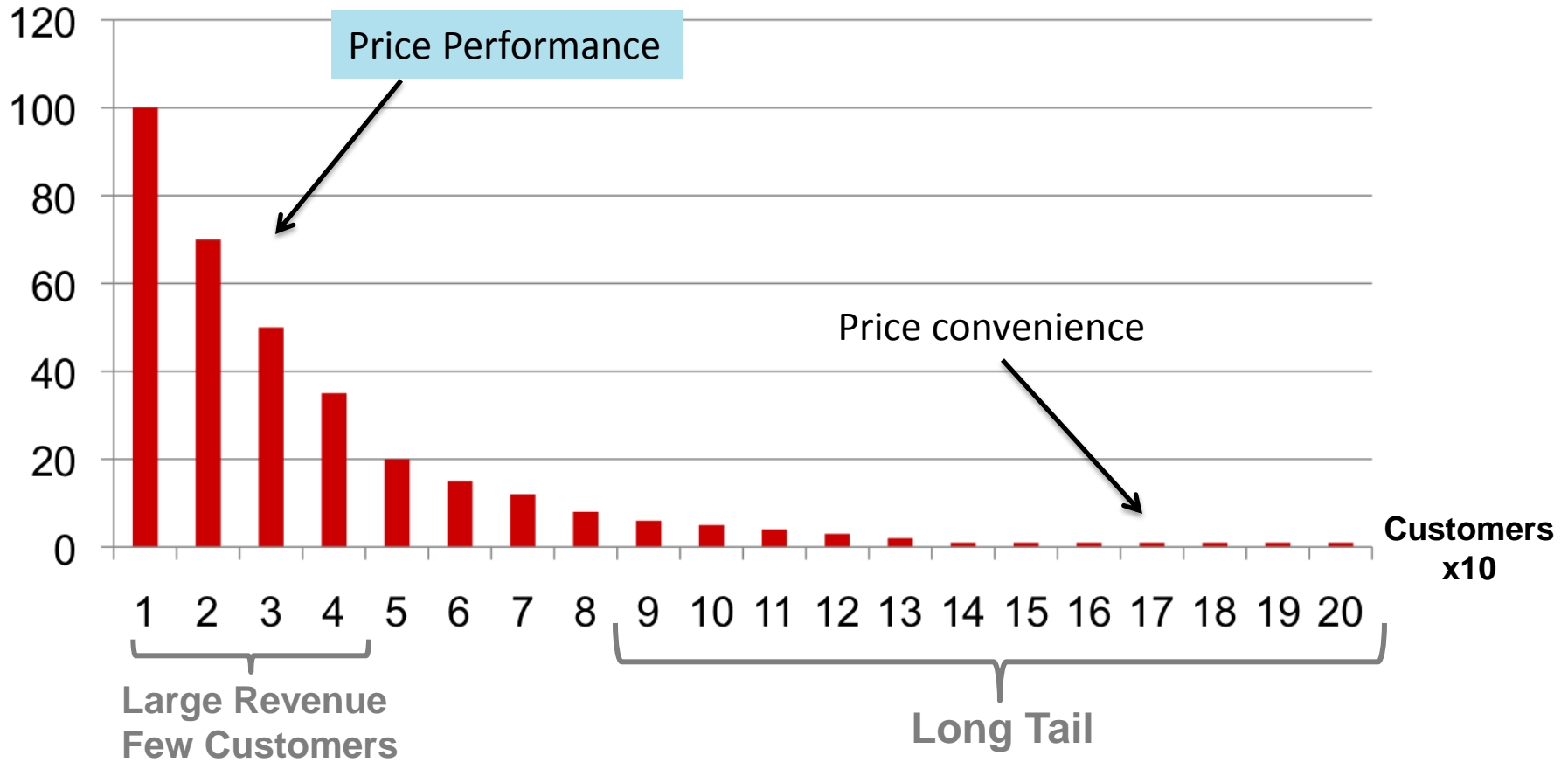
# Electronic Design in the Cloud: Lessons Learned

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# 80 – 20 Rule

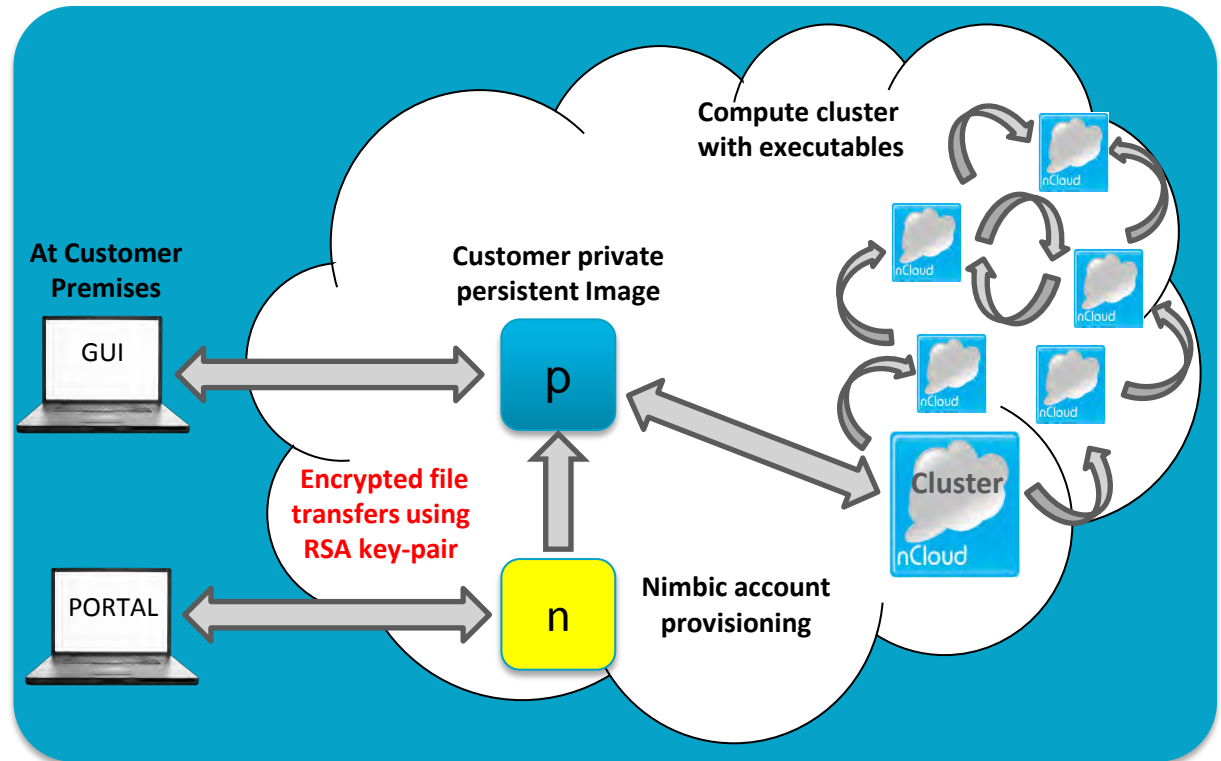
# Licenses



# So We Built...

## Geared towards performance

- Parallelism, allocates clusters up to 100's nodes
- VERY secure
- Flexible account provisioning, any business model



# Our Intended Customers

Rank 2011	Rank 2012	Vendor	2011 Revenue	2012 Revenue	2011-2012 Growth (%)	2012 Market Share (%)
1	1	Intel	50,669	49,089	-3.1	16.4
2	2	Samsung Electronics	27,764	28,622	3.1	9.5
6	3	Qualcomm	9,998	13,177	31.8	4.4
4	4	Texas Instruments	11,754	11,111	-5.5	3.7
3	5	Toshiba	11,769	10,610	-9.8	3.5
5	6	Renesas Electronics	10,650	9,152	-14.1	3.1
8	7	SK Hynix	9,388	8,965	-4.5	3.0
7	8	STMicroelectronics	9,635	8,415	-12.7	2.8
10	9	Broadcom	7,160	7,846	9.6	2.6
9	10	Micron Technology	7,643	6,917	-9.5	2.3
		Others	151,343	146,008	-3.5	48.7
		<b>Total Market</b>	<b>307,773</b>	<b>299,912</b>	<b>-2.6</b>	<b>100.0</b>

*Top 10 Semiconductor vendors, worldwide, 2012, in \$M*

*Source: Gartner (April 2013)*

# What They Told Us

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- Existing in-house resources can deliver same experience as cloud computing
- Cloud computing is less secure than on premises computing
- Cloud computing is inappropriate with large data sets
- Cost is higher
- The business model (on-demand) is a problem
- EDA Interactive graphics must be done locally

# In-House IT

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- Hard to get past this point – these resources already exist
- Need IT to champion cloud
- EDA won't move a company to the cloud - but it will follow as a company moves to the cloud

# Security

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- We believe that it can be made more secure than in house
- Need to consider legal aspects: liability, auditability, etc.
- Basically, it is a business risk and should be dealt with that way.

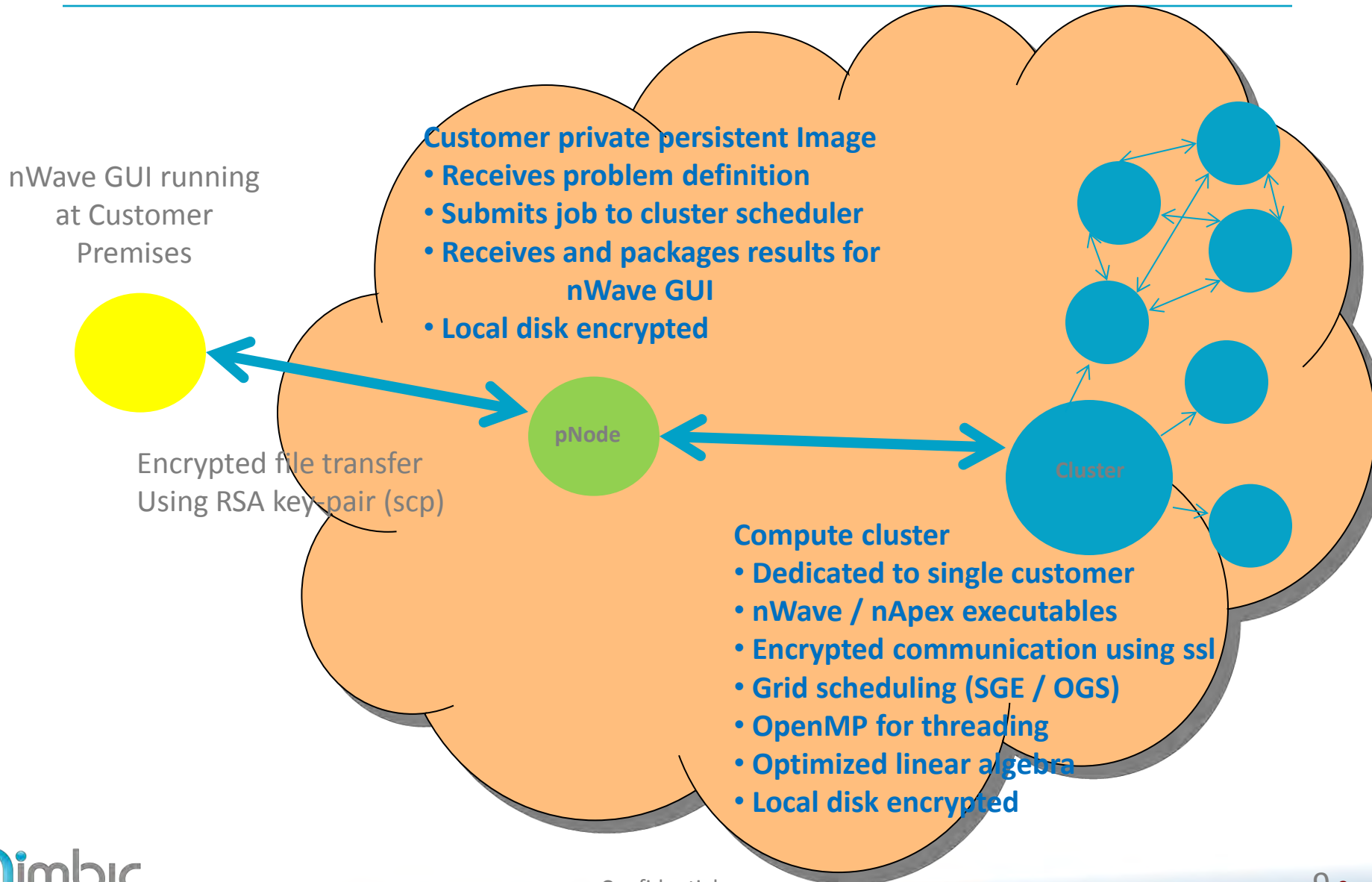
# Consider Cloud Security

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- As in any security protocol, **Keep it Simple**
  - Complexity is the enemy of security
- Three broad directives on Data to follow:
  - Keep data Isolated
  - Protect data at rest
  - Protect data in transit



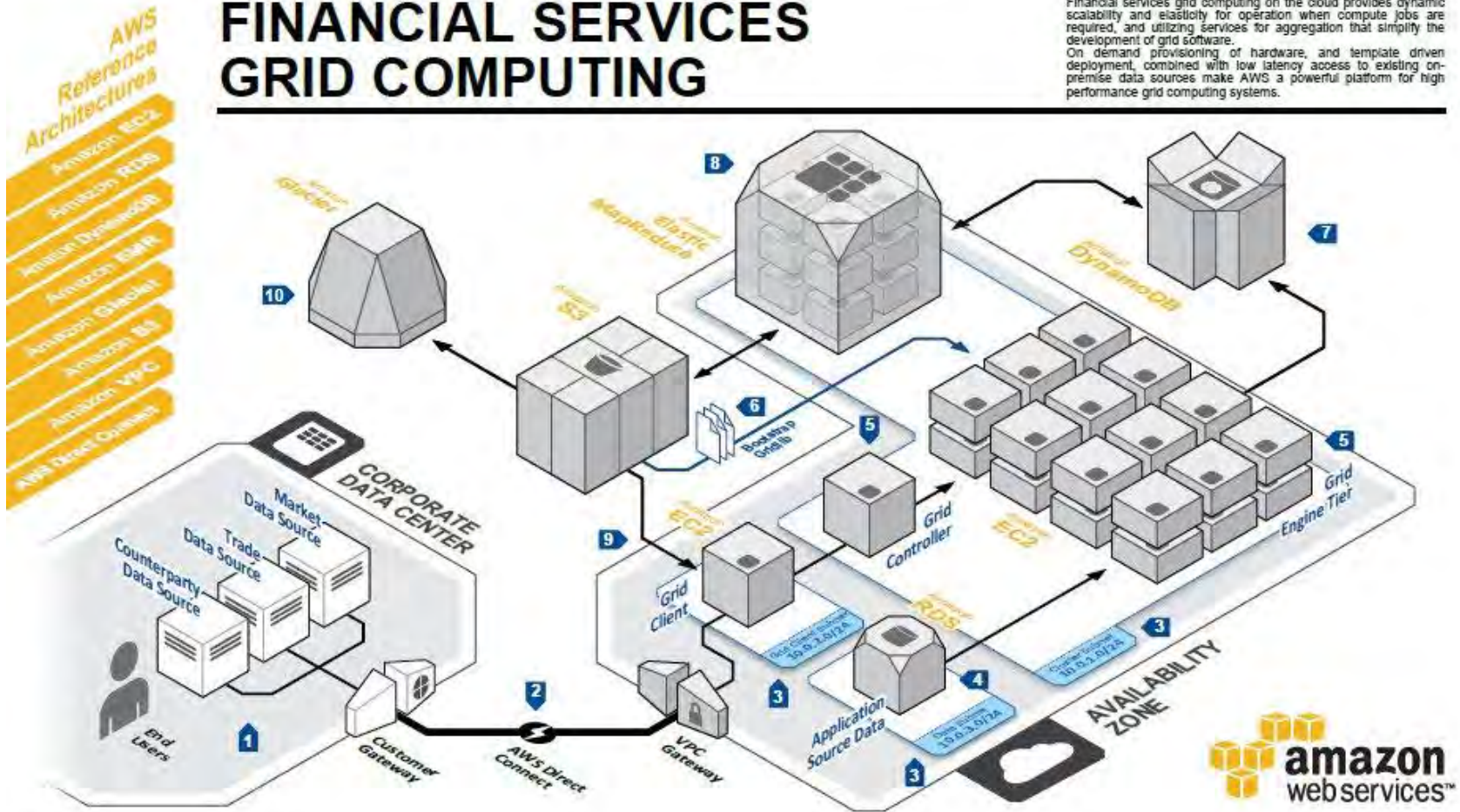
# On Amazon EC2



# A Similar Architecture

## FINANCIAL SERVICES GRID COMPUTING

Financial services grid computing on the cloud provides dynamic scalability and elasticity for operation when compute jobs are required, and utilizing services for aggregation that simplify the development of grid software. On demand provisioning of hardware, and template driven deployment, combined with low latency access to existing on-premise data sources make AWS a powerful platform for high performance grid computing systems.



Source: <http://aws.amazon.com/architecture/>

# Big Data

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- Human bandwidth is low, only need to support interaction at these rates
- Follow the same philosophy as that used for big data... keep the data cloud resident and bring computation to data
  - Avoid data round trips
- For 3D Wave solvers, all the large data is generated in the cloud.

# EM Simulation Data Transfer

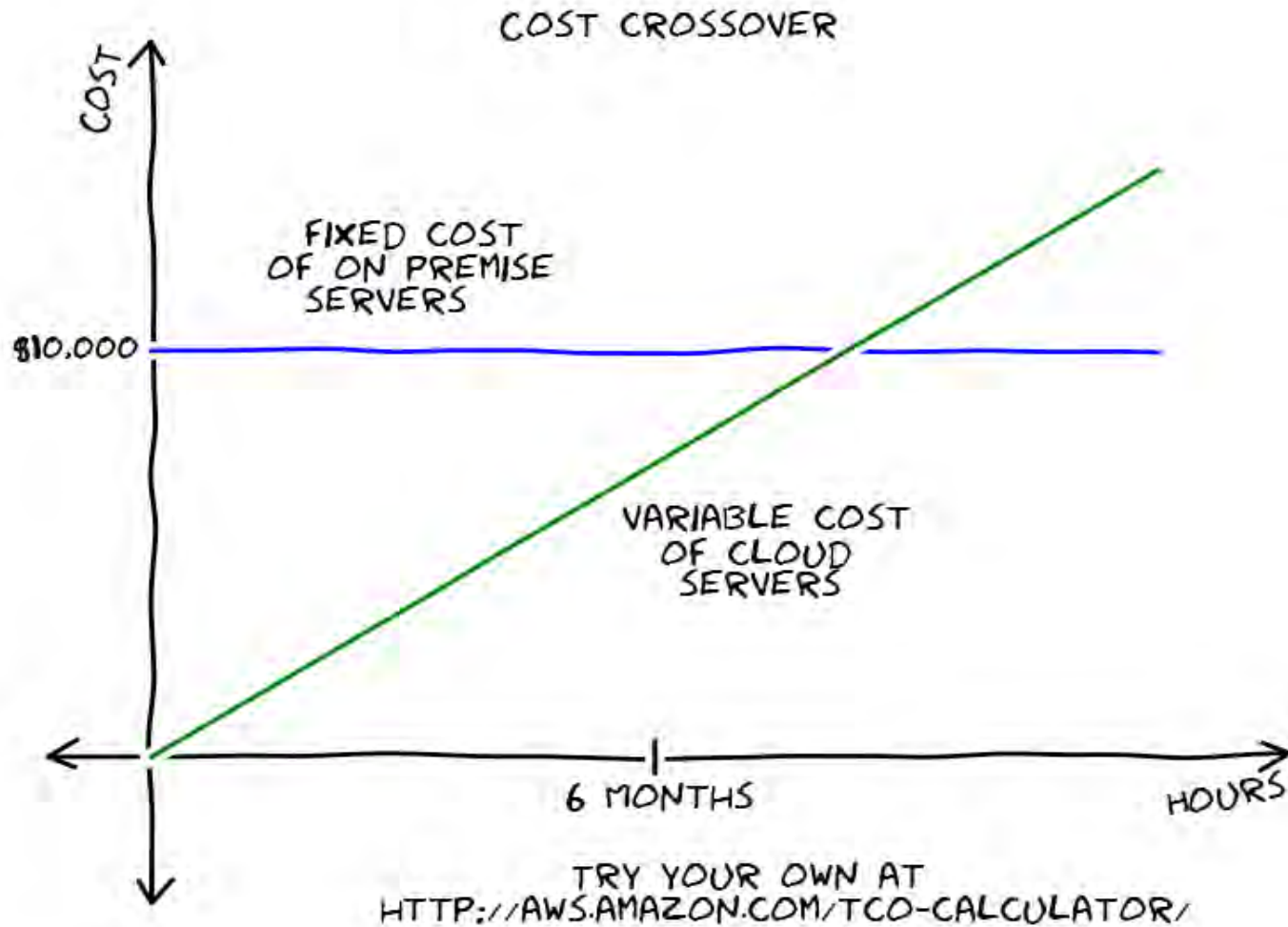


- We have also developed the infrastructure to easily add other EDA tools to nCloud

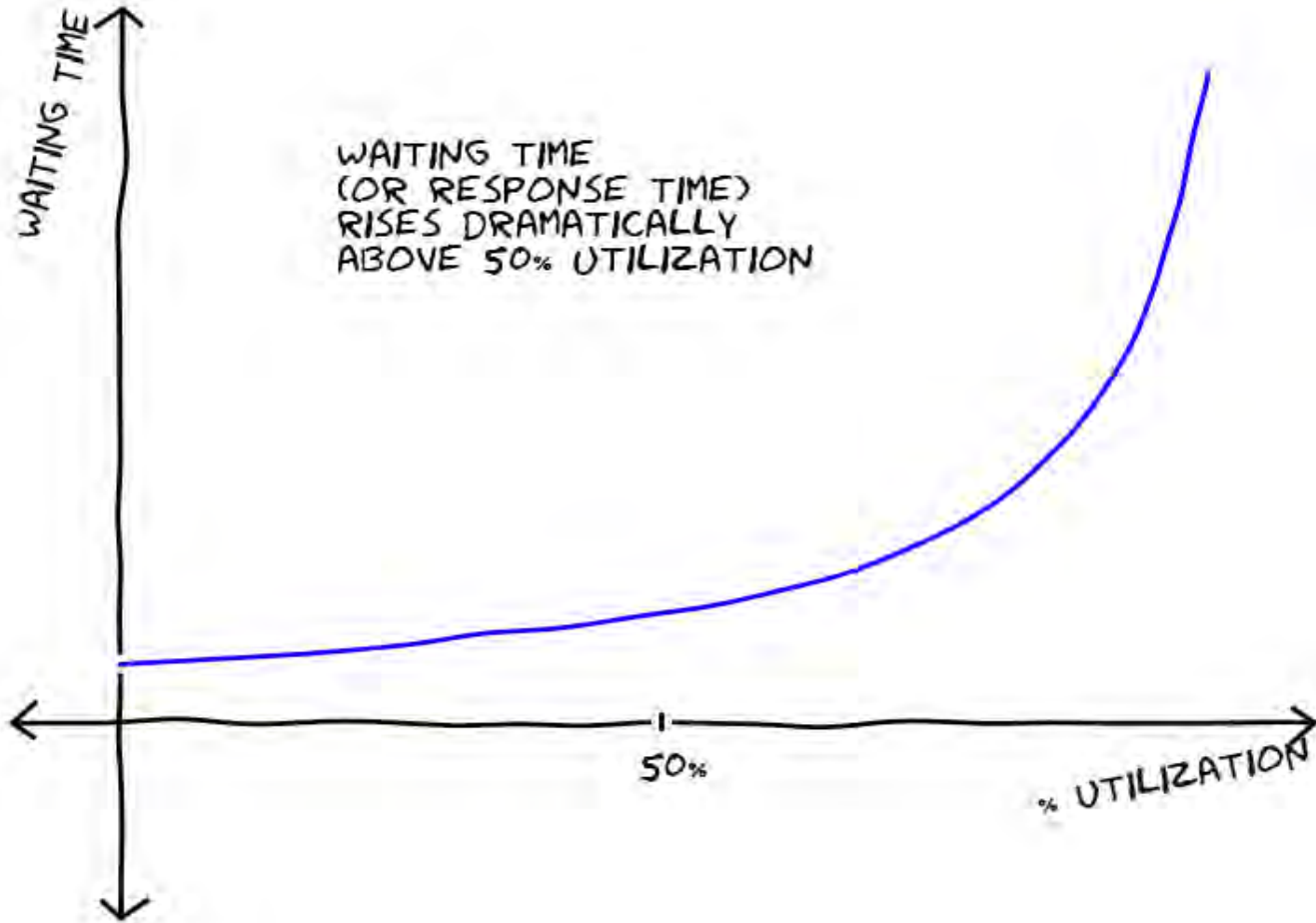
# EC2 On-Demand Pricing

HM Extra Large	m2.xlarge	17.1GB	6.5	2	420GB	64bit	\$0.410	\$0.570
HM Double Extra Large	m2.2xlarge	34.2GB	13	4	850GB	64bit	\$0.820	\$1.140
HM Quad Extra Large	m2.4xlarge	68.4GB	26	8	1690GB	64bit	\$1.640	\$2.280
M3 Extra Large	m3.xlarge	15GB	13	4	EBS only	64bit	\$0.500	\$0.980
M3 Double Extra Large	m3.2xlarge	17.1GB	26	8	EBS only	64bit	\$1.000	\$1.960
High CPU Medium	c1.medium	1.7GB	5	2	350GB	32/64bit	\$0.145	\$0.285
High CPU Extra Large	c1.xlarge	7GB	20	8	1690GB	64bit	\$0.580	\$1.140
Cluster Eight Extra Large	cc2.8xlarge	60.5GB	88	8x2	3370GB	64bit	\$2.40	\$2.97
High Mem Cluster 8 Extra Large	cr1.8xlarge	244 GB	88	2x8	240GB SSD	64bit	\$3.500	3.831
Cluster GPU Quad Extra Large	cg1.4xlarge	22GB	33.5	2x8	1690GB	64bit	\$2.100	2.600
High IO Quad Extra Large	hi1.4xlarge	60.5GB	35	16	2x1024GB SSD	64bit	\$3.100	3.580

# Crossover in Costs



# But Queuing Theory Says



# Business Model

- On demand = unpredictable costs?
  - Most budgets do not allow this
- Need subscriptions, with the compelling advantage of unlimited on demand usage

Term	1 year time	Cloud + burst	Pay as you go
Cost	\$50K / year	\$50K / year	\$15 / hr
Budgeting	Predictable	Predictable	Unpredictable
Flexibility	Low	High	High
Performance	Sequential	Parallel	Parallel



# Interactive Graphics

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- The Browser is the GUI
  - There is a sea-change underway to browser based GUIs, even for the desktop, which are enabled by...
- HTML 5
  - Targeted at video and graphics performance. Design driven by ability to run on 'weak' platforms (cell phones)
- WebGL
  - 3D graphics performance acceleration using GPU functionality
- No plugins.
- Server based architecture enables collaborative design

# Browser Based Interactive Graphics

The screenshot shows a web browser window titled "nWebApp - nWave" with the address bar displaying "192.168.183.129:8000". The browser's address bar also shows "Python Extension Pa..." and "Wikipedia, the free e...". The application interface is divided into several panels:

- Project Browser:** Located on the left, it shows a tree view of the project structure. The selected object is "Model".
- Object Browser:** Located on the right, it shows a list of objects in the 3D model, including Materials, Layers, Bond Wires, Solder Balls, Lead Frames, Vias, Nets, Pins, Pin Groups, Components, Ports, and Circuit Ports.
- 3D View:** The central area displays a 3D rendering of a PCB layout, showing various components and traces in a perspective view.
- Properties Browser:** Located at the bottom left, it shows "No selected object".
- Status Messages:** A table at the bottom left showing the progress of various tasks.
- Script Messages:** A panel at the bottom right showing the output of script commands.

The 3D view shows a complex PCB layout with various components and traces. The view is rendered in a perspective view. The status bar at the bottom of the 3D view shows the following coordinates and units:

Position: X:	-3.3088	Y:	0.48539	Z:	0.73152	Units:	Millimeters (mm)
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The Status Messages panel shows the following progress:

Status Messages	Progress
Loading 3D Layout	Done
Loading 2D Layout	Done
Finished Reading Project 'import_demo!'	Done
Finished Reading Simulation 'EXT-REF!'	Done
Finished Reading Solver Data File.	Done
Finished Creating the Core Solver.	Done

The Script Messages panel shows the following output:

```
layoutoptions.getUnitString() # Millimeters (mm)
layoutoptions.getUnitMultiplier() # 0.001
mode4.isUndoAvailable() # True
mode4.isRedoAvailable() # False
layoutoptions = mode4.getLayoutOptions()
layoutoptions.getUnitString() # Millimeters (mm)
layoutoptions.getUnitMultiplier() # 0.001
mode4.isUndoAvailable() # True
mode4.isRedoAvailable() # False
```

# Conclusions: Nimbic Lessons Learned

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- For large enterprises what can Cloud deliver?
  - + Performance / Parallelism
  - + Uniform Deployment
  - + Flexibility, unlimited resources, fast provisioning
  - EDA is the tail, we'll move when the dog does.
- For the long tail (small companies)
  - + Convenience
  - + Price, business model, etc. everything cloud
  - Support model

# Conclusions: Nimbic Lessons Learned

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- Important Technical Issues for EDA
  - Remote graphics
    - Must pay close attention to the partitioning between client and server.
  - Open stack – a standard architecture is emerging
    - Internal clouds can reduce (but not eliminate!) management costs
    - One compute model for internal / external compute
  - Overall compute model moving to the cloud
    - Flexibility, cost reduction, uniform deployment, and delivering performance based on parallelism.