

CS5412: THE CLOUD VALUE PROPOSITION

Lecture XXII

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Cloud Hype



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- The cloud is cheaper!
- The cloud business model is growing at an unparalleled pace without any limit in sight
- In the future everything will be on the cloud

... can we find evidence to support, or refute, such claims?

Crossing the Chasm

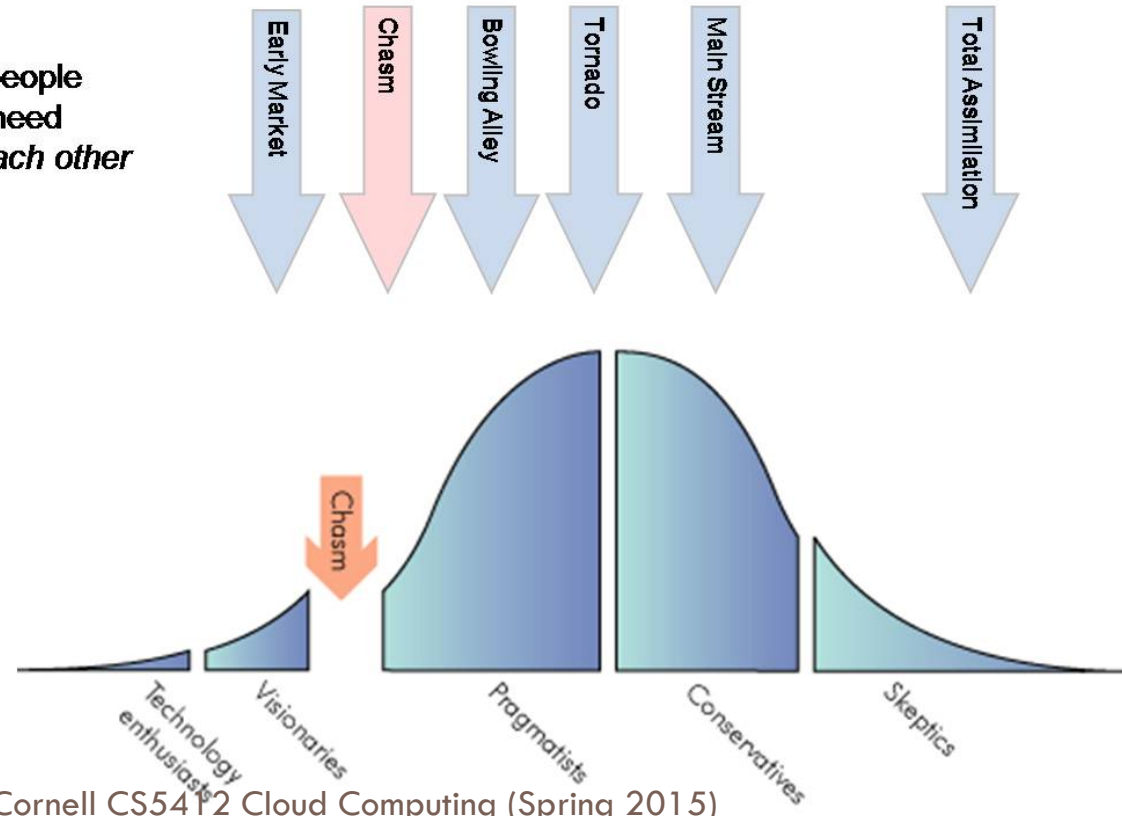
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□ Insight from Geoff Moore

Six phases of market development

Market

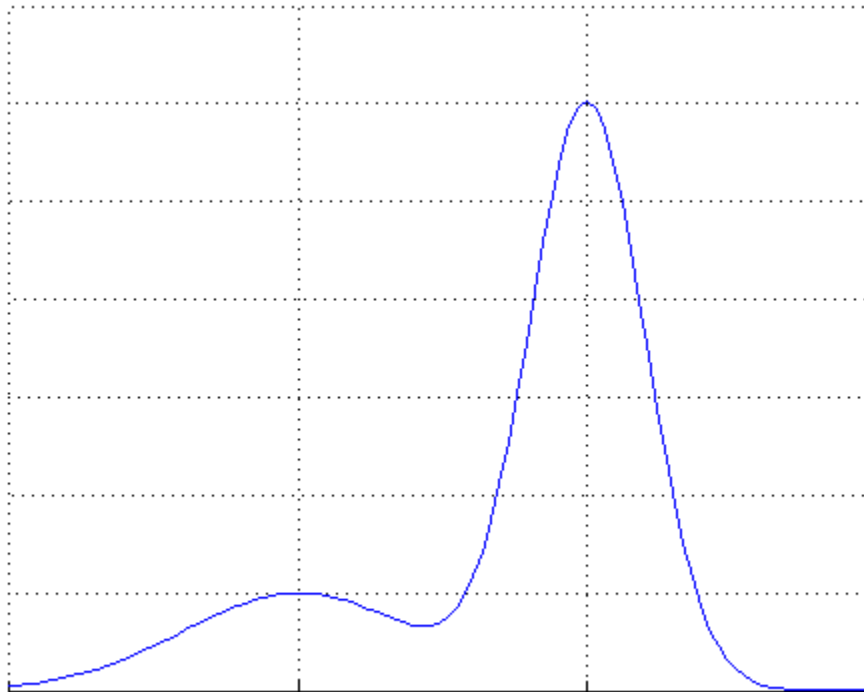
1. Group of people
2. Common need
3. Refer to each other



How does the revenue picture look?

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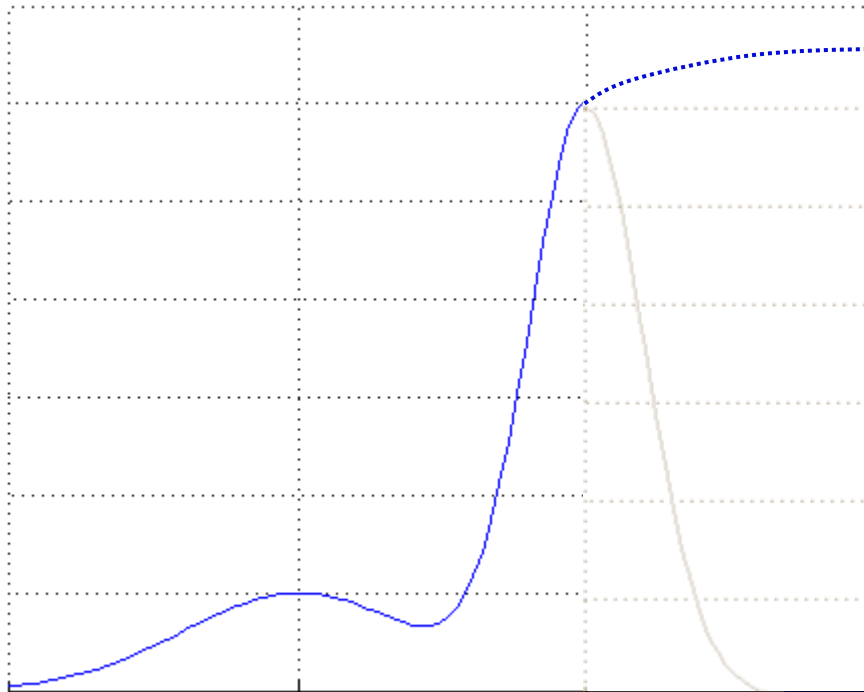
- One-time purchases



How does the revenue picture look?

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- “Recurring” revenue: vendor keeps getting paid



Why are these relevant?

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- Moore was talking about “old tech”.
- Do cloud solutions need to cross the same chasm?
 - ▣ Are there ways in which the cloud chasm is different?
 - ▣ Centers on whether cloud revenue/expenses are similar
- Do cloud solutions have revenue cycles?
- Cloud solutions often use existing components. Does this change anything compared to the past?

But many cloud solutions are free!

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- Who pays for a “free” app?
 - ▣ Some games have advertising but many apps don't
 - ▣ So what's the interest in having the app?
- Even more extreme: Who pays for LinkedIn?
 - ▣ Huge number of users so it must cost a lot to run
 - ▣ Yet no advertising and the site is free
 - ▣ They charge companies for “head hunting” but this can't be a huge revenue stream: how often do people change jobs?

... and the answer is?

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- LinkedIn exists to either be acquired, or to eventually change its revenue model using ads
 - ▣ In the “eventually profitable” case, the company would be sustained by venture capital in the interim period
 - ▣ Then an IPO lets the company cash in on its “value”

- But what does “value” ultimately mean if the company sells a product that doesn’t really create revenue at all?

Factors to consider

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- Who pays...
 - ▣ To develop the system?
 - ▣ To use the system?

- Why will it be in *their interest* to pay?

- How expensive is a cloud system to build and operate? Is the answer very different compared with old-school approaches

... things we pay for

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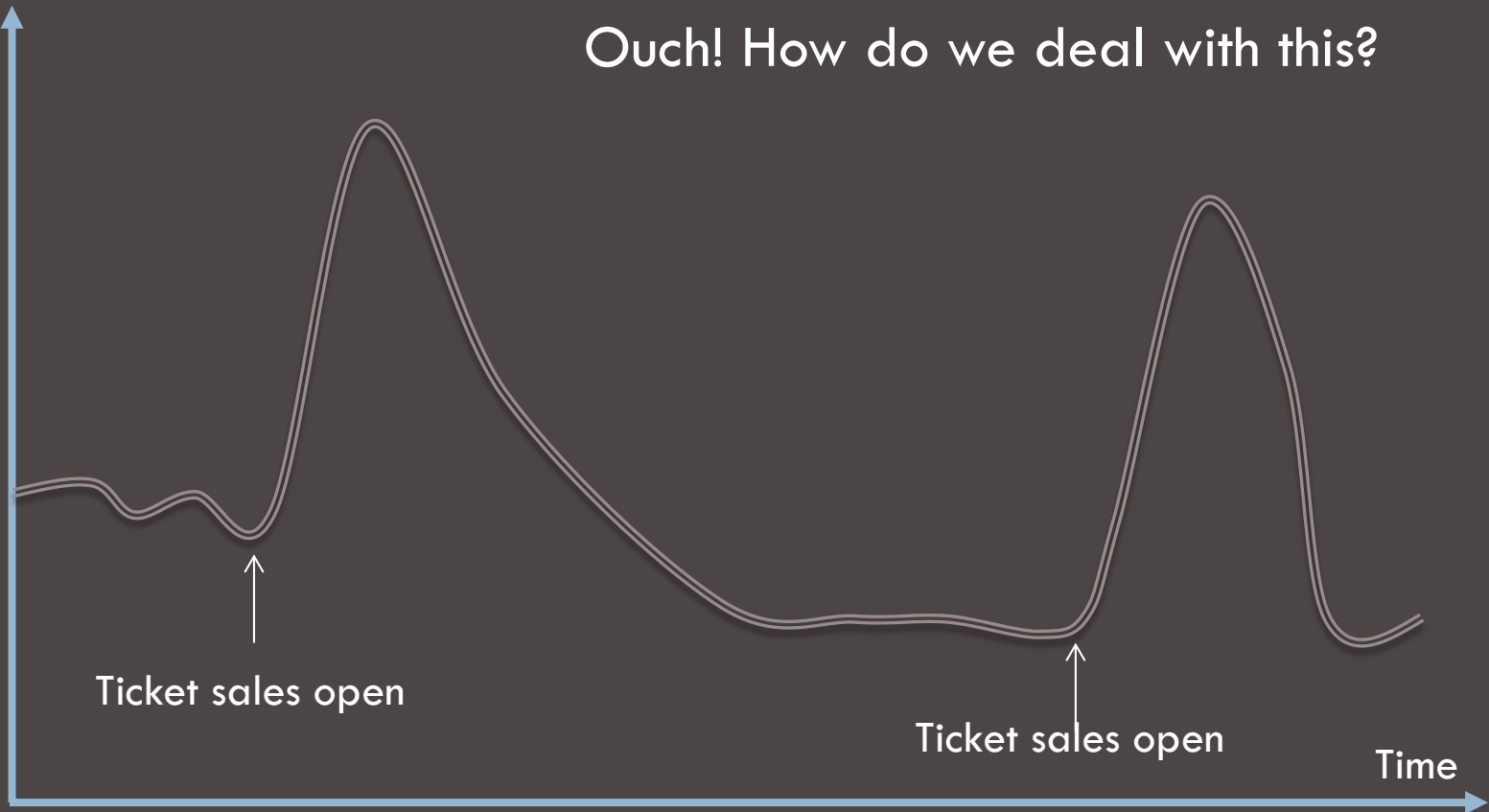
- People to write the code
 - ▣ Do we need more or fewer in the cloud? (Fewer: they ideally work by integrating powerful existing stuff)
- Places to run the code on
 - ▣ Cloud: Rent what you need, when you need it
- People to operate the hardware
 - ▣ Cloud: Amortized over many customers, hence cheaper

Coping with Demand Bursts

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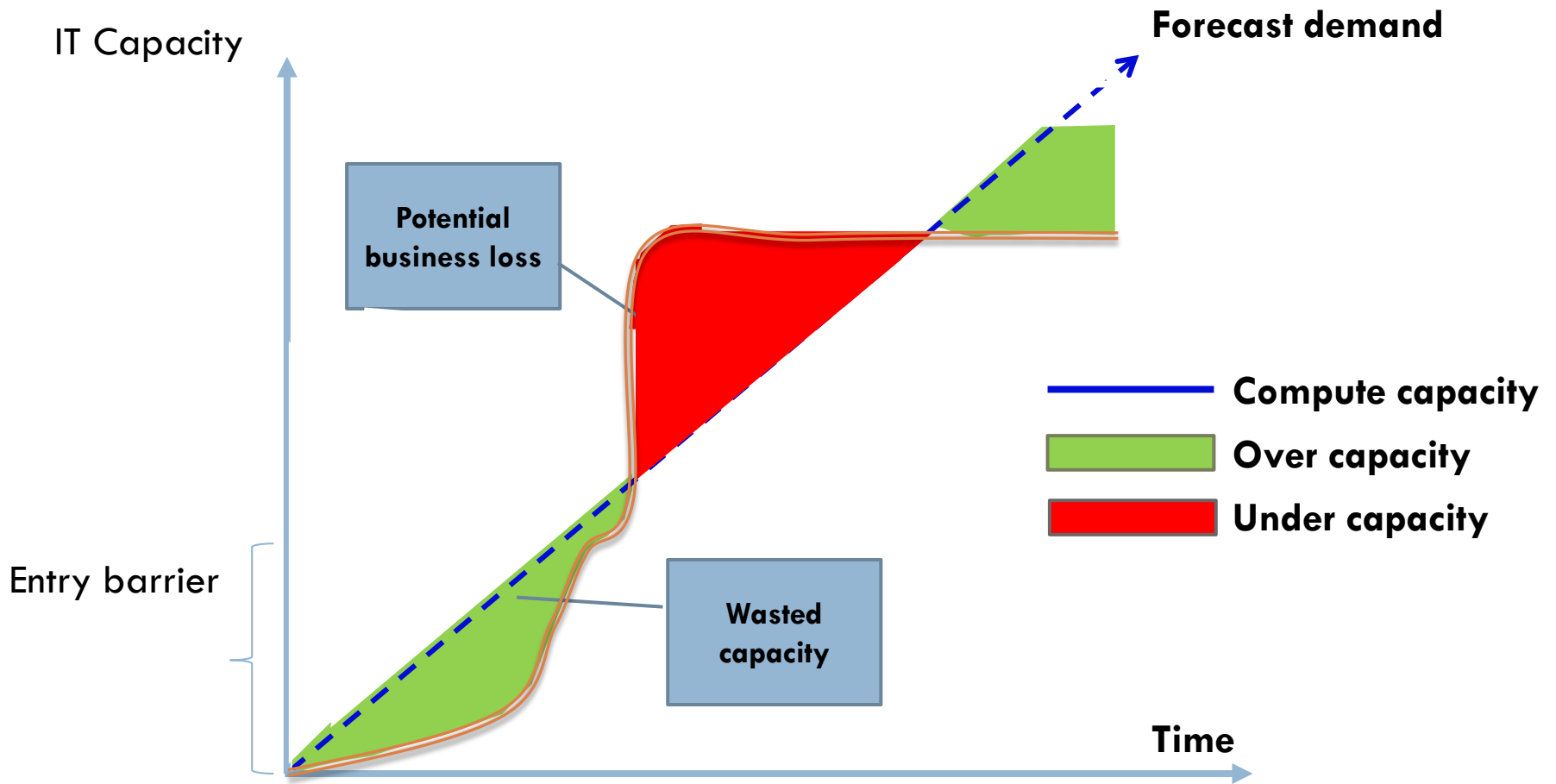
Demand

Ouch! How do we deal with this?



Managing Demand

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IT Agility

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- How quickly can you
 - ▣ Scale up the infrastructure and applications?
 - ▣ Upgrade to the latest OS?
 - ▣ Respond to a company merger with new requirements for business process and IT capacity?
 - ▣ Respond to a divestiture

Cloud Computing and IT Agility

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- Shared, multi-tenant environment: costs shared!
- Pools of resources: enables dynamic applications
 - ▣ Resources can be requested as required
 - ▣ Pay as you go

- Available via the Internet
 - ▣ Works anywhere with a connection (but only with connections that are fast enough and stable)
 - ▣ Private clouds can be available via private WAN or by using encryption for tunnels on the public WAN

Pulling these threads together

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- We can see that yes, the cloud *does* change the landscape in ways that matter
 - ▣ It enables new kinds of businesses (like Facebook)
 - ▣ But it also enables small startups that could never have been successful, at all, in the past!
 - ▣ The reuse of technology is central to this change, but in addition there are exciting aspects tied to new capabilities. So the picture is a little confusing: the game isn't the same, but on aspects that *are* the same, the cloud also changes the costs

Technologies and monetization

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- Fundamentally, a technology *must be profitable to survive*.
 - ▣ Better technologies often fail
 - ▣ The technology everyone buys wins. Then eventually it might acquire features from the losing solutions

- Moreover, the income story needs to “scale”

Two more examples. Who wins?

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- Company A has an amazing technology but you need to be an expert to use it.
 - ▣ So they hire and train experts of their own
 - ▣ When you buy their package they do the work for you

- Company B has a less amazing technology but it just installs itself and works
 - ▣ No need to hire experts
 - ▣ Just buy as many user accounts as you need

Theil (Stanford)

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- *Better doesn't always win!*
- In addition to incorrectly assuming that better technology wins over inferior technology, people often confuse competition with competitive success
- In effect: the best position to be in is to create your own niche and operate it as a mini-monopoly!
 - Hence first to dominate the niche wins!

Theil (Stanford)

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- ... And winners get better over time!
 - ▣ Aggressive competition often *drives pricing down*
 - ▣ Much better to be the owner of a unique niche: sole provider of such-and-such a must-have application
 - You can charge higher prices (although not *too high* or competitors move in aggressively). So profit margins will be sharply higher
 - You become a must-be-there platform for advertising aimed at your class of clients, bringing you revenue

Key insight

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- Company A will eventually be limited by the number of experts it can actually hire & train
 - ▣ So after a period of growth it will stall
 - ▣ The revenue stream peaks and this chokes investment in the evolution of the product
 - ▣ Ultimately, company A will either fail or at least reach some sort of saturation point
- Company B sees no end in sight and the money pours in
 - ▣ This allows B to invest to improve its technology
 - ▣ Eventually it will catch up with A on features

Applied to cloud computing?

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- We need to ask which stage of the cloud we've reached!
 - ▣ But one complication: it isn't just "one" cloud
 - ▣ The cloud is a "sum" of multiple business stories/models
- Early business of the cloud was the initial Internet boom (it gave us pets.com and similar web sites)
 - ▣ Only a few survived, like Amazon.com, Expedia
 - ▣ Winning wasn't easy for them or much fun!

Waves of the cloud revolution

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- Early web browser stage
 - ▣ Search and advertising (Google)
 - ▣ Social Networking (Facebook, Twitter)
 - ▣ Cloud as your “home”: AOL, Yahoo!, MSN, Google
- Emergence of true web services model
 - ▣ Infrastructure as a service (“rent a VM”) Apps (Apple)
 - ▣ Frames, full cross-site federation
 - ▣ Full-featured scripting languages (Javascript, Caja, Silverlight, Adobe Flash...)
- What next?

Each has its own revenue model!

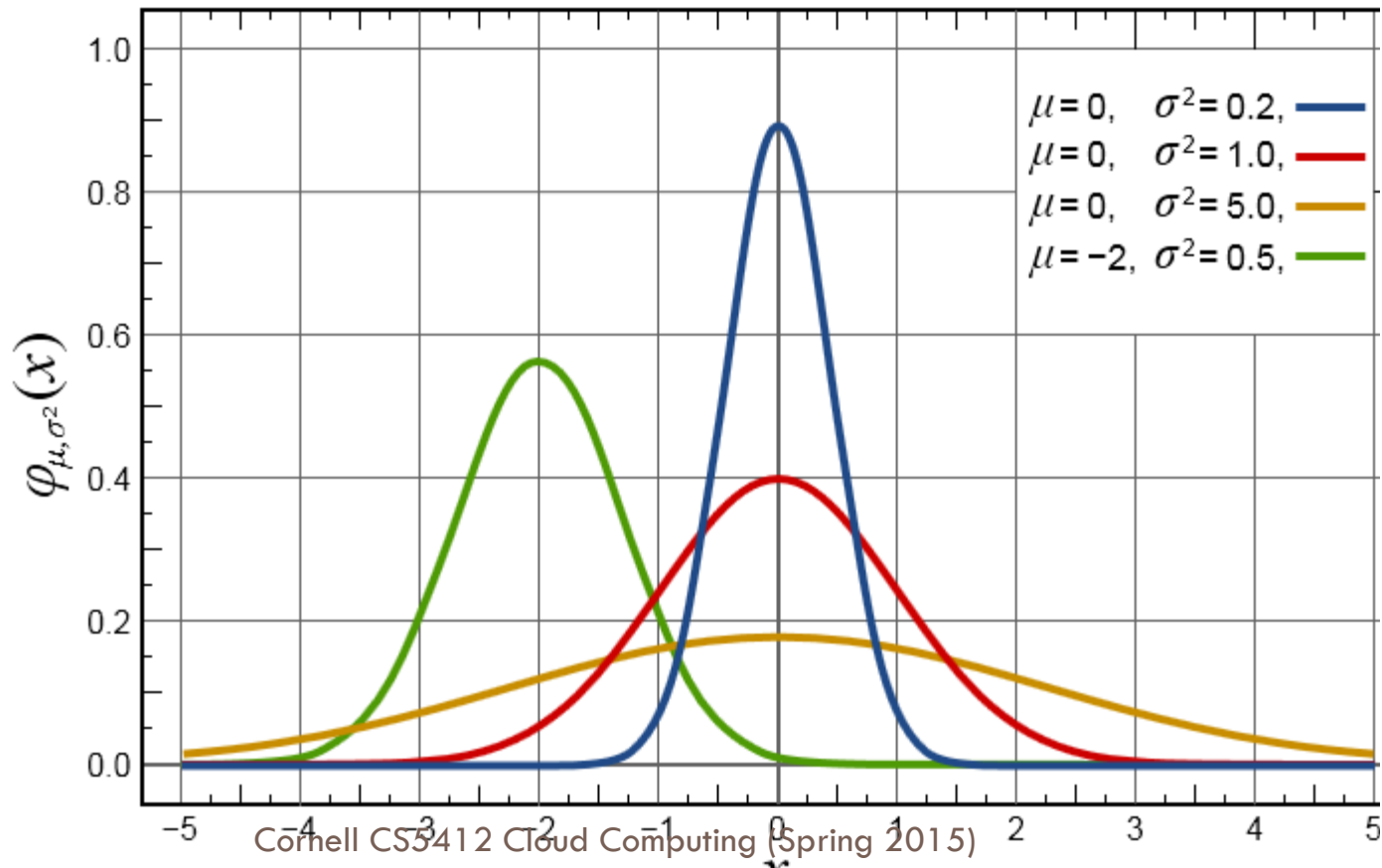
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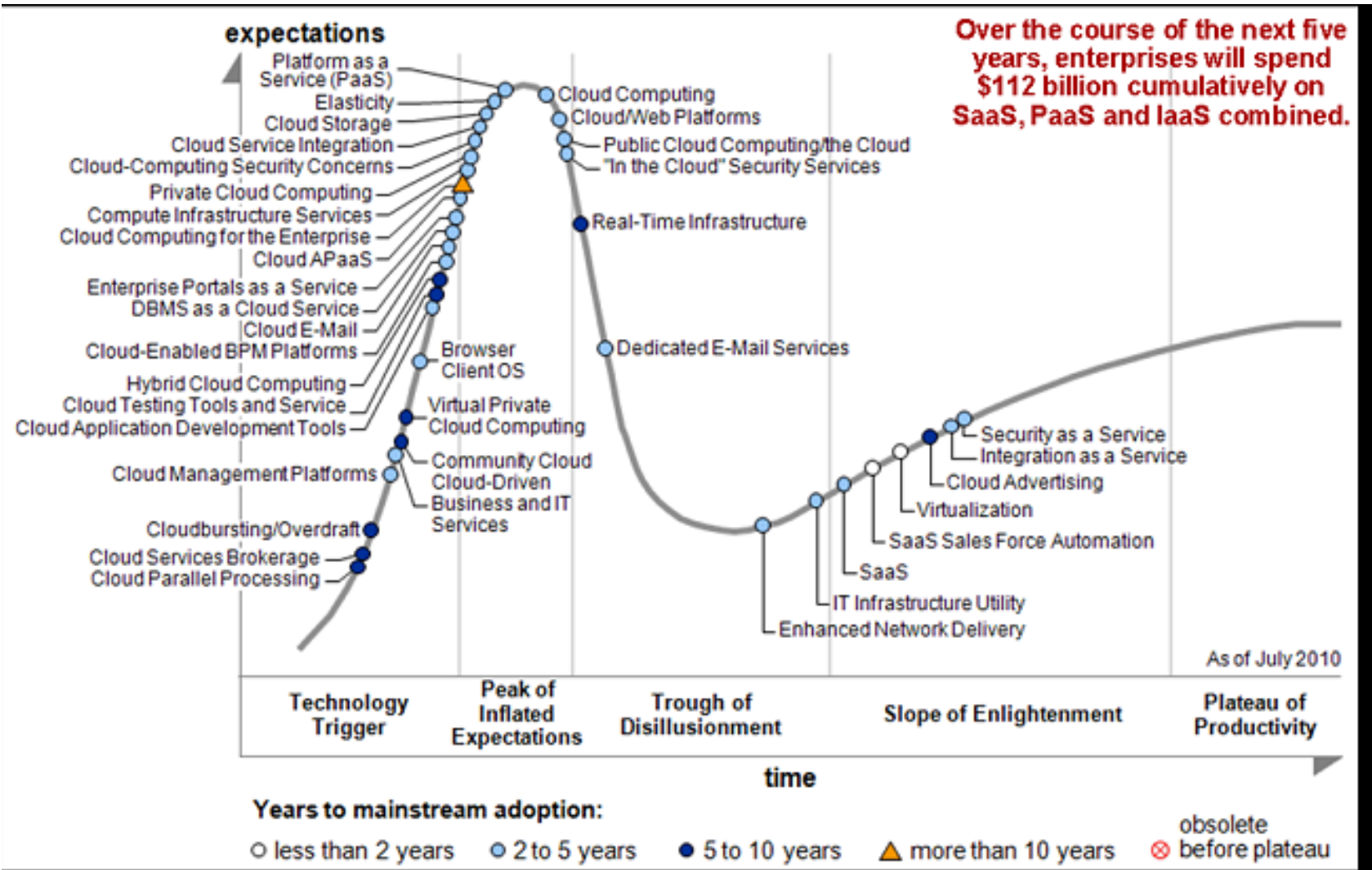
- For each style of web solution need to ask what monetizes that model!
 - ▣ Google and Facebook make their money on advertising
 - ▣ Microsoft combines technology license revenue with advertising, but earns much more on technology
 - ▣ Apple earns money on every App
 - ▣ Amazon sells stuff but also runs massive data centers really well, and rents space on those
 - ▣ Infosys does rote tasks incredibly well and incredibly cheaply (because most of their employees earn \$6,500/yr)
- Following the money is the key to understanding what directions each will follow

So the cloud is a sum of stories

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- Many of these revenue stories “superimposed”





Inescapable Conclusion?

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- **While the cloud enables new models and new kinds of computing stories, it doesn't really eliminate the need to create value.**
- **Some of today's cloud computing stories will probably fail as business models**
- **Wallstreet may not realize this, yet!**

The terms have too many meanings!

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- Everyone talks about cloud computing but there is very little consensus on what cloud computing means
 - ▣ We've studied it all semester now
 - ▣ But the cloud brings together a lot of technologies that each do very different things
- Best definition so far is basically:
 - ▣ *A style of computing that makes extensive use of network access to remote data and remote data centers, presented through web standards.*
 - ▣ But this is so general it says almost nothing!
- Can we be more concrete and tie this back to the business models that matter?

What is a Cloud Platform?

Some defining characteristics

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- It lets developers create and run apps, store data, and more
- It provides self-service access to a pool of computing resources
- It allows granular, elastic allocation of resources
- It allows charging only for the resources an application uses

Public Clouds and Private Clouds

Typical definitions

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- **Public cloud:** A cloud platform run by a service provider made available to many end-user organizations
- **Private cloud:** A cloud platform run solely for a single end-user organization, such as a bank or retailer
 - The technology can be much like public clouds, but the economics are different
- **Most organizations will probably use some hybrid of both**

Cloud Platform Technologies

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- The most important today:
 - ▣ Computing
 - Infrastructure as a Service (IaaS)
 - Platform as a Service (PaaS)
 - ▣ Storage
 - Relational storage
 - Scale-out storage
 - Blobs

- There are many more
 - ▣ Messaging, identity, caching, ...

Computing

Infrastructure as a Service (IaaS)

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- Developers create virtual machines (VMs) on demand
 - ▣ They have full access to these VMs
- Strengths:
 - ▣ Can control and configure environment
 - ▣ Familiar technologies
 - ▣ Limited code lock-in
- Weaknesses:
 - ▣ Must control and configure environment
 - ▣ Requires administrative skills to use

Computing

Platform as a Service (PaaS)

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- Developers provide an application, which the platform runs
 - ▣ They don't work directly with VMs
- Strengths:
 - ▣ Provides higher-level services than IaaS
 - ▣ Requires essentially no administrative skills
- Weaknesses:
 - ▣ Allows less control of the environment
 - ▣ Can be harder to move existing software

Computing

What's the most popular approach?

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- IaaS is more widely used today than PaaS
 - Gartner estimates that public IaaS revenues are significantly greater than public PaaS revenues today
- Perspective:
 - IaaS is easier to adopt than PaaS
 - IaaS emulates your existing world in the cloud
 - Over time, PaaS is likely to dominate
 - PaaS should have an overall lower cost than IaaS
 - It's typically a better choice for new applications

Storage

Relational

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- Traditional relational storage in the cloud
 - With support for SQL
- Strengths:
 - Familiar technologies
 - Many available tools, e.g., for reporting
 - Limited data lock-in
 - Can be cheaper than on-premises relational storage
- Weaknesses:
 - Scaling to handle very large data is challenging

Storage

Scale-out

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- Massively scalable storage in the cloud
 - No support for SQL
- Strengths:
 - Scaling to handle very large data is straightforward
 - Can be cheaper than relational storage
- Weaknesses:
 - Unfamiliar technologies
 - Few available tools
 - Significant data lock-in

Storage

Blobs

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- Storage for *Binary Large Objects* in the cloud
 - ▣ Such as video, back-ups, etc.
- Strengths:
 - ▣ Globally accessible way to store and access large data
 - ▣ Can be cheaper than on-premises storage
- Weaknesses:
 - ▣ Provides only simple unstructured storage

Back to business models

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- Consider business A that uses cloud as an IaaS but also hosts lots of storage on the cloud
- Business B is working in a PaaS model
- Suppose they both offer medical records as their goal. Is one fundamentally better than the other?

Time to market

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- Because business A uses IaaS, they need to develop much more of their own infrastructure
 - ▣ The developers rent virtual machines from Amazon or some other vendor, but the whole technical structure is their private solution
 - ▣ This lets them innovate more and perhaps to offer better privacy assurances or better guarantees
- But business A is facing a harder development cycle that will take longer and be more challenging

Time to market

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- Business B is in the PaaS model, maybe using Amazon's Elastic Beanstalk or Oracle's Cloud solution over Oracle DB, or Microsoft's MySQL Cloud
 - ▣ Easier and faster to create and launch the product
 - ▣ It will also scale “automatically” and because it has the familiar look and feel of such solutions, people will not be surprised by the API
- But the weaker guarantees may be an issue (medical privacy laws: HiPPA). And much easier for other companies to compete with identical API and features

So...

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- Business B probably makes it to the market sooner and cheaper, and can scale easily, but has more competition and hence can't charge very much (0?)

- Business A can offer stronger “proprietary” story, but is harder to build, might not scale as well.
 - But can perhaps make guarantees that business A can't afford to offer because A can't control the properties of the underlying PaaS technologies
 - A's use of cloud storage might worry us too: will this be a weak point for A's goal of satisfying HiPPA?

Crossing the cloudy chasm

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- As these companies scale they will face different challenges
 - ▣ Company A needs to find ways to build a bigger and bigger solution without performance problems or inconsistency or other major issues.
 - ▣ Hopefully they took Cornell's CS5412
 - ▣ Company B may see more and more consistency issues as they scale because PaaS solutions embrace CAP
 - ▣ And it can be harder to come up with novel pricing strategies in PaaS settings: “one size fits all”

Is either better?

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- They represent different basic choices
- Ken's guess: ultimately because PaaS makes dubious decisions on important things, IaaS is "better" if the required properties can be provided
- Then could branch out: why not offer a PaaS solution based on company A's amazing "hardened" cloud infrastructure for medical records?

Need for standards

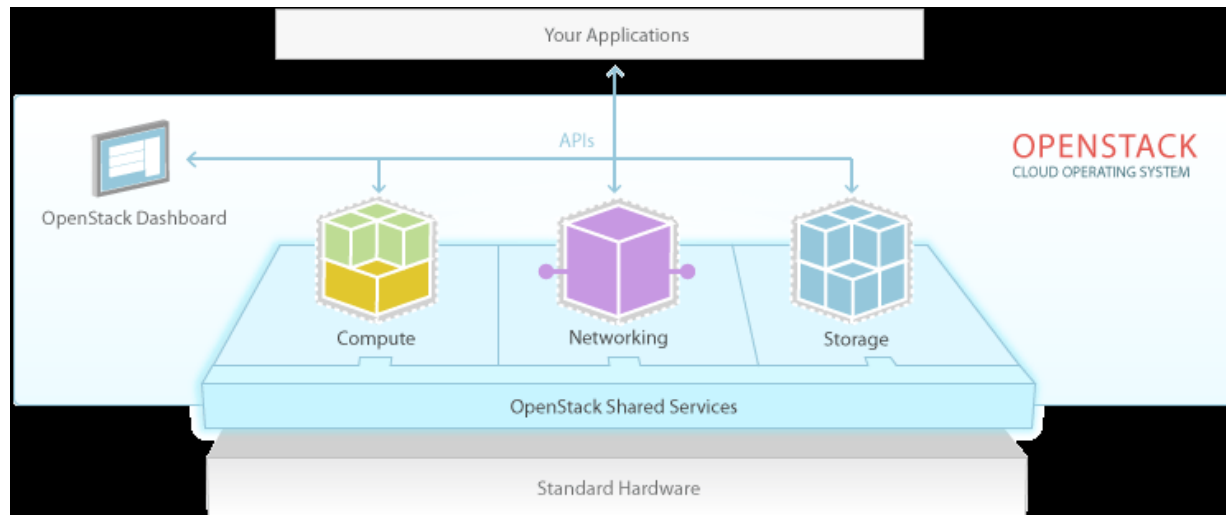
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- Fear of vendor lock-in and hidden but critical dependencies today limits the cloud
- A huge market yet probably just in its infancy if these issues can be solved
- Standards can really help: like SuperCloud but now industry wide.

OpenStack.org

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- A standards organization for cloud technology



- Key insight: if everything is standard, we can trust the cloud more easily because risks are reduced

The last word

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- Joni Mitchell summed it up best:

*I've looked at clouds from both sides now
From up and down, and still somehow
It's cloud illusions I recall...
I really don't know clouds at all*

- The cloud is a very complex marketplace and evolving rapidly.
 - Economics are the key
 - But nobody really understands cloud economics
 - There are many barriers to entry

