CS5412: THE CLOUD VALUE PROPOSITION

Lecture XXII

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Cloud Hype

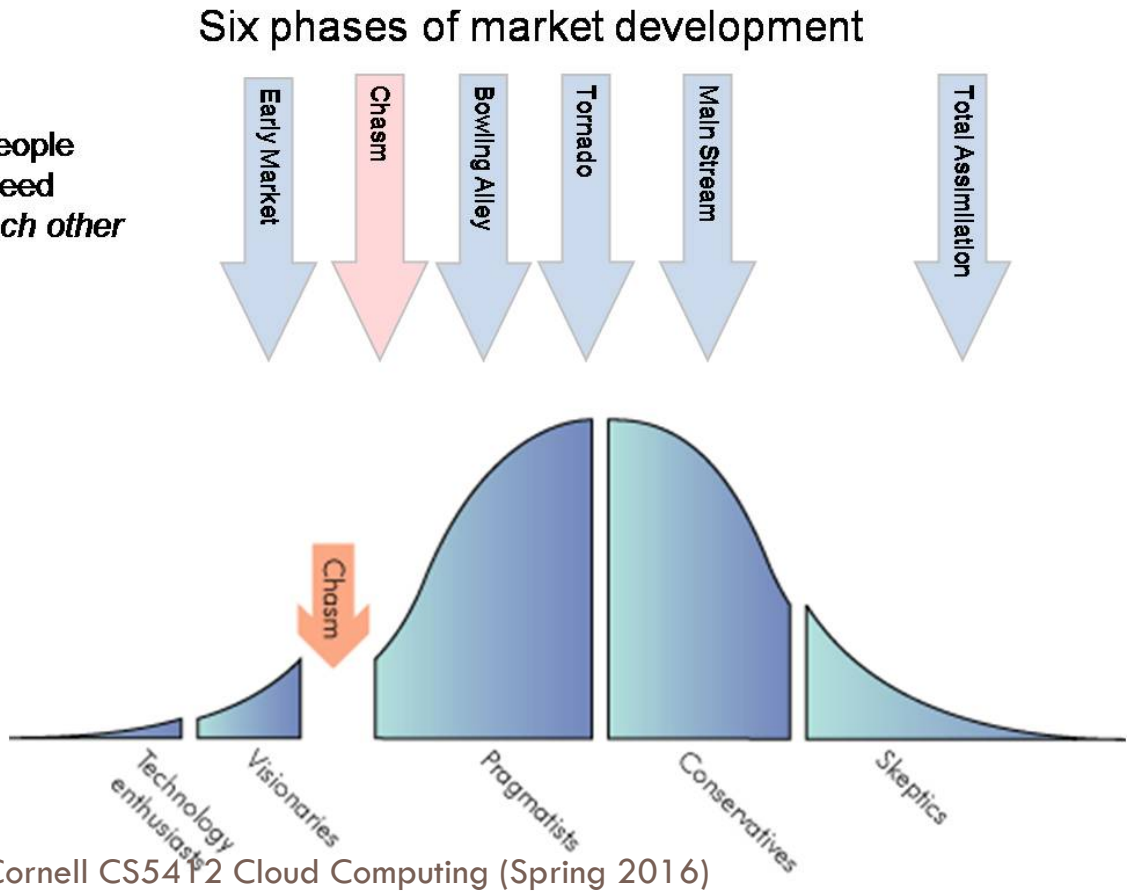
- The cloud is cheaper!
- The cloud business model is growing at an unparalleled pace without any limit in sight
- In the future everything will be on the cloud

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

Crossing the Chasm

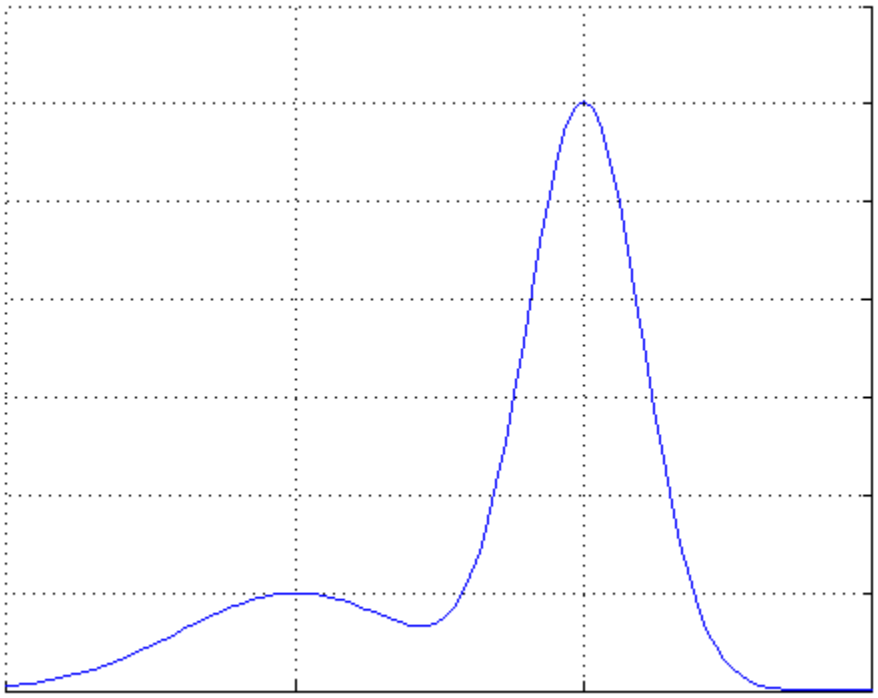
- Insight from Geoff Moore

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



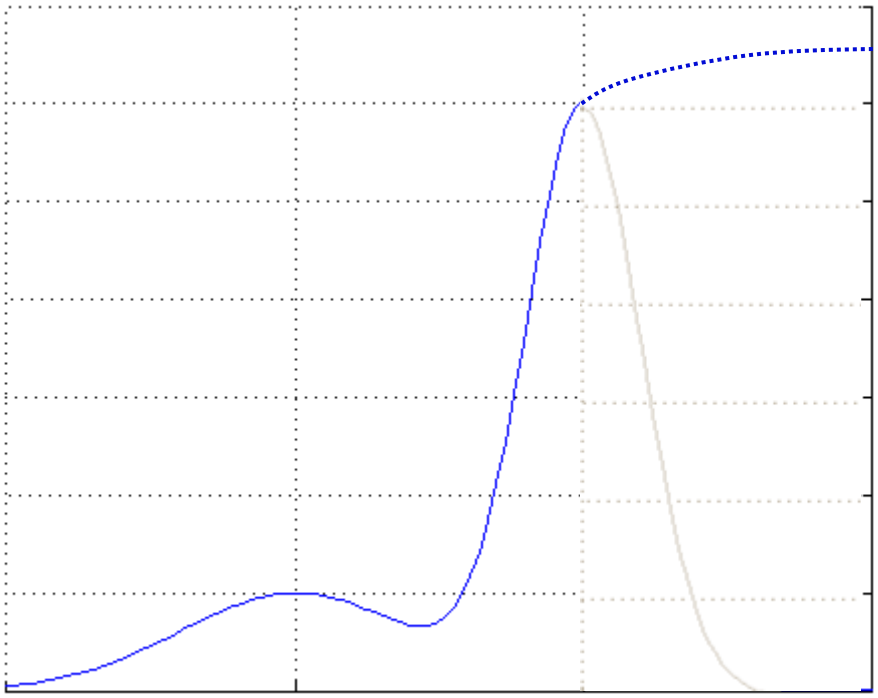
How does the revenue picture look?

- One-time purchases



How does the revenue picture look?

- "Recurring" revenue: vendor keeps getting paid



Why are these relevant?

- 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!

- 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?

- 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?

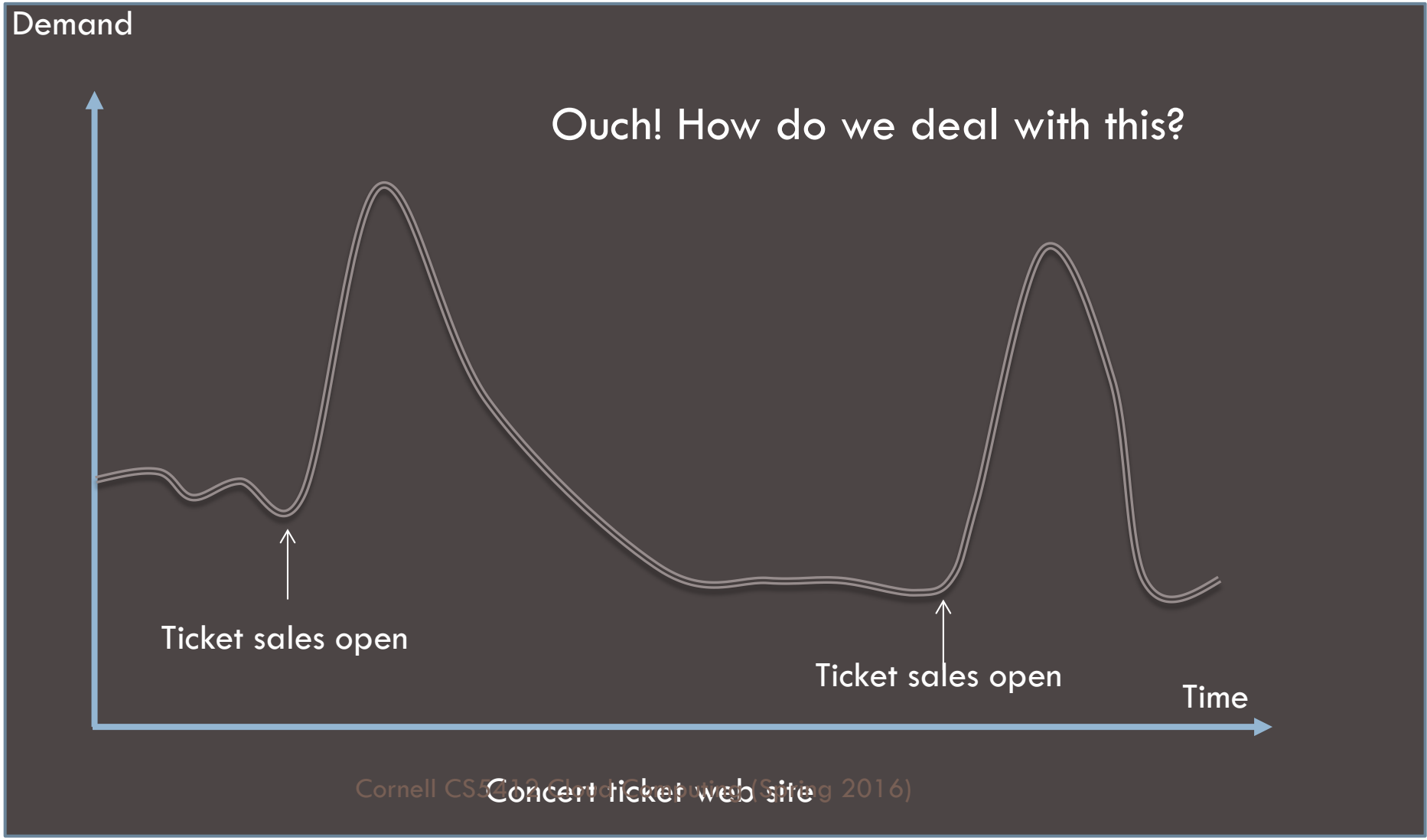
Factors to consider

- 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

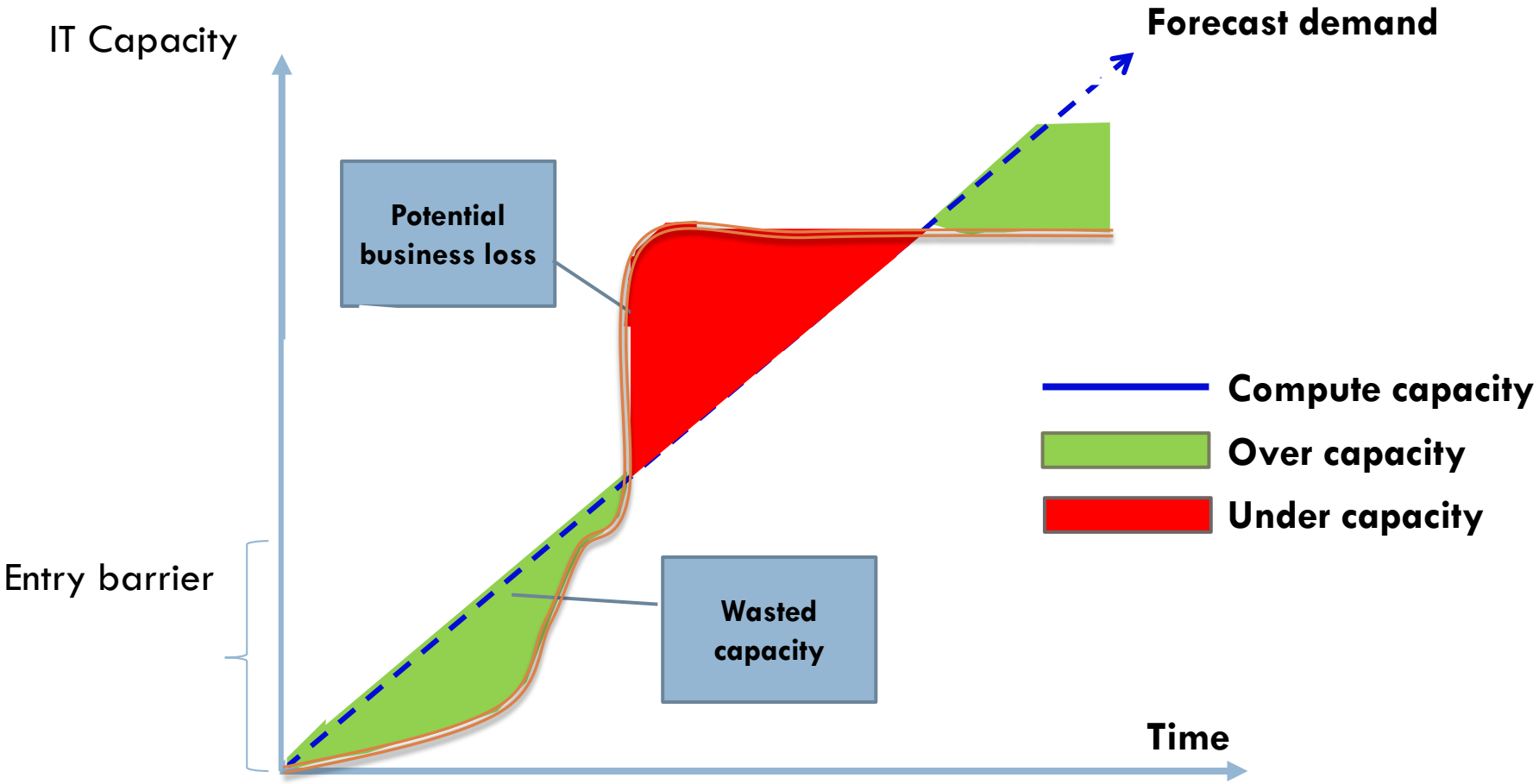
… things we pay for

- 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



Managing Demand



IT Agility

- 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

- 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

- 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

- 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?

- 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)

- *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)

- … 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

- 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?

- 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

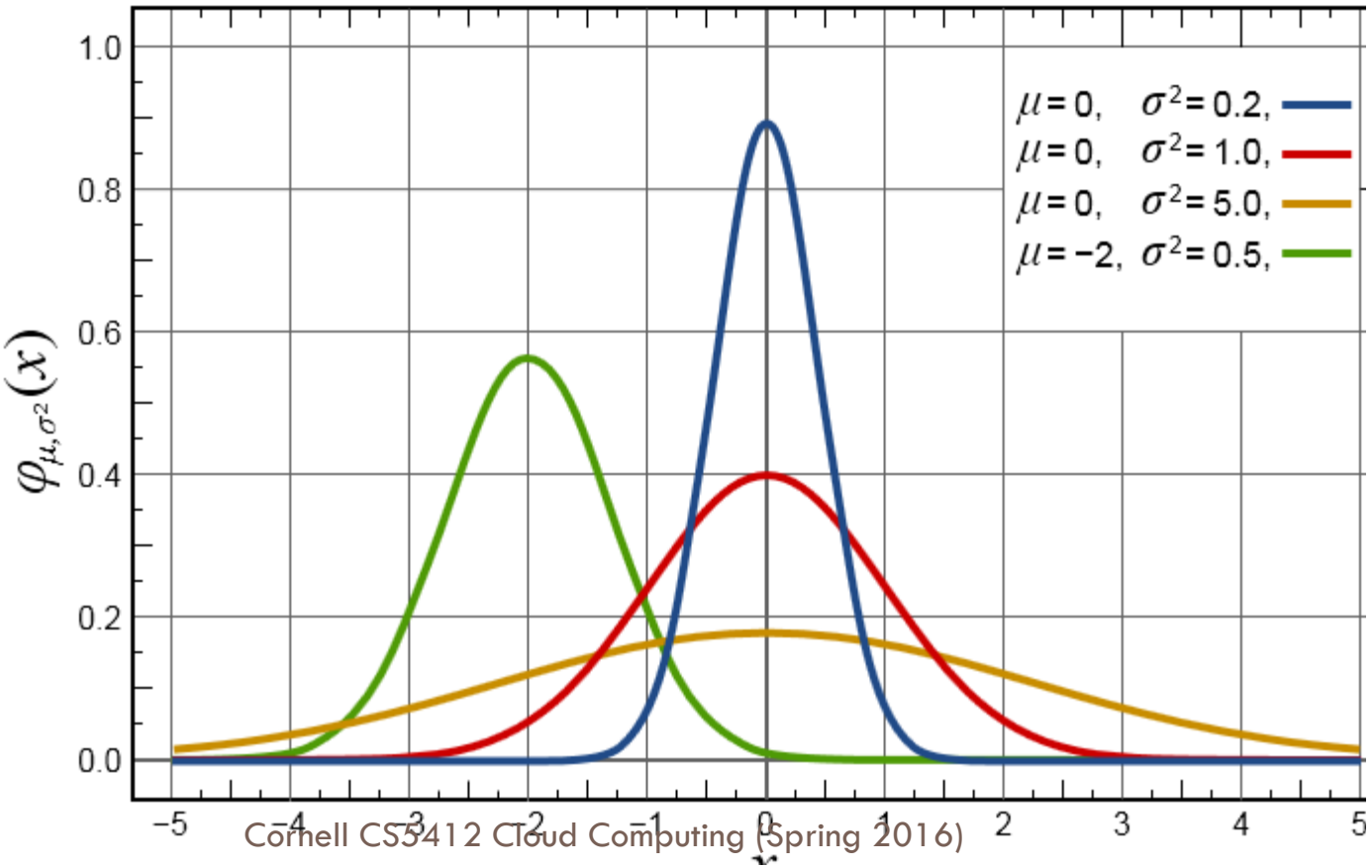
- Early web browser stage
  - Search and advertising (Google)
  - Social Networking (Facebook, Twitter)
  - Cloud as your "home": AOL, Yahoo!, MSN, Google
- Emergence of true web services model
  - Infrastructure as a service ("rent a VM") Apps (Apple)
  - Frames, full cross-site federation
  - Full-featured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

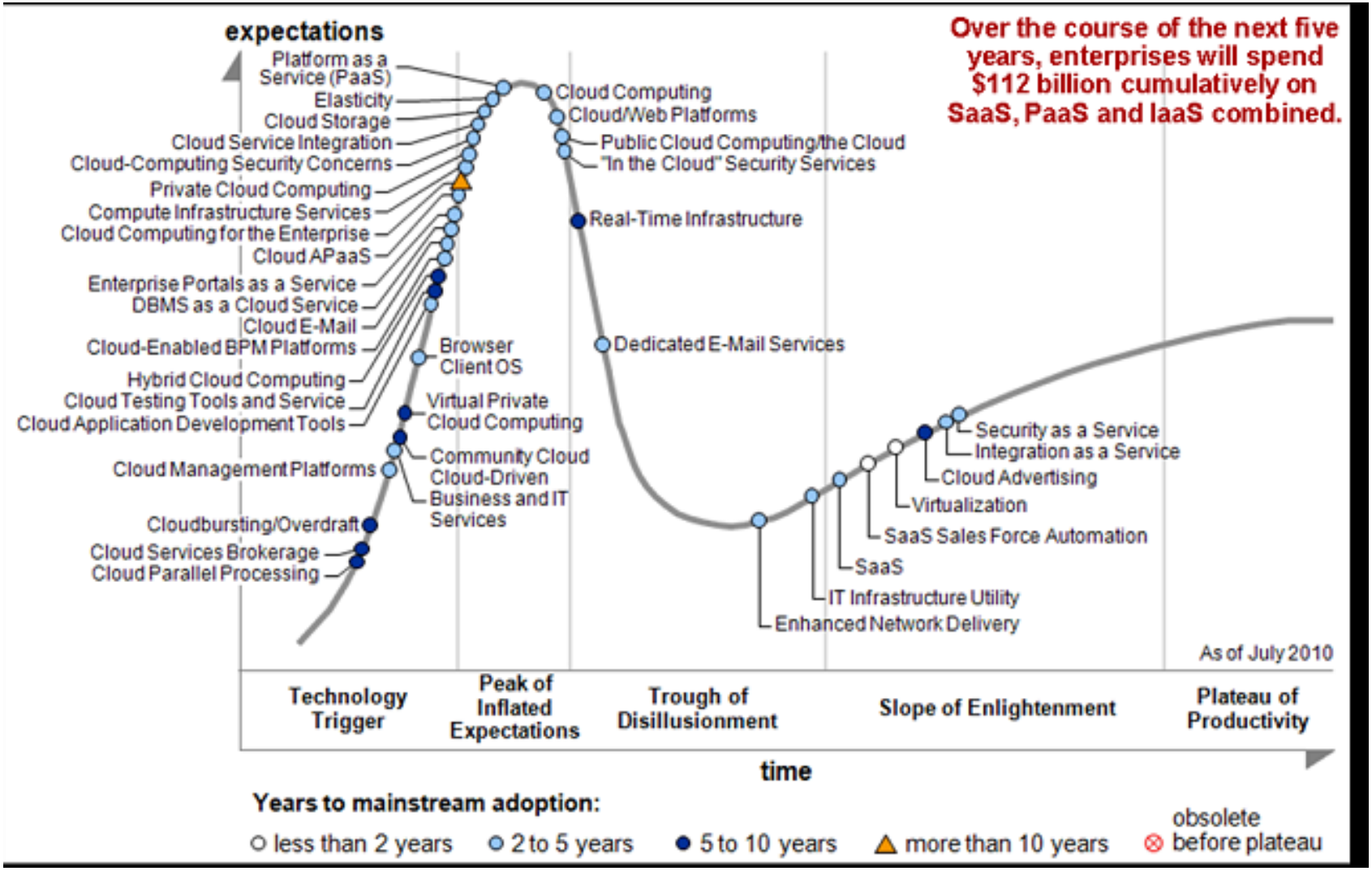
Each has its own revenue model!

- 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

- Many of these revenue stories "superimposed"




expectations
Over the course of the next five years, enterprises will spend $112 billion cumulatively on SaaS, PaaS and IaaS combined.
Platform as a Service (PaaS)
Elasticity
Cloud Storage
Cloud Service Integration
Cloud-Computing Security Concerns
Private Cloud Computing
Compute Infrastructure Services
Cloud Computing for the Enterprise
Cloud APaaS
Enterprise Portals as a Service
DBMS as a Cloud Service
Cloud E-Mail
Cloud-Enabled BPM Platforms
Hybrid Cloud Computing
Cloud Testing Tools and Service
Cloud Application Development Tools
Cloud Management Platforms
Cloudbursting/Overdraft
Cloud Services Brokerage
Cloud Parallel Processing
Browser Client OS
Virtual Private Cloud Computing
Community Cloud
Cloud-Driven Business and IT Services
Cloud Computing
Cloud/Web Platforms
Public Cloud Computing/the Cloud
"In the Cloud" Security Services
Real-Time Infrastructure
Dedicated E-Mail Services
Security as a Service
Integration as a Service
Cloud Advertising
Virtualization
SaaS Sales Force Automation
SaaS
IT Infrastructure Utility
Enhanced Network Delivery
As of July 2010
Technology Trigger
Peak of Inflated Expectations
Trough of Disillusionment
Slope of Enlightenment
Plateau of Productivity
time
Years to mainstream adoption:
less than 2 years
2 to 5 years
5 to 10 years
more than 10 years
obsolete before plateau

Inescapable Conclusion?

- **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!

- 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

- 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

- 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

- 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)

- 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)

- 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?

- 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

- 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

- 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

- Storage for *B*inary *L*arge *OB*jects 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

- 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

- 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

- 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…

- 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

- 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?

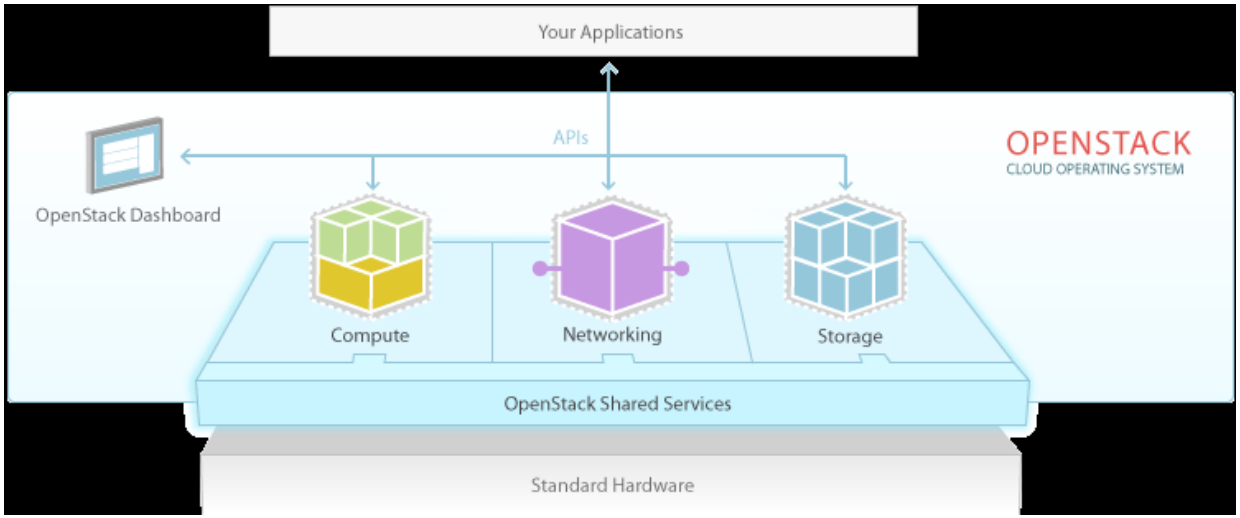
- They represent different basic choices
- Ken's guess: ultimately because PaaS makes dubious decisions on important things, IaaS is "better" if the required properties can be provided
- Then could branch out: why not offer a PaaS solution based on company A's amazing "hardened" cloud infrastructure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

Need for standards

- 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

- 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

- 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