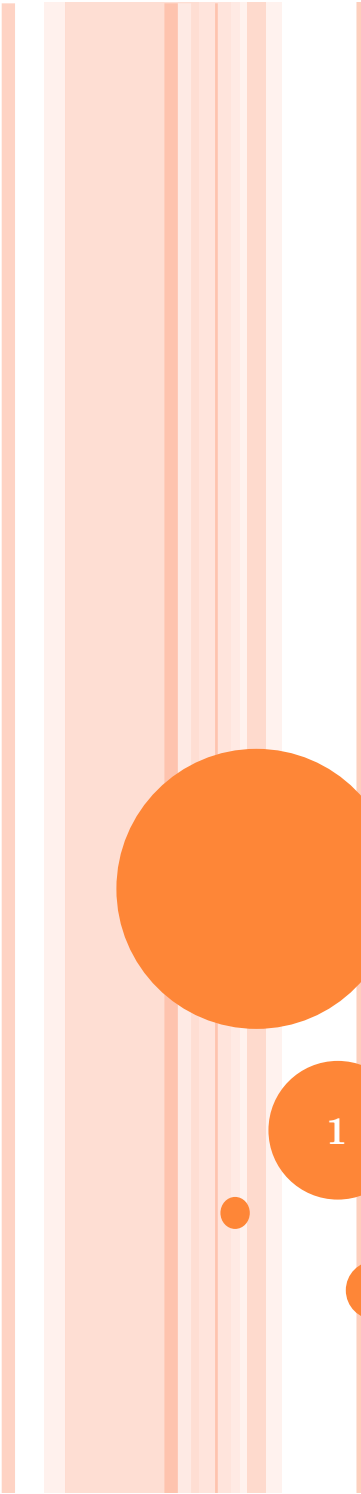


A decorative graphic on the left side of the slide. It consists of a vertical bar with a gradient of orange shades, from light to dark. To the right of the bar are several orange circles of different sizes. One circle is large and contains the number '1'. Another circle is smaller and contains the number '2'. There are also several smaller circles without numbers.

EE4221: LECTURE 1 SUPPLEMENTARY - CLOUD COMPUTING

Dr Eric Wong

THE FUNDAMENTAL IDEA OF THE CLOUD

**Why do it yourself if you can
find someone to do it for you?**

OUTLINE

- Summary on Service Models (IaaS, PaaS and SaaS)
- SaaS and IaaS (Cloud Computing) Examples
- Benefits and Downsides of Cloud Computing
- Cloud Computing Economics
- Utility Computing and Utility Storage
- Opportunities and Challenges of Cloud Computing

CLOUD SERVICES

- **Infrastructure as a service (IaaS)**
- **Platform as a service (PaaS)**
- **Software as a service (SaaS)**

Recall the fundamental idea of the cloud:

“Why do it yourself if you can find/pay someone to do it for you?”

- **The decision of which service to be used depends on how much you would like the cloud to do it for you.**

SUMMARY ON SERVICE MODELS

IaaS

The customer outsources **hardware infrastructure** and uses/develops their own **software infrastructure** (Windows, Unix) and **applications**

PaaS

The customer outsources **hardware infrastructure** and **software infrastructure** but uses/develops their own **applications**

SaaS

The customer outsources all **hardware infrastructure, software infrastructure** and **applications**

IAAS/CLOUD EXAMPLE 1

“At the time of this writing, you can rent a Quad Core Xeon server running at 2.4 GHz with 8GB of memory and 250GB of disk space for about \$300 per month. That’s \$3,600 per year. A server of this kind doesn’t cost a great deal (say \$2,000-\$3,000), but if you’re going to use it as a Web server, the cost of ownership will most likely be significantly more than \$3,600 per year when you take into account the networking, Internet connections, server management, and everything else the ISP provides.”

Source: <http://www.dummies.com/>

SAAS/CLOUD EXAMPLE 2

“Instead of selling you a copy of **Microsoft Word** for US\$300, a cloud computing model would "rent" word processing software to you through the Internet for perhaps 5 dollars a month. You would not install any special software, nor would you be confined to your home machine to use this rented online product. You simply use your modern web browser to login from any web-enabled computer, and you can access your word processing documents in the same way that you would access your Gmail.”

Source: <http://netforbeginners.about.com>

SAAS/CLOUD EXAMPLE 3

“Your small car sales business would not spend thousands of dollars on a **sales database**. Instead, the company owners would "rent" access to a sophisticated online sales database, and all the car salesmen would access that information through their web-enabled computers or handhelds.”

Source: <http://netforbeginners.about.com>

SAAS/CLOUD EXAMPLE 4

“You decide to start a health club in your hometown, and need computer tools for your receptionist, financial controller, 4 salespeople, 2 membership coordinators, and 3 personal trainers. But you do not want the headaches nor the cost of paying part-time IT staff to build and support those computer tools. Instead, you give all your health club staff access to the cloud of the Internet, and rent their **office software** online, which will be stored and supported somewhere in Arizona. You will not need any regular IT support staff then; you will just need occasional contract support to ensure that your hardware is maintained.”

Source: <http://netforbeginners.about.com>

THE BENEFITS OF SAAS/CLOUD COMPUTING

- The primary benefit of Software as a Service is reduced cost for everyone involved. (a Win-Win case!!)
- Software vendors do not have to spend thousands of hours supporting users over the phone... they would simply maintain and repair a single central copy of the product online.
- Conversely, users wouldn't have to shell out the large up-front costs of fully purchasing word processing, spreadsheet, or other end user products. Users would instead pay nominal rental fees to access the large central copy.

THE DOWNSIDES OF SAAS/CLOUD COMPUTING

- The risk of Software as a Service and cloud computing is that the users must place a high level of trust into the online software vendors that they will not disrupt the service.
- In a way, the software vendor holds its customers "hostage" because all of their documentation and productivity is now in the vendor's hands.
("hybrid cloud" may be a solution!)
- Security and protection of the file privacy becomes even more necessary, as the massive Internet is now part of the business network.

Source: <http://netforbeginners.about.com>

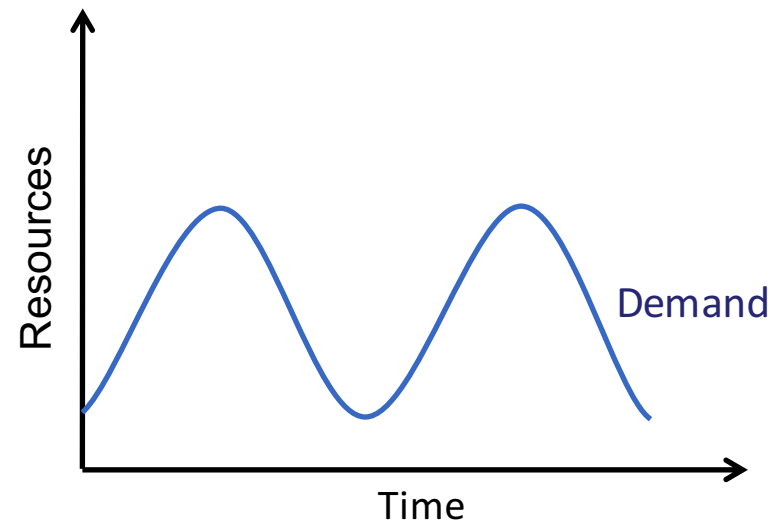
MORE WORDS ON THE BENEFITS AND DOWNSIDES OF SAAS/CLOUD COMPUTING

- When a 600-employee business switches to cloud computing, they must choose their software vendor carefully.
- There will be dramatically-reduced administration cost to use cloud computing software.
- But there will be an increase in the risks of service disruption, connectivity, and online security.
- **Again, “hybrid cloud” may be a solution!!**

Source: <http://netforbeginners.about.com>

CLOUD APPLICATION DEMAND

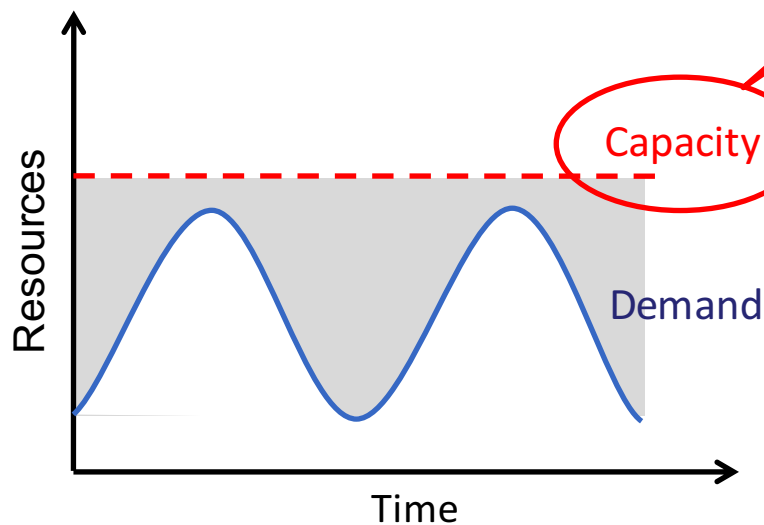
- Many cloud applications have cyclical demand curves
 - Daily, weekly, monthly, ...
- Workload spikes more frequent and significant
 - Death of Michael Jackson:
 - 22% of tweets, 20% of Wikipedia traffic, Google thought they are under attack
 - Obama inauguration day: 5x increase in tweets



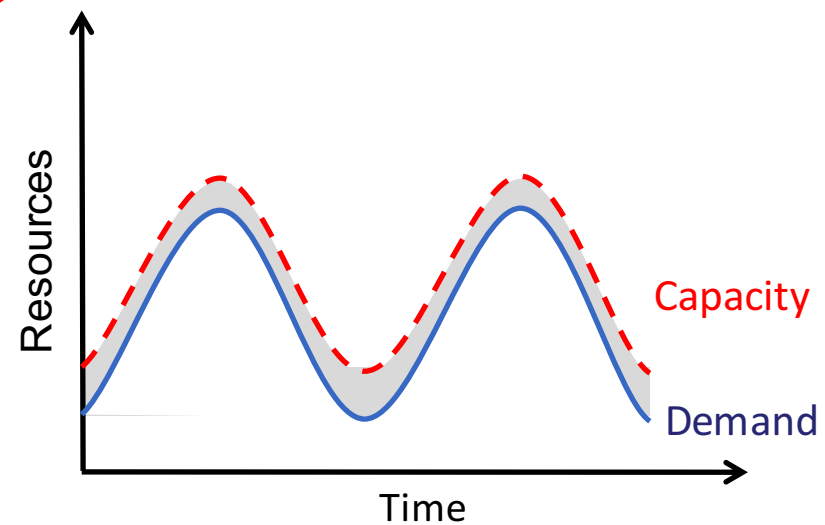
ECONOMICS OF CLOUD USERS

- Pay by use instead of provisioning for peak
- Data center costs > US\$100M and takes 24+ months to design and build

How do you pick a capacity level?

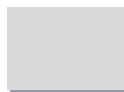


Static data center



Data center in the cloud

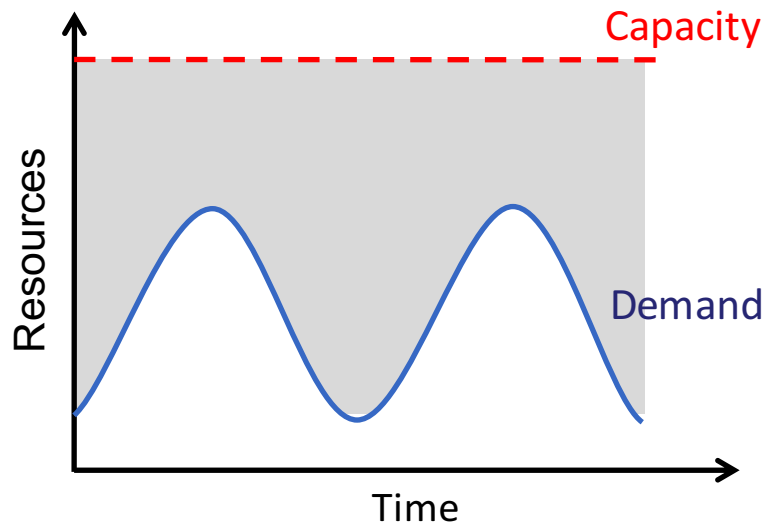
Source: the slide is from RAD Lab at UC Berkeley about the cloud and Jimmy Lin



Unused resources

ECONOMICS OF CLOUD USERS

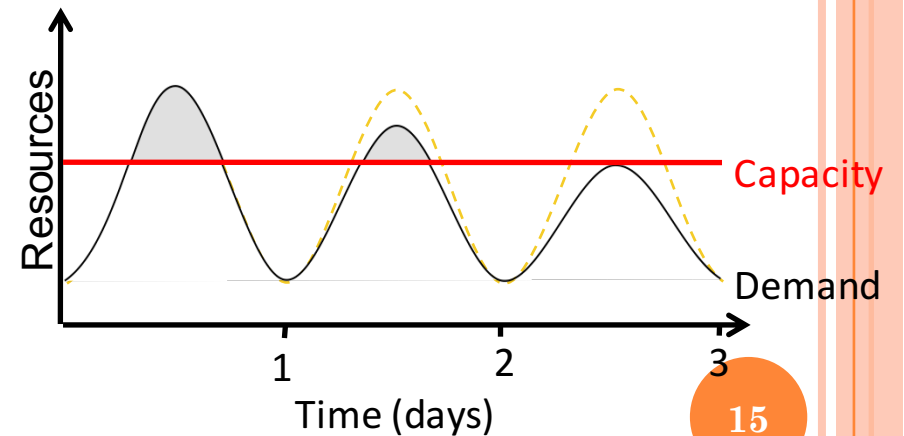
- Risk of over-provisioning: underutilization
 - Huge investment cost in infrastructure



Static data center



Unused resources



UTILITY COMPUTING ARRIVES

- Amazon Elastic Compute Cloud (EC2)
- “Compute unit” rental: US\$ 0.085-0.68/hour
 - 1 CU $\approx$ 1.0-1.2 GHz 2007 AMD Opteron/Intel Xeon core

	Platform	Units	Memory	Disk
Small - US\$.085/hour	32-bit	1	1.7GB	160GB
Large - US\$0.35/hour	64-bit	4	7.5GB	850GB – 2 spindles
X Large - US\$0.68/hour	64-bit	8	15GB	1690GB – 4 spindles
High CPU Med - US\$0.17	64-bit	5	1.7GB	350GB
High CPU Large - US\$0.68	64-bit	20	7GB	1690GB
High Mem X Large - US\$0.50	64-bit	6.5	17.1GB	1690GB
High Mem XXL - US\$1.20	64-bit	13	34.2GB	1690GB
High Mem XXXL - US\$2.40	64-bit	26	68.4GB	1690GB

- No up-front cost, no contract, no minimum
- Billing rounded to nearest hour

Northern VA cluster

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Source: the slide is from RAD Lab at UC Berkeley about the cloud and Jimmy Lin

UTILITY STORAGE ARRIVES

- **Amazon S3 and Elastic Block Storage offer low-cost, contract-less storage**

OPPORTUNITIES AND CHALLENGES

- The use of the cloud provides a number of opportunities:
 - It enables services to be used without any understanding of their infrastructure.
 - Cloud computing works using economies of scale:
 - It potentially lowers the outlay expense for start up companies, as they would no longer need to buy their own software or servers.
 - Cost would be by on-demand pricing.
 - Vendors and Service providers claim costs by establishing an ongoing revenue stream.
 - Data and services are stored remotely but accessible from “anywhere”.

Source: The slide is from Mark Baker

OPPORTUNITIES AND CHALLENGES (CONT'D)

- In parallel there has been backlash against cloud computing:
 - Use of cloud computing means dependence on others and that could possibly limit flexibility and innovation:
 - The others likely become the bigger Internet companies like Google and IBM, who may monopolise the market.
 - Some argue that this use of supercomputers is a return to the time of mainframe computing that the PC was a reaction against.

OPPORTUNITIES AND CHALLENGES (CONT'D)

- Security could prove to be a big issue:
 - It is still unclear how safe out-sourced data is and when using these services ownership of data is not always clear.
- There are also issues relating to policy and access:
 - If your data is stored abroad whose policy do you adhere to?
 - What happens if the remote server goes down?
 - How will you then access files?
 - There have been cases of users being locked out of accounts and losing access to data.

Q&A