

Cloud Computing Continued

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Recapitulation

- ▶ Connect Anywhere, Anytime
- ▶ Central administration
- ▶ Cloud applications
- ▶ WEB applications – Architecture
- ▶ Cloud architecture
- ▶ Deployment models
- ▶ Higher Reliability and Uptime



Data center – functional requirements

- ▶ A place to locate computer, storage, and networking devices safely and securely
- ▶ To provide the power needed to maintain these devices
- ▶ To provide a temperature-controlled environment within the parameters required to run these devices
- ▶ To provide connectivity to other devices both inside and outside the data center



Data center size

- Small server in the cellar – small business data server
- Medium company >50 servers?
- Large company >1000 servers?
- Google, AWS, ... 10^6 ?
- Elasticity – appearance of infinite computational power and memory



Size of the center

- ▶ Microsoft data centers in 2007 Quincy Washington investment \$550 million in building a 44,000 m² hydro-electric power from nearby dams on the Columbia River. A year later it unveiled a similar 45,000 m² in San Antonio – 300,000 hectoliters of water a month.



Data transfer bottleneck

- ▶ Let us suppose LAN bandwidth is 100Mbits/s
- ▶ $\approx 10\text{MB/s}$

- ▶ 1GB $10^9 / 10^7 = 100\text{s} = 2 \text{ min}$
- ▶ 1TB $10^{12} / 10^7 = 280 \text{ hours} = 12 \text{ days}$

- ▶ Conclusion: storage is not very scalable



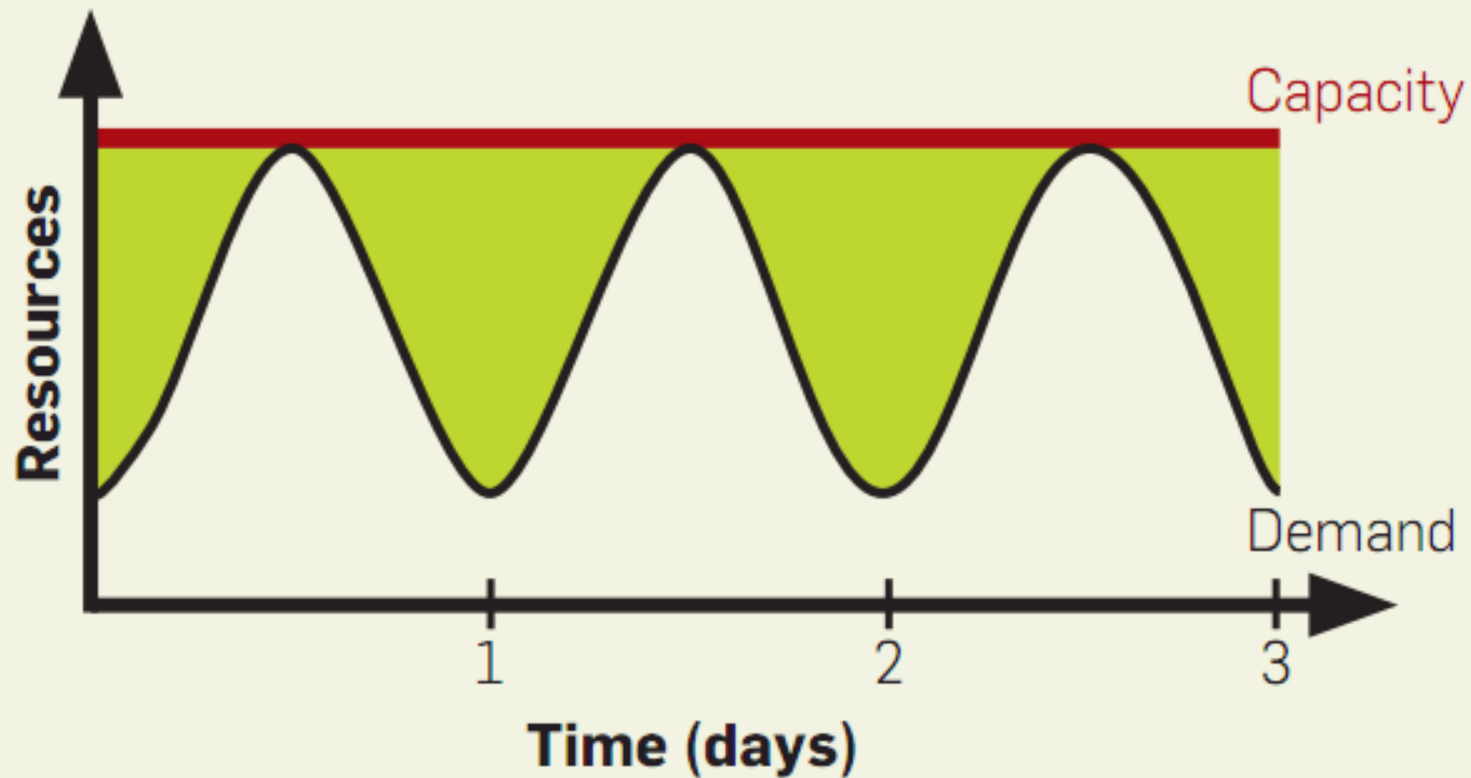
Economy of scale

- Cloud data centers are built from computer with minimum number of parts in massive quantities,
- Centers with thousands of servers allow efficient ratio of staff to machines.
- On a per-user basis, these economies of scale allow higher levels of efficiency than can be achieved by SMBs.
- Electricity cost is decreased 5-7 times in a large center (5MW)
- The most commonly used metric to determine the energy efficiency of a data center

$$\text{PUE} = \frac{\text{Total Facility Power}}{\text{IT Equipment Power}}$$

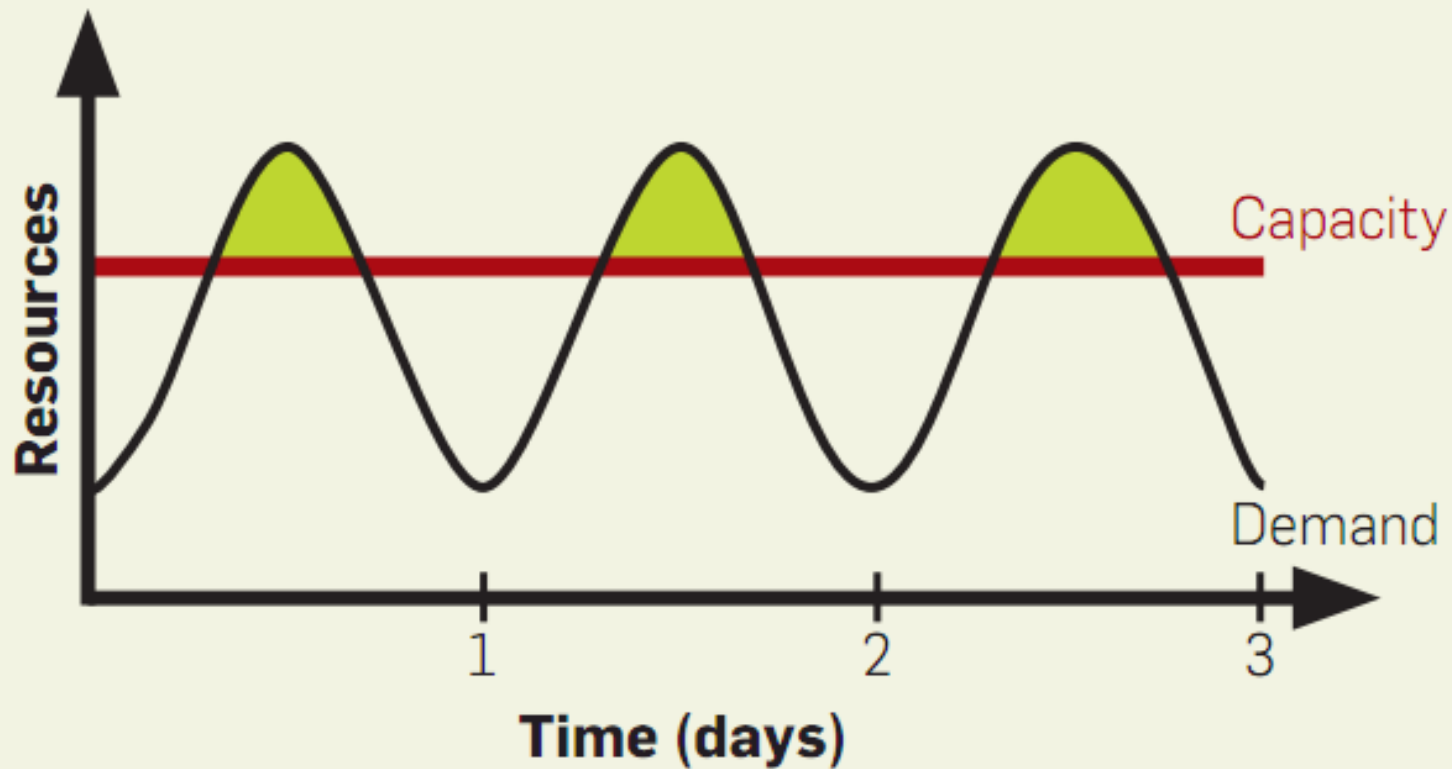


Utilization



(a) Provisioning for peak load

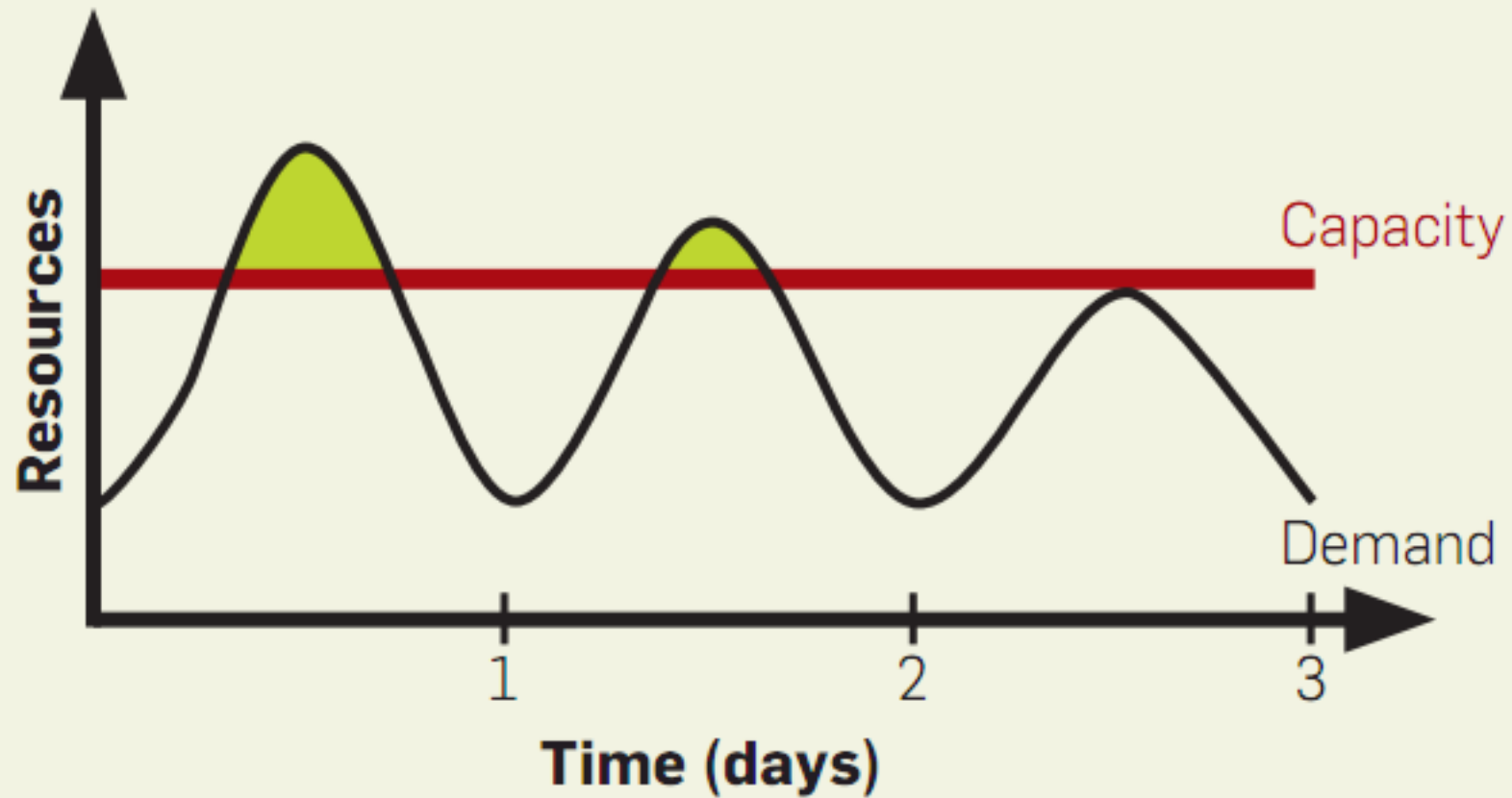
Utilization



(b) Underprovisioning 1

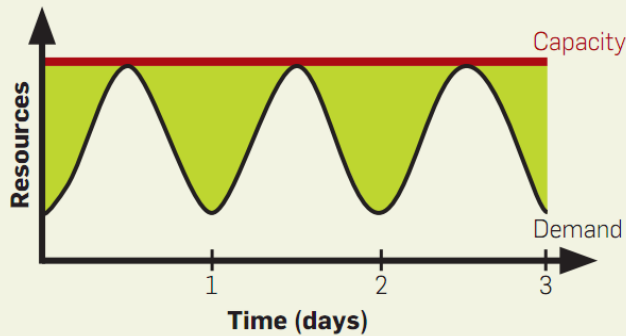


Utilization

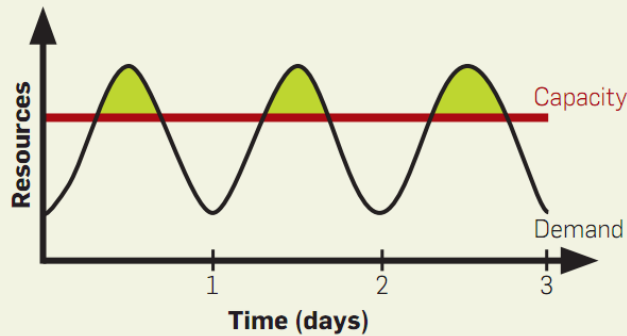


(c) Underprovisioning 2

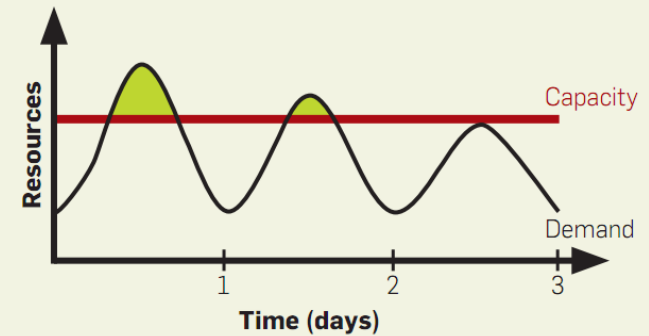
Virtualization



(a) Provisioning for peak load



(b) Underprovisioning 1

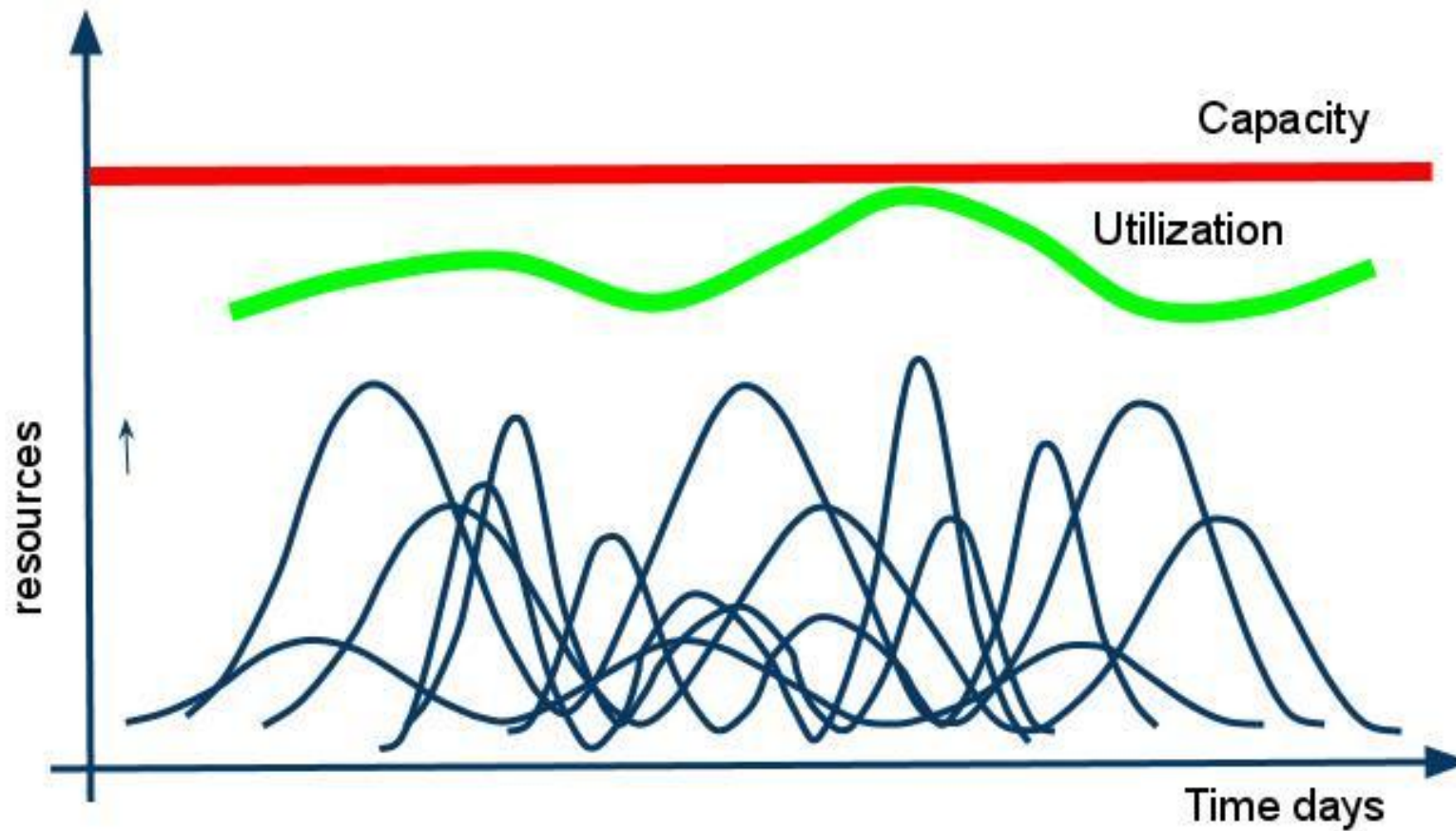


(c) Underprovisioning 2

- ▶ Run several applications on the same box
- ▶ Virtualize – use 20% of available resources
- ▶ Utilize the whole box 80%



Virtulization



Public - private center

Advantage	Public cloud	Private cloud
Appearance of infinite computing resources	yes	no
Elimination of up front payment by cloud user	yes	no
Pay as you use	yes	no
Economies of scale due to very large center	yes	Usually not
Higher utilization by multiplexing resources	yes	Depends on size



Security

- Google, Amazon, Sun, IBM and other major cloud players investment in physical and process-based security.
- SAS 70 Type II audit
- Browser-based applications do not need to save sensitive data on local devices.
- Lost laptops and memory stick minimize the amount of sensitive data stored on these devices
- Regular staff training and educating in all aspects internet safety and security is must.



SAS 70 Type II

- **Logical security:** reasonable assurance of providing access to authorized individuals only
 - **Privacy:** reasonable assurance of data privacy, implement proper policies and procedures
 - **Data center physical security:** good protection of data centers and corporate offices
 - **Incident management and availability:** reasonable assurance data centers and applications are redundant and incidents are properly reported, responded to, and recorded
 - **Change management:** reasonable assurance that development and changes are properly tested
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Data center requirements

Tier	Requirements
1	<ul style="list-style-type: none">•Single non-redundant distribution path serving the IT equipment•Non-redundant capacity components•Basic site infrastructure guaranteeing 99.671% availability
2	<ul style="list-style-type: none">•Fulfills all Tier 1 requirements•Redundant site infrastructure capacity components guaranteeing 99.741% availability
3	<ul style="list-style-type: none">•Fulfills all Tier 1 & Tier 2 requirements•Multiple independent distribution paths serving the IT equipment•All IT equipment must be dual-powered and fully compatible with the topology of a site's architecture•Concurrently maintainable site infrastructure guaranteeing 99.982% availability
4	<ul style="list-style-type: none">•Fulfills all Tier 1, Tier 2 and Tier 3 requirements•All cooling equipment is independently dual-powered, including chillers and Heating, Ventilating and Air Conditioning (HVAC) systems•Fault tolerant site infrastructure with electrical power storage and distribution facilities guaranteeing 99.995% availability

Web , Cloud Applications

Cloud apps plusses and minuses

	WEB app	Installed
Installation	Sign up	Download , register
Company wide install	No	Yes
Up front payment	No	50%
Patches upgrades distribution	No	Yes
Backup data	50%	Yes
Client disaster strategy	No	Yes
Data security	50%	100%
Connectivity	must	No
SLA	Not clear	In house



Single Sign On (SSO)

- mail, contacts, calendar, apps, ...
- SSO,
- Universal navigation,
- Mash up
- Administration of Google apps
- Apps script,
- gadgets,
- data access

- Distribution models multi tenant



Single Sign On (SSO)

- ▶ Reduces phishing success
- ▶ Reducing password fatigue
- ▶ Reducing time spent re-entering passwords
- ▶ Reducing IT costs due to lower number of IT help desk calls about passwords

- ▶ SSO provides access to many resources
- ▶ Other authentication methods like smart cards
- ▶ loss of their availability can result in denial of access to all systems unified under the SSO.
- ▶ SSO can thus be undesirable for systems to which access must be guaranteed at all times



Applications distribution

- ▶ Business on the Internet
- ▶ As a developer, you can use the Apps Marketplace as a channel to sell your own applications.
- ▶ Apps development Apps Marketplace applications are designed to work closely with Google Apps
- ▶ Google Apps Marketplace developers are free to deploy their applications on a server stack of their choosing.
- ▶ REQUIRED: Use Single Sign-On to reduce user passwords
- ▶ Recommended: Universal navigation: add yourself to Google's menu
- ▶ Create a Listing - Submit your application to Google for approval, and create a compelling listing.
- ▶ PR and Marketing
 - ▶ Publish [press releases](#), blog posts, tweets, and more
 - ▶ [Create a video](#) about your application for the Apps Marketplace [YouTube channel](#)
 - ▶ Place the [Add to Apps](#) button on your company's web page to drive traffic to your Marketplace listing
- ▶ Bill Your Customers





- ▶ OpenID Foundation (OIDF)

