

Cloud Computing Paradigm Shift

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Business expectations

- ▶ Improving business processes
- ▶ Reducing enterprise costs
- ▶ Increasing the use of information/analytics
- ▶ Improving enterprise workforce effectiveness
- ▶ Attracting and retaining new customers
- ▶ Creating new products or services (innovation)
- ▶ Managing change initiatives
- ▶ Expanding current customer relationships
- ▶ Consolidating business operations
- ▶ Targeting customers and markets more effectively



Computing Evolution



2000 Cloud computing

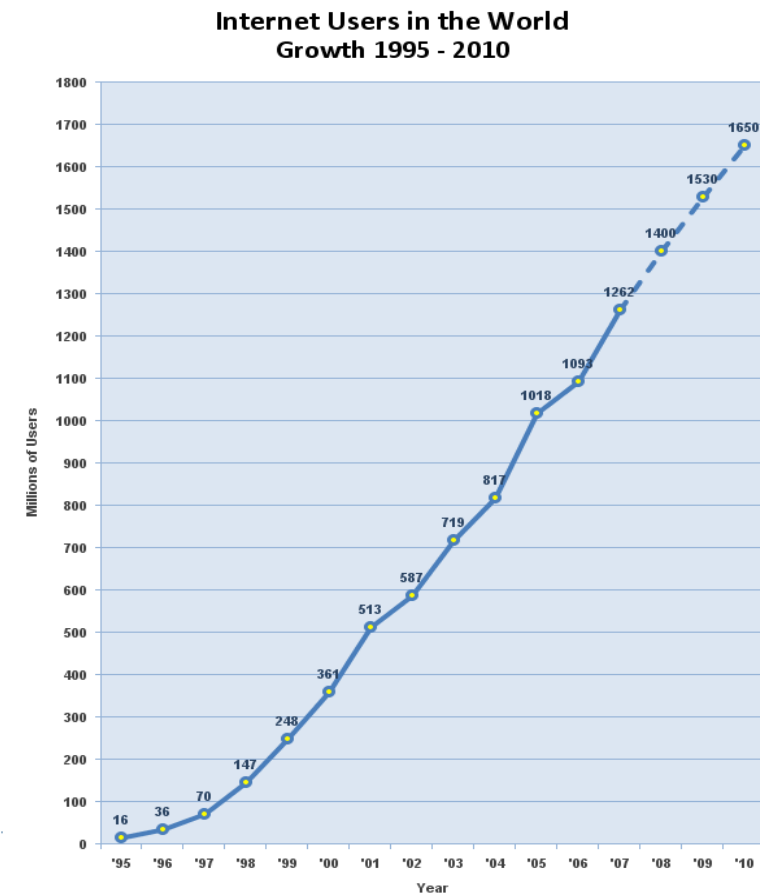


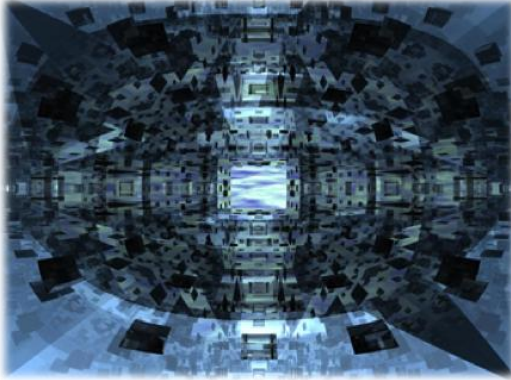
1990 Internet

1980 IBM PC



1970 IBM 370





Gartner predicts:

- Virtualization
- Cloud computing
- Web 2.0



IDC, Gartner

\$16B – revenue drive by public cloud in 2009

\$55B – revenue anticipated by 2014

12% public cloud share in IT spending

25% - new growth in IT spending



Aggressive prediction

\$63B - 2010 revenue, public cloud

\$148B – 2014 in SaaS, PaaS, IaaS

Agenda - Cloud computing

- ▶ Cost - Economy of scale
- ▶ Centralized management
- ▶ Easy on users
- ▶ Access any time any place, compatible browser
- ▶ Deployment model
- ▶ Elasticity, endless processing power, endless memory
- ▶ High service availability
- ▶ Security
- ▶ Types of applications



Economy of scale

- Cloud data centers with large number of computers
 - Built from computers with minimum number of parts.
 - Bought in massive quantities.
 - Efficient ratio of staff to machines.
 - Electricity cost is decreased 5-7 times in a large center (5MW)
 - Cost advantage, no upfront payment, pay as you go, Freemium
- Global companies => large data centers
- SMBs, SaaS, CAPEX => OPEX



Central administration

- Cloud central administration - fast distribution of new functionality and upgrades
- Employees easier adapt to small improvements than to disruptive changes.
- Traditional software - long learning cycle



Connect Anywhere, Anytime

Cloud, Web-based applications give users full access their information **anywhere, anytime**,

- Windows, OS X, Linux
- FireFox, IE, Chrome, Safari ...
- Mobile phone, tablet computer

The data is stored in the cloud – not on employees computers, sharing

Multiple users can access and contribute to projects simultaneously

Employees need only notebook + connectivity.



The name cloud computing was inspired by the cloud symbol that's often used to represent the Internet in flow charts and diagrams.



Deployment models

- ▶ Public cloud – internet

Internet

Community
Data center

▶

Deployment models

- ▶ Public cloud – internet
- ▶ Private cloud – intranet

Intranet

Private data
center

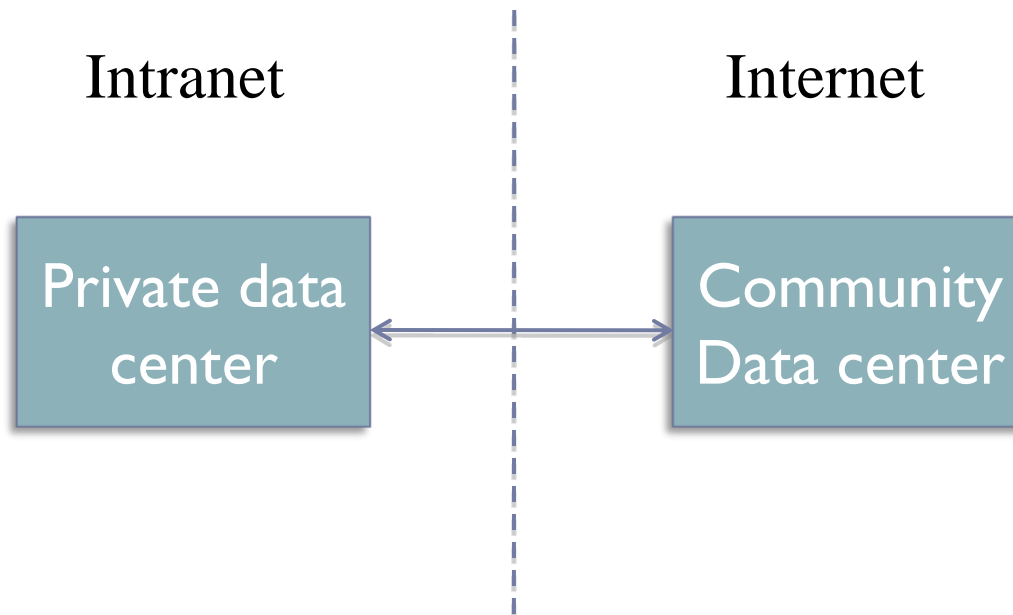
Internet

Community
Data center



Deployment models

- ▶ Public cloud – internet
- ▶ Private cloud – intranet
- ▶ Hybrid cloud – internet + intranet
- ▶ Community cloud – intranet



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



Higher Reliability and Uptime

- Service Level Agreement (SLA)
 - Disaster recovery plan
 - Recovery point objective (RPO) design target is zero
 - Recovery time objective (RTO) design target is instant fail over
- Databases NoSQL Data replication
 - build in redundancy
- Elasticity, virtualization, endless computing power
- Fall back to secondary data center, regions, zones
- This level of reliability with on-premises or hosted technology is tremendously costly and complex



Security

- 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 audit
 - **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



Cloud architecture - apps

- ▶ **Client**
 - ▶ any browser, native app
- ▶ **Software as a Service – SaaS**
 - ▶ Google,
 - ▶ Microsoft
- ▶ **Platform as a Service – PaaS**
 - ▶ Google app engine
 - ▶ Microsoft Azure
- ▶ **Infrastructure as a Service – IaaS**
 - ▶ Amazon AWS,
 - ▶ Rack space

Browser

SaaS

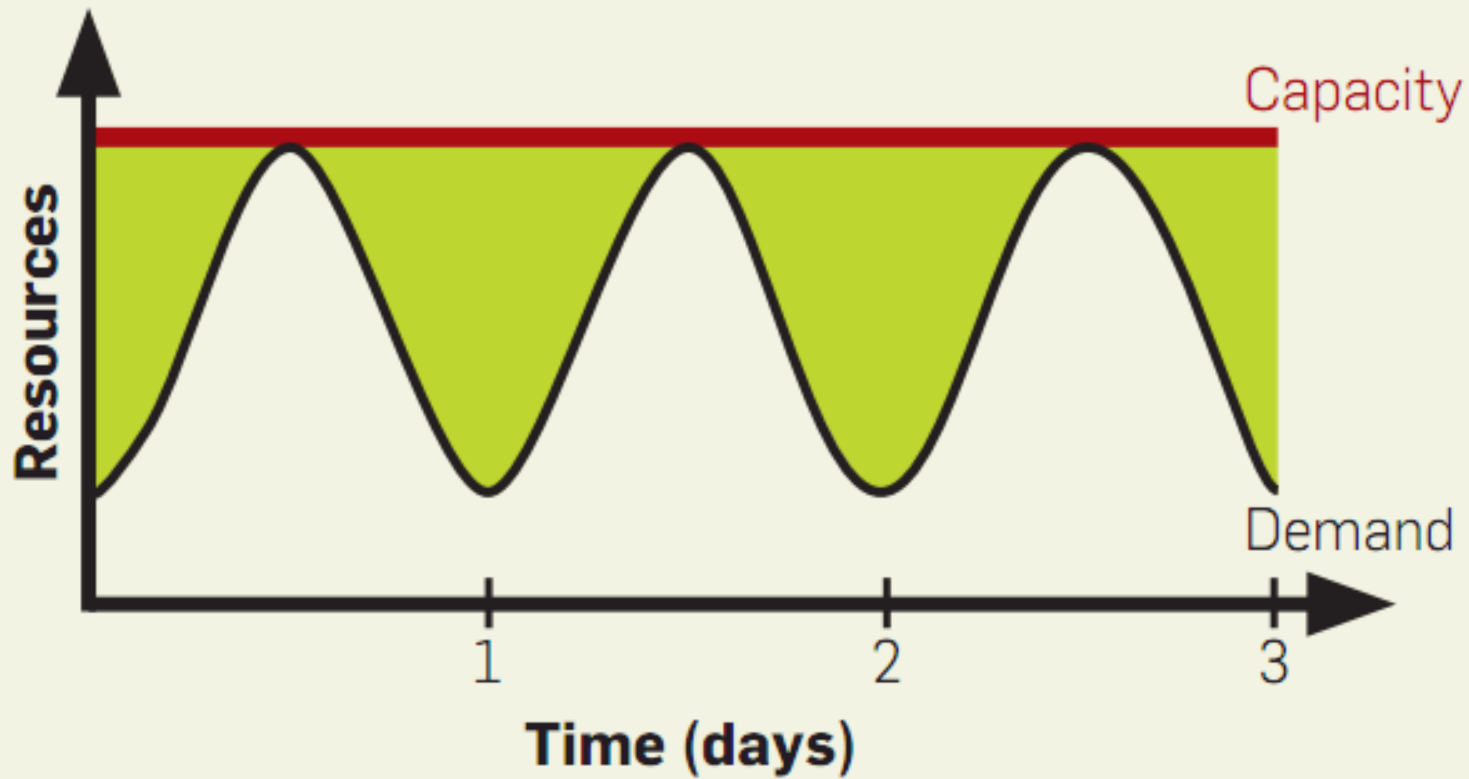
PaaS

IaaS

servers

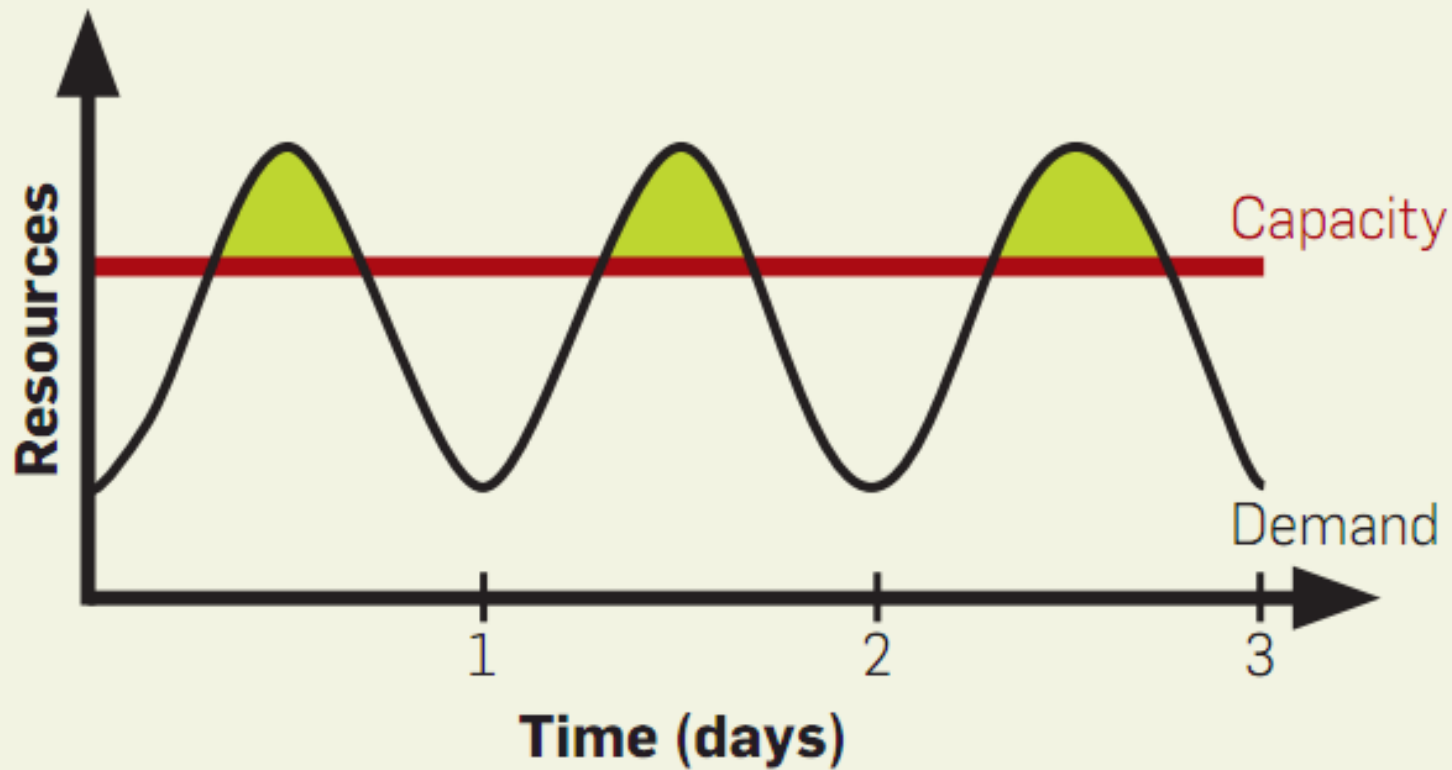


Utilization



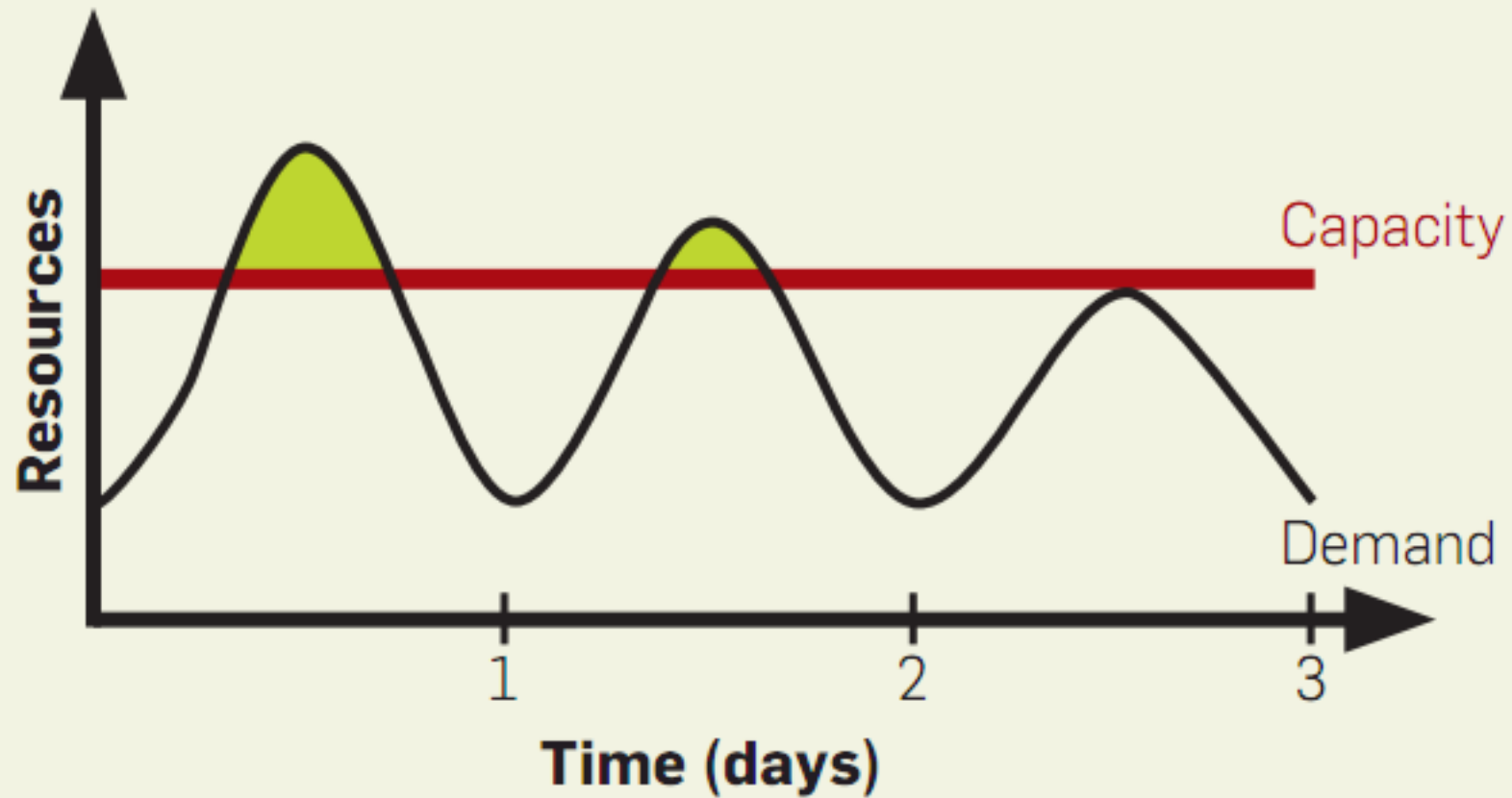
(a) Provisioning for peak load

Utilization



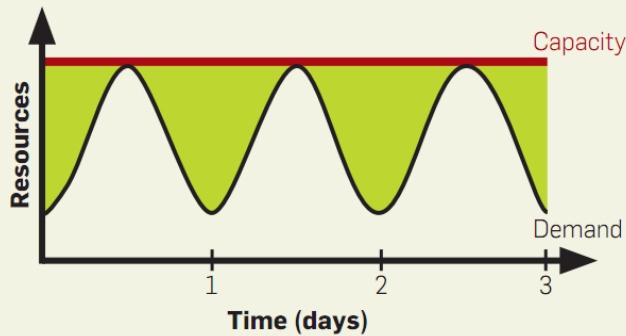
(b) Underprovisioning 1

Utilization

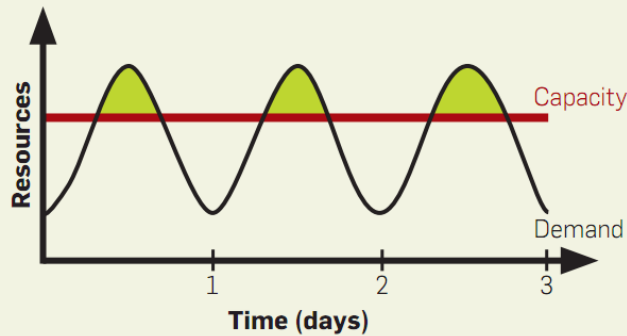


(c) Underprovisioning 2

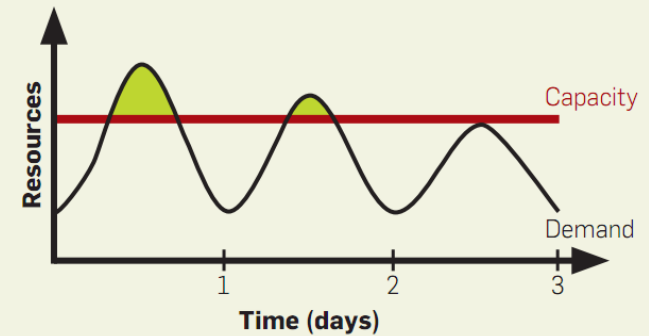
Virtualization



(a) Provisioning for peak load



(b) Underprovisioning 1

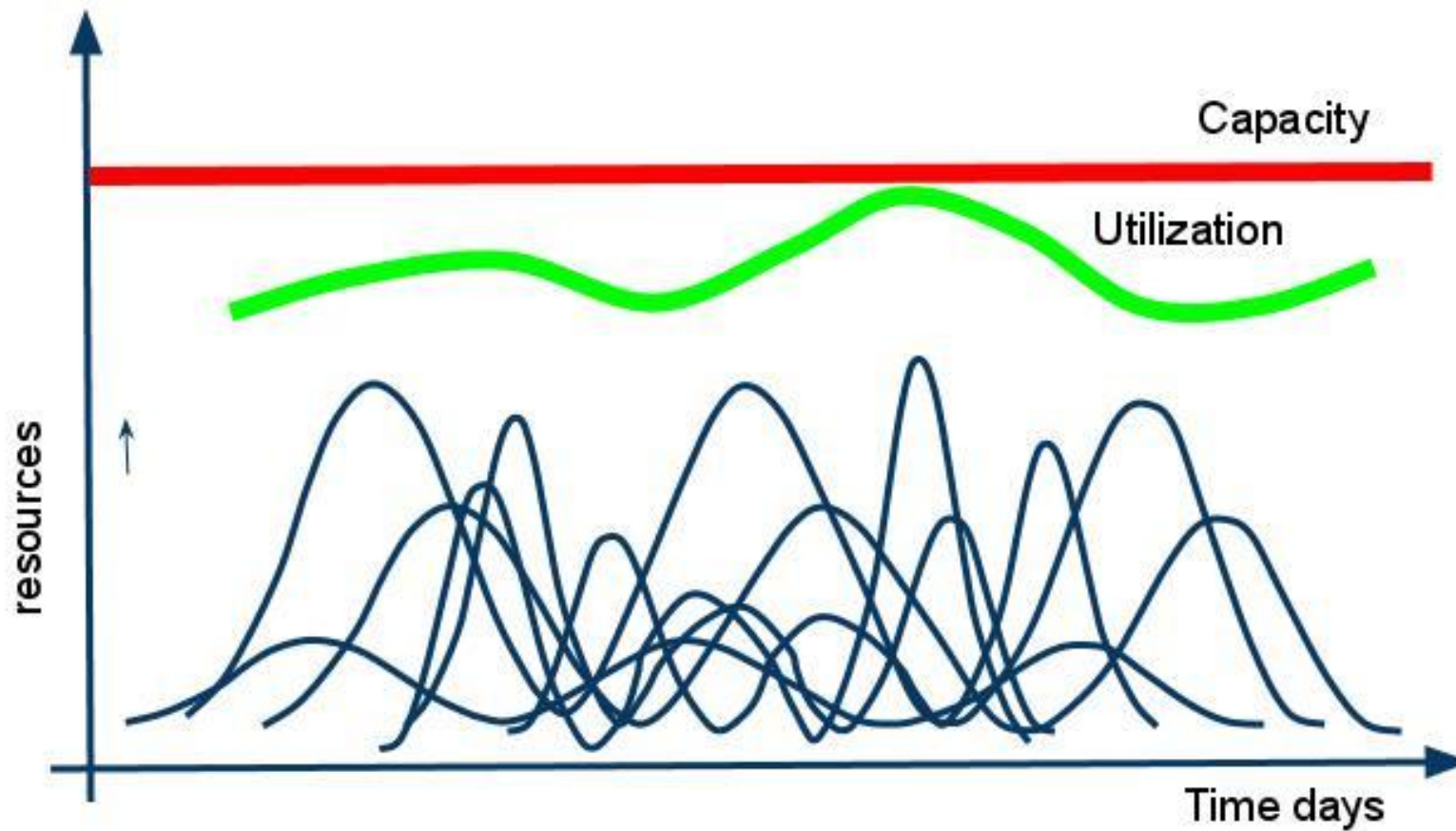


(c) Underprovisioning 2

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

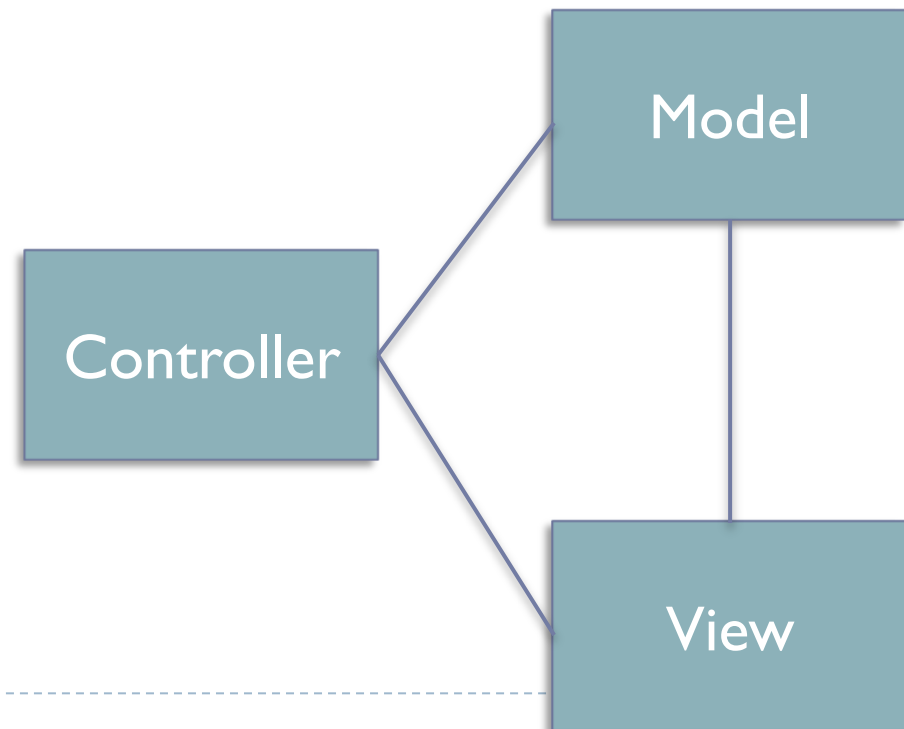


Virtulization



WEB applications - Architecture

- ▶ multiple *cloud components* communicating with each other
- ▶ 3-tier architecture. Architectonical pattern MVC model
- ▶ API application programming interfaces,
- ▶ web services software architecture = Representational State Transfer (REST)
- ▶ View, interaction – browser, native application, different platforms



Cloud applications

- ▶ Storage – backup
 - ▶ General number crunching applications
 - ▶ Web applications - services
 - ▶ Autonomic computing
 - ▶ Client–server model
 - ▶ Grid computing
 - ▶ Mainframe computer
 - ▶ Utility computing
 - ▶ Peer-to-peer
 - ▶ Service-oriented computing
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