Cloud Networking (VITMMA02)

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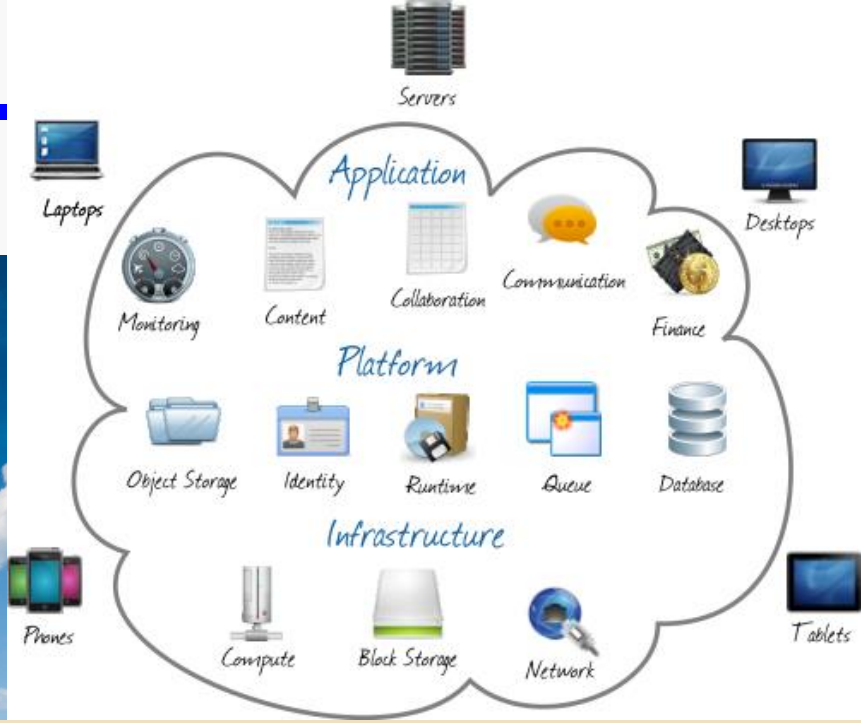
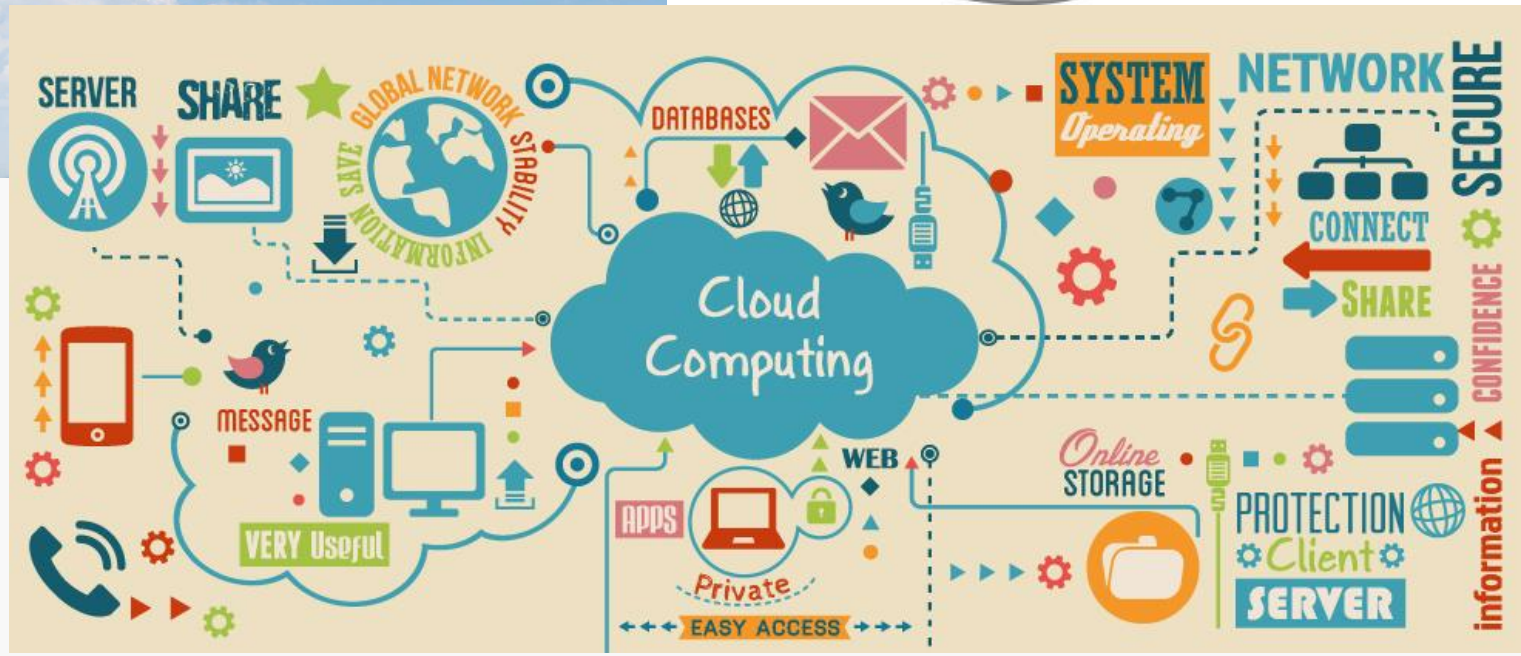
Course Info

- General subject info, requirements: https://portal.vik.bme.hu/kepzes/targyak/VITMMA02/en/
- Subject homepage: http://www.tmit.bme.hu/vitmma02?language=en
- Course homepage: http://www.tmit.bme.hu/vitmma02-2020-en?language=en

Cloud computing





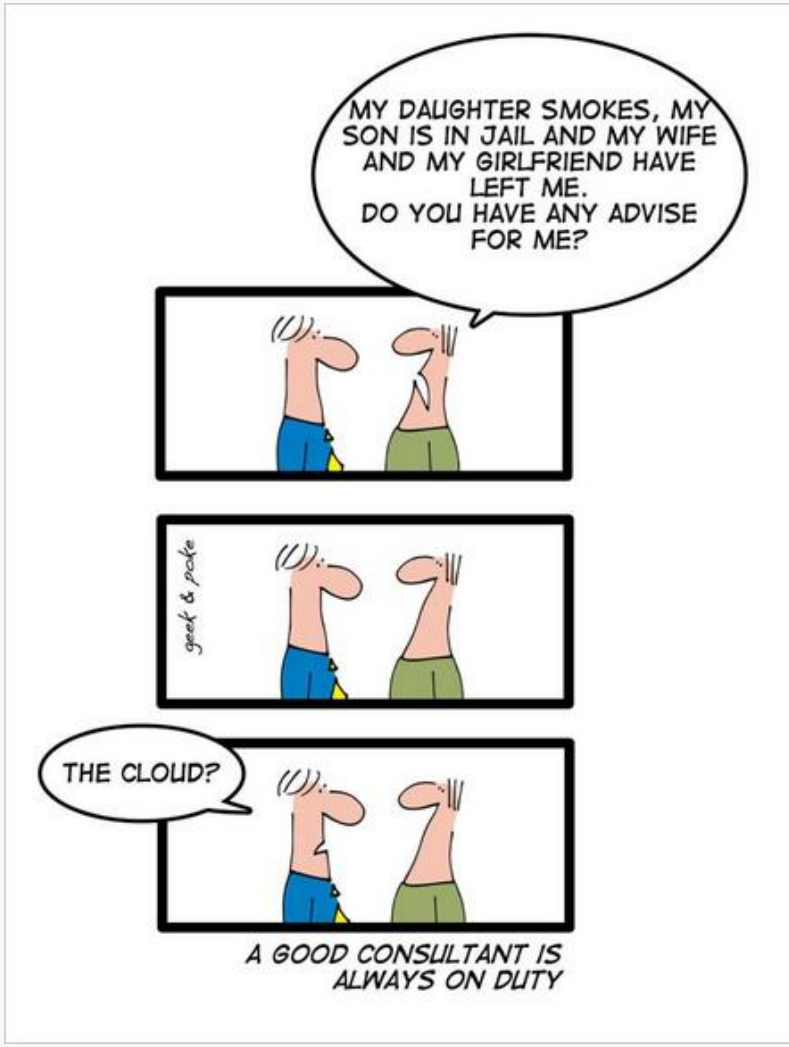
Definition of Cloud

- Many characterizations, for example:
  - using services and applications any time, from anywhere
  - using information technology with usage based costs
  - an overall virtualization model from the infrastructure to the applications
  - using dynamically scalable virtual resources as a service over the Internet
- Definition of National Institute of Standards and Technology (NIST) /2011. sept./
  - „ Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”
  - 5 key properties + 3 service models + 4 deployment models

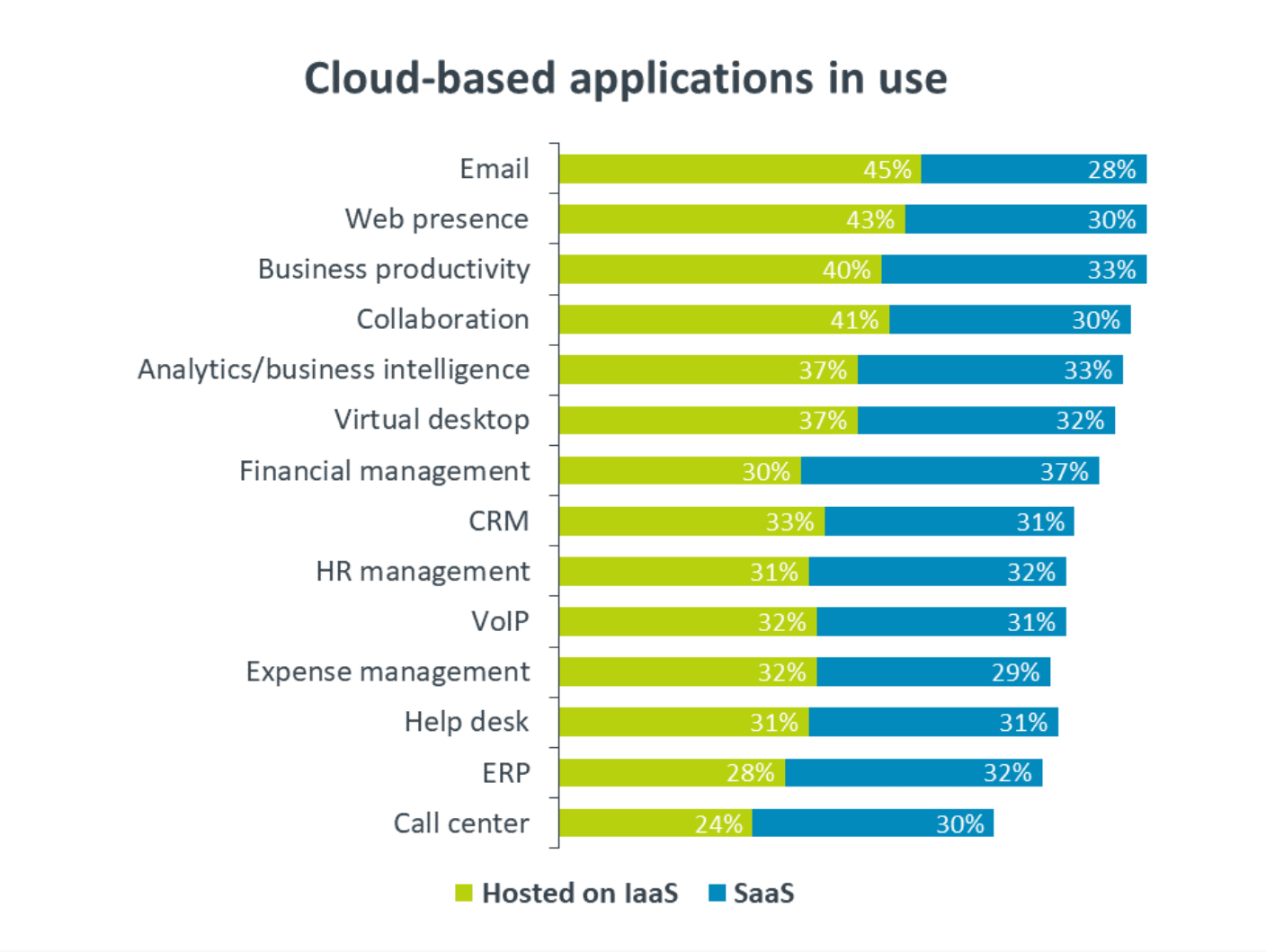
5 key properties	3 service models	4 deployment models
on-demand self-service	Software as a Service	Private cloud
broad network access	Platform as a Service	Community cloud
resource pooling	Infrastructure as a Service	Public cloud
rapid elasticity		Hybrid cloud
measured service		

Is it a buzzword to solve everything?

- "With the cloud, individuals and small businesses can snap their fingers and *instantly set up enterprise-class services*." -Roy Stephan, 2011
- Cloud computing is really a no-brainer for any start-up because it allows you to *test your business plan very quickly for little money*." -Brad Jefferson, Animoto CEO. 2009.
- Larry Ellison, CEO of Oracle
  - in 2009: „What do you mean by "cloud computing"?…All the cloud is is computers on a network.
    Our industry is so bizarre. They just change a term and they think they've invented technology….You can't just come up with a [slogan] like "Let's call that 'cloud." [But] it sure beats innovation.
  - in 2014: We think these three product areas — database, cloud applications, and engineered systems — will drive Oracle's growth in calendar 2014.



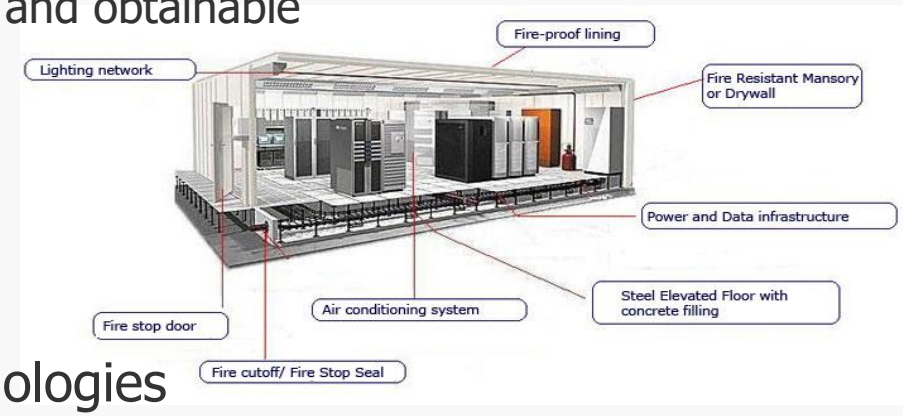
Cloud Applications



Source: CompTIA, 2018 Trends in Cloud Computing

Introduction

- A clear trend: centralizing computing resources in big datacenters
  - similarly to power-plants
- Requirements
  - commodity hardware: relatively cheap and obtainable
  - place, building
  - electrical power, cooling
  - network
- Cloud concept
  - efficiency in cost and productivity
  - remote network access
- Re-used functions from legacy technologies
  - parallel processing
  - distributed systems
  - usage-based pricing for computing (pay as you go)
- Possible tasks for a cloud engineer
  - regular checking and development of cloud infrastructure
  - development, deployment and management of cloud applications
  - creation, orchestration and operation of cloud services

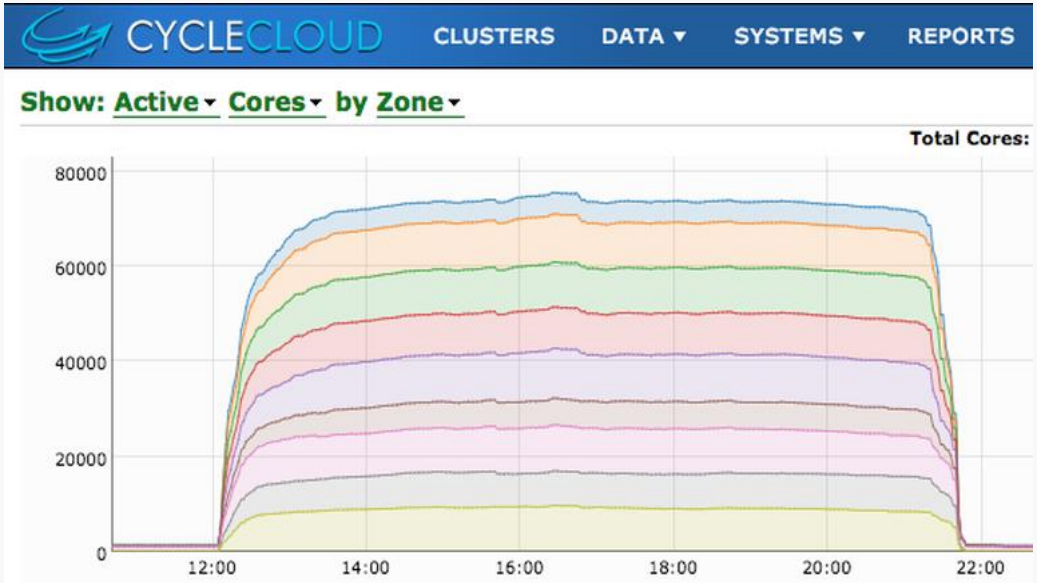


Properties of a Public Cloud Service

- It is not owned by You
- Details of service operation is hidden from the cloud user
  - no maintenance tasks
  - You cannot see it ☺
- Usage-based billing (optionally free)
- Dynamically scales according to the requirements
  - scalable, elastic

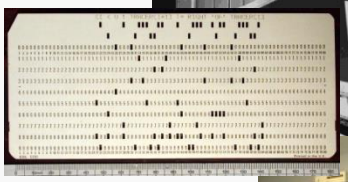
Advantages

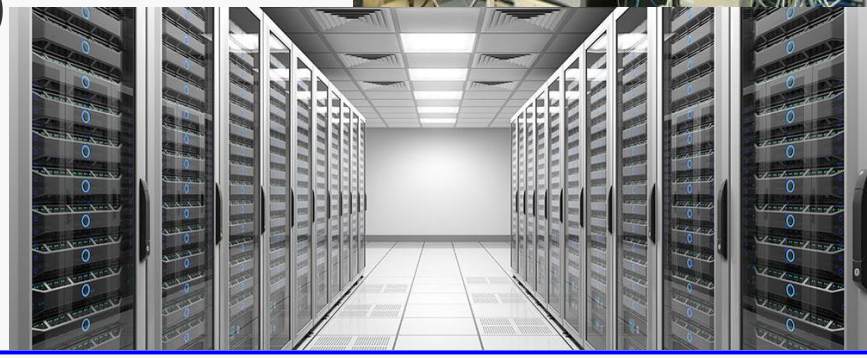
- Quick server(cluster) creation
- E.g. Amazon Web Services
  - a fun cloud run (2014): 70,980 cores on AWS for $5,593.94
    (http://www.zdnet.com/article/a-fun-cloud-run-70980-cores-on-aws-for-5593-94/)
  - from 0 to 50 000 CPU cores: 23 min
  - ~ 10 hours runtime
  - 729 TeraFLOPS cluster
  - ~ 63. supercomp.
  - analysis and simulations (MatLab)



Generations of Technologies

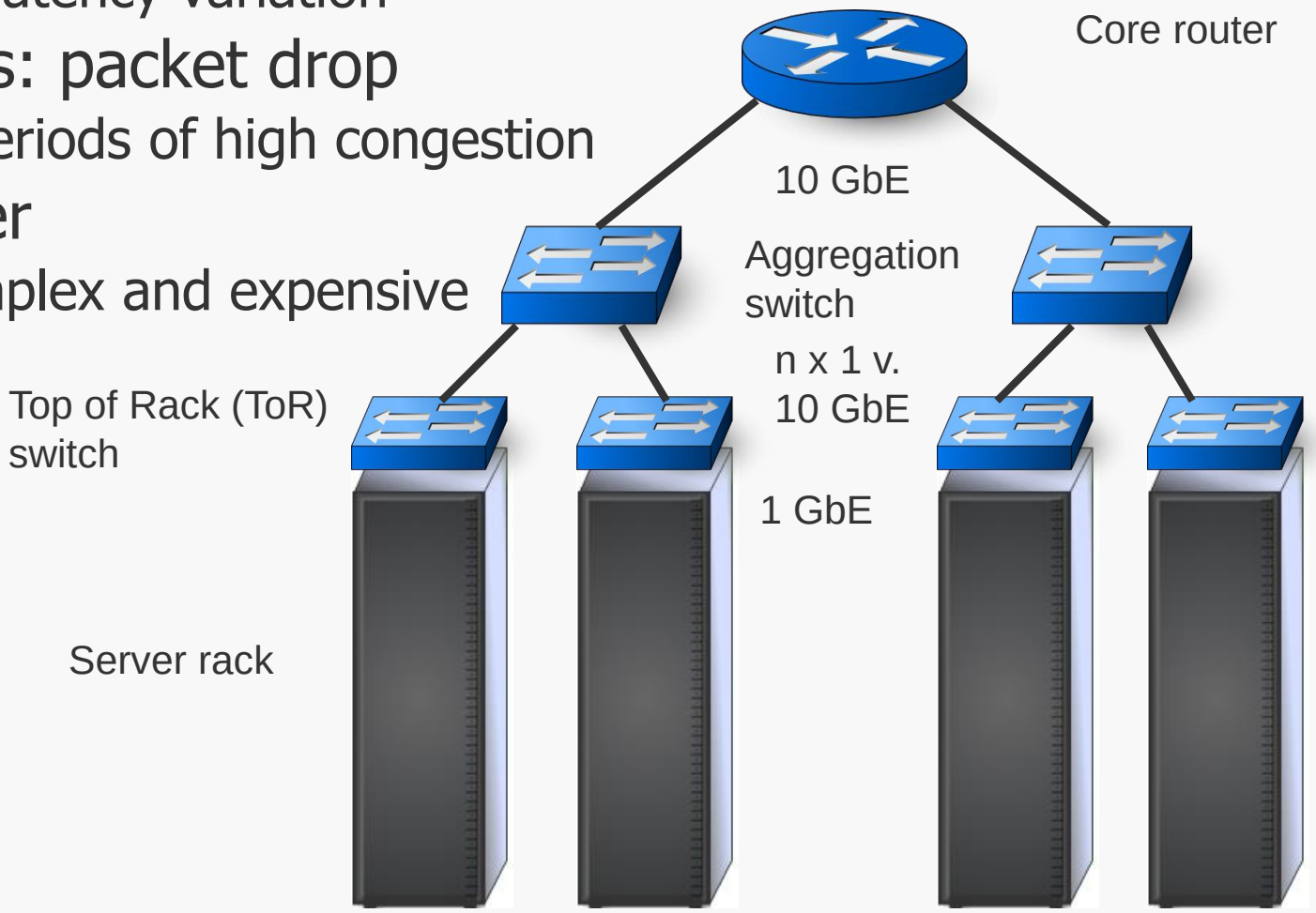
- Or: what is new in cloud systems?
- Data Center Evolution
  - mainframe era: ~ from the 1960s
    - 1 mainframe computer: centralized compute and storage, time sharing
    - punch card, printer, later teletype
    - thin client
  - minicomputers connected with LAN, later servers + LAN connects clients too: from 1980s
    - terminals and servers
    - distributed compute and storage
  - enterprise data centers (1990s)
    - servers in racks
  - cloud data centers
    - commodity hardware
    - horizontal scaling (scale out)





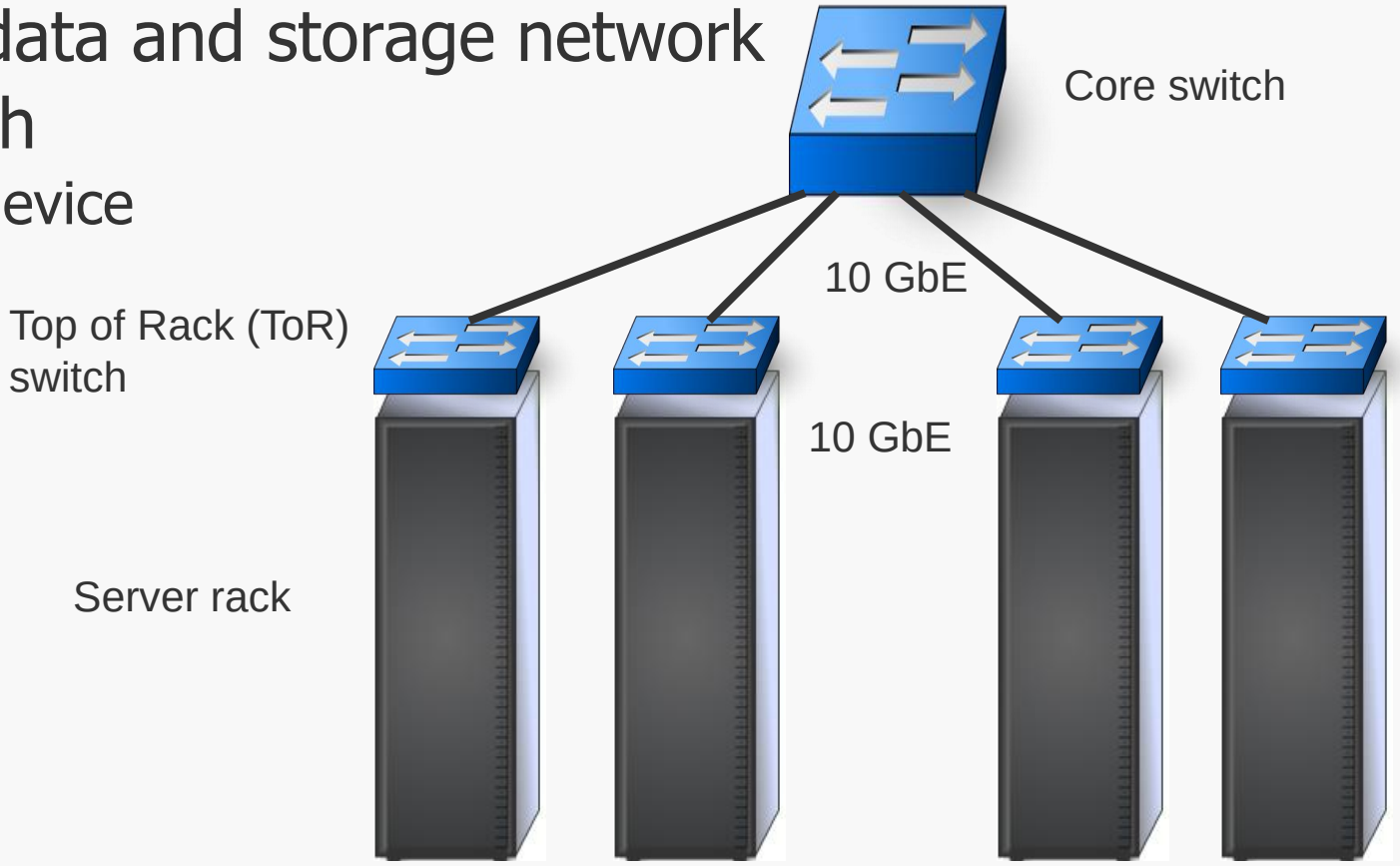
Enterprise Data Center

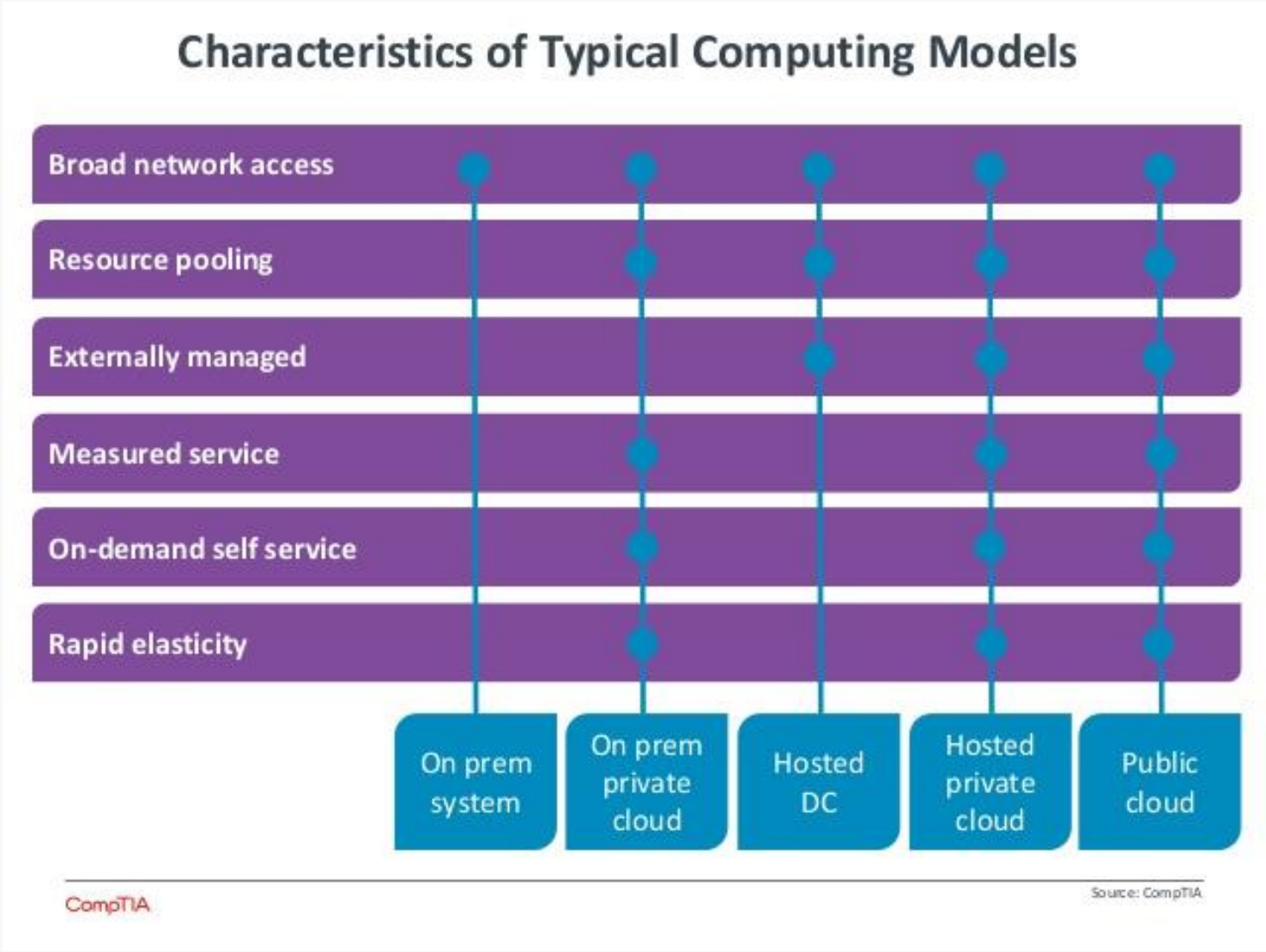
- Traffic between servers over multiple hops
  - latency, latency variation
- Traffic loss: packet drop
  - during periods of high congestion
- Core router
  - very complex and expensive



Cloud Data Center

- Traffic between servers over few hops
  - flat(ter) network topology
  - lower latency and latency variation
- Common data and storage network
- Core switch
  - simpler device




Characteristics of Typical Computing Models
Broad network access
Resource pooling
Externally managed
Measured service
On-demand self service
Rapid elasticity
On prem system
On prem private cloud
Hosted DC
Hosted private cloud
Public cloud
CompTIA
Source: CompTIA

Driving Forces

- Technology
  - web services and service oriented architecture (SOA)
  - low server utilization ⇨ virtualization
    - PCs, servers: 10%-50%
    - storage: 50%
  - high speed networks
- Economies of scale: bulk of devices – lower cost
  - CPU
  - servers
  - storage
- costs
  - electrical power
  - cooling
  - network access
- environment-friendly, a.k.a green
  - consolidation of workloads to avoid idle servers
  - concentrated energy consumption
- considered as the first milestone: 2006 opening the access to Amazon web services for outside developers
- outsourcing processes and information using cloud resources

Similar Concepts

- Cluster computing
  - similar (or identical) computers
  - in the same place, connected by LAN
  - operating as powerful supercomputer
- Grid computing
  - independent, usually different computers
  - even at different physical locations
  - operating as a distributed system
- Cloud computing
  - similar (or identical) computers
  - usually at different physical locations
  - resources provided as services

Comparison of Similar Concepts

Cluster

- tightly coupled, identical systems (HW and OS)
- centralized task management and scheduling
- dedicated low latency and high speed network
- for solving a specific task

Grid

- loosely coupled, different systems (HW and OS)
- autonomous components with own resource management, distributed control
- a large task is divided among the components
- powerful computers
- connected over the Interneten

Cloud

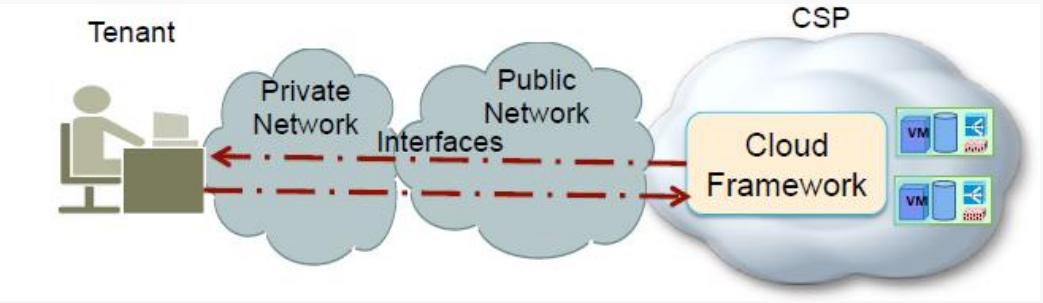
- identical or different systems
- independent components, resources are managed by a hypervisor (virtual machine manager)
- numerous different applications running in the same time
- dedicated low latency and high speed network

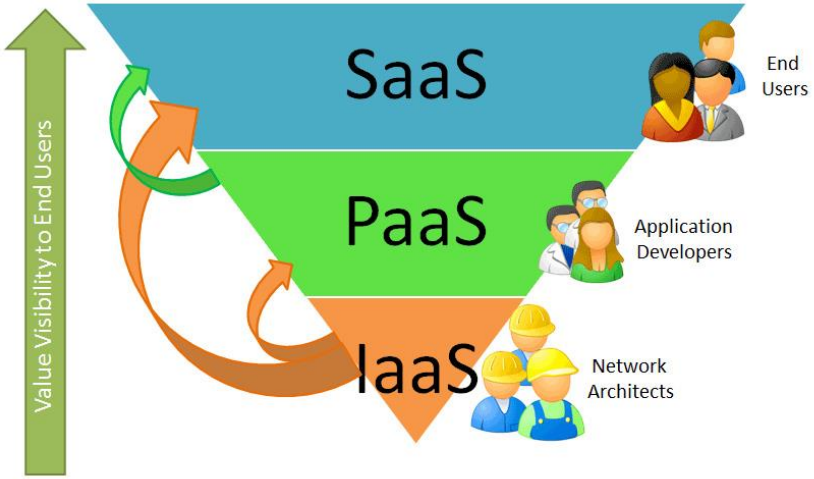
Cisco Global Cloud Networking Survey 2012

- applications and services
  - email and web services
  - virtual desktop
  - collaboration tools
  - storage
- migration to cloud is getting more and more accepted
  - cost savings
  - flexibility
  - less operational tasks

Roles

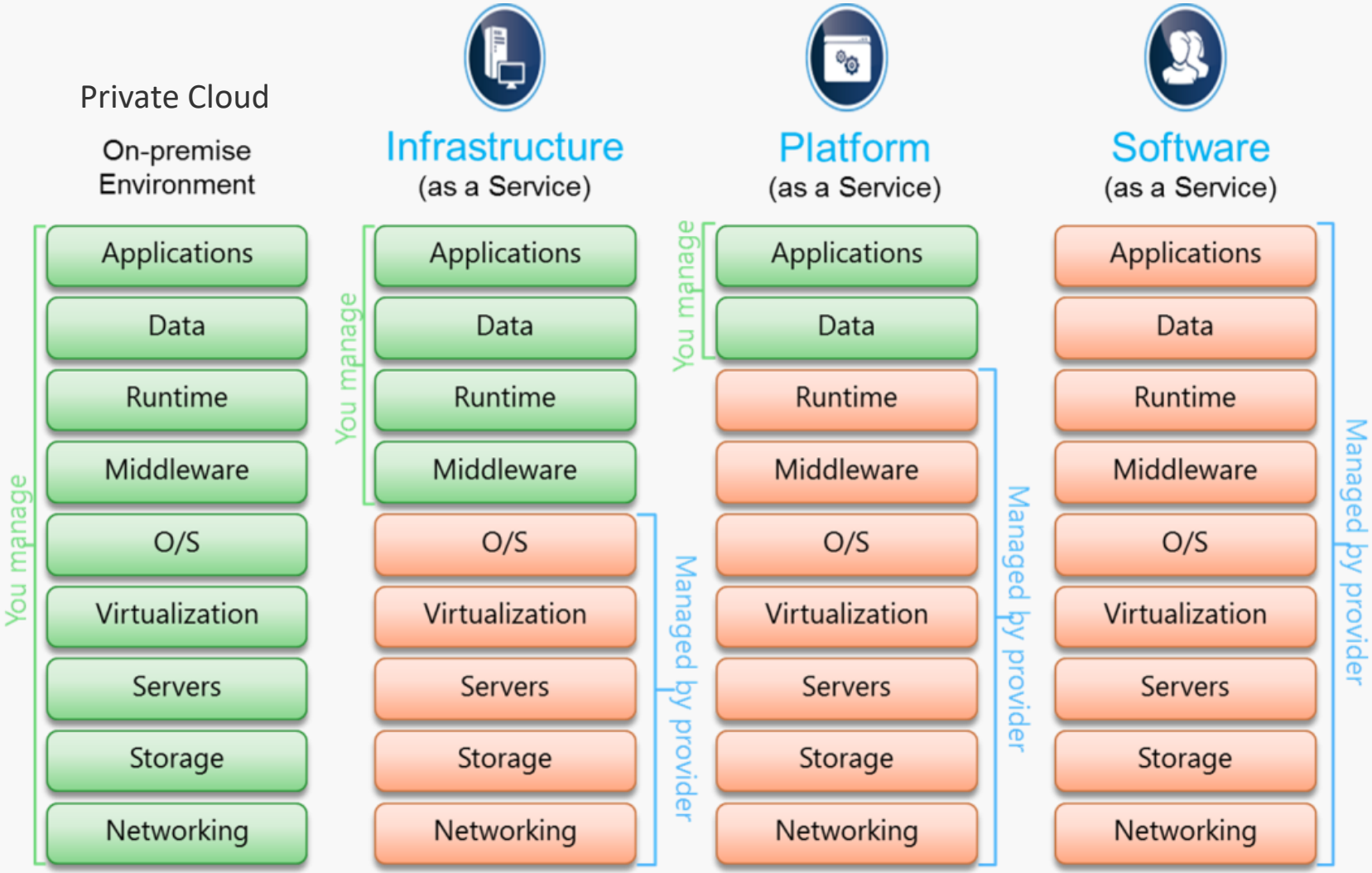
- Cloud Service Provider – CSP
- Cloud end-user, tenant, consumer
- Cloud (networking) designer/engineer/architect
- Cloud application designer/engineer/architect
- Cloud administrator, operator





Forrás: https://jaymanalotoibm.wordpress.com/2013/11/03/delivering-ibm-tririga-from-the-cloud/

Responsibilities



Source: https://www.simple-talk.com/cloud/cloud-development/a-comprehensive-introduction-to-cloud-computing/

IaaS

- Infrastructure aaS: „Hardware” as a Service
- Managed environment for existing applications and services
- Components
  - server (physical or virtual) – compute resource
  - storage: disk drive
  - network + network devices: firewall, load balancer, etc.
    ⇨ network architect
- Providers: e.g. Amazon EC2, S3; Rackspace, Microsoft Azure, Google Compute Engine, etc.

PaaS

- Services
  - „solution stack”: developer, test and runtime environment
  - OS, developer tools, databases, application servers, webservers all-in-one
- Access via API (App. Programming Interface)
- For cloud application developers
  - full development cycle: source code repository and control, compile, build, test, etc.
- Built on IaaS
- Providers: e.g. Microsof Azure PaaS, Google App Engine, AWS Elastic Beanstalk, Red Hat OpenShift, Cloud Foundry, Heroku
- typically not portable between different PaaS providers

SaaS

- Software application as a Service
  - a complete solution, product
    - usually business applications
    - e-mail, calendar, CRM, office suite, project management, helpdesk, etc.
  - software licensing modell, subscription fee
- SaaS provider maintains hardware and software
  - reducing IT operating costs
- Very few customization options