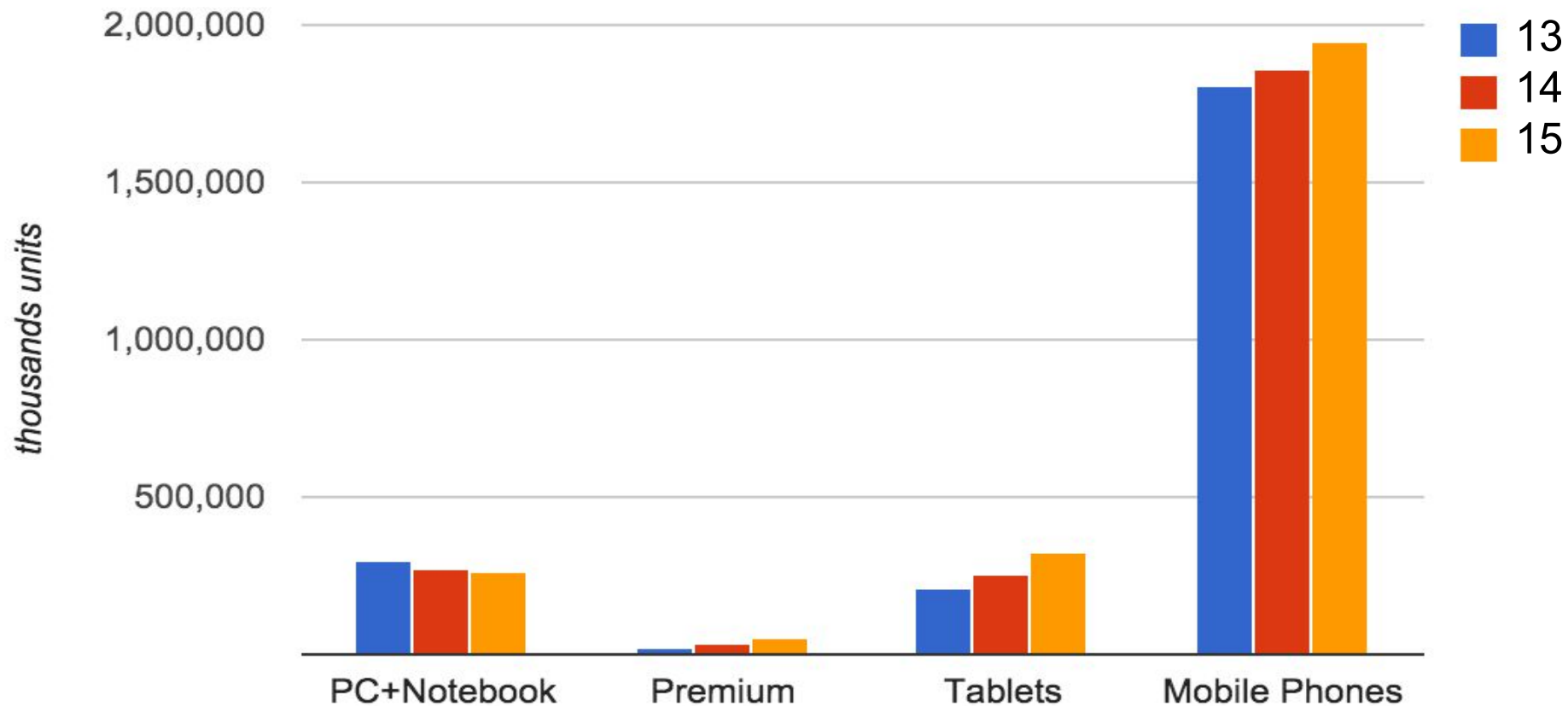# Mobile Cloud Computing

Jan Šedivý
ČVUT FEL, dept. of Cybernetics

Worldwide Device Shipments by Segment
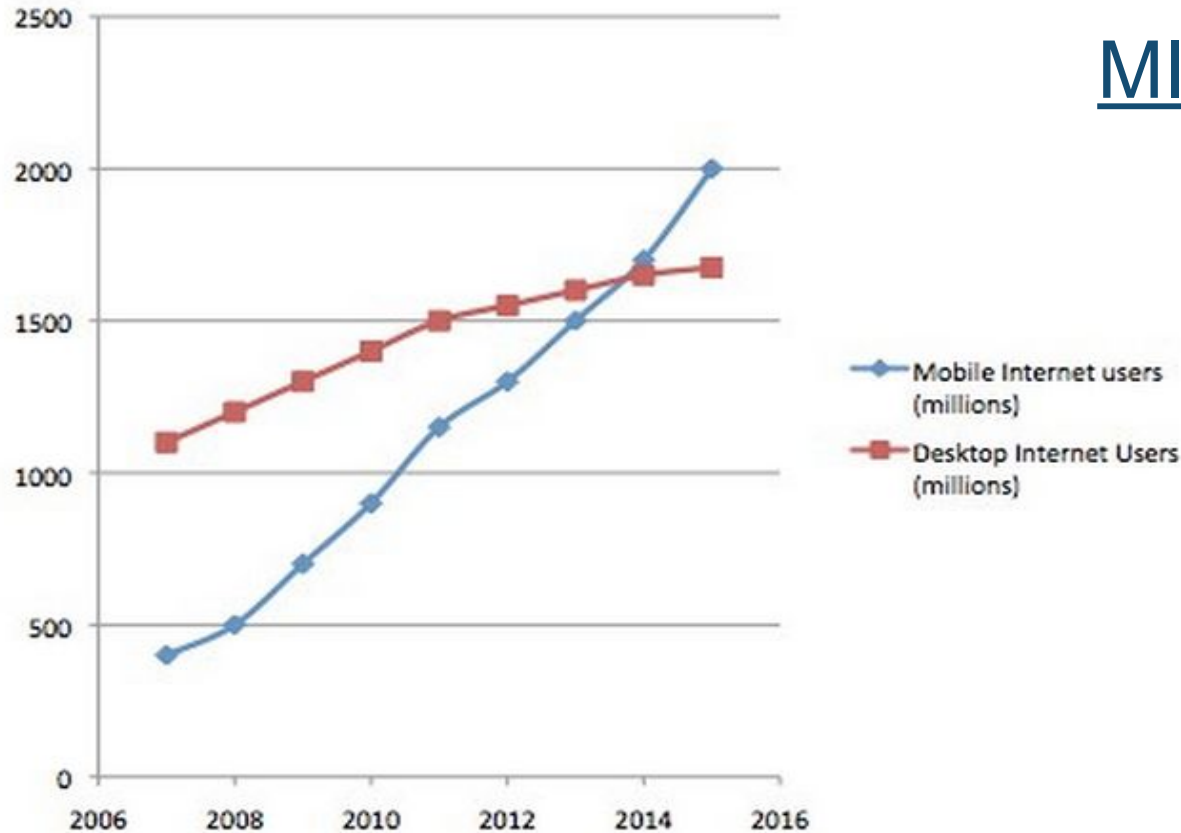

Gartner (June 2014)

Mobile devices

MIGHTYminnow

"mobile first"

Wearables
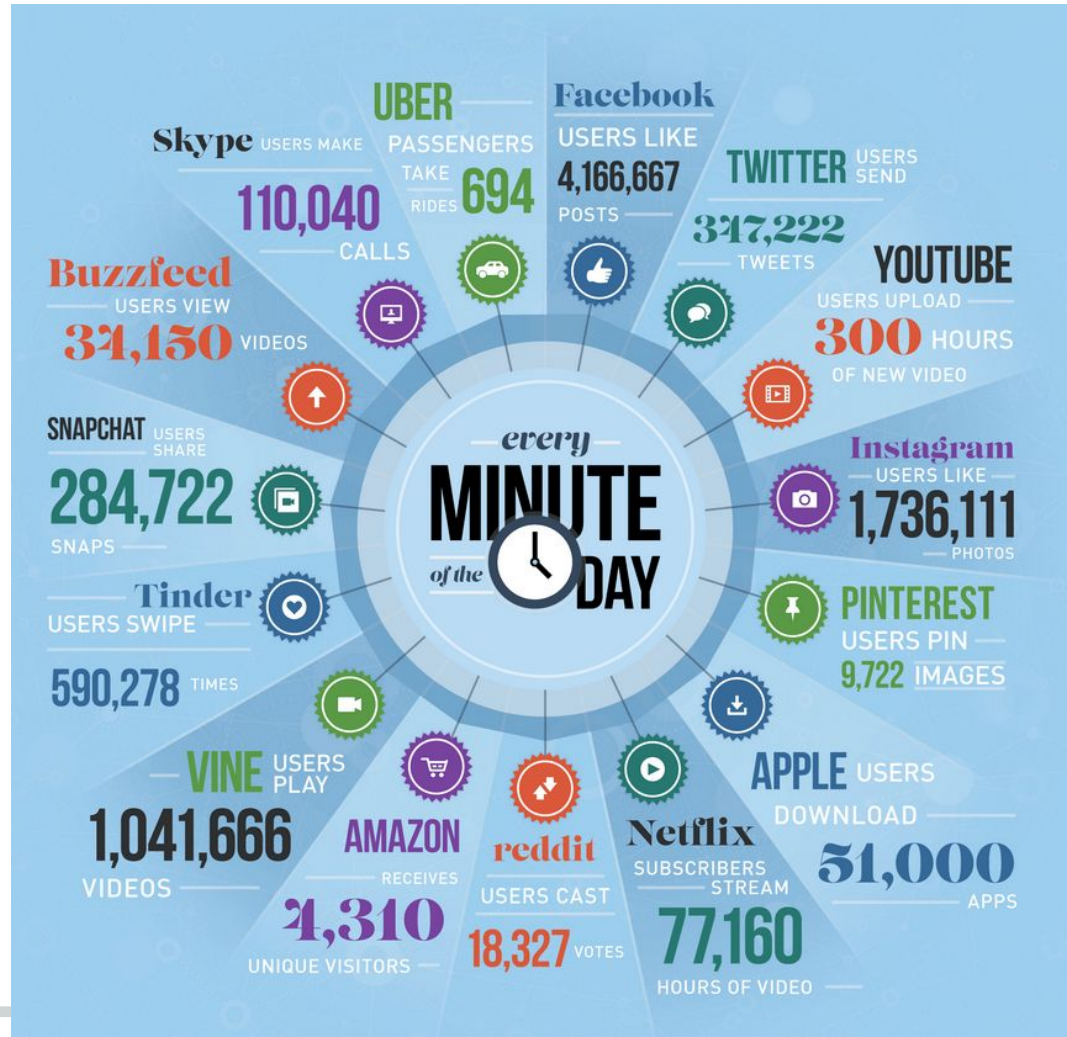Google glass
Google watch
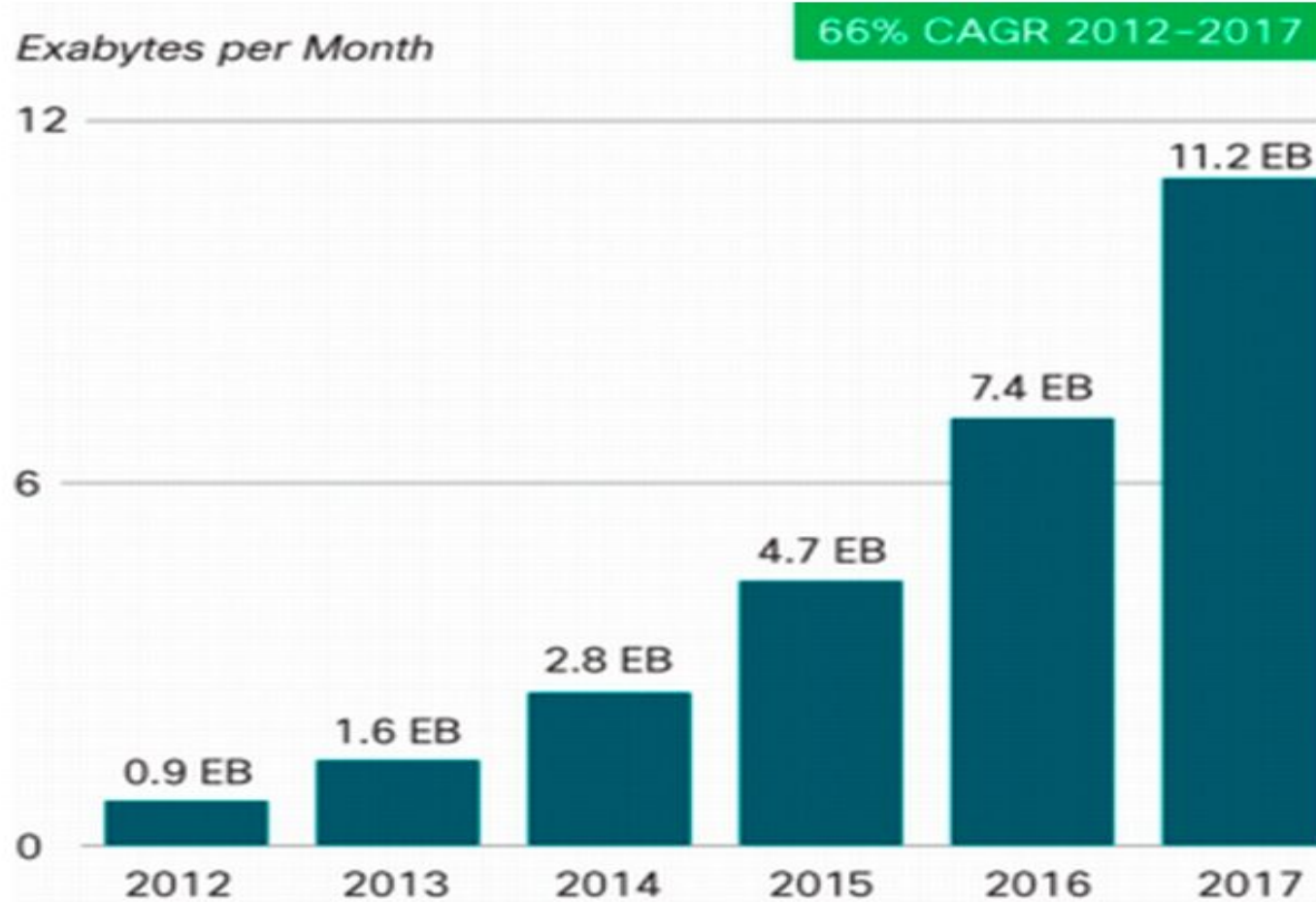Automotive
PC, notebook
Home TV

Data Growth

traffic

content

[Data Never Sleeps](#)

[Worldmeters](#)
[Internetlivestats](#)

Figure 1. Cisco Forecasts 11.2 Exabytes per Month of Mobile Data Traffic by 2017

Exabytes per Month

66% CAGR 2012–2017

- 2012: 0.9 EB
- 2013: 1.6 EB
- 2014: 2.8 EB
- 2015: 4.7 EB
- 2016: 7.4 EB
- 2017: 11.2 EB
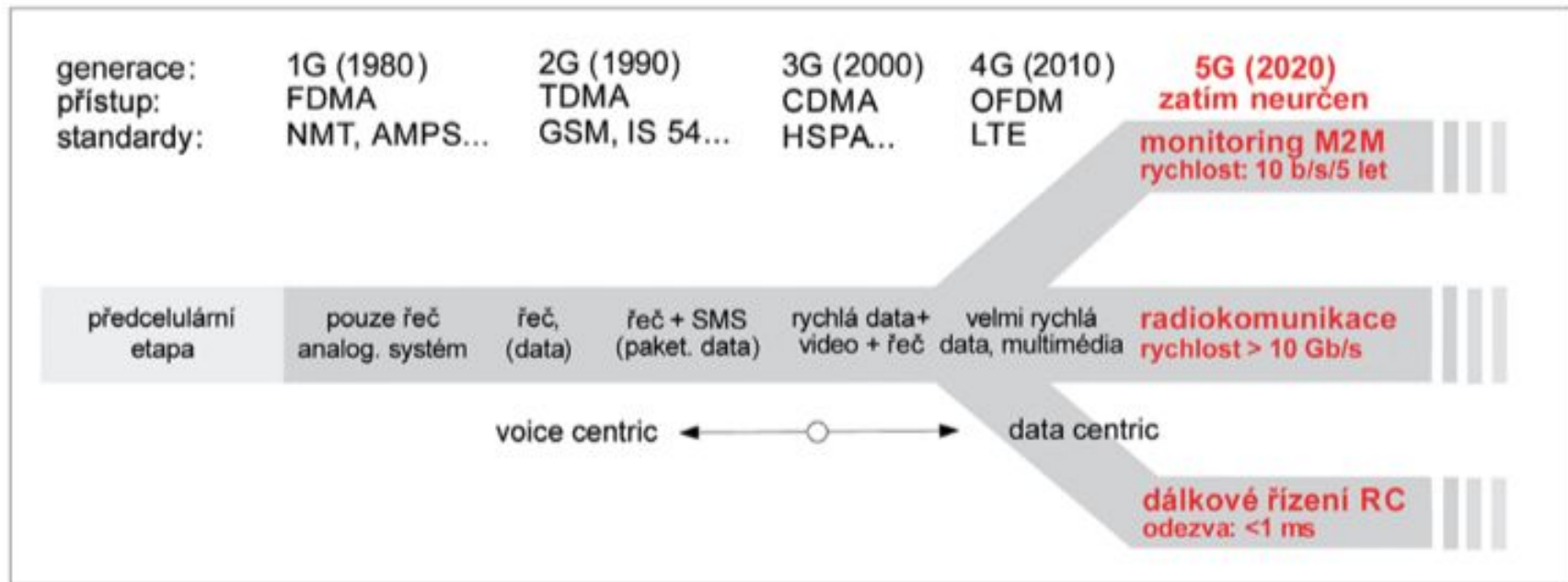
1 EB = 10^18 bytes
= 1000 petabytes
= 10^6 terabyte
= 10^9 gigabytes

Radio Access Network

RAN history

5G Networks Requirements

Cloud-based RAN

RAN services: networking (voice, data), authentication, billing, administration, monitoring, logs, analytics

RAN == web applications
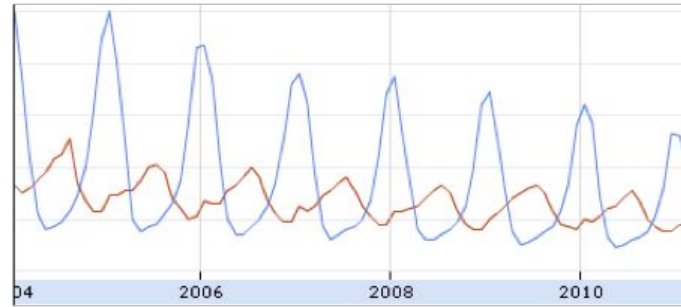
Cloud computing model => cost and efficiency benefits

Cloud Computing Basics

VIRTUALIZATION

Seasonality

Utilization
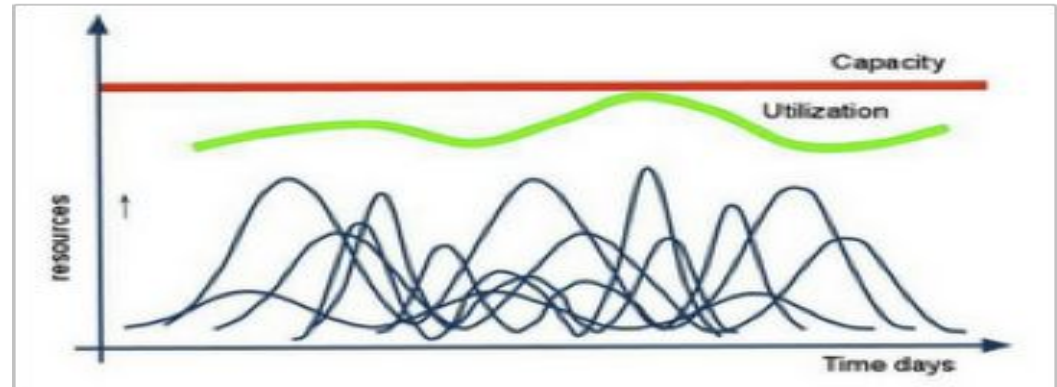
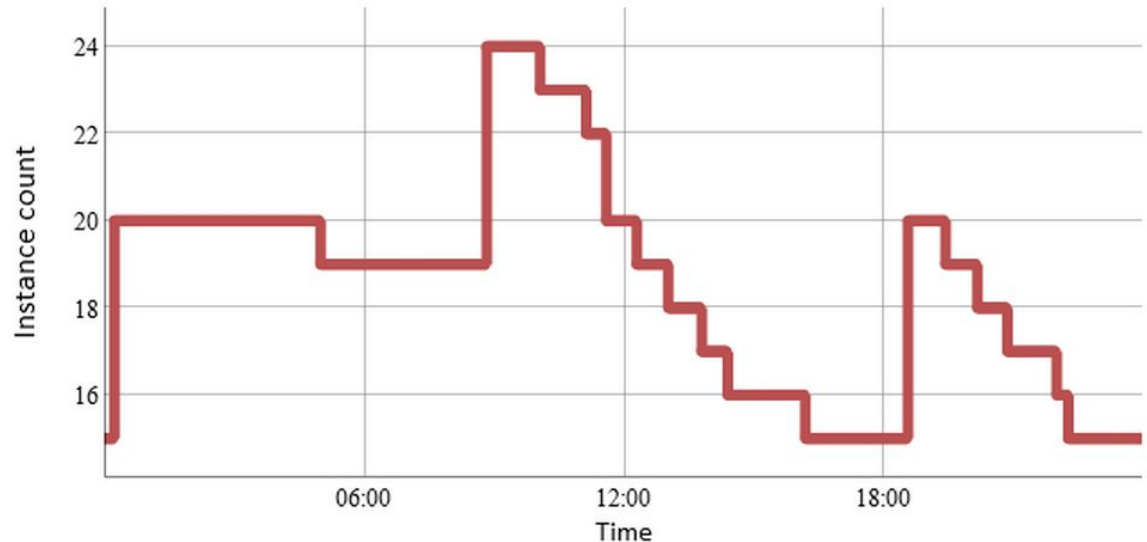# **Scaling**

Elasticity

Autoscaling

Load balancing

C - RAN

- 3G separates the Remote Radio Head (RRH) from
- Baseband unit (BBU) connected by fiber to cloud
- C-RAN BBU virtual machine
  - X86/ARM CPU based servers
  - Interface cards to handle fiber link to RRH
  - 4G/3G/2G function modules from different vendors coexist

- Software-defined networking (SDN)
- Better resources utilization

RAN architecture

- provisioned on commercial servers allows load balancing and switching network capacity and resources on demand from cell sites in light traffic areas to regions experiencing heavy mobile traffic

- C-RAN will trade the additional cost of fiber-based fronthaul by reduction in equipment cost, energy consumption and network operation expenses.

- Ultra fast virtual machine provisioning required

- Fast SDN configuration required

- Mobile Edge Computing with ultra-low latency and high bandwidth as well as direct access to a real-time radio network for offering context-related services.
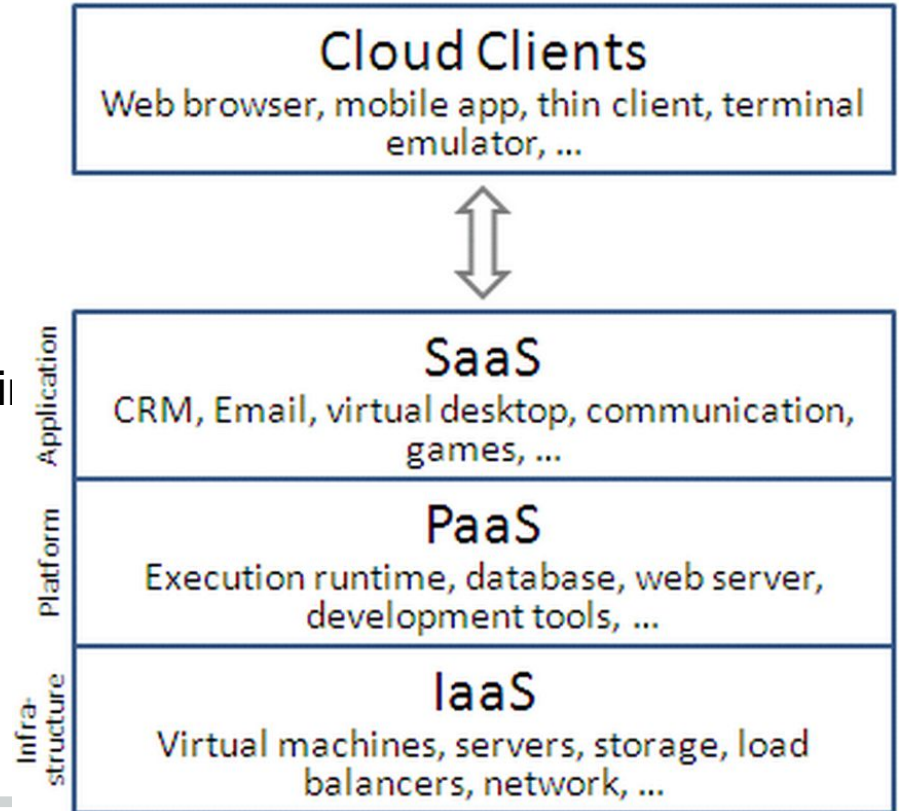
Deployment model

- Public cloud - open Internet
- Community cloud - shares infrastructure between several organizations
- Hybrid cloud - Cloud bursting
- Private cloud - on/off premise solution
- Distributed cloud - connected to a single network or hub service

Service model

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service

- Amazon Web Services
- Google App Engine, Compute ebgi
- Microsoft Azure
- IBM Smartcloud
- Salesforce.com

Cloud Clients
Web browser, mobile app, thin client, terminal emulator, ...

↕

Application

SaaS
CRM, Email, virtual desktop, communication, games, ...

Platform

PaaS
Execution runtime, database, web server, development tools, ...

Infra-structure

IaaS
Virtual machines, servers, storage, load balancers, network, ...

Summary

- **Scalability and elasticity -** endless CC and memory
- **Utility cost model** - CAPEX to OPEX
- **Pervasive availability independence** - browser, IP
- **Maintenance** - easier applications administration
- **Multitenancy -** one application many customers
- **Centralization** - cheaper infrastructure
- **Utilisation and efficiency** often only 10–20% utilisation
- **Reliability** - redundancy
- **Security**

Politics and religion are obsolete;
the time has come for science and spirituality.

Clarke likes to quote the first Indian Prime Minister, Pandit Nehru