
CS 436

Cloud Computing

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About the instructor



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Research Interests: Edge Computing, Telecommunication Systems, IoT, Industry 4.0, 5G Systems, 6G and beyond, Cloud Computing, Applied Machine Learning, Computer Game Engines.

About the course

Lecture Hours: Thursdays (13:40 – 16:30)

Grading:

Term Project & Assignments -> 20%

Quizzes & in-class work -> 15%

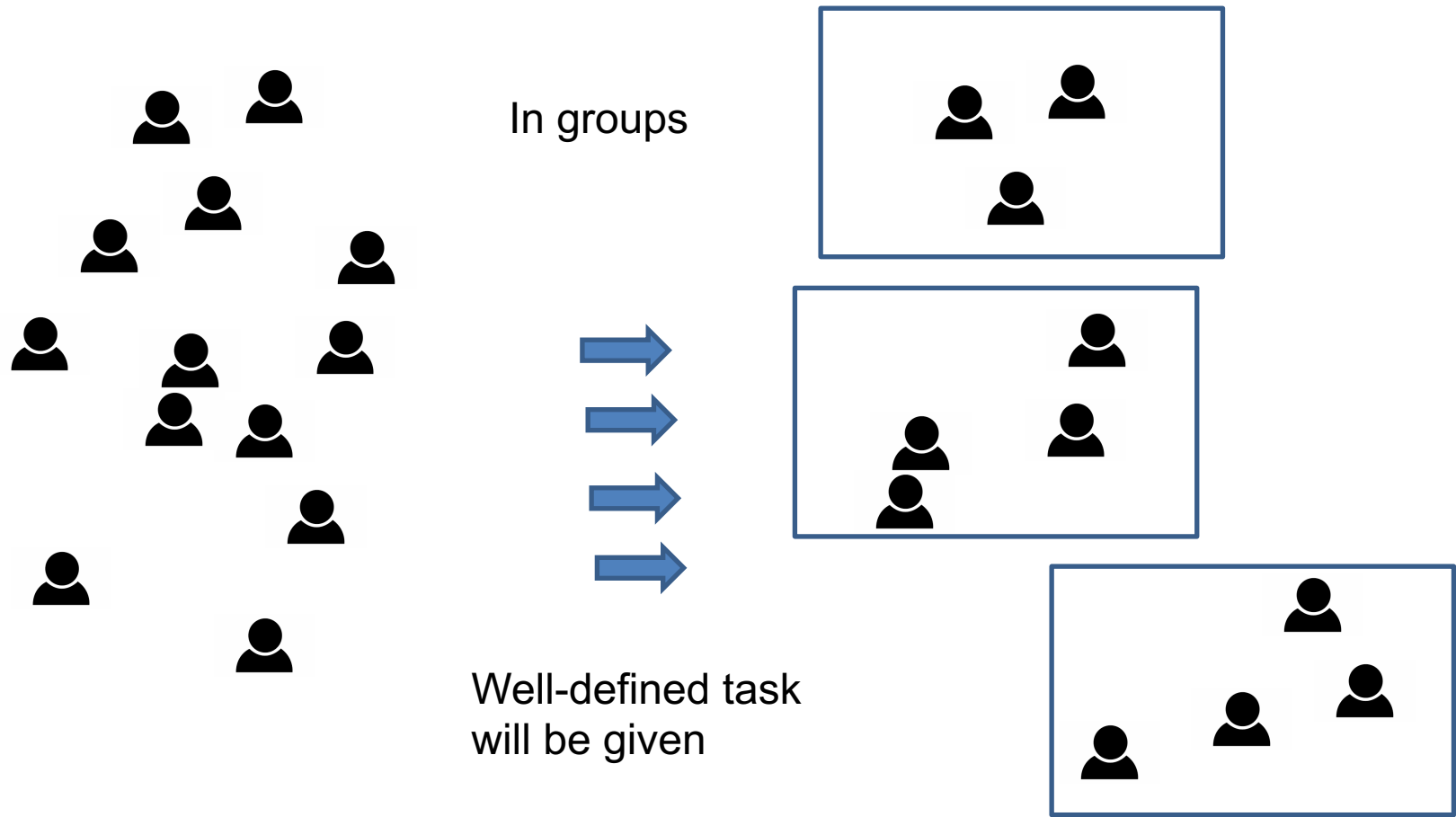
Midterm -> 25%

Final Exam -> 40%

Attendance Policy:

Students must attend 80% of the in-class
assessments

In Class Work



Practical Work Involved



On your computer
(Standalone)

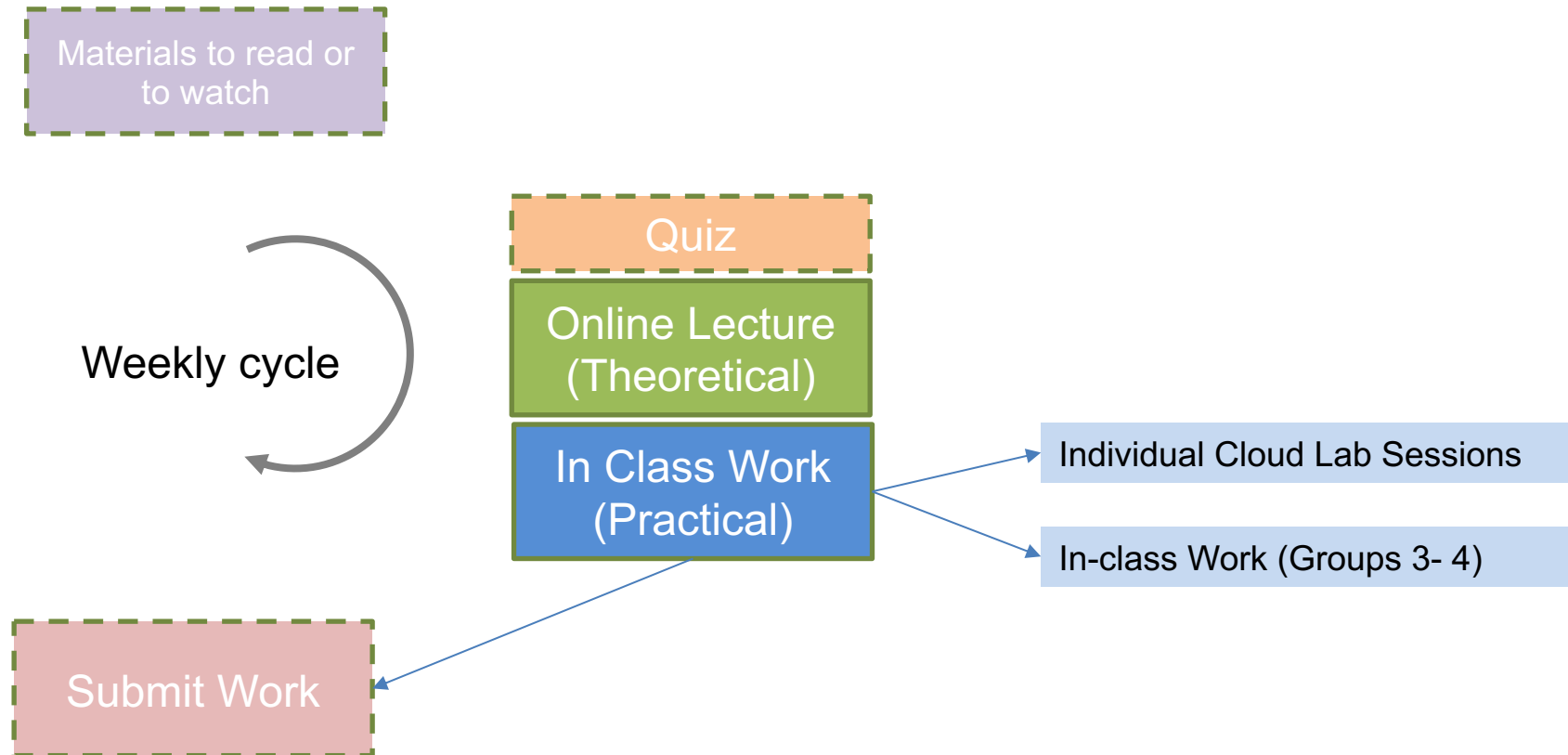


Google Cloud Platform

On the cloud –
Web based dashboards

Warm up with Linux-Ubuntu if not used before !

Typical Flow of the Course



Aim of this course

New EC2 Experience Tell us what you think

EC2 Dashboard

- EC2 Global View
- Events
- Tags
- Limits
- ▼ **Instances**
 - Instances **New**
 - Instance Types
 - Launch Templates
 - Spot Requests
 - Savings Plans
 - Reserved Instances **New**
 - Dedicated Hosts
 - Scheduled Instances
 - Capacity Reservations
- ▼ **Images**
 - AMIs
- ▼ **Elastic Block Store**

Resources [EC2 Global view](#)

You are using the following Amazon EC2 resources in the Europe (Ireland) Region:

Instances (running)	0	Dedicated Hosts	0
Elastic IPs	0	Instances	0
Key pairs	0	Load balancers	0
Placement groups	0	Security groups	7
Snapshots	0	Volumes	0

Account attributes

Supported platforms

- VPC

Default VPC
vpc-b7ec34d2

Settings

- EBS encryption
- Zones
- EC2 Serial Console
- Default credit specification
- Console experiments

Explore AWS

Save Up to 45% on ML Inference
EC2 Inf1 instances provide high performance and lowest cost ML inference in the cloud. [Learn more](#)

Enable Best Price-Performance with AWS Graviton2

Launch instance
To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.

Service health

Region: Europe (Ireland) Status: **✔ This service is operating normally**

Launch instance **▼**

[Migrate a server](#)

Notification: Easily size, configure, and deploy Microsoft SQL Server Always On availability groups on AWS using the AWS Launch Wizard for SQL Server. [Learn more](#)

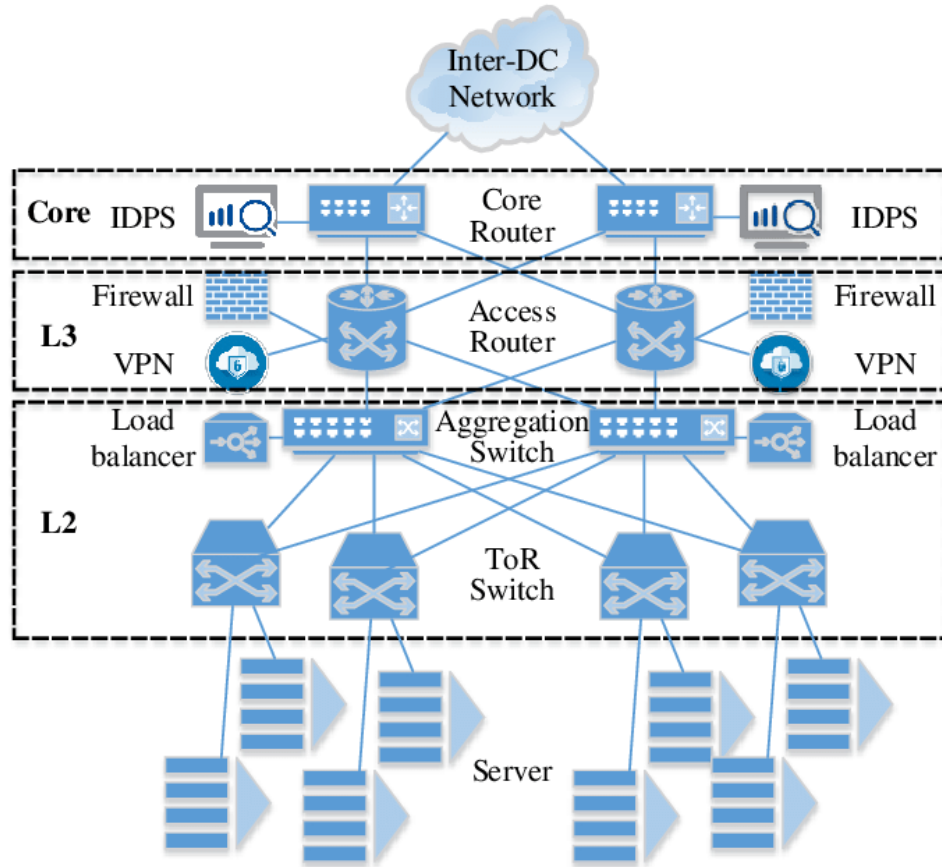
VERY IMPORTANT



**BUDGET
ALARM !**

Never operate on AWS, GCP, AZURE
without first turning on Budget Alarm.

Aim of this course



Ref: Liu, Y., Ren, G., Wu, J., Zhang, S., He, L., & Jia, Y. (2015). Building an IPv6 address generation and traceback system with NIDTGA in Address Driven Network. *Science China Information Sciences*, 58(12), 1-14.

One last word: Vendor Independence

Concepts on which Cloud Computing Systems operate are **same** everywhere: AWS, GCP, Azure, IBM, DigitalOcean

Virtualization

Datacenter

VM

Container

However, when you engineer a solution, you need to know the tools, jargon and approach of a vendor.

This course does not endorse any vendor !, but names and brands of them will be unavoidably all over the slides.

Aim: (i) to give strong understanding of the principles of Cloud Systems,
(ii) Enable enough acquaintance on how certain services operate on real world CSPs.

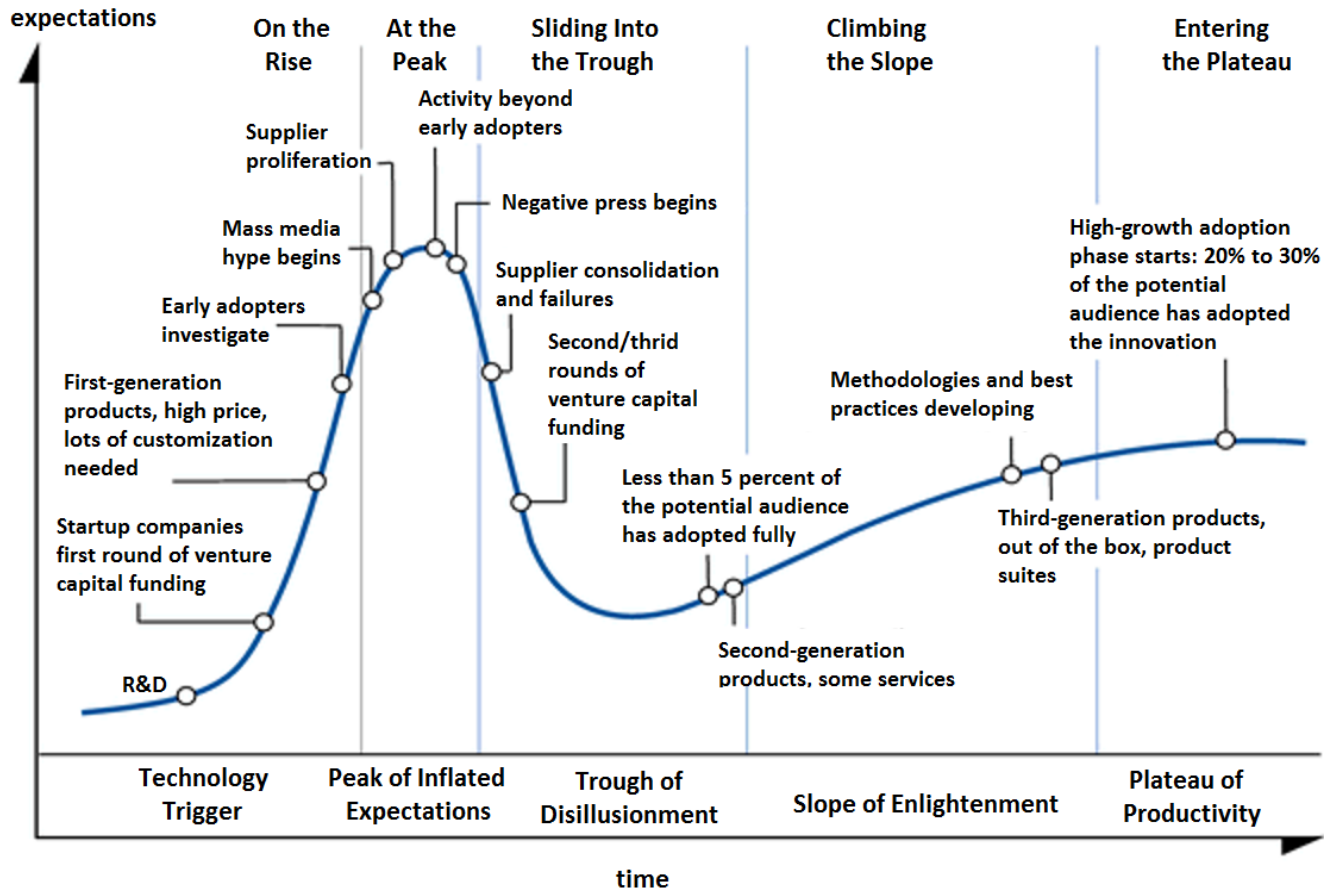
Now, the course begins!

One Slide Summary

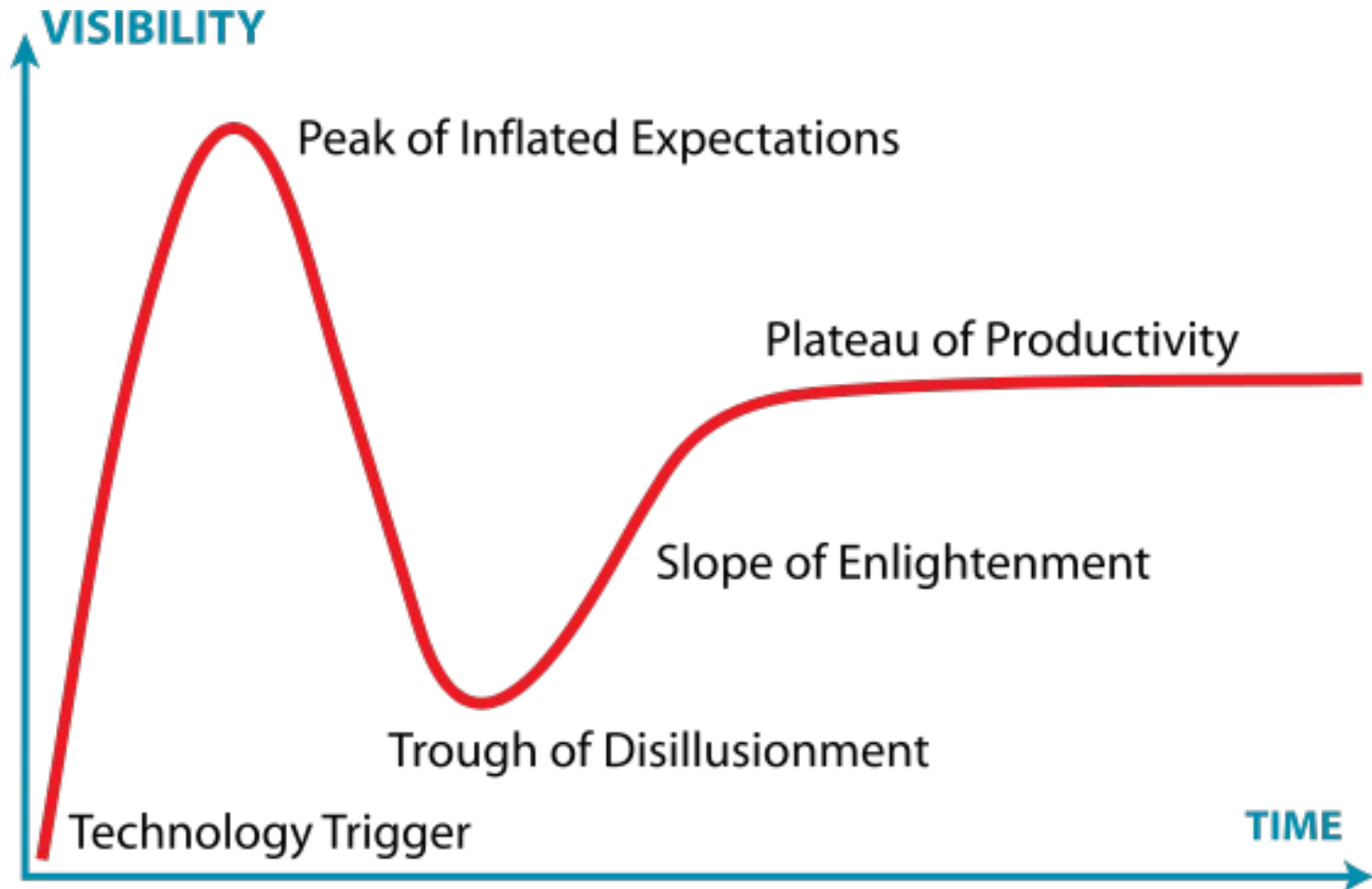


Hype Cycle

(Teknoloji Balonu Çevrimi)

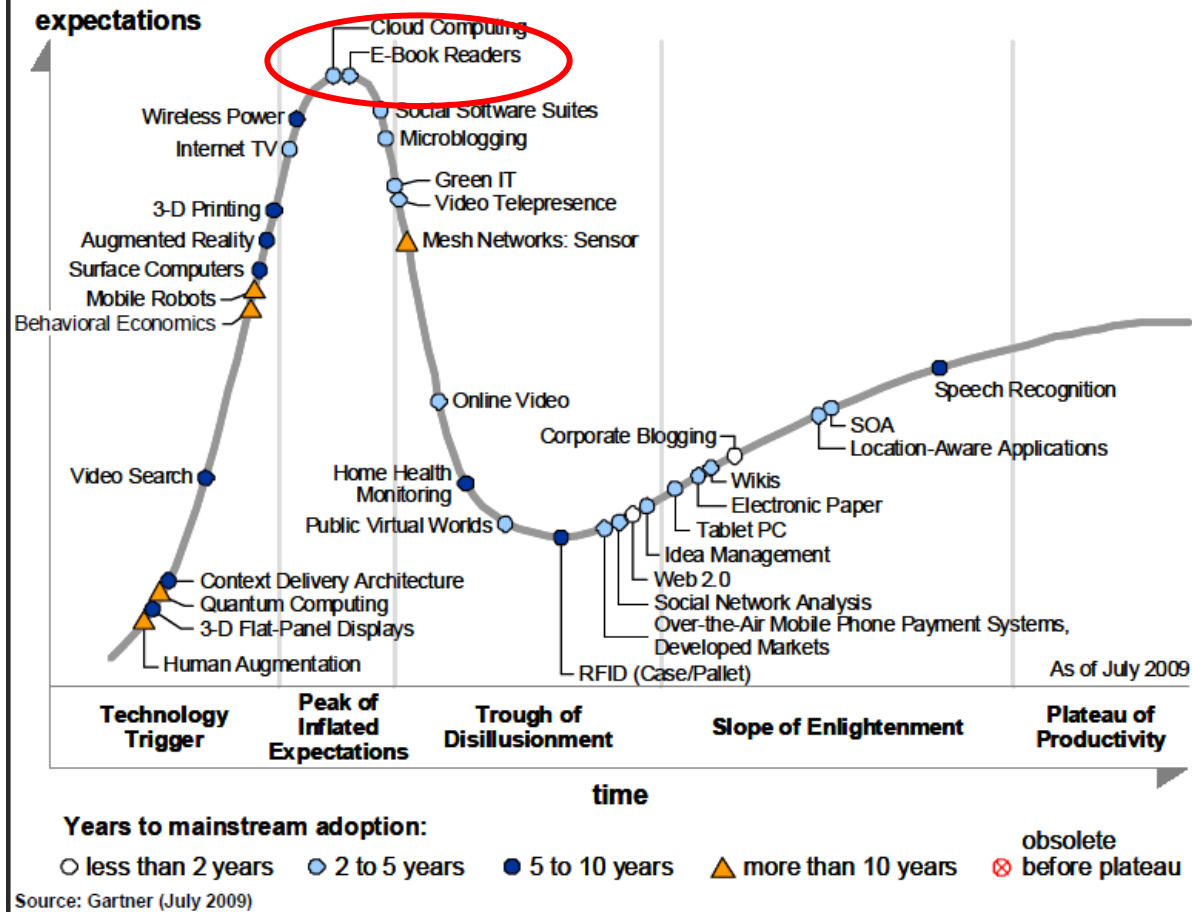


“Hype Cycle” Özü

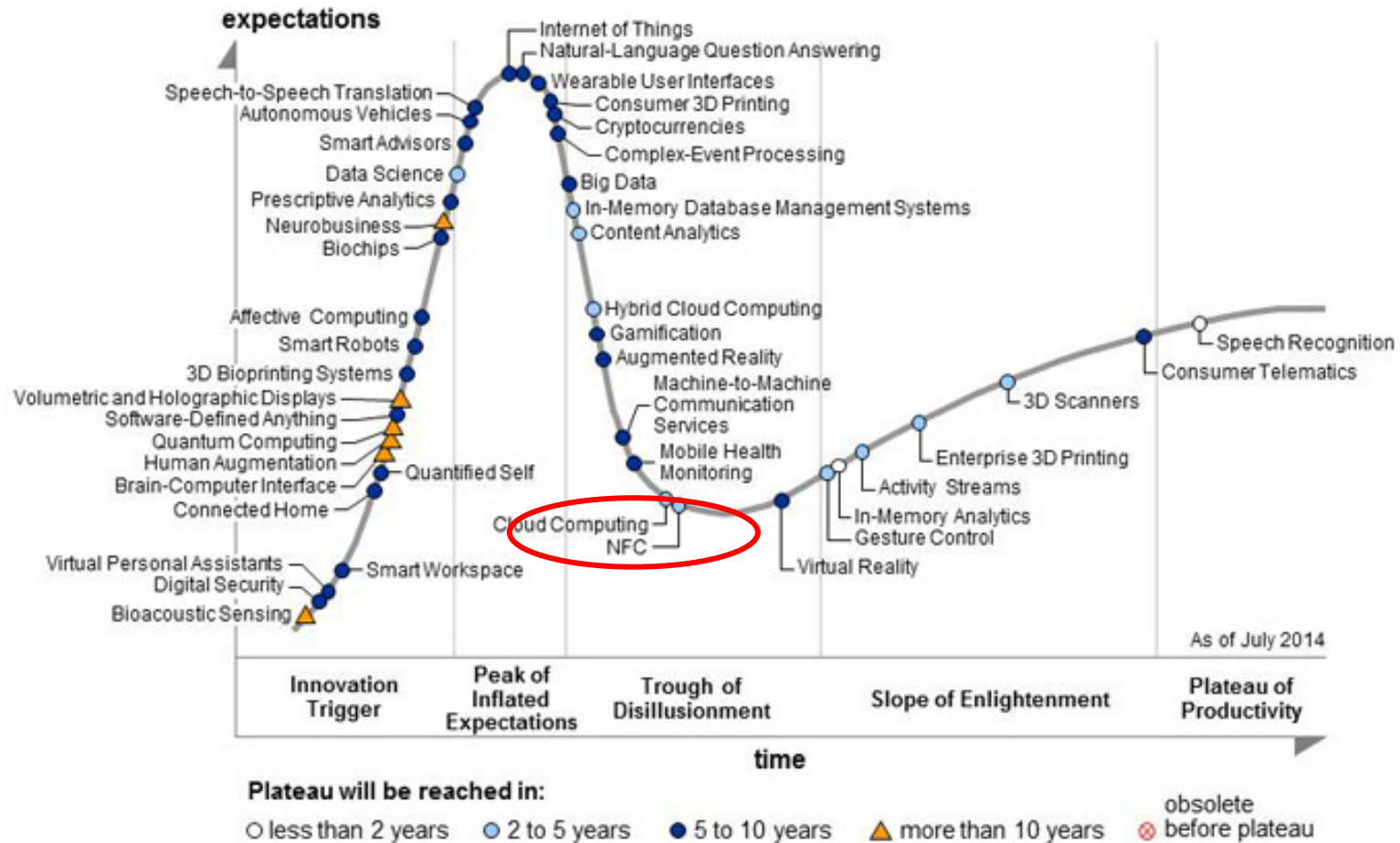


Gartner Hype Cycle 2009

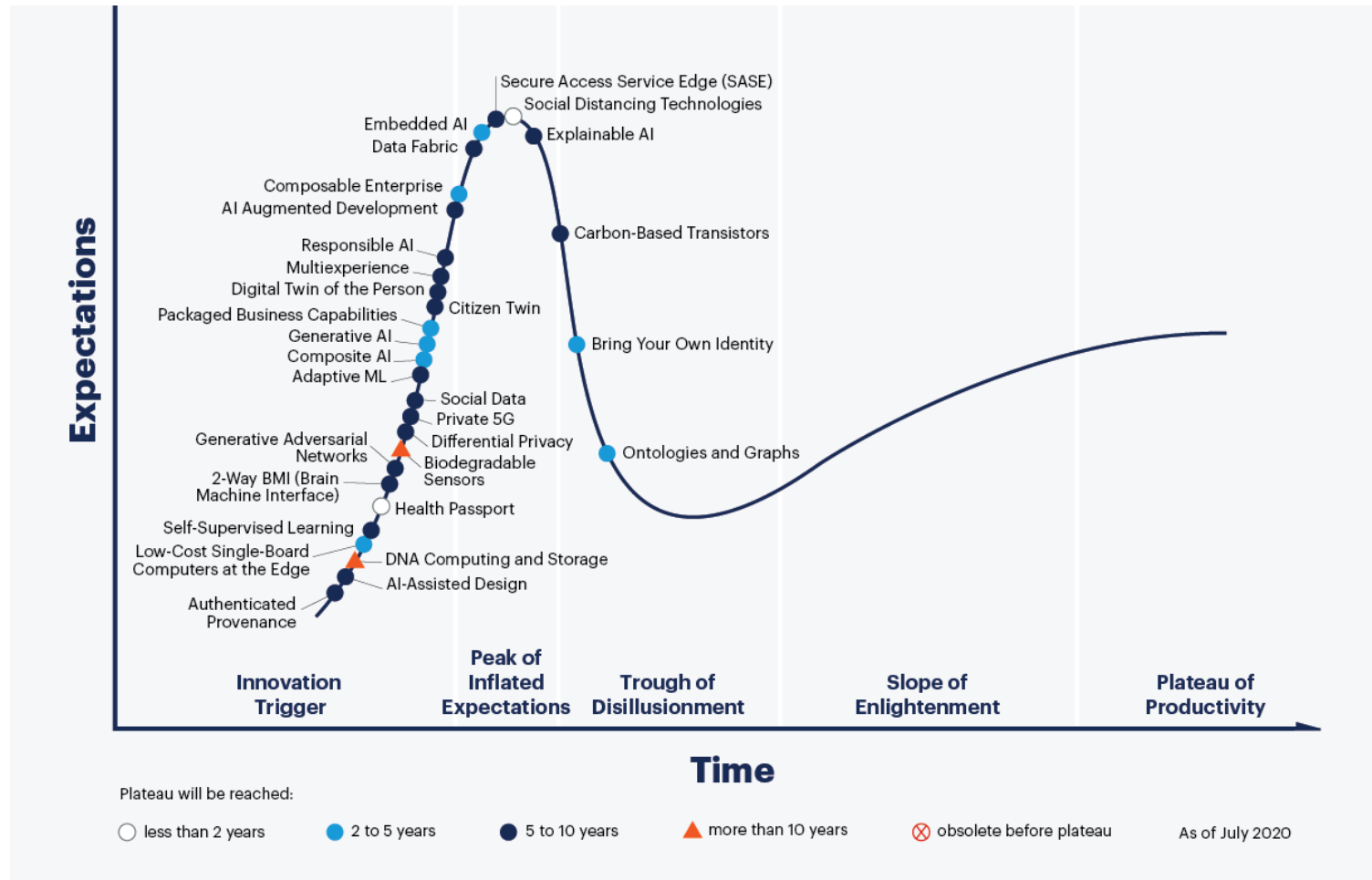
Figure 1. Hype Cycle for Emerging Technologies, 2009



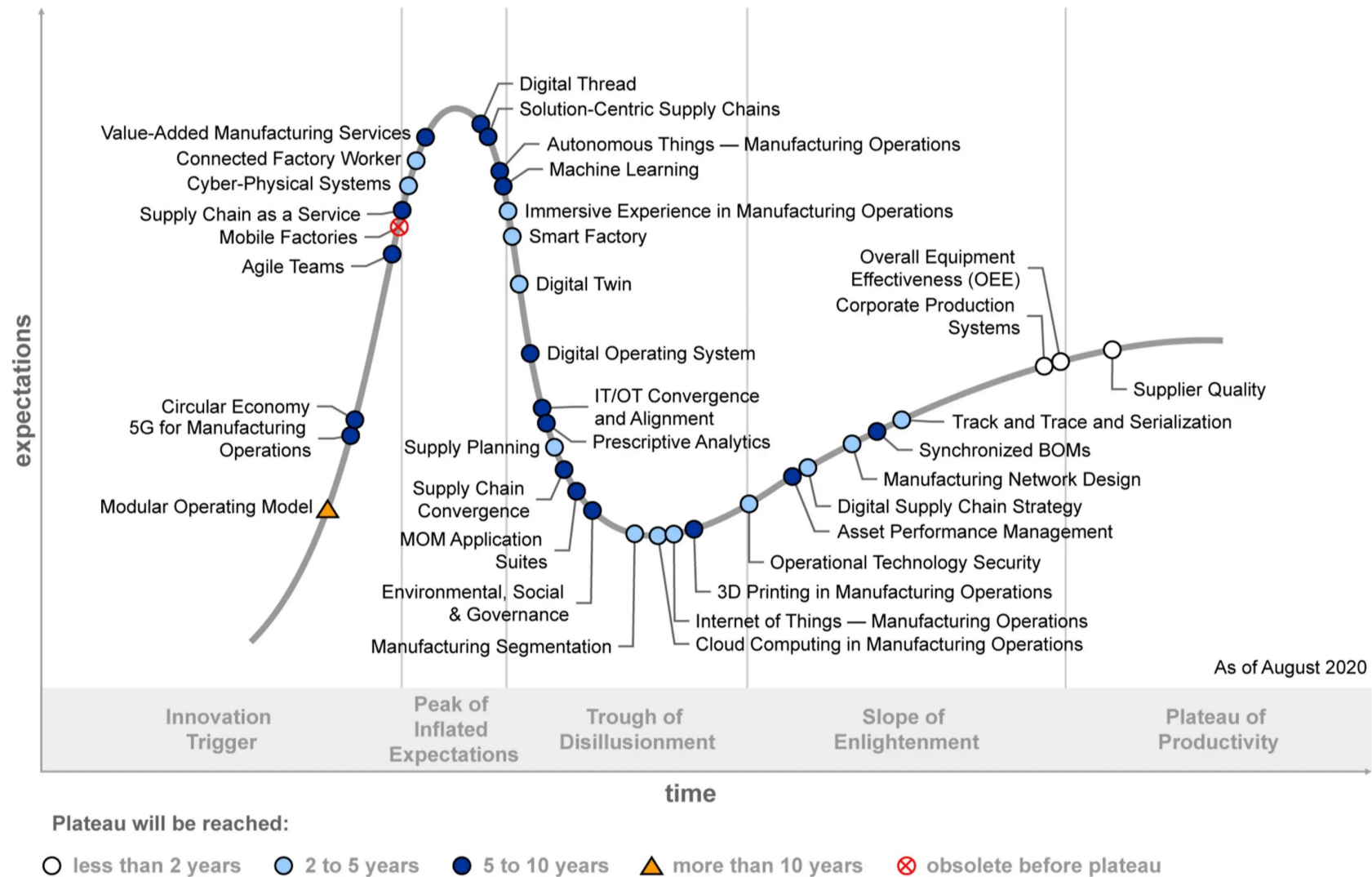
Gartner Hype Cycle 2014



Hype Cycle, Emerging Technologies 2020



Hype Cycle for Manufacturing Operations Strategy, 2020



Bulut Bilişim Tanımı

(Cloud Computing Definition)

NIST (ABD Ulusal Standartlar ve Teknoloji Enstitüsü) Tanımı

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.

Bulut bilişim, düşük yönetim çabası veya servis sağlayıcı etkileşimi ile, hızlı alınıp salıverilebilen ayarlanabilir bilişim kaynaklarının paylaşılır havuzuna, istendiğinde ve uygun bir şekilde ağ erişimi sağlayan bir modeldir.

Türkçe çevrimi Yakup Korkmaz

Temel Özellikler

(Essential Characteristics)

On-demand self-service. A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

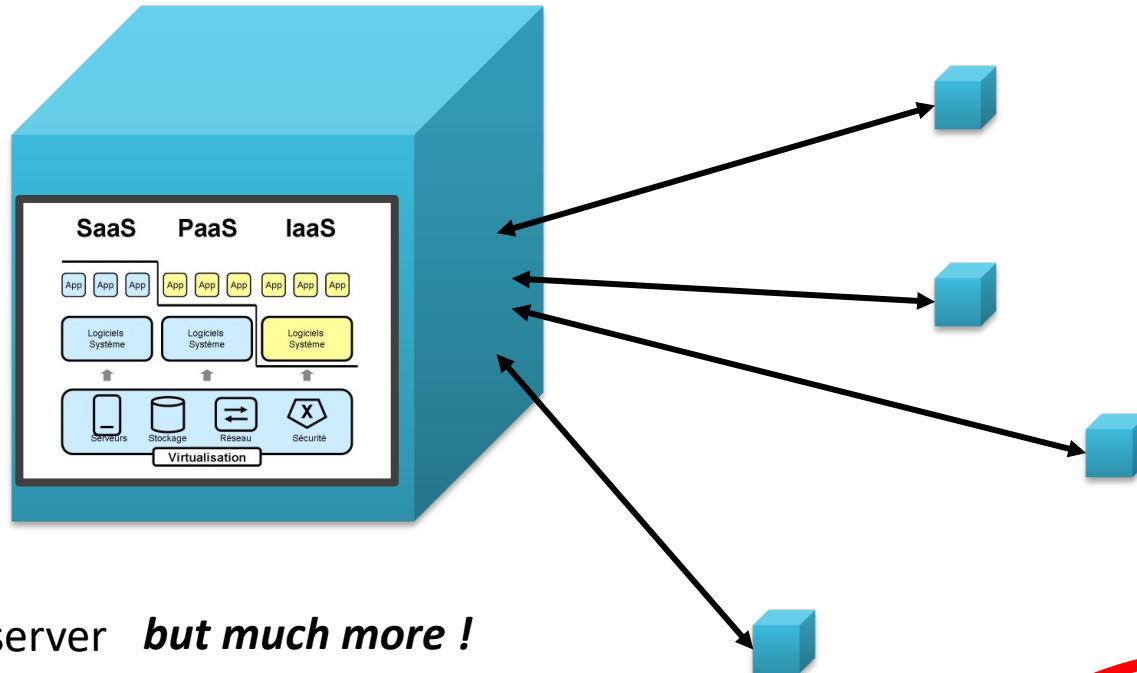
Broad network access. Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

Resource pooling. The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

Rapid elasticity. Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

Measured service. Cloud systems automatically control and optimize resource use by leveraging a metering capability¹ at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Understanding Cloud Computing



Resembles client-server ***but much more !***

Virtualization

Change usage dynamically on customer demand. Dynamically allocate-deallocate resources

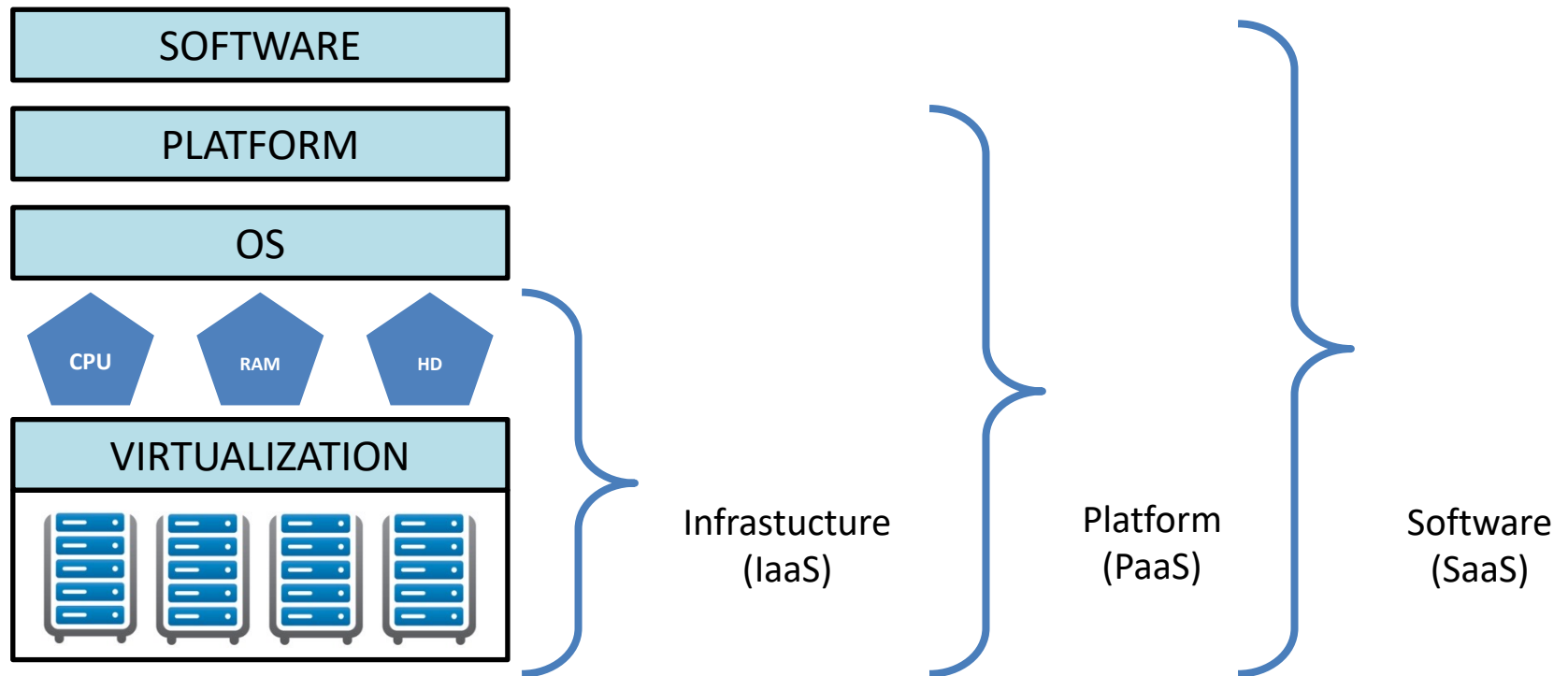
Elastic

On-demand

Computation becomes a utility that you consume as much as you like
(money, money, money)

Cloud Computing Service Models

In what forms can I buy this utility (computing) ?



XaaS Anything as a Service

CaaS

(Communication as a Service)

DaaS

(Desktop as a Service)

SECaaS

(Security as a Service)

HaaS

(Healthcare as a Service)

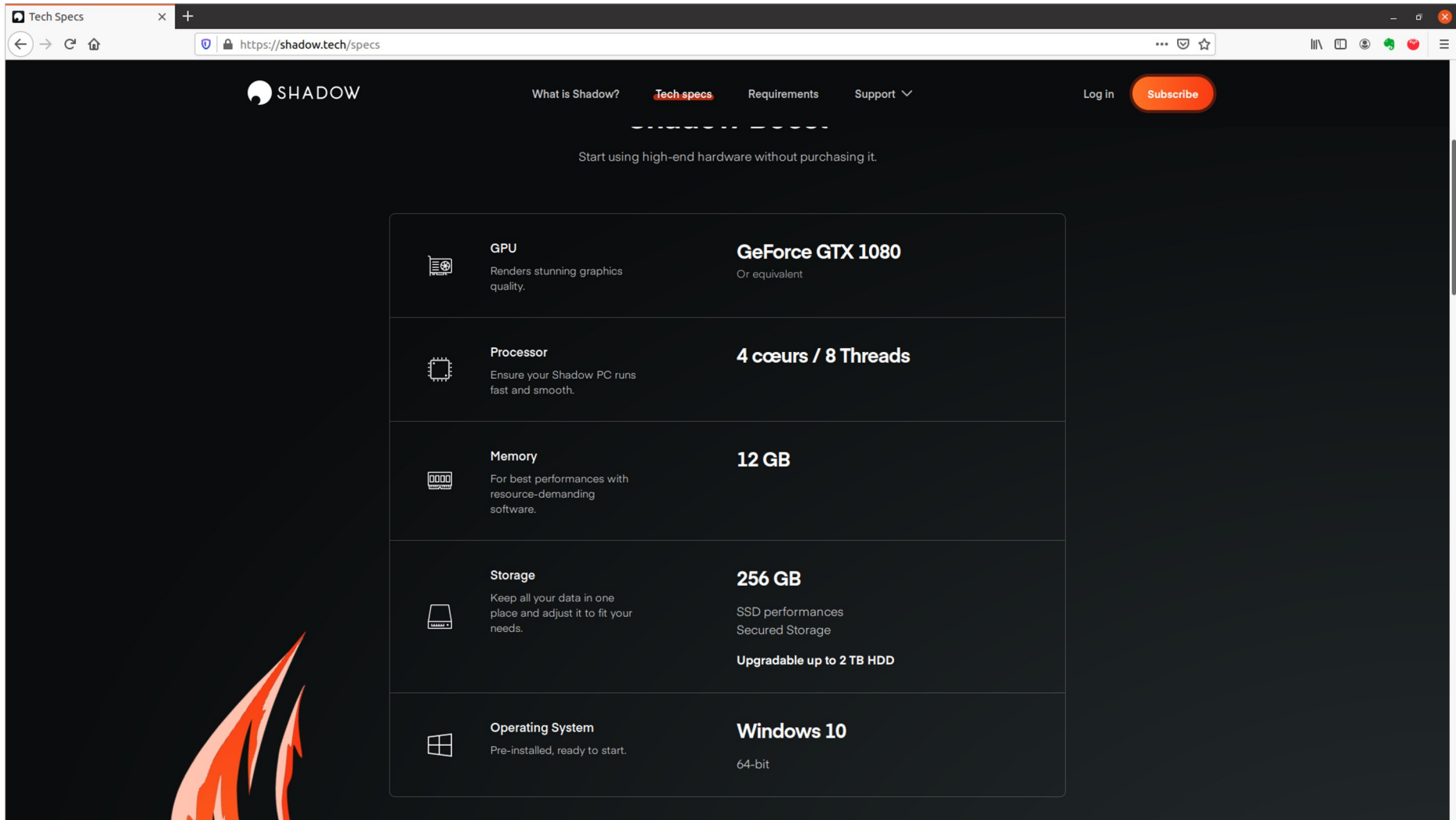
DBaaS

(Database as a Service)






TaaS

(Transportation as a Service)

Game Desktop as a Service



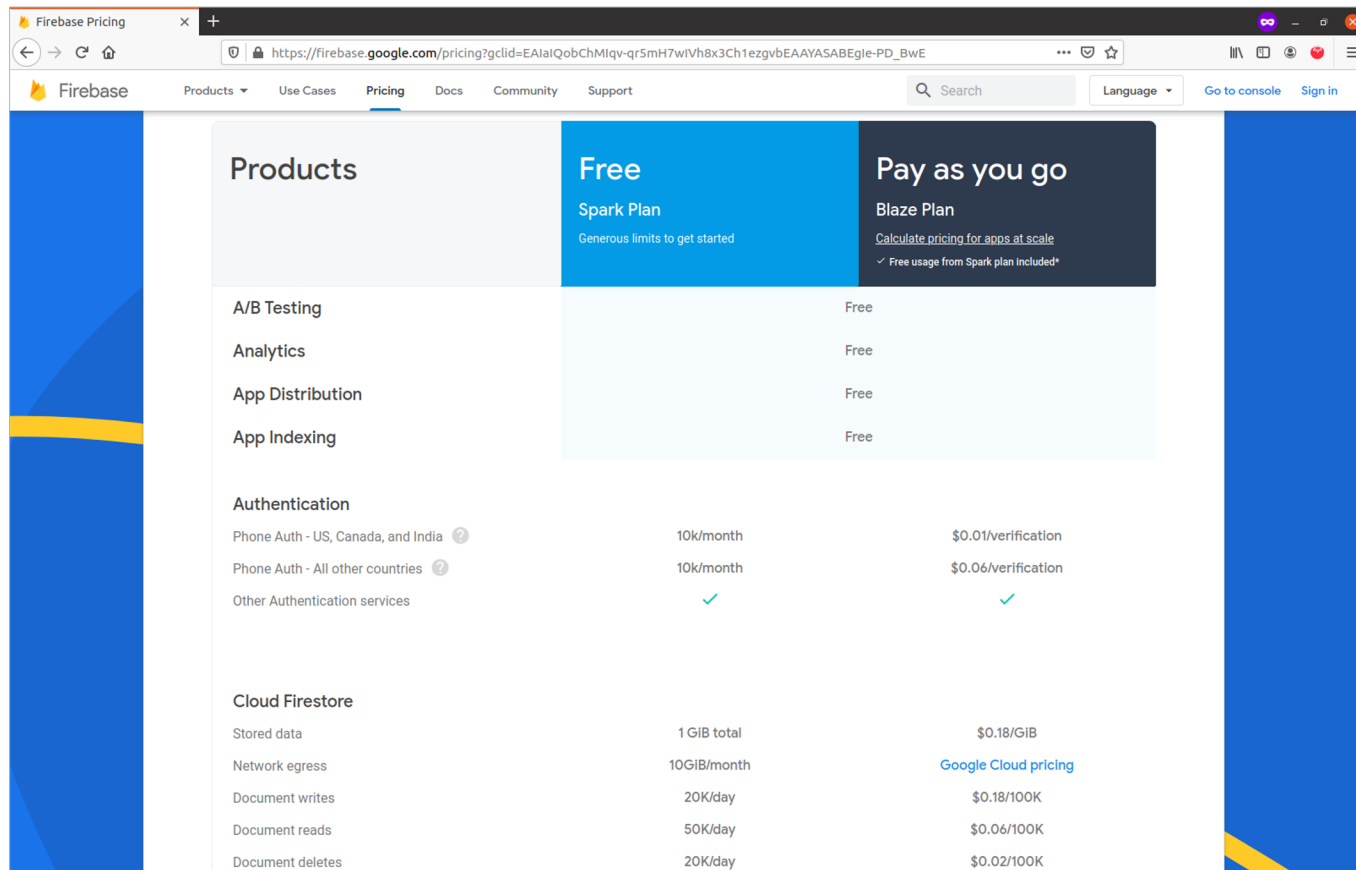
The screenshot shows a web browser window with the address bar displaying "https://shadow.tech/specs". The page features the Shadow logo and navigation links: "What is Shadow?", "Tech specs" (highlighted), "Requirements", and "Support". There are "Log in" and "Subscribe" buttons in the top right. The main content area has a dark background with a stylized flame graphic on the left. It lists five specifications in a table-like format:

	GPU Renders stunning graphics quality.	GeForce GTX 1080 Or equivalent
	Processor Ensure your Shadow PC runs fast and smooth.	4 cœurs / 8 Threads
	Memory For best performances with resource-demanding software.	12 GB
	Storage Keep all your data in one place and adjust it to fit your needs.	256 GB SSD performances Secured Storage Upgradable up to 2 TB HDD
	Operating System Pre-installed, ready to start.	Windows 10 64-bit

Backend as a Service



Firebase Pricing



The screenshot displays the Firebase Pricing page with a navigation bar at the top. The main content area is divided into two columns: 'Free Spark Plan' and 'Pay as you go Blaze Plan'. A table below compares the pricing for various products between these two plans.

Products	Free Spark Plan	Pay as you go Blaze Plan
A/B Testing	Free	Free
Analytics	Free	Free
App Distribution	Free	Free
App Indexing	Free	Free
Authentication		
Phone Auth - US, Canada, and India	10k/month	\$0.01/verification
Phone Auth - All other countries	10k/month	\$0.06/verification
Other Authentication services	✓	✓
Cloud Firestore		
Stored data	1 GiB total	\$0.18/GiB
Network egress	10GiB/month	Google Cloud pricing
Document writes	20K/day	\$0.18/100K
Document reads	50K/day	\$0.06/100K
Document deletes	20K/day	\$0.02/100K

<https://firebase.google.com/pricing>