



Aspectos Profissionais e Sociais da Engenharia Informática

Big tech: the hyperscaling effect...

Rui L Aguiar, UA/IT

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Recap of the classes...

- Artificial Intelligence
 - Social aspects, law
- Standardization, IPR and OpenSource
 - Derivative works, license models
- Ethics and conceptual problems (identities)
 - Trolley, Theseus.
- Cybersecurity
 - Crime, social and personal responsibility
 - reputation
 - Cybersec ecosystem and lawful interception
 - GPDR
- The Effect of networking (**last lecture**)
 - Social networks
 - Scalling
- The models
 - How networks work
 - What can be this be modelled.

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Today

- Hyperscalers
 - What are they
 - And why are they relevant

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NETWORKING EFFECTS RECALL

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Network Effects?

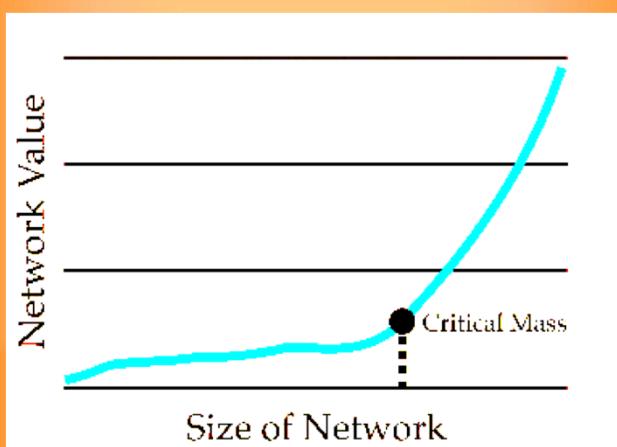
- Same-side effects
 - direct network effects that occur on the same side of a multi-sided (2-sided or N-sided) network
- Cross-side effects
- Indirect
- Critical Mass
- Assymptotic returns
 - network effects with diminishing returns
- Negative network effects

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Critical mass

The critical mass of a network refers to the point at which the value produced by the network exceeds the value of the product itself and of competing products.



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Asymptotic Effects

- Law of diminishing returns

Asymptotic Network Effects

The graph shows a blue S-shaped curve starting from a low value on the y-axis and approaching a horizontal asymptote. The y-axis is labeled 'Value' and the x-axis is labeled 'Network Usage'. There are three horizontal lines: a lower one at the start of the curve, a middle one at the inflection point, and an upper one at the asymptote level.

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Networking effects in informatics

- There are ways of looking into the networking effects
- We can model them!
 - And derive what to do to be successful
 - Hyperscalers explore these in terms of technology and **economics**.

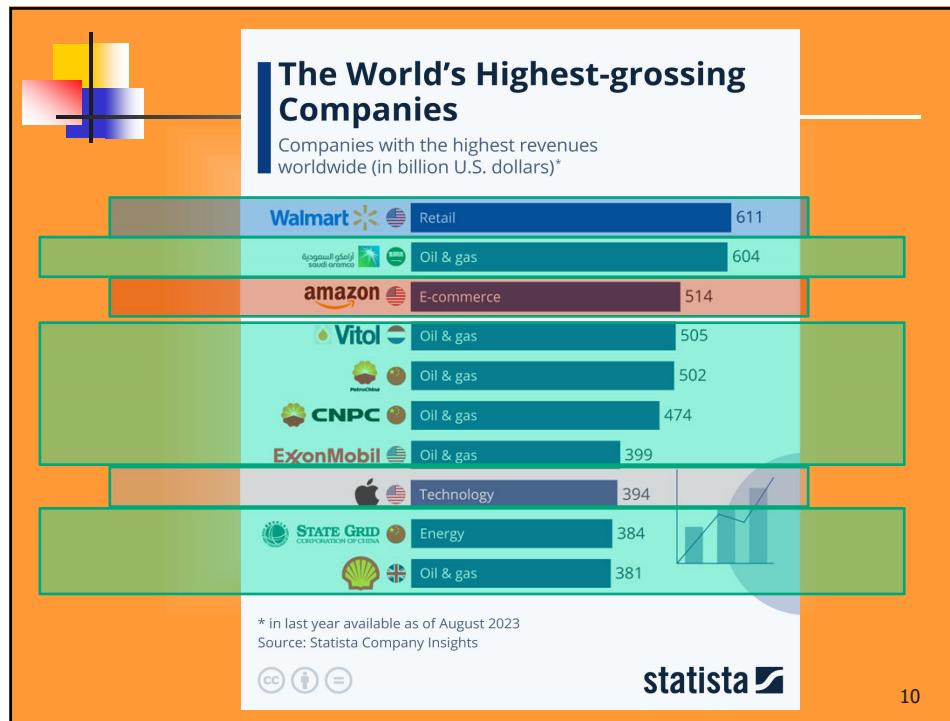


Any succesfull technology in our field explores network effects in some way

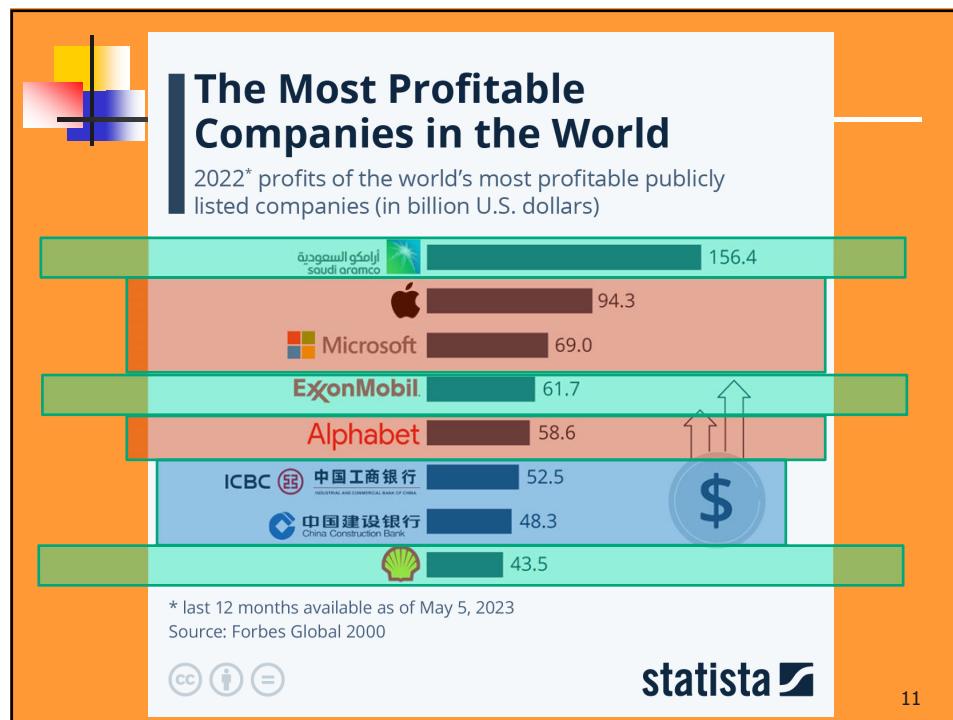
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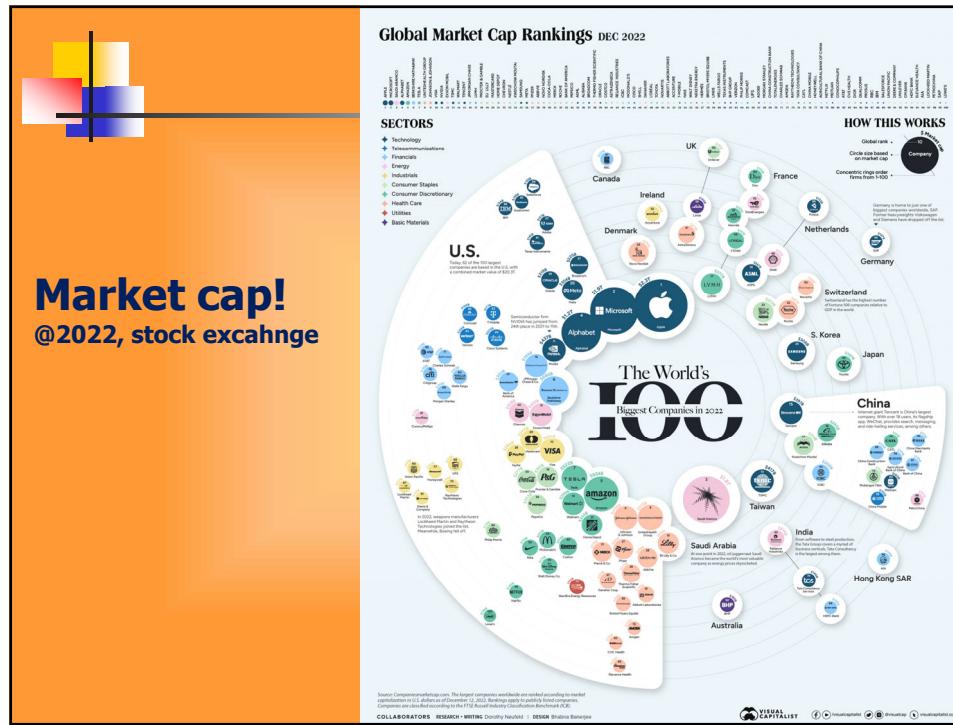
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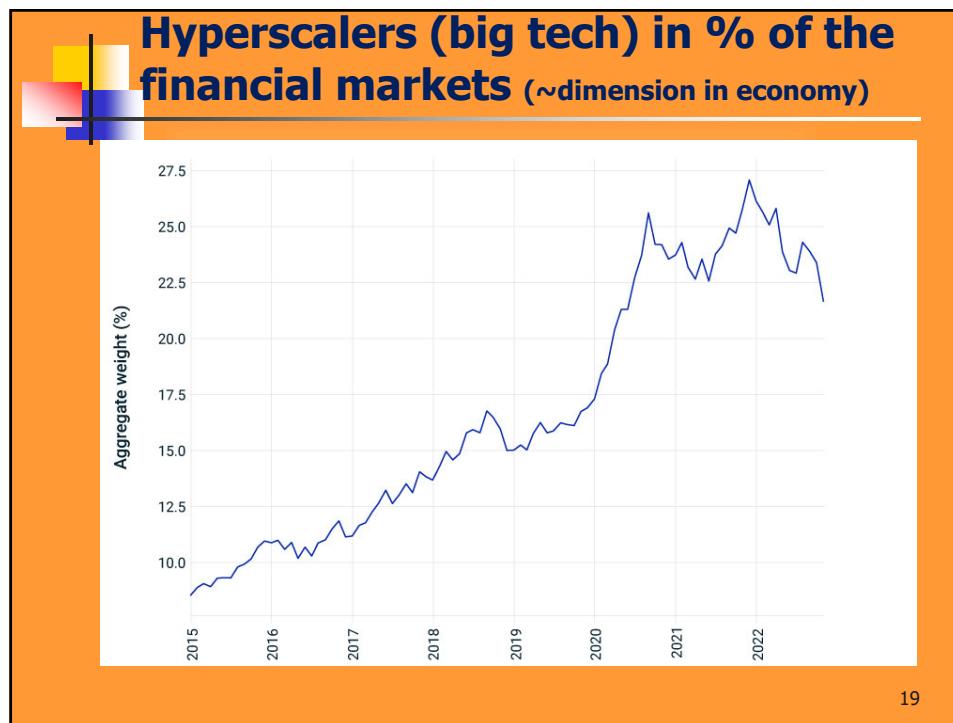
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FANG	MAMAA	Magnificent 7
<ul style="list-style-type: none"> ■ Facebook ■ Amazon ■ Netflix ■ Google ■ Later... ■ Apple 	<ul style="list-style-type: none"> ■ Meta ■ Alphabet ■ Microsoft ■ Amazon ■ Apple 	<ul style="list-style-type: none"> ■ Meta ■ Alphabet ■ Microsoft ■ Amazon ■ Apple ■ Nvidia ■ Tesla

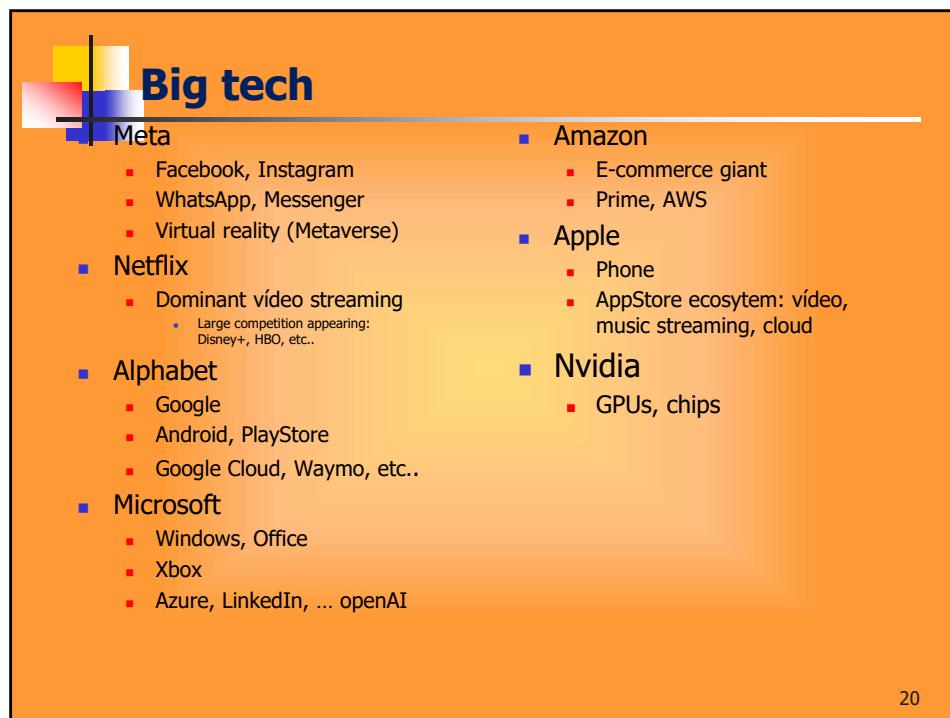
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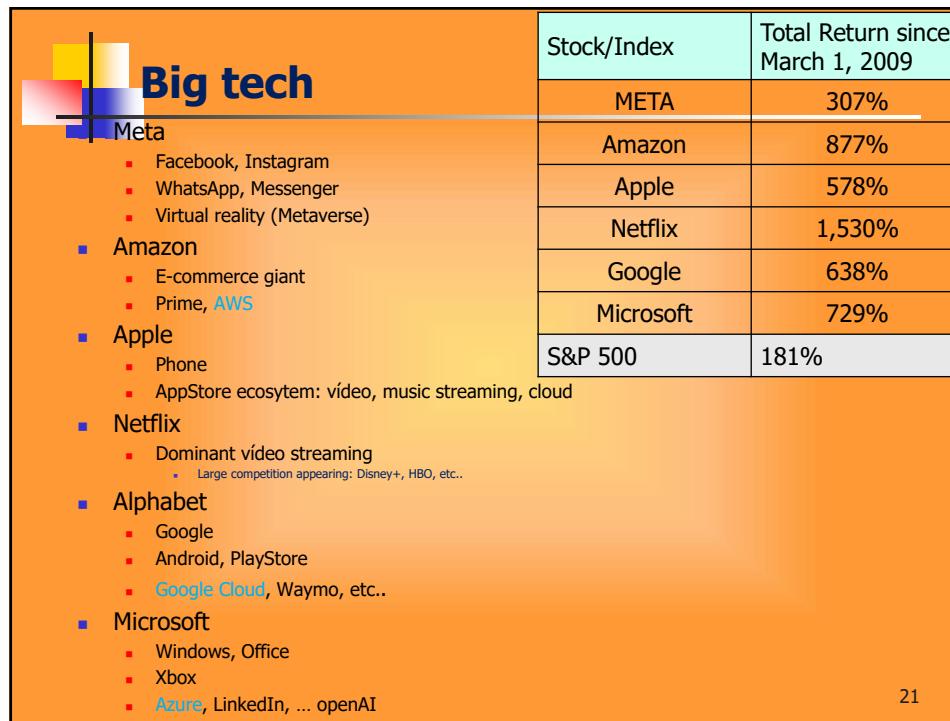


Big tech

- Meta
 - Facebook, Instagram
 - WhatsApp, Messenger
 - Virtual reality (Metaverse)
- Netflix
 - Dominant video streaming
 - Large competition appearing: Disney+, HBO, etc..
- Alphabet
 - Google
 - Android, PlayStore
 - Google Cloud, Waymo, etc..
- Microsoft
 - Windows, Office
 - Xbox
 - Azure, LinkedIn, ... openAI
- Amazon
 - E-commerce giant
 - Prime, AWS
- Apple
 - Phone
 - AppStore ecosystem: video, music streaming, cloud
- Nvidia
 - GPUs, chips

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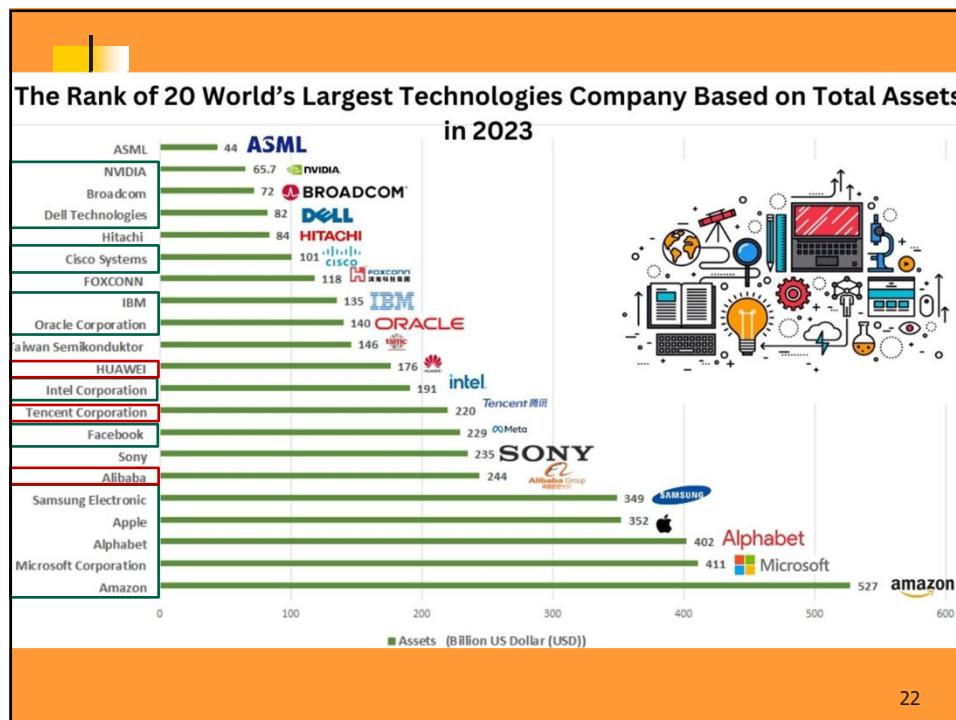
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Stock/Index	Total Return since March 1, 2009
META	307%
Amazon	877%
Apple	578%
Netflix	1,530%
Google	638%
Microsoft	729%
S&P 500	181%

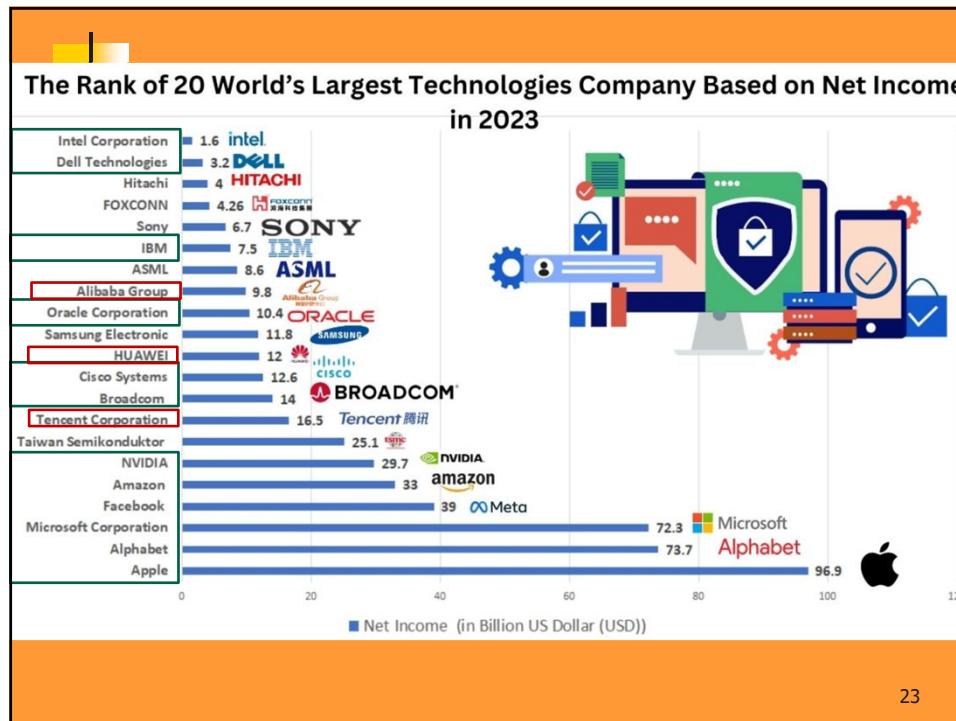
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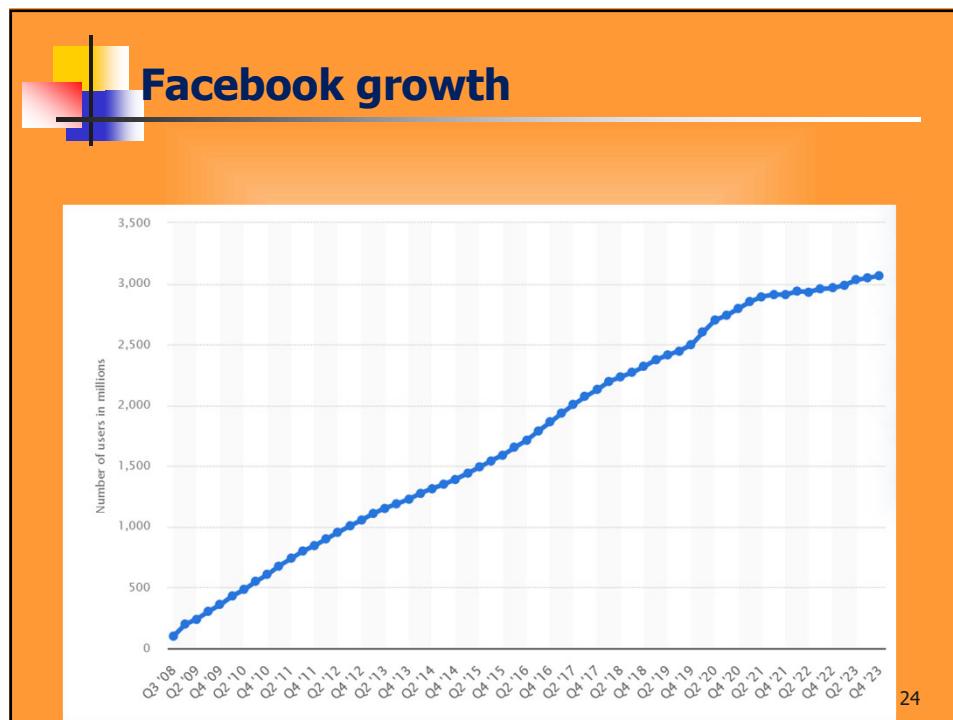
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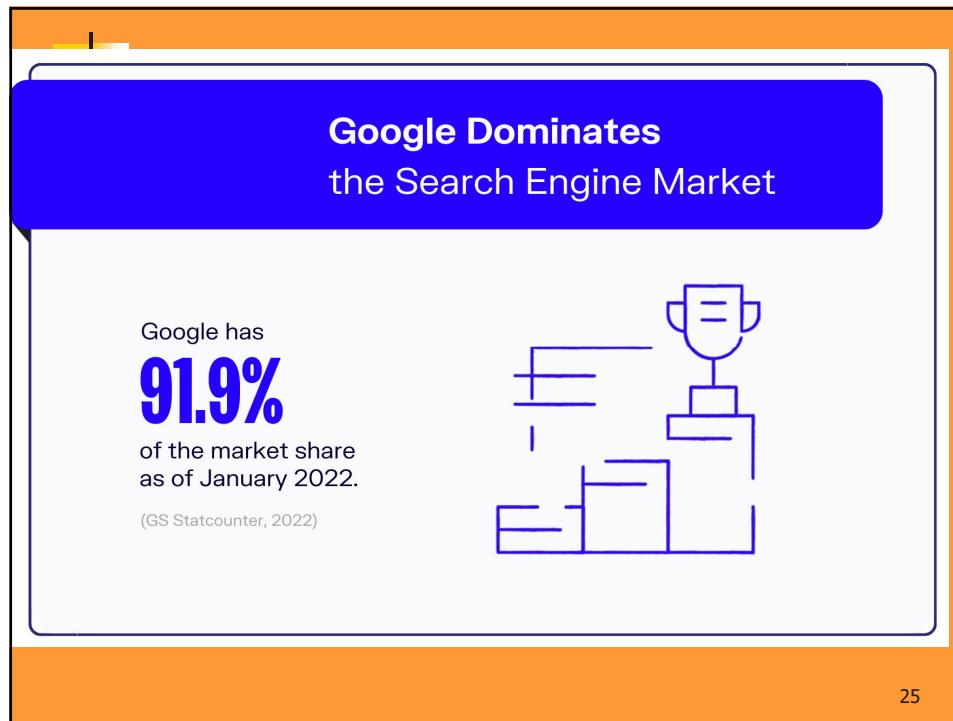


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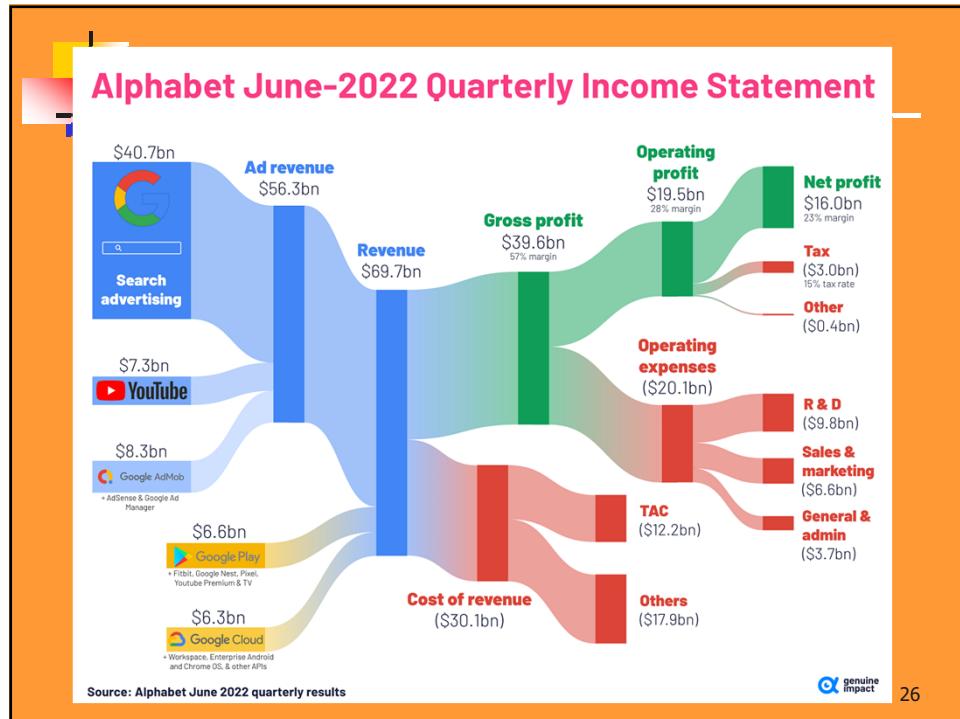
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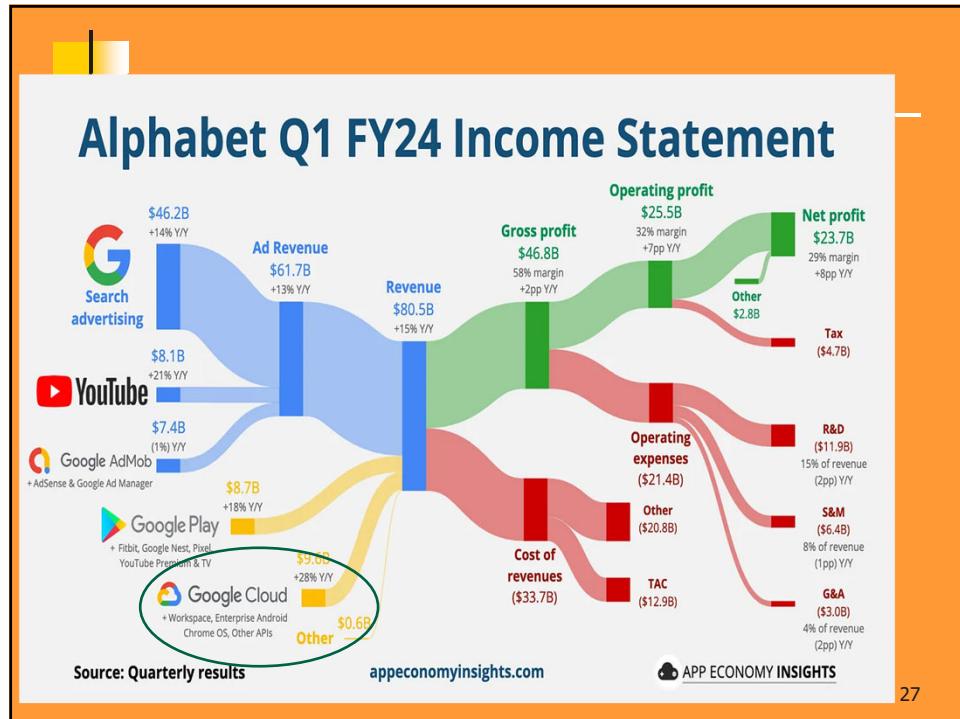
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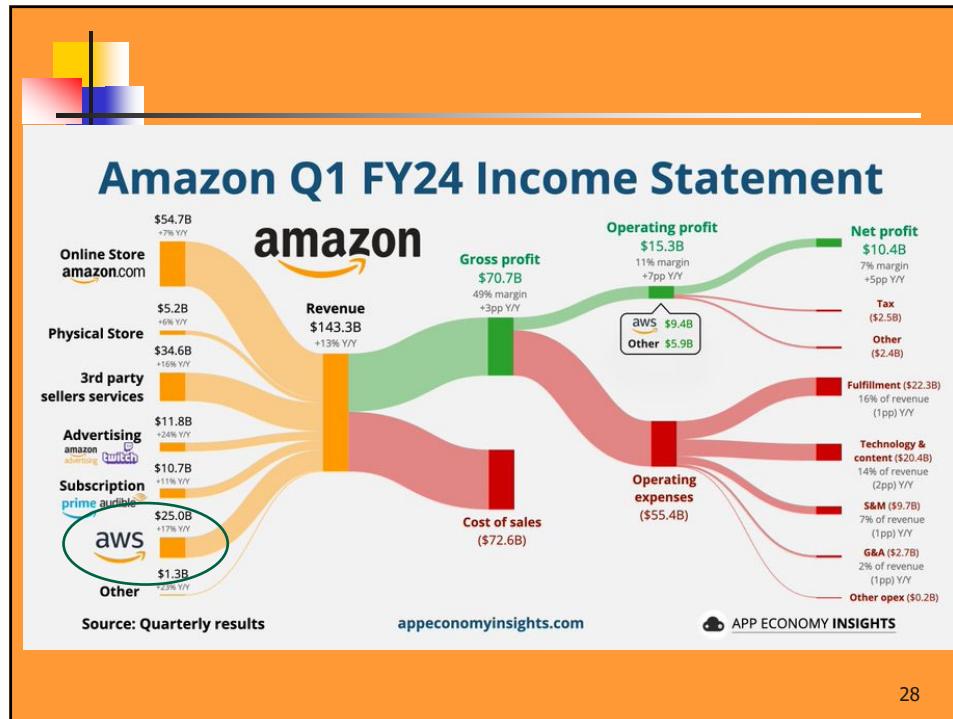
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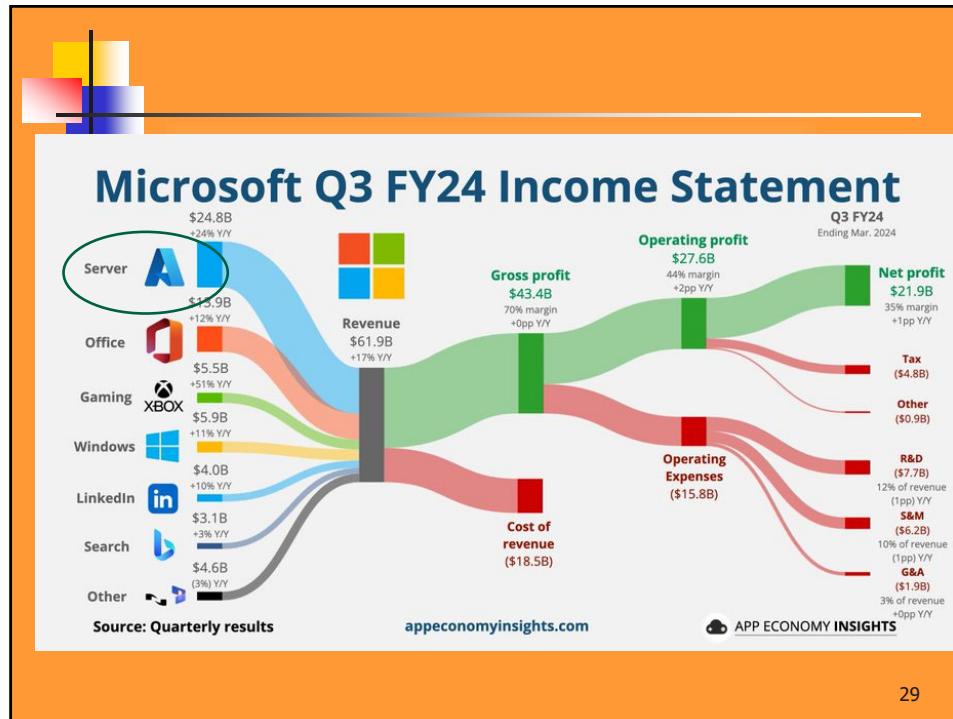


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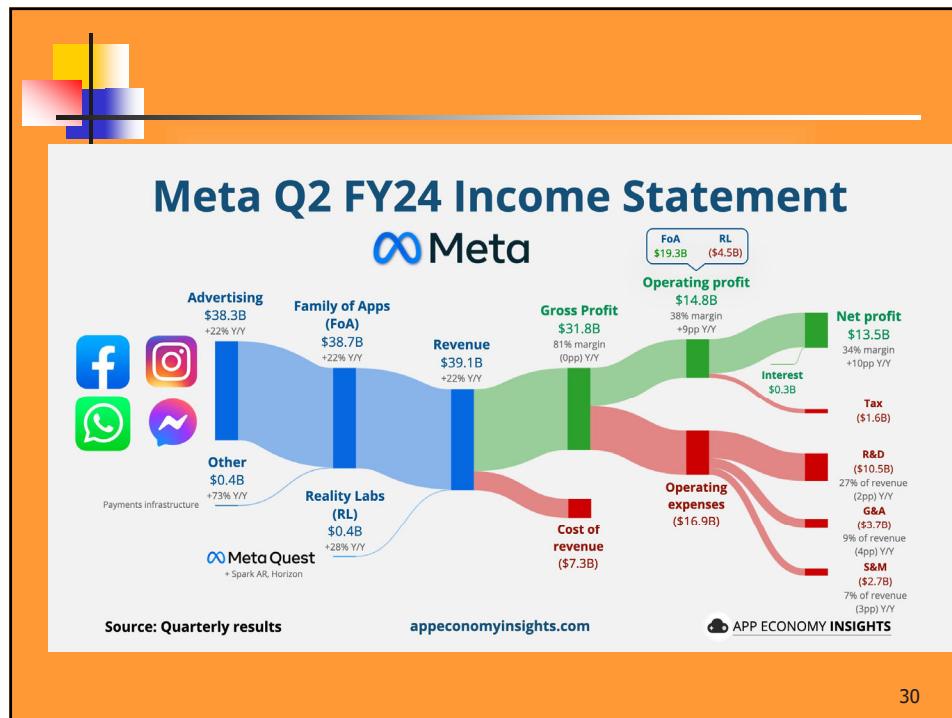
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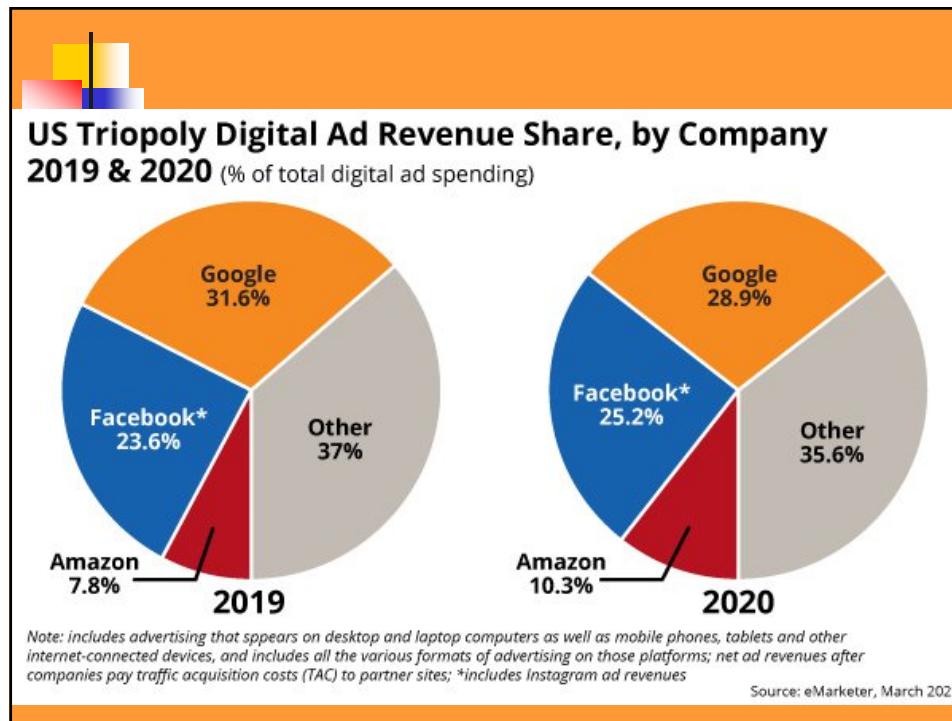


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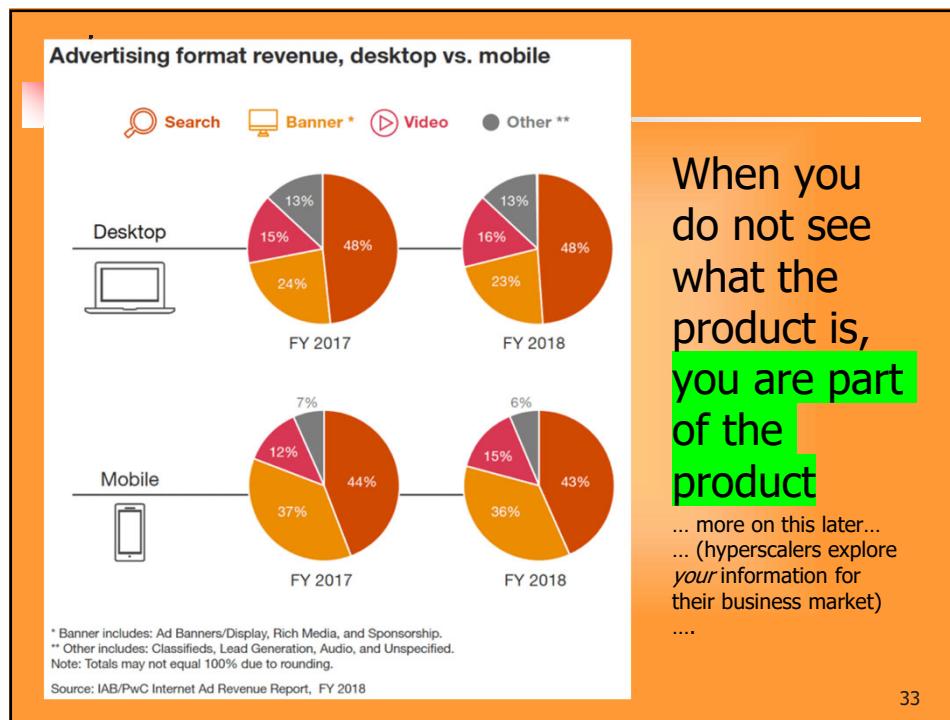
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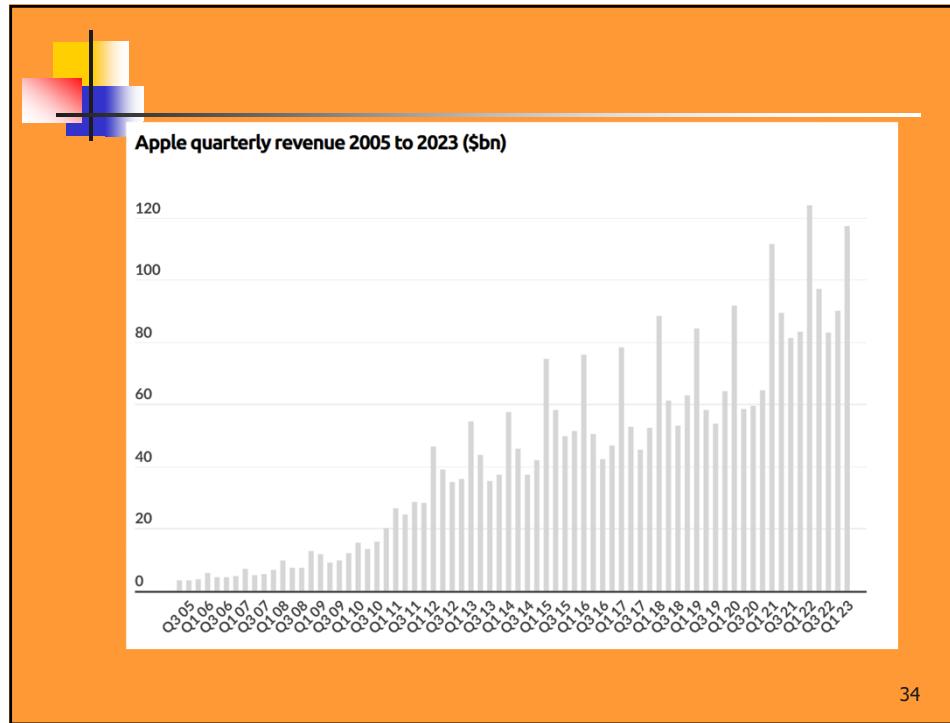
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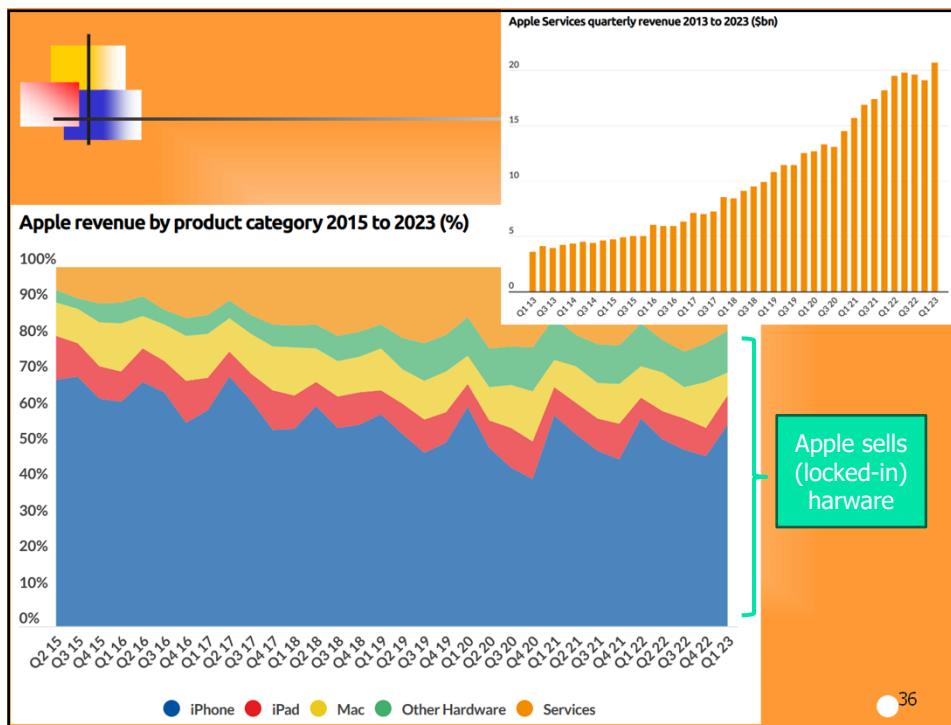
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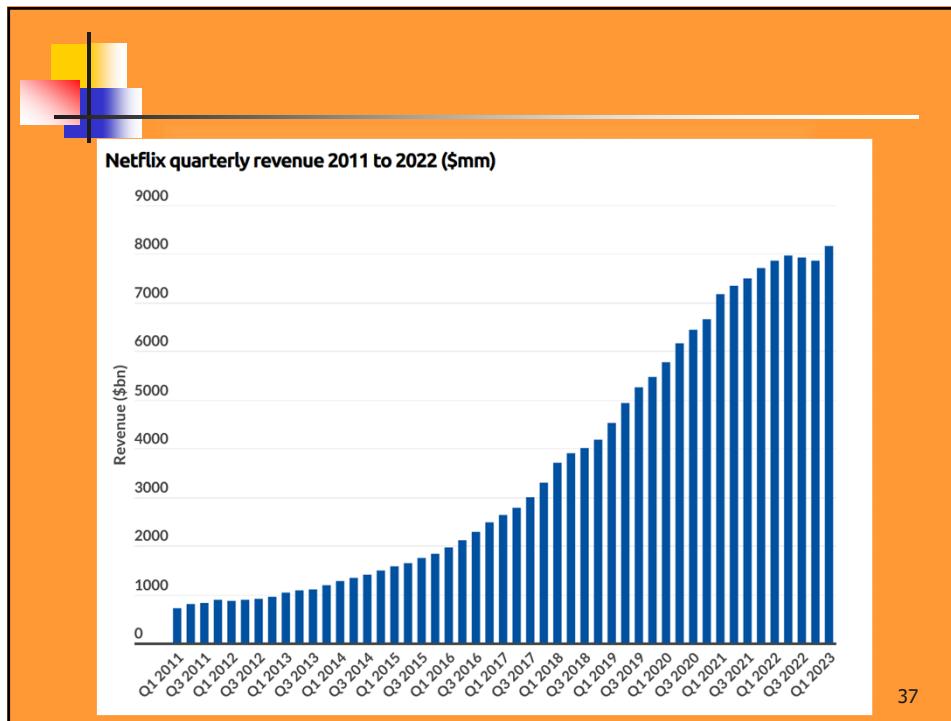
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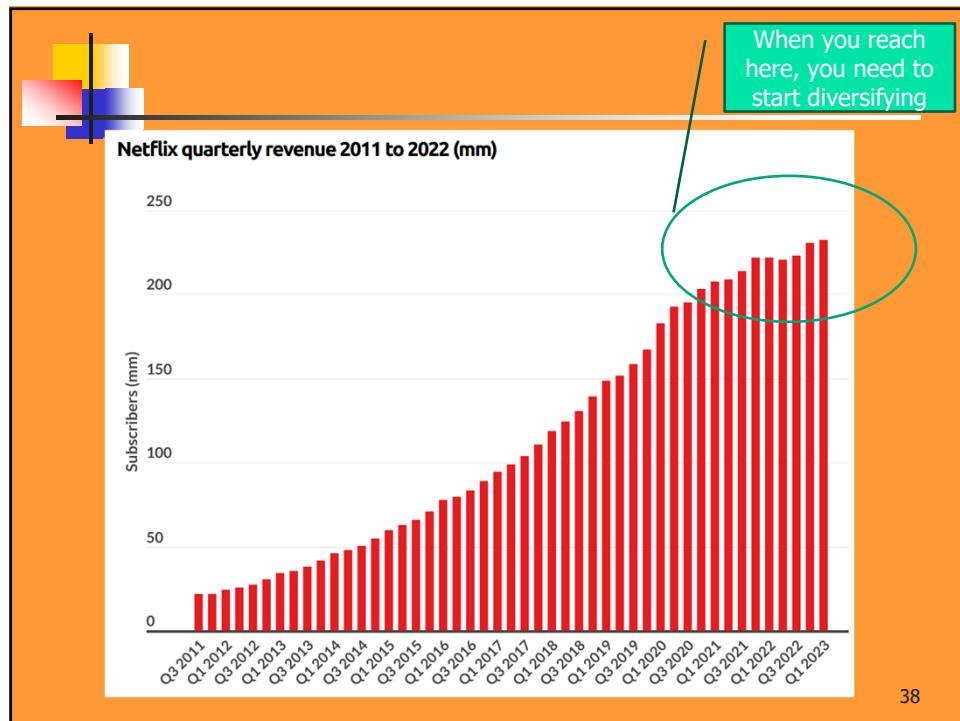


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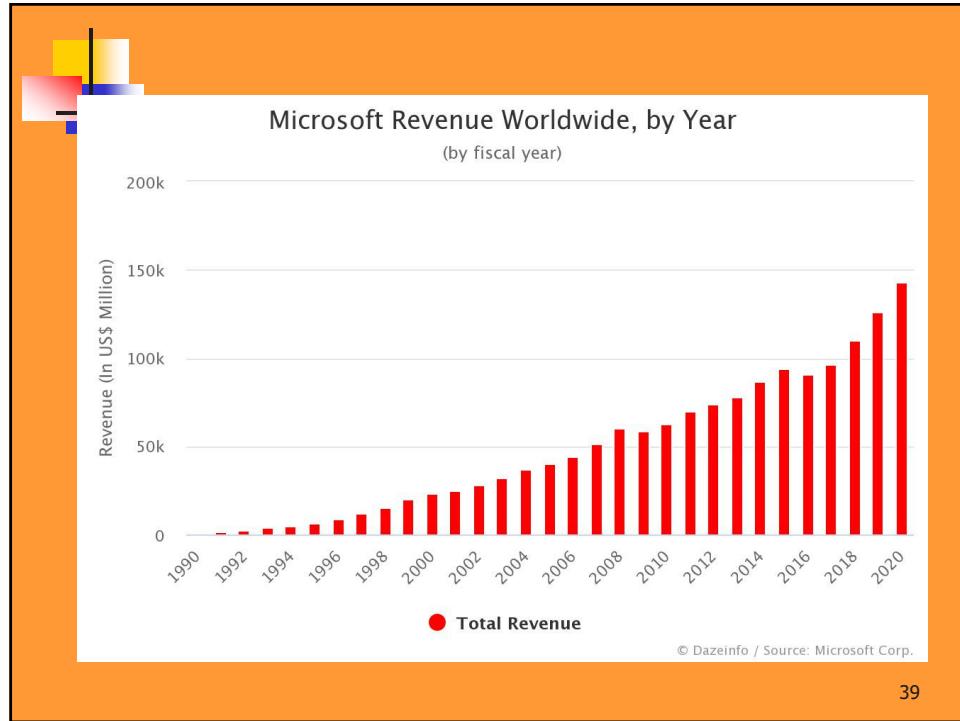
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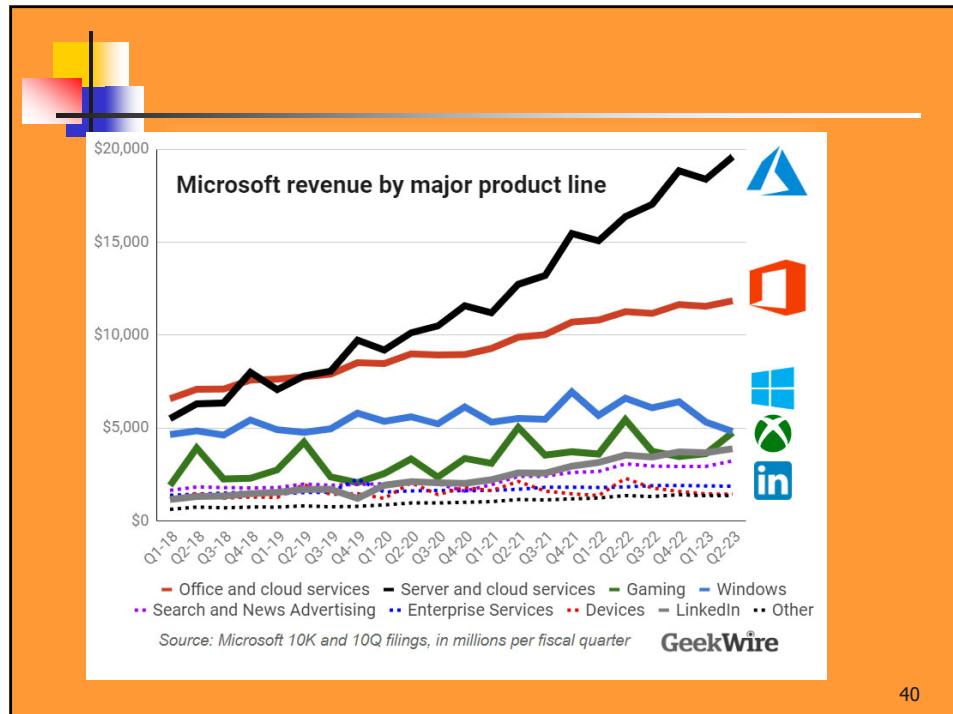
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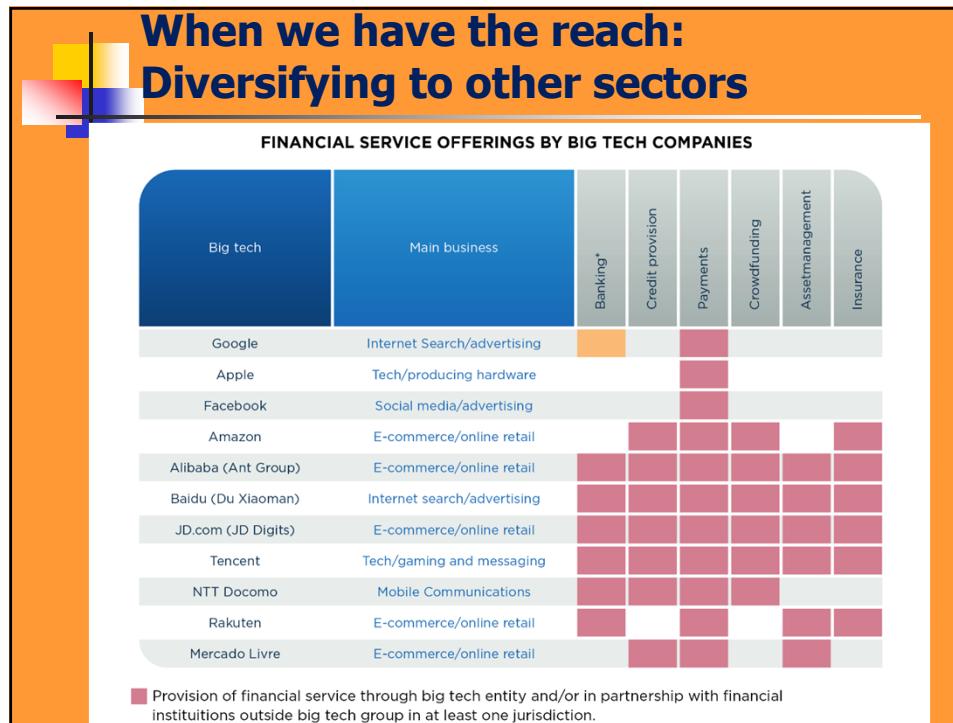
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Reaching out to other markets

- Different approach to the same market
 - But big tech takes a piece of it

ILLUSTRATION OF VALUE CHAIN FOR APPLE CARD

Stage	Activities	Company
PRODUCT DESIGN	Application approval decision Card offerings (merchant discount)	GOLDMAN
FINANCIAL RESOURCES	Balance sheet	
INFRASTRUCTURE & FULFILMENT	Card issuance Card network	APPLE
PRODUCT DELIVERY	Payment authentication and approval	
CUSTOMER ANALYTICS	Credit assessment	
CUSTOMER INTERFACE	Branding and naming Customer portal (Apple Pay)	MASTERCARD

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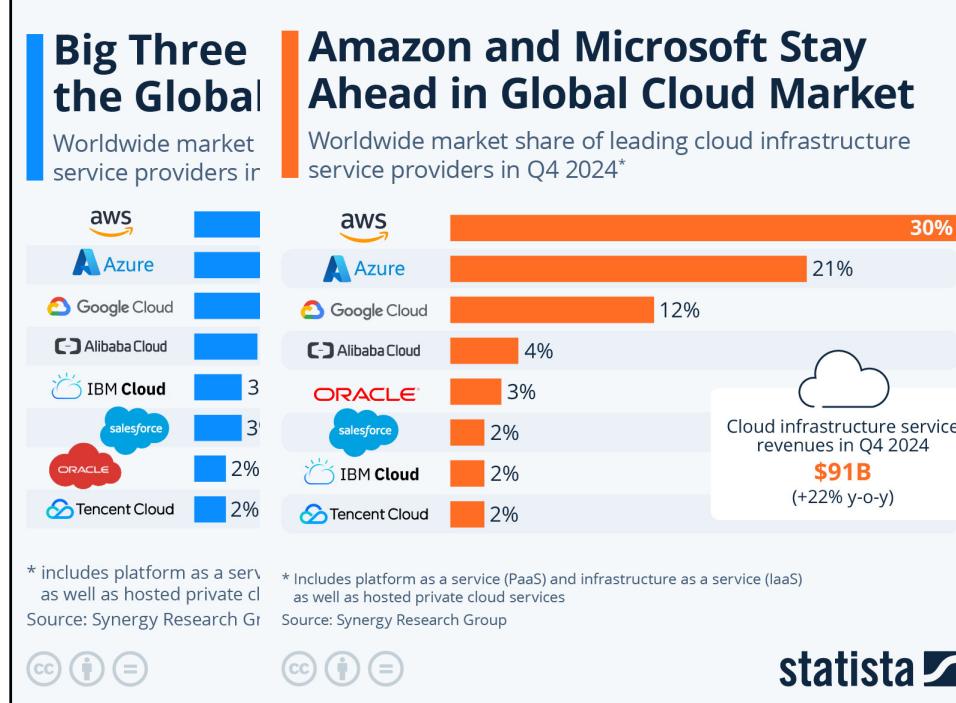
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Cloud services

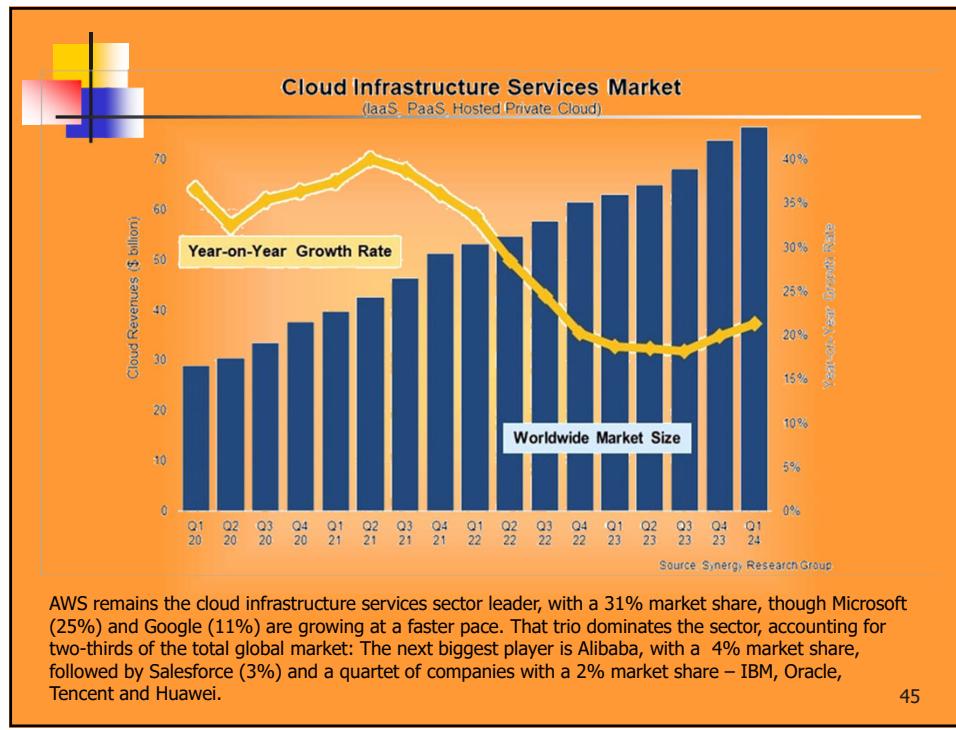
Layer	Resources Managed at Each layer	Examples:
End Users	Software as a Service (SaaS)	Google Apps, Facebook, YouTube, Salesforce.com
Application	Business Applications, Web Services, Multimedia	
Platforms	Software Framework (Java/Python/.Net) Storage (DB/File)	Microsoft Azure, Google AppEngine, Amazon SimpleDB/S3
Infrastructure	Computation (VM) Storage (block)	Amazon EC2, GoGrid, Flexiscale
Hardware	CPU, Memory, Disk, Bandwidth	Data Centers

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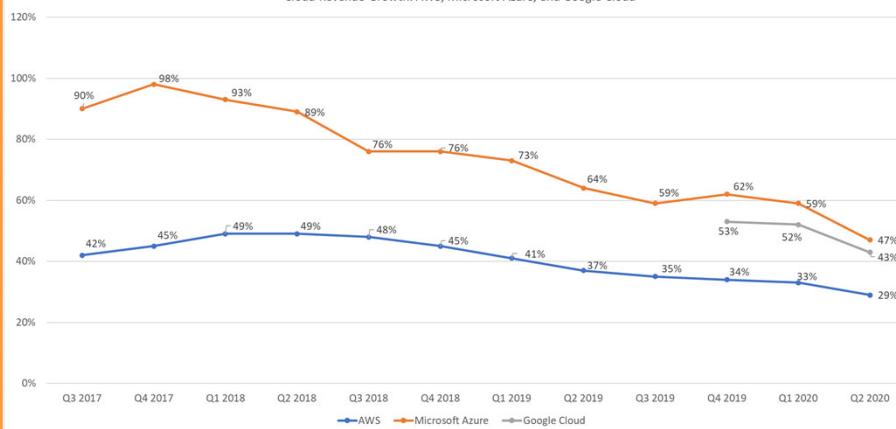
Cloud market (US)

	Microsoft Azure	Amazon AWS	Google Cloud
IaaS Marketshare 2020	19.7 % (12.7 Bil. USD)	40.8 % (26.2 Bil. USD)	6.1 % (3.9 Bil. USD)
IaaS Growth 2020	59.2 %	28.7 %	66.1 %
Number of regions	> 60	24	24
Number of Cloud Services	249	> 175	171
Swiss Datacenter	Yes (2x)	No (1x in 2022)	Yes (1x)
Categories with most services	Microsoft 365 (27) Government (26) KI & Machine Learning (26)	Machine Learning (25) Government (21)	Google Workspace (18) Management Tools (15) Security (13)
Strengths	Productivity Apps (M365) Identity Management (AD) Service Portfolio Regions	Price Developer Base Experience (2006)	Price Simplicity

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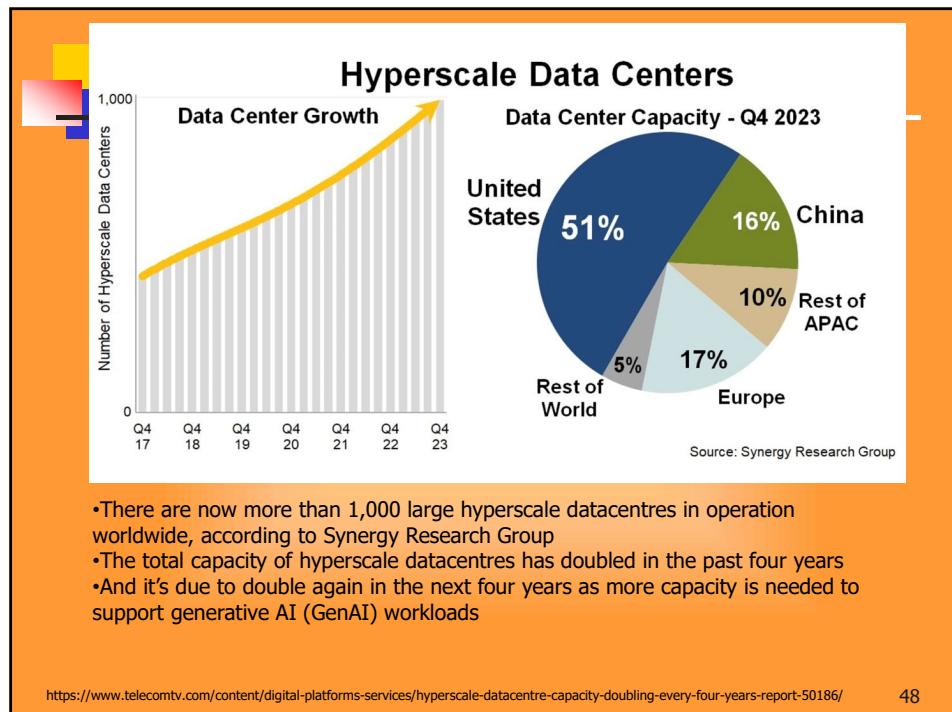
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Cloud Revenue Growth: AWS, Microsoft Azure, and Google Cloud

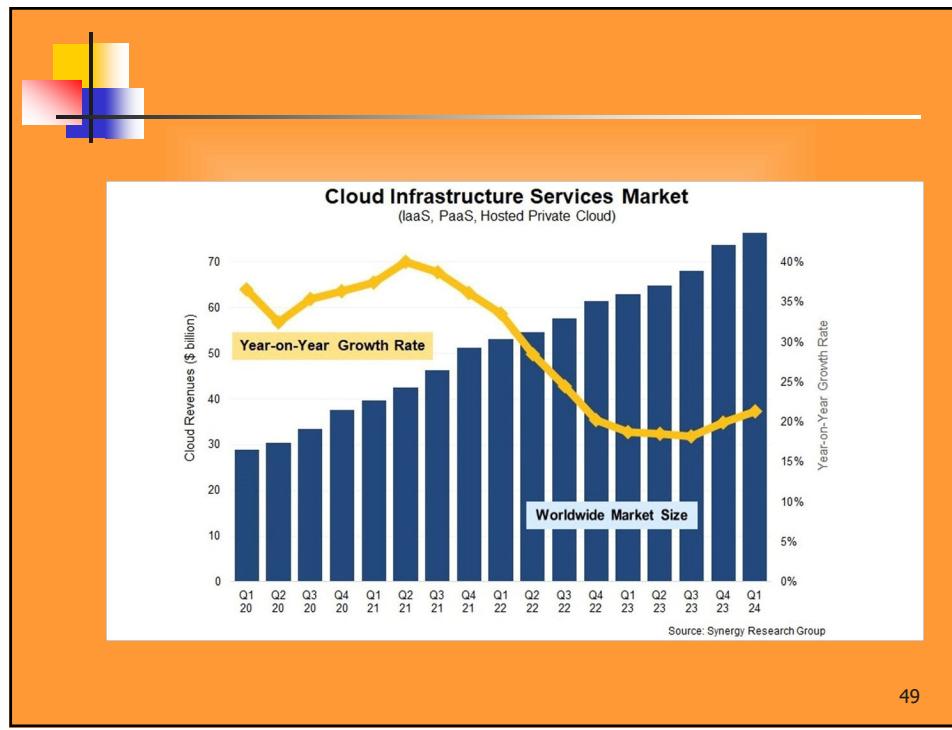


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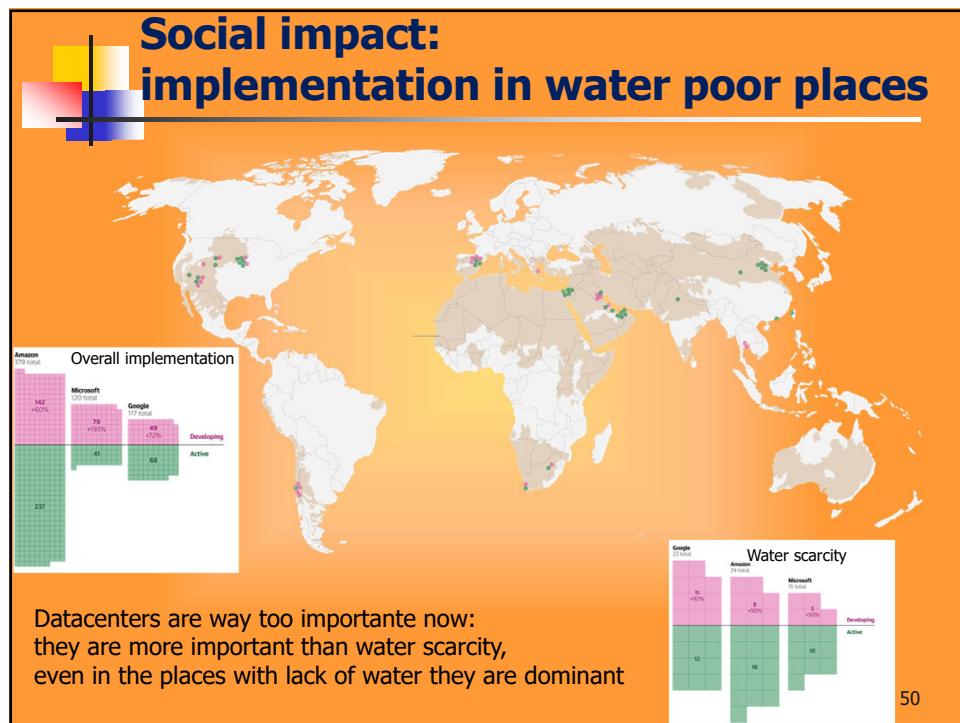
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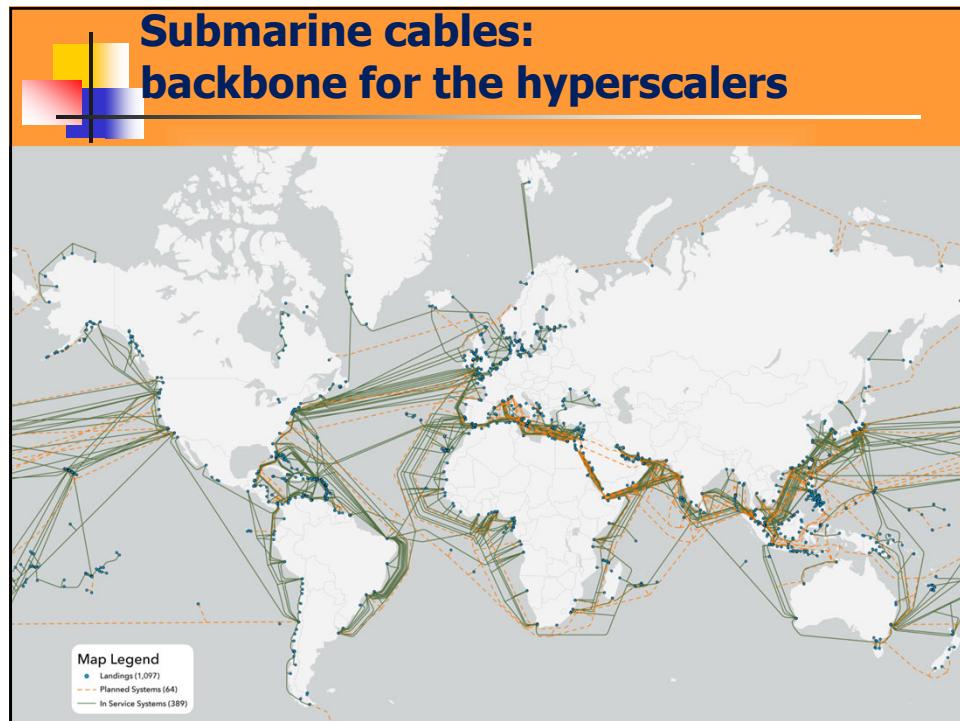
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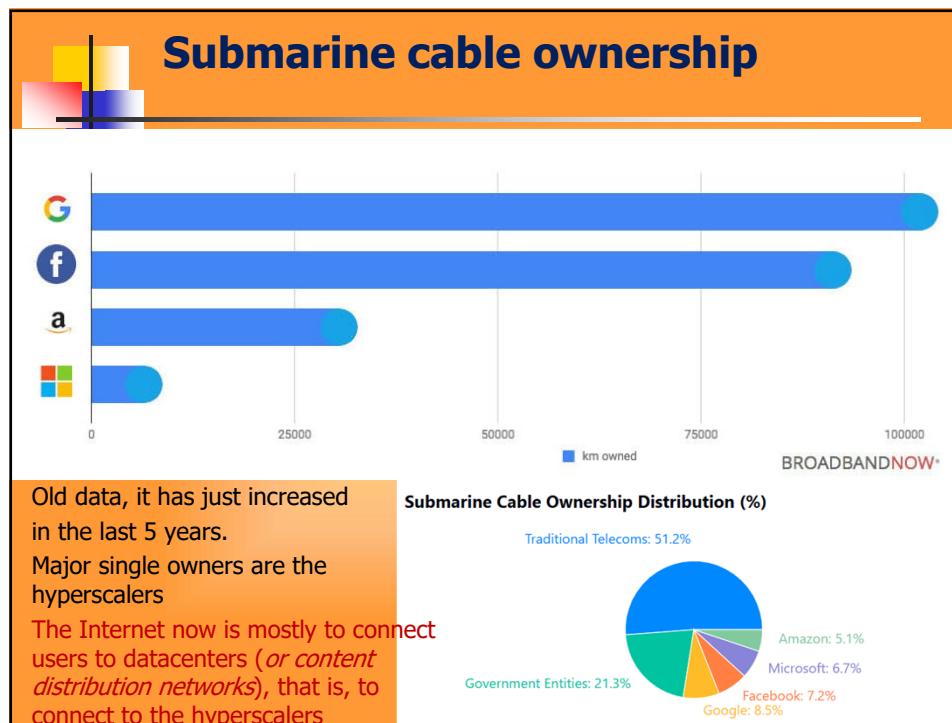
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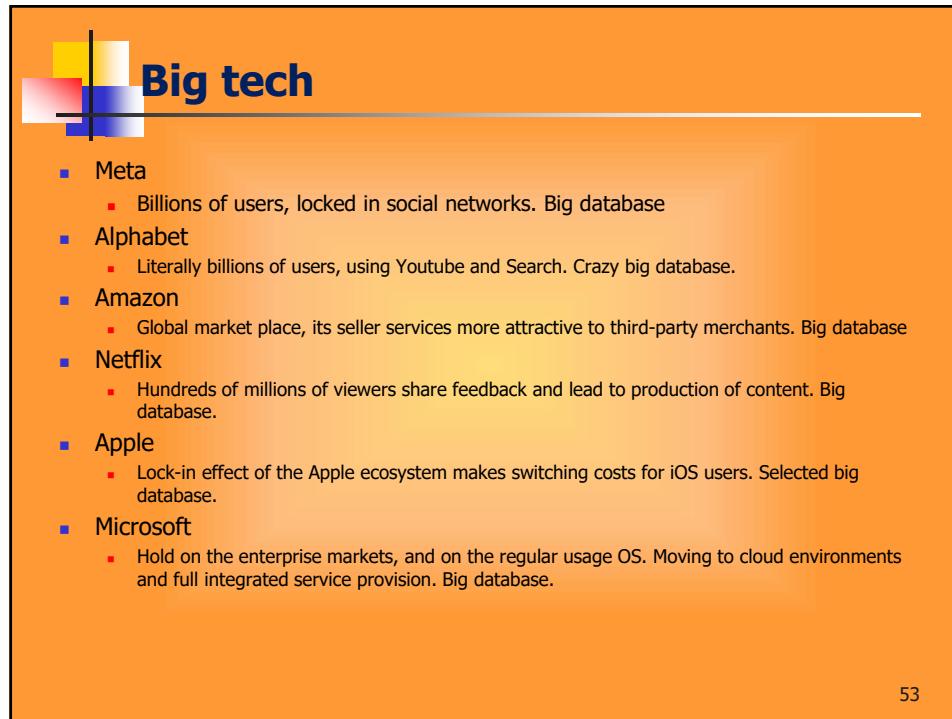
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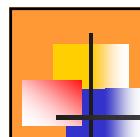


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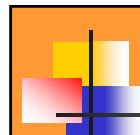
Big tech

Market: user personal information and its exploitation

- Meta
 - Billions of users, locked in social networks. Big database
- Alphabet
 - Literally billions of users, using Youtube and Search. Crazy big database.
- Amazon
 - Global market place, its seller services more attractive to third-party merchants. Big database
- Netflix
 - Hundreds of millions of viewers share feedback and lead to production of content. Big database.
- Apple
 - Lock-in effect of the Apple ecosystem makes switching costs for iOS users. Selected big database.
- Microsoft
 - Hold on the enterprise markets, and on the regular usage OS. Moving to cloud environments and full integrated service provision. Big database.

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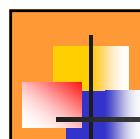
Big tech

Market: shoppers

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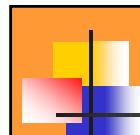
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Market: movie goers
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Market: professional or quasi-professional services

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What to conclude?

- Market dominance has a power per itself
- Large numbers dominate
 - Better service provision
 - Network effects
 - Several problems when reaching a plateau
- The issue is not the product
 - The issue is the market being sought for
 - The technology is **just the tool** to dominate the market
 - Facebook is not on the market of "providing social networks".
Facebook provides social networks to compete in the advertising market.

How to combat this **inherent** (and desired) monopoly trend
enabled by high tech?

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European regulation: DSA/DMA

- Digital Services Act (DSA) and the Digital Market Act (DMA)
 - a single set of rules that apply across the whole EU.
- Main goals:
 - To create a safer digital space in which the fundamental rights of all users of digital services are protected
 - To establish a level playing field to foster innovation, growth, and competitiveness, both in the European Single Market and globally.
- Why are the DSA and DMA necessary?
 - Digital services impact our lives in many different ways. We use them to communicate with each other, shop, order food, find information, watch films, listen to music and more.
 - Digital services also make it easier for companies to trade across borders and access new markets.

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Digital Services

- What are digital services?
 - Digital services include a large category of online services, from simple websites to internet infrastructure services and online platforms.
 - The rules specified in the DSA primarily concern online intermediaries and platforms. For example, online marketplaces, social networks, content-sharing platforms, app stores, and online travel and accommodation platforms.
- The DSA includes specific rules for very large online platforms and search engines.
 - online platforms and intermediaries that have more than 45 million users per month in the EU.
 - They must abide by the strictest obligations of the Act.
- The Digital Markets Act includes rules that govern gatekeeper online platforms.
 - Gatekeeper platforms are digital platforms with a systemic role in the internal market that function as bottlenecks between businesses and consumers for important digital services.
 - Some of these services are also covered in the Digital Services Act, but for different reasons and with different types of provisions.

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DMA's Safe Competition Spaces (1, 2 & 3)

The diagram illustrates the three kinds of platform competition protected under the DMA:

- (1) **inter-platform competition:** Shows two separate "gatekeeping platform" boxes. One box has a "business users" node above it and an "end users" node below it, connected by a vertical dashed line. The other box has a "business users" node above it and an "end users" node below it, also connected by a vertical dashed line.
- (2) **intra-platform competition:** Shows a single "gatekeeping platform" box. It has a "business users" node above it and an "end users" node below it, connected by a vertical dashed line. A blue curved arrow points from the "business users" node down to the "end users" node, indicating competition within the same platform.
- (3) **extra-platform competition:** Shows a "gatekeeping platform" box with a "business users" node above it and an "end users" node below it, connected by a vertical dashed line. A green dashed arrow points from the "end users" node to a separate green cube labeled "ancillary service", representing competition with external services.

Fig. 1 – The three kinds of platform competition protected under the DMA: (1) inter-platform competition, (2) intra-platform competition and (3) extra-platform competition.

Source: Moreno & Petit, 2022

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European regulation: DSA/DMA

While these are some examples of the many benefits of the digital transformation, there are also problems. Despite a range of targeted, sector-specific interventions at EU level, there are still significant gaps and legal burdens to address:

- some large platforms control important ecosystems in the digital economy.
- They are now **the gatekeepers** in digital markets, with the power to act as private rule-makers (see current discussions around X/Twitter).
 - Their rules sometimes result in unfair conditions for businesses using these platforms and less choice for consumers.
- trade and exchange of illegal goods, services and content online.
- online services are being misused by manipulative algorithmic systems to amplify the spread of disinformation, and for other harmful purposes.

These challenges and the way platforms address them have a significant impact on fundamental rights online.

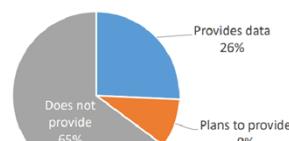
- DSA/DMA: a modern legal framework that:
 - ensures the safety of users online,
 - establishes governance with the protection of fundamental rights at its forefront,
 - maintains fair and open online platform environment.

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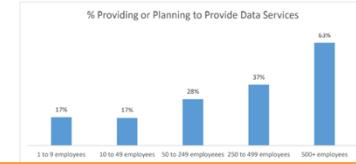
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Data providers and users (2023)

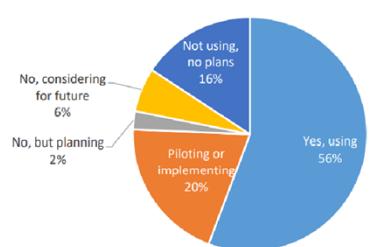
% of companies acting as data providers



% Providing or Planning to Provide Data Services



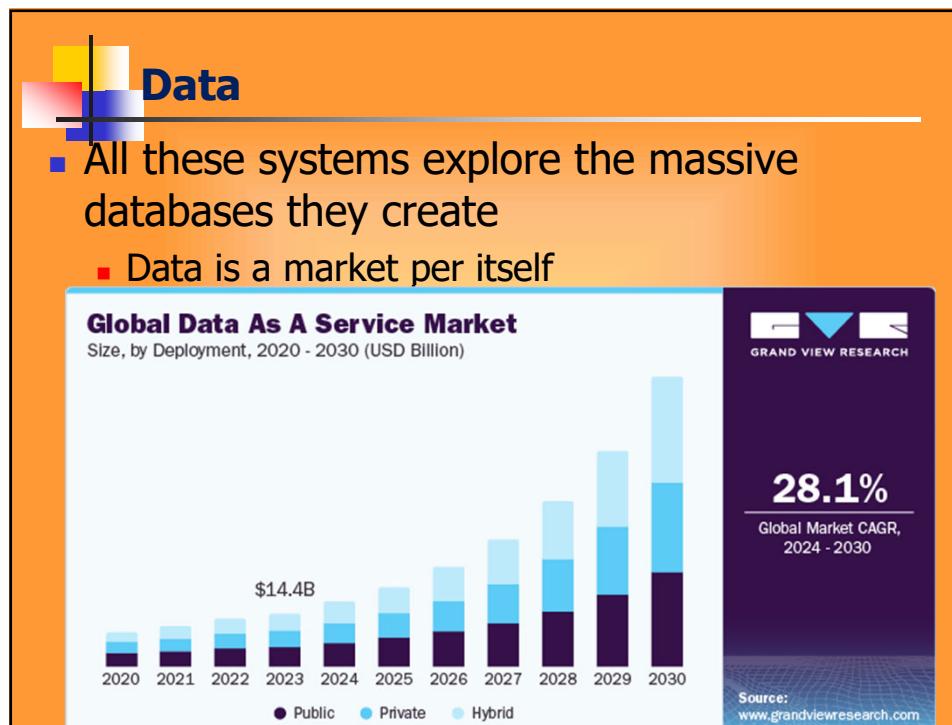
Usage of Analytics/Big Data Technologies



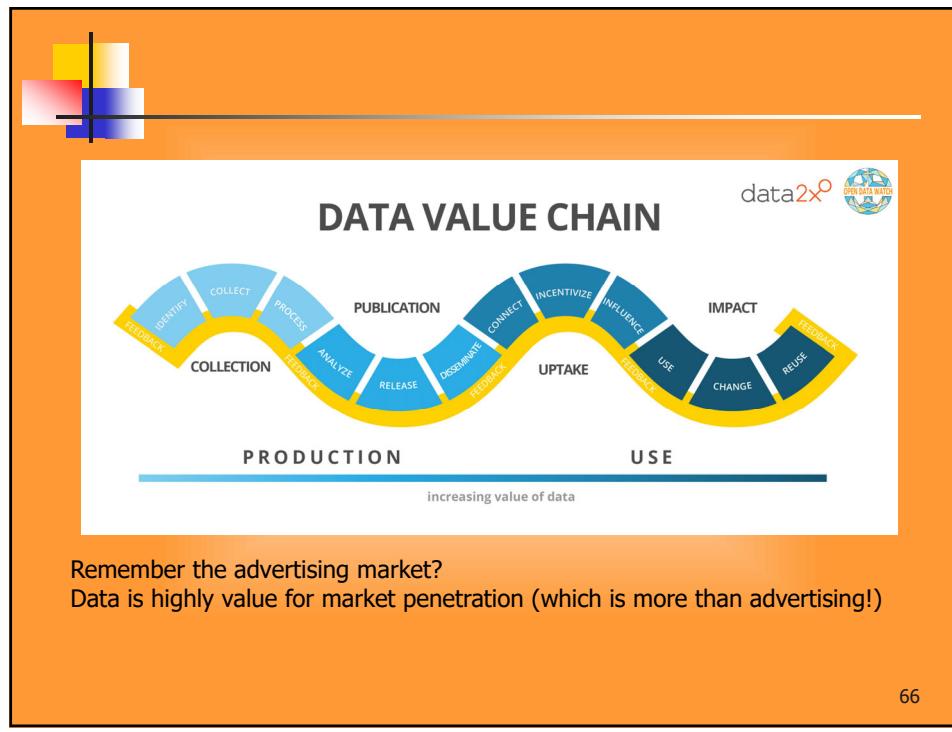
Source: <https://digital-strategy.ec.europa.eu/en/library/results-new-european-data-market-study-2021-2023>

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Remember the advertising market?
Data is highly value for market penetration (which is more than advertising!)

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The path to a single European market for data

European Data Strategy

- Adopted Feb 2020
- Genuine internal data market
- Built on EU values and rules

Common European data spaces

- Staff Working Document – Feb 2022
Overview development data spaces, at request European Council
 - ✓ Horizontal aspects + sectoral initiatives
 - ✓ EU funding, programmes

A cross-sectoral legislative framework

- [Data Governance Act](#) – in force July 2022
- [Data Act](#) – Proposal Feb 2022
- [Implementing Act on High-value datasets](#)
(Open Data Directive) – draft Act May 2022

European Commission

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More market → more data → more market

The difficulty in Pricing Data

Data trading as a constantly growing field and a key sector in Digital Economy

The amount of data has increased

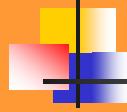
The reliance of companies on data has grown

New technologies allow the collection, storage, processing and dissemination of data

Data Trading is becoming a blooming business

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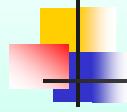
What is informatics here for?

SCALE

- Ecosystem creation
(how many companies in the business stack?)
- Full exploration of networking effects
 - **Data is a tool** for this – so much more that it creates a separate market per itself.
 - Google is not on the “search business”. The “search” is the tool used to take a hold in the advertising (and others) market
 - Leading to new market explorations from a dominant position
 - Huge societal impact, not because of the technology, but because of the market size
 - And this is replicated on the data market

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PRACTICAL WORKS

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Assignment 3 –groups of 3 students!

Analyse the major challenges to be overcome.

- There is a video with four major scenes on a new technology ecosystem.
- Your problem is to set a team to address the key challenges to be solved to realize this video.
- You DO NOT need to solve the challenges. But you are going to lead the teams that will address the challenges that you have identified: you are the future team leader, of a very large team, that will be able to drive to answer the problems you identified, with the guidelines that you suggest.

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Grading criteria

- You will need to address three different APSEI domains

(hint: there are four different scenes in the video, you can structure these answers per scene)

- Technology challenges to overcome
 - What are the major challenges you identify that need to be addressed?
 - Proper identification of the scope and limitations of the answers provided (and why)
 - Law and regulation blockers
 - Does law and regulation allow the scenarios that are being presented?
 - What needs to be changed/adapted?
 - Address all ecosystem legal and social limitations to be overcome
 - Scalability and challenges
 - What will be the impact of doing this for the whole Europe?
 - What can we expect in terms of scaling problems in a real wide system?
 - What would need to be standardized/already is for these solutions?
- All points to be (soft) graded: D,C,B,A
 - Also quality of delivery will be evaluated
 - Format:
 - Video up to 10 minutes demonstrating/describing the system
 - 12-minute presentation + 5 minutes for questions
 - Presentation handouts. One slide/page per topic, with a maximum of one page per topic per scene

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Assignment 3 –Deadlines

Process of presentations as before.
List on the elearning with the timings for presentations, upload of materials (two days before the presentations).

Full time on the 8th May.

----- ***NEXT PRACTICAL CLASS*** -----

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