The Software Industry

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COSS B01

Agenda

1. Definition (software)
2. The software industry
3. A (very) short history
4. The main players
5. Software products
6. Software platforms
7. Software ecosystems

1. What is Software?

Software Definition

- **Software** (technical definition)
  - Is a set of instructions to make computers perform work
  - Can come in several equivalent forms (source, binary)
  - Is formed into components and programs
  - Programs can be built from components
- **Software** (economic definition)
  - Is a **digital good** that **can be sold**


Online Dashboard
Recent AdWord Events Statistics
Leads By AdWords Report
Cost per Leads By AdWords Report


facebook
Facebook helps you connect and share with the people in your life.


WORLD WARCRAFT

Software as a Product

- A **product**
  - Is a **man-made artifact sold to customers in a market**
  - Has a life-cycle
    - Is born,
    - Grows and matures,
    - Eventually dies

- A **software product** is a product that
  - Is intellectual property
  - Is non-physical, does not rot
  - Has near-zero copying costs
  - Is extremely malleable

2. The Software Industry

The Software Industry

- The software industry
  - Is the set of business that provide
    - Software products and
    - Software services such as
      - Operating services
      - Consulting services
        - Development services
        - Implementation services
  - to other industries as well as itself
- The software industry
  - Is highly concentrated
  - Is highly internationalized
  - Has strong network effects
  - Has a high speed of innovation
  - Is rapidly expanding into new domains

Global Software Industry Spending [1] in $bn

	2019 Spending	2019 Growth (%)	2020 Spending	2020 Growth (%)	2021 Spending	2021 Growth (%)
Data Center Systems	205	-2.7	208	1.9	212	1.5
Enterprise Software	456	8.5	503	10.5	556	10.5
Devices	682	-4.3	688	0.8	685	-0.3
IT Services	1,03	3.6	1,081	5.0	1,14	5.5
Comm. Services	1,364	-1.1	1,384	1.5	1,413	2.1
Overall IT	3,737	0.5	3,865	3.4	4,007	3.7

[1] From https://www.gartner.com/en/newsroom/press-releases/2020-01-15-gartner-says-global-it-spending-to-reach-3point9-trillion-in-2020


“Software is eating the world”
Wall Street Journal
2011-08-20

The CEO Interview

Change and Innovation at the Speed of Software

- Products increasingly include software components
  - Hardware components traditionally have long innovation cycles
  - Software has a significantly faster innovation cycle
  - Innovation speed is continuously increasing
- Products are being adapted to take advantage of software
  - Products can be reconfigured at speed of software
  - Products evolve at speed of software innovation
- Examples increased innovation speed
  - Cars are fully delivered with features switched off
  - Cars evolve at speed of over-the-air update
- Software is eating established industries and products

[1] See https://dirkriehle.com/2019/12/09/the-first-derivative-of-software-is-eating-the-world/

Societal Significance of Software and Software Systems

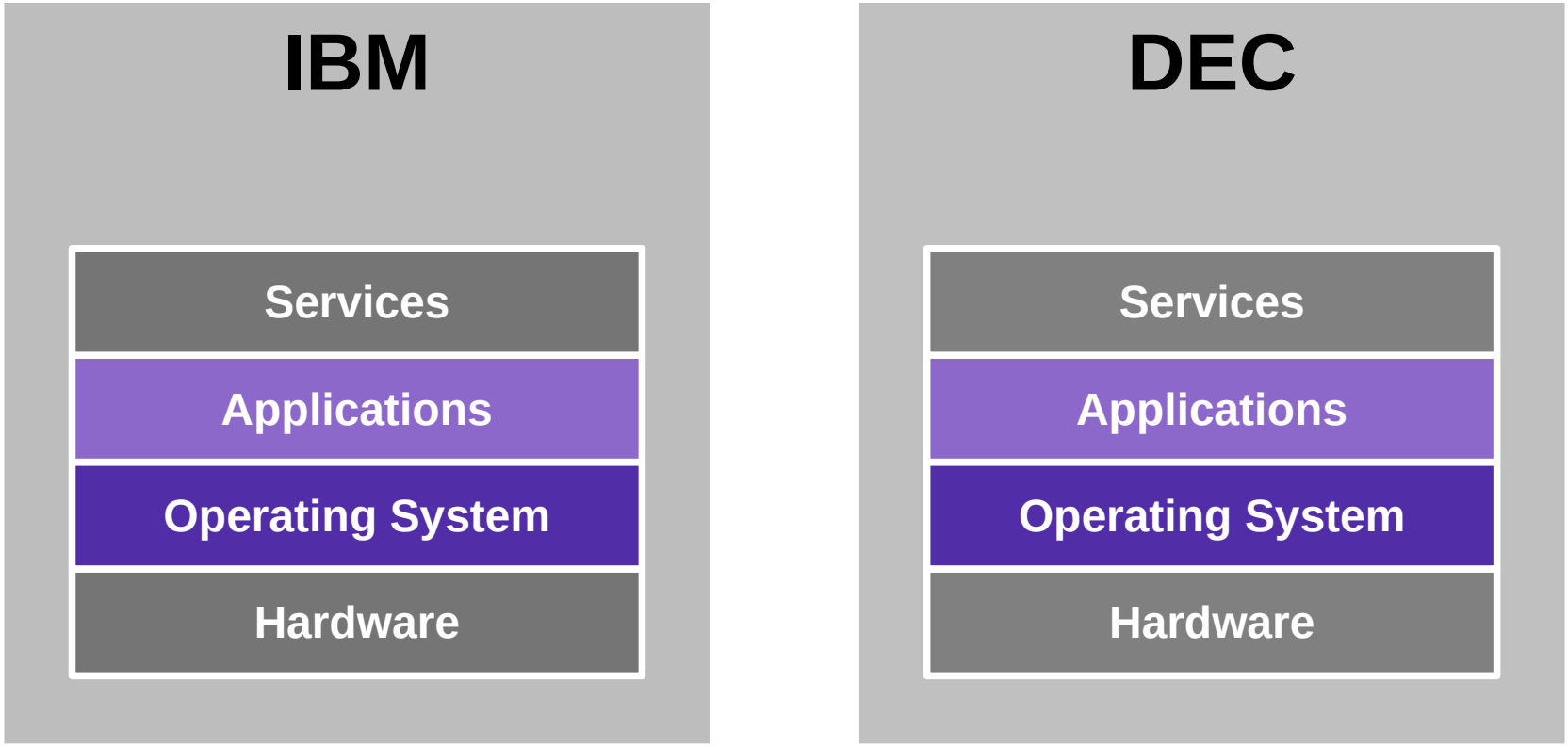
- Software and software systems are changing society
  - Empowerment vs. stratification
  - Enlightenment vs. misinformation
  - Sociability vs. isolation
- Internet and email have become basic utilities

3. A (Very) Short History

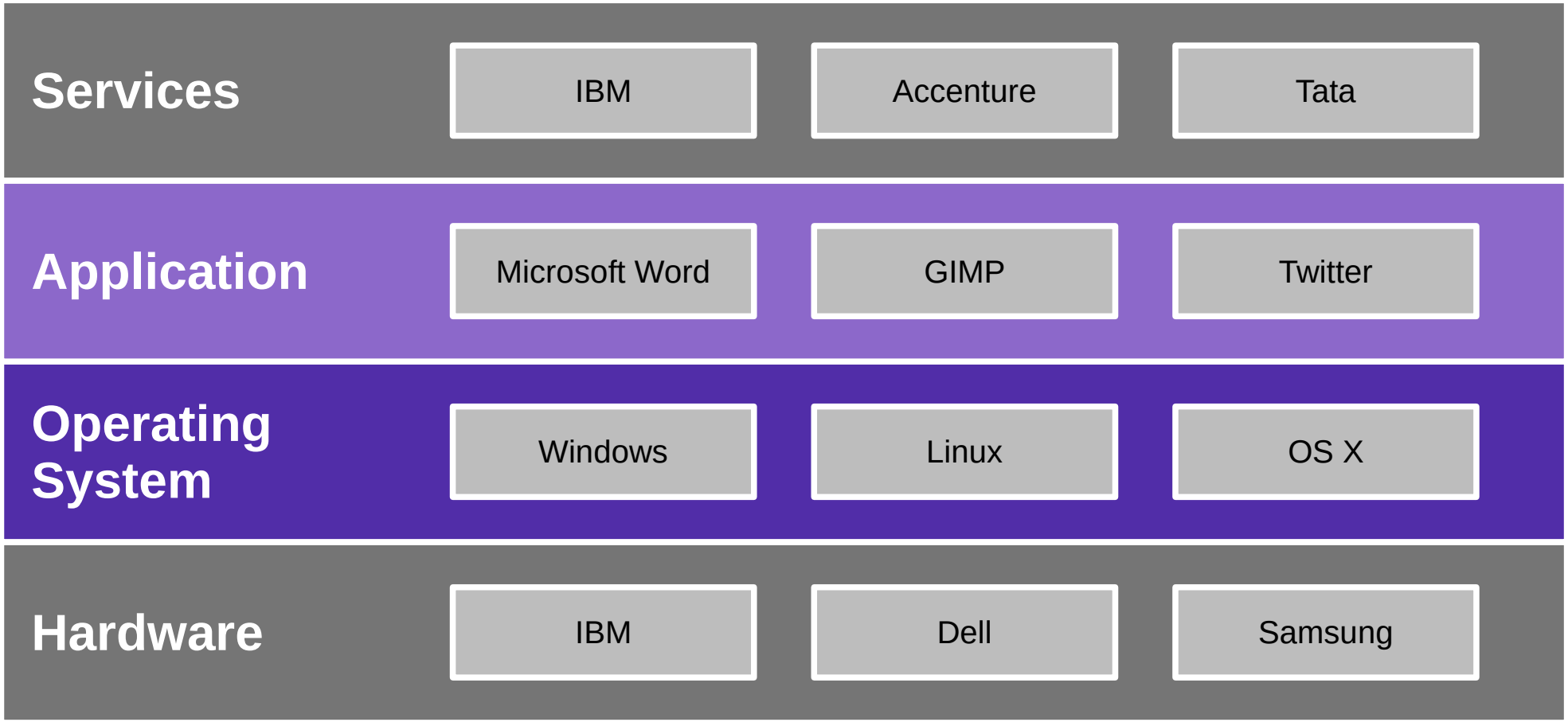
Short History of the Software Industry

- 1959
  - First mentioning of term “software”
- 1969
  - US Dept. of Justice separates hardware from software in landmark decision
- 1980ties
  - From vertical to horizontal integration; growth of platforms and ecosystems
- 1990ties
  - Centralization, dominance of Windows
- 2000ties
  - Diversification, multiple platforms; growth of open source software
- 2010ties
  - Back to vertical integration in the form of cloud computing

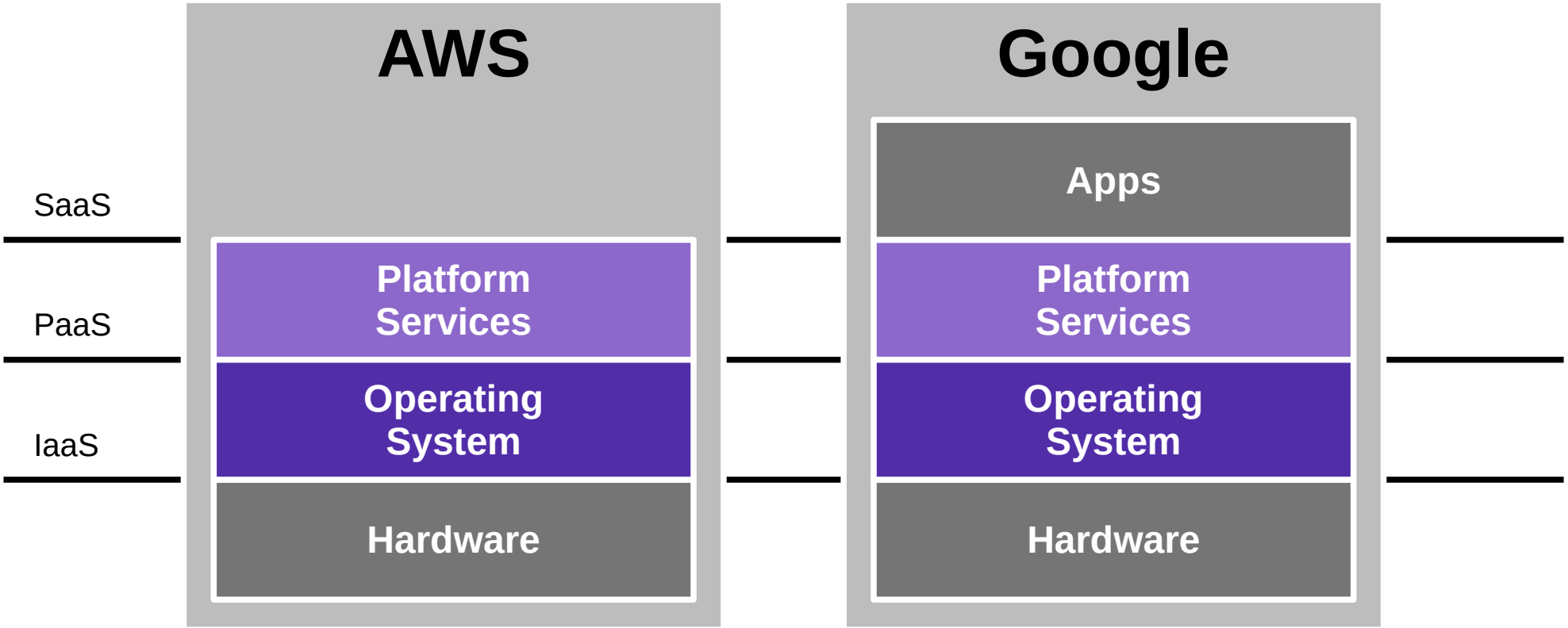
Vertical Integration (Until 1980ties)

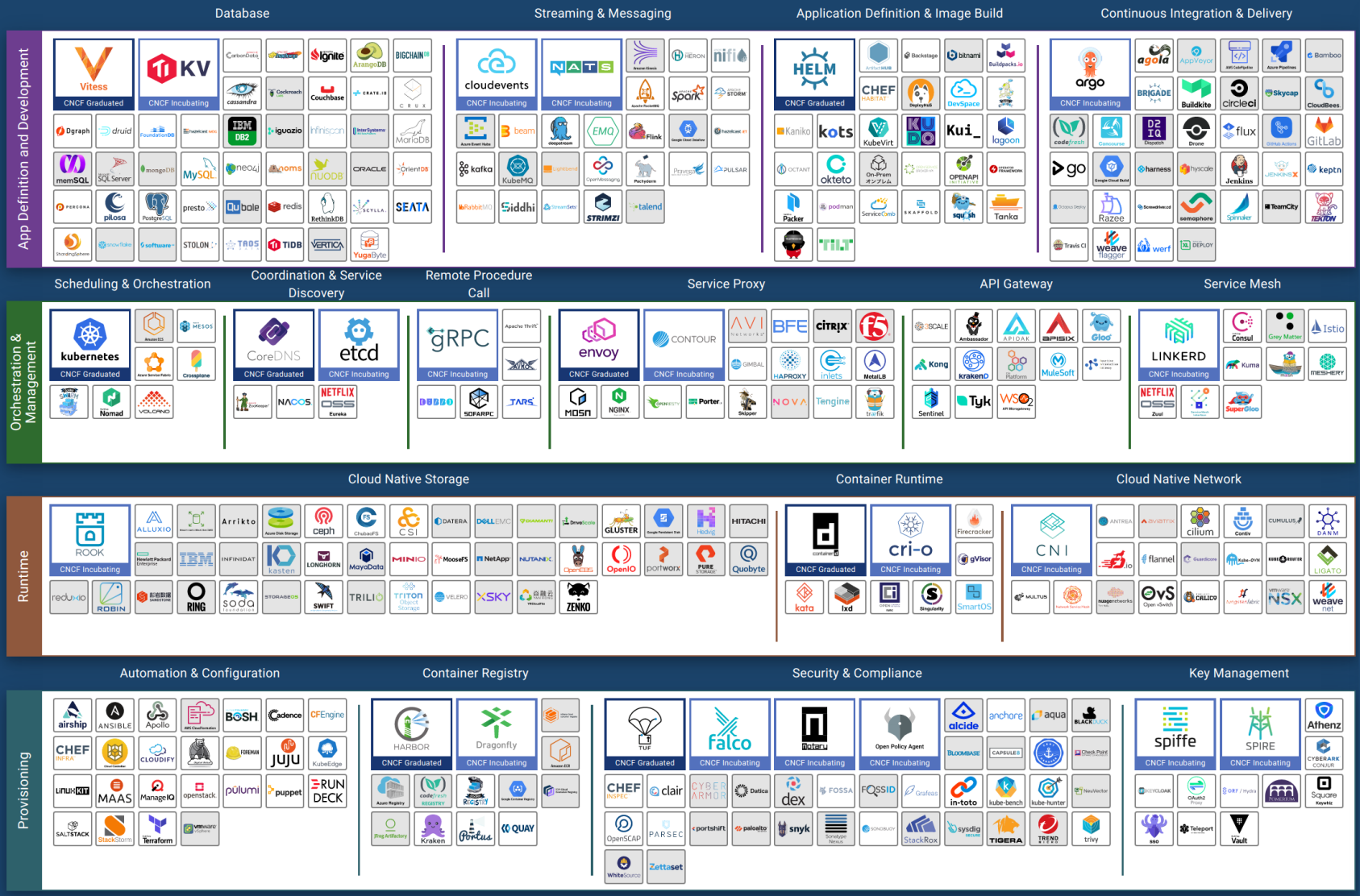


Horizontal Integration (Since 1990ties)

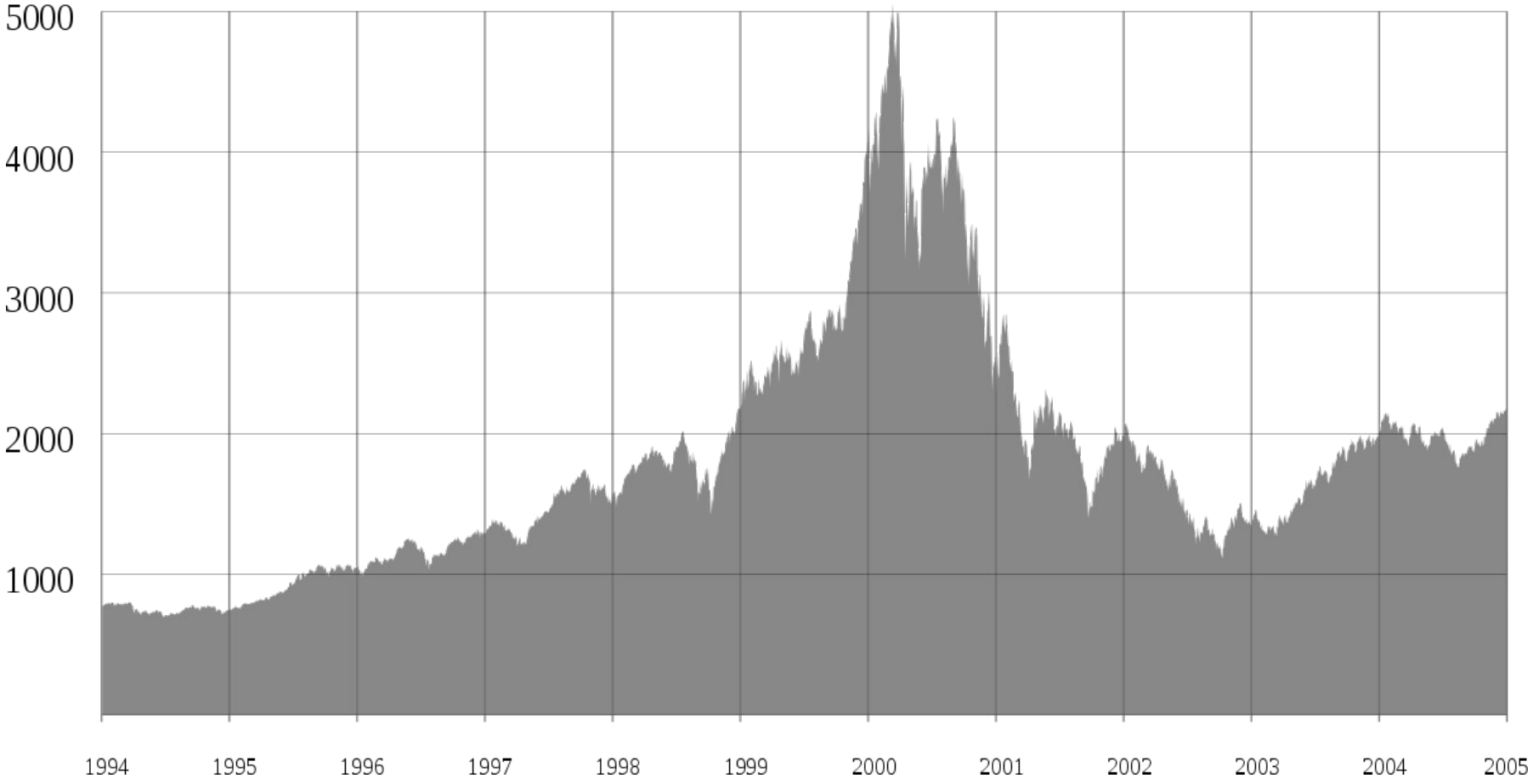


Cloud Computing (Since 2000ties)




App Definition and Development
Database
Vitess
CNCF Graduated
KV
CNCF Incubating
Streaming & Messaging
cloudevents
CNCF Incubating
NATS
CNCF Incubating
Application Definition & Image Build
HELM
CNCF Graduated
Continuous Integration & Delivery
argo
CNCF Incubating
Orchestration & Management
Scheduling & Orchestration
kubernetes
CNCF Graduated
Coordination & Service Discovery
CoreDNS
CNCF Graduated
etcd
CNCF Incubating
Remote Procedure Call
gRPC
CNCF Incubating
Service Proxy
envoy
CNCF Graduated
CONTOUR
CNCF Incubating
API Gateway
Service Mesh
LINKERD
CNCF Incubating
Runtime
Cloud Native Storage
ROOK
CNCF Incubating
Container Runtime
containerd
CNCF Graduated
cri-o
CNCF Incubating
Cloud Native Network
CNI
CNCF Incubating
Provisioning
Automation & Configuration
Container Registry
HARBOR
CNCF Graduated
Dragonfly
CNCF Incubating
Security & Compliance
TUF
CNCF Graduated
falco
CNCF Incubating
Notary
CNCF Incubating
Open Policy Agent
CNCF Incubating
Key Management
spiffe
CNCF Incubating
SPIRE
CNCF Incubating

The “Dot-Com” Bubble and Burst (1995-2000)



[1] See https://en.wikipedia.org/wiki/File:Nasdaq_Composite_dot-com_bubble.svg

The NASDAQ Composite Index Continued

1. Microsoft
2. Apple
3. Amazon
4. Alphabet
5. Facebook
6. Intel
7. Cisco Systems
8. Comcast
9. PepsiCo
10. Adobe Systems

4. The Main Players

The Main Types of Industry Players

- Standard product providers
  - (Independent) software vendors (ISVs)
    - Produce software products (“standard software” or “commercial off-the-shelf software”)
  - Cloud service providers (e.g. “Internet companies”)
    - Operate any form of software (and hardware)
- Software consulting firms
  - Development services firms
    - Produce custom software
  - Implementation services firms
    - Configure software products for use by customers
- Non-profit organizations
  - Standards organizations
  - Regulatory bodies
  - Certification agencies

Top 10 Independent Software Vendors (ISVs) in 2019 [1]

Rank	Organization	Sales (B$)	FY	Market cap (B$)	Headquarters
1	Microsoft	118.2	2019	946.5	Redmond, WA, US
2	Oracle	39.6	2019	186.3	Redwood City, CA, US
3	SAP	29.1	2019	134.9	Walldorf, Germany
4	Adobe Inc.	9.5	2019	132	San Jose, CA, US
5	Salesforce	13.3	2019	120.9	San Francisco, CA, US
6	VMware	9.0	2019	77.2	Palo Alto, CA, US
7	Intuit	6.4	2019	66.8	Palo Alto, CA, US
8	ServiceNow	2.6	2019	42.9	Santa Clara, CA, US
9	Workday	2.8	2019	41.7	Pleasanton, CA, US
10	Dassault Systèmes	4.1	2019	39.2	Vélizy-Villacoublay, France

[1] Forbes Global 2020, see https://en.wikipedia.org/wiki/List_of_the_largest_software_companies

Software Vendors vs. “Internet Companies” [1]

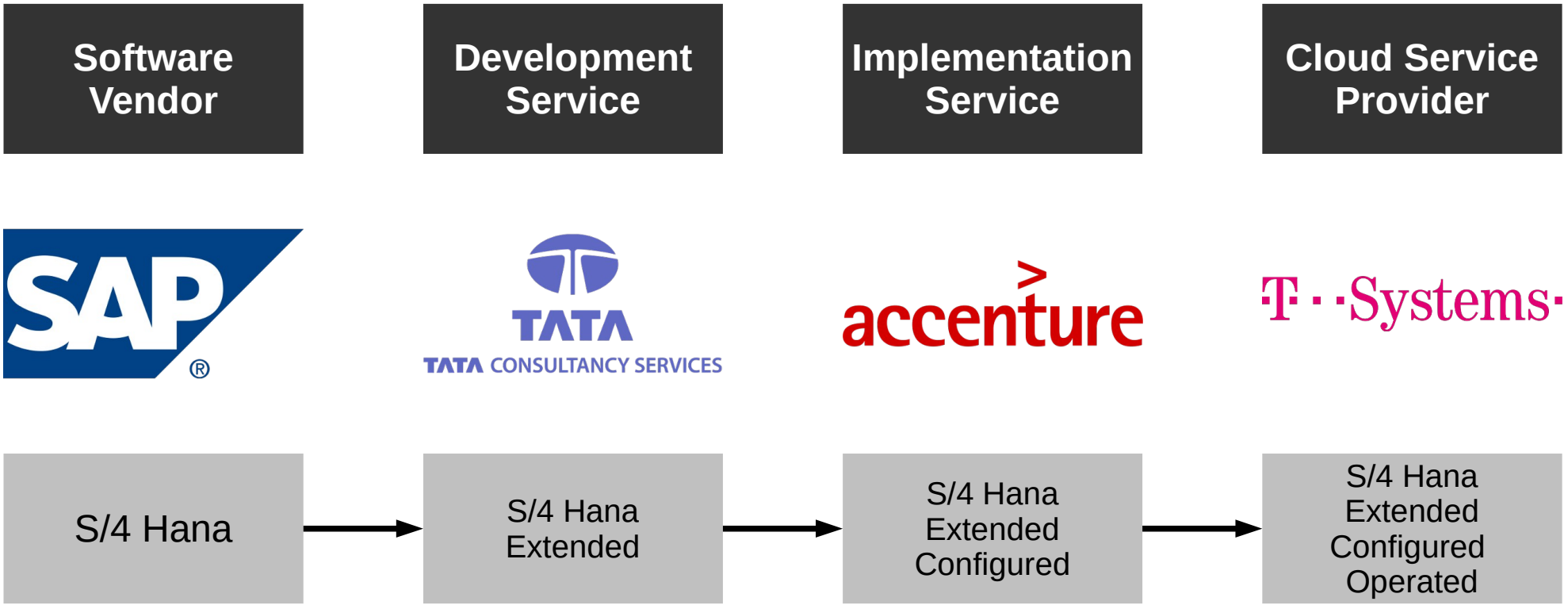
[1] See https://en.wikipedia.org/wiki/List_of_largest_Internet_companies

Software Vendors vs. Service Provider / Operator

- Software vendor
  - Product is a licensed-out artifact
- Examples (before cloud offering)
  - Microsoft
  - Oracle
  - SAP
  - Adobe

- Service provider / operator
  - Product is a standardized service
- Examples
  - Amazon Web Services (if it was broken out)
  - Various Google services
  - Salesforce
  - Facebook

Software Vendors, Consulting Firms, and Service Providers



Standards Organizations

- A standards organization
  - Is a public (often non-governmental) organization financed by industry
  - That serves as meeting point and platform to define industry standards
  - Conformance to which may be required before admission to market
  - Is one player (of three) in standards and certification processes

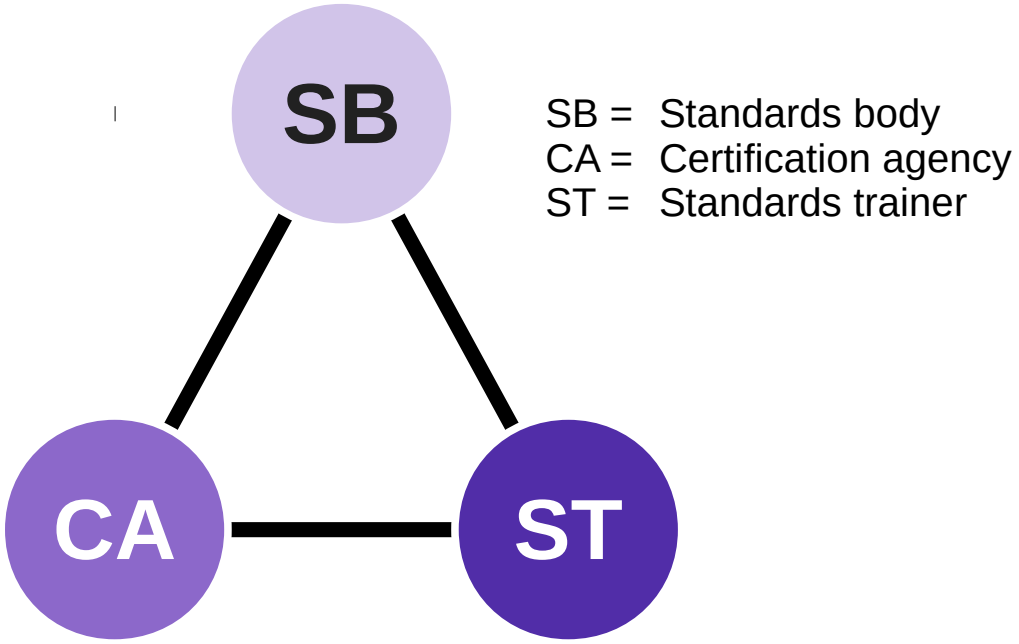
- Examples
  - ISO (“International Standards Organization”)
  - VDE (“Verband der Elektrotechnik”)
  - VDA (“Verband der Automobilindustrie”)

Regulatory Bodies (Regulators)

- A regulatory body
  - Is a public organization or government agency (state-level, federal-level, union-level)
  - Which by way of laws and directives regulates industries and industry player behavior
  - To protect the public by preventing undesired behavior and enforcing desired one
- Examples
  - European Union
    - European commission → Data protection (GDPR) → Enforcement by Information Commissioner's Office (ICO)
  - U.S.A.
    - Federal and state governments → Antitrust law → Enforcement by Federal Trade Commission (FTC), DoJ

Certification Agencies

- A certification agency
  - Is a non-profit organization that provides certification services for given standards



SB = Standards body
CA = Certification agency
ST = Standards trainer

5. Software Products

Consumer vs. Enterprise Customers

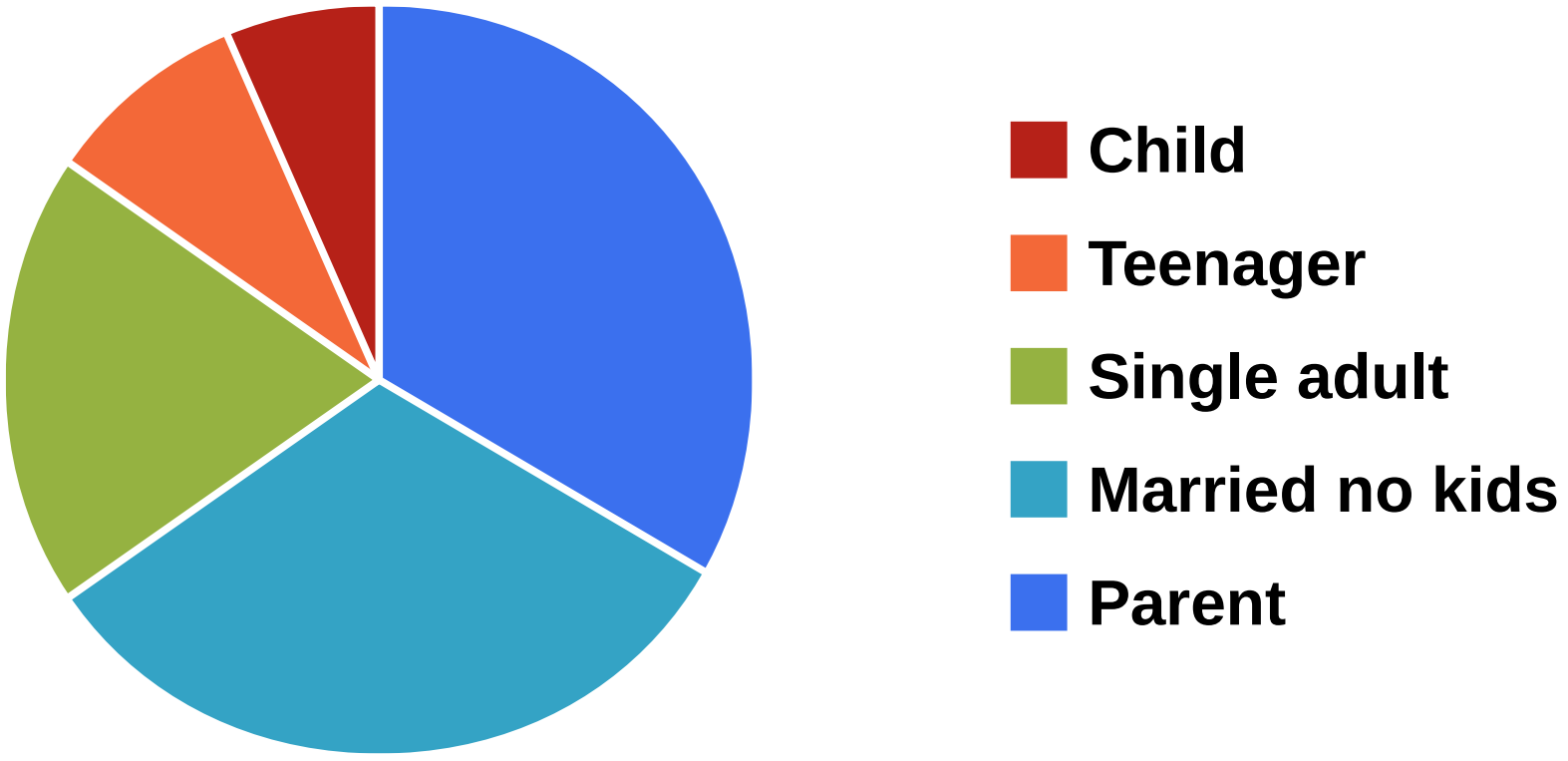
- Retail customers (B2C)
  - Are willing to trade time for money
- Enterprise customers (B2B)
  - Are willing to trade money for time

Consumer vs. Enterprise Software Products (and Markets)

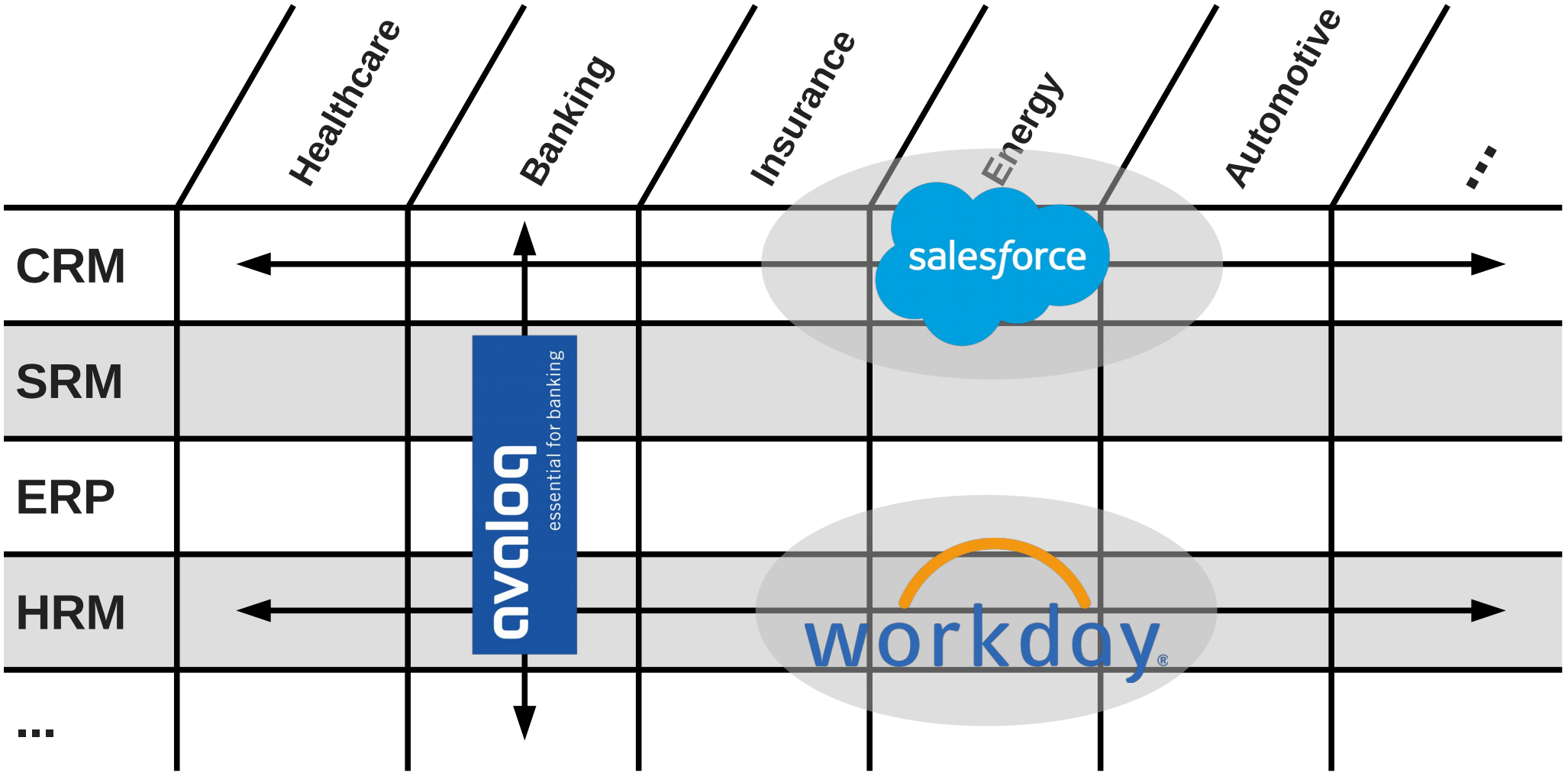
- Consumer (retail) products
  - Pricing
    - Comparatively cheap
    - Often free, then subsidized
  - Segmentation
    - Usually by demographics, e.g.
      - By age group
      - By gender
  - Adoption
    - Out of the box

- Enterprise software products
  - Pricing
    - Into million Euros
    - Often the real product behind consumer software
  - Segmentation
    - Horizontal vs. vertical, e.g.
      - By business function
      - By industry
  - Adoption
    - May require implementation project

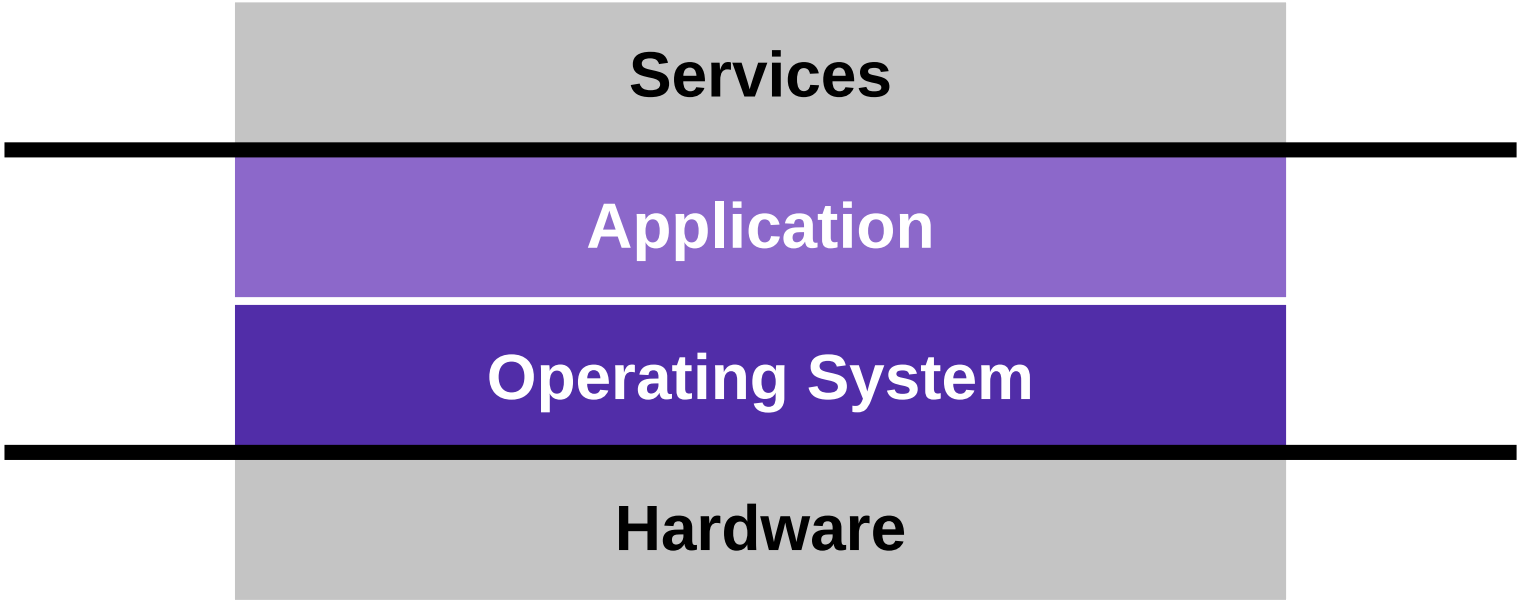
Consumer Market Segmentation [1]



Enterprise Software Market Segmentation



Customers Want to Buy a “Solution”

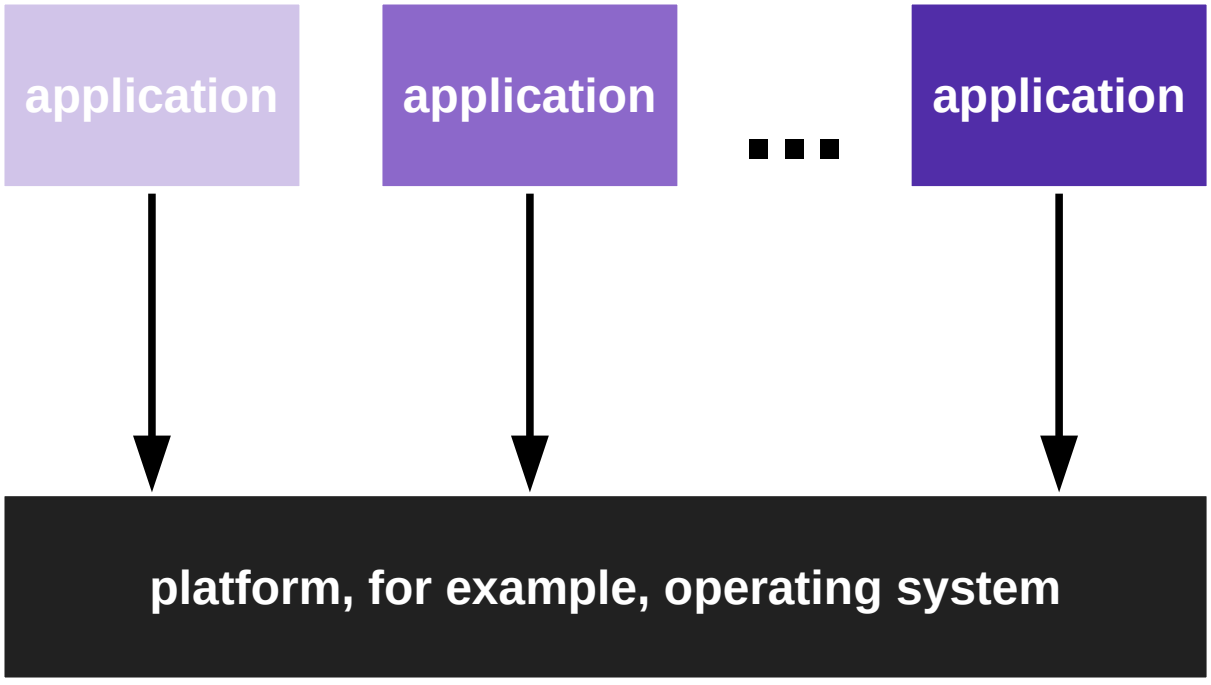


6. Software Platforms

Categories of Software Products

- **Applications**
  - Software that is not built upon
  - Software that delivers immediate business value
  - Top-layer of the solution stack
- **Platforms**
  - Software that is built upon
  - Software that supports other software in delivering business value
  - Everything that is not the top layer
- **Why does everyone want to be a platform?**

Software Platform 1 / 2



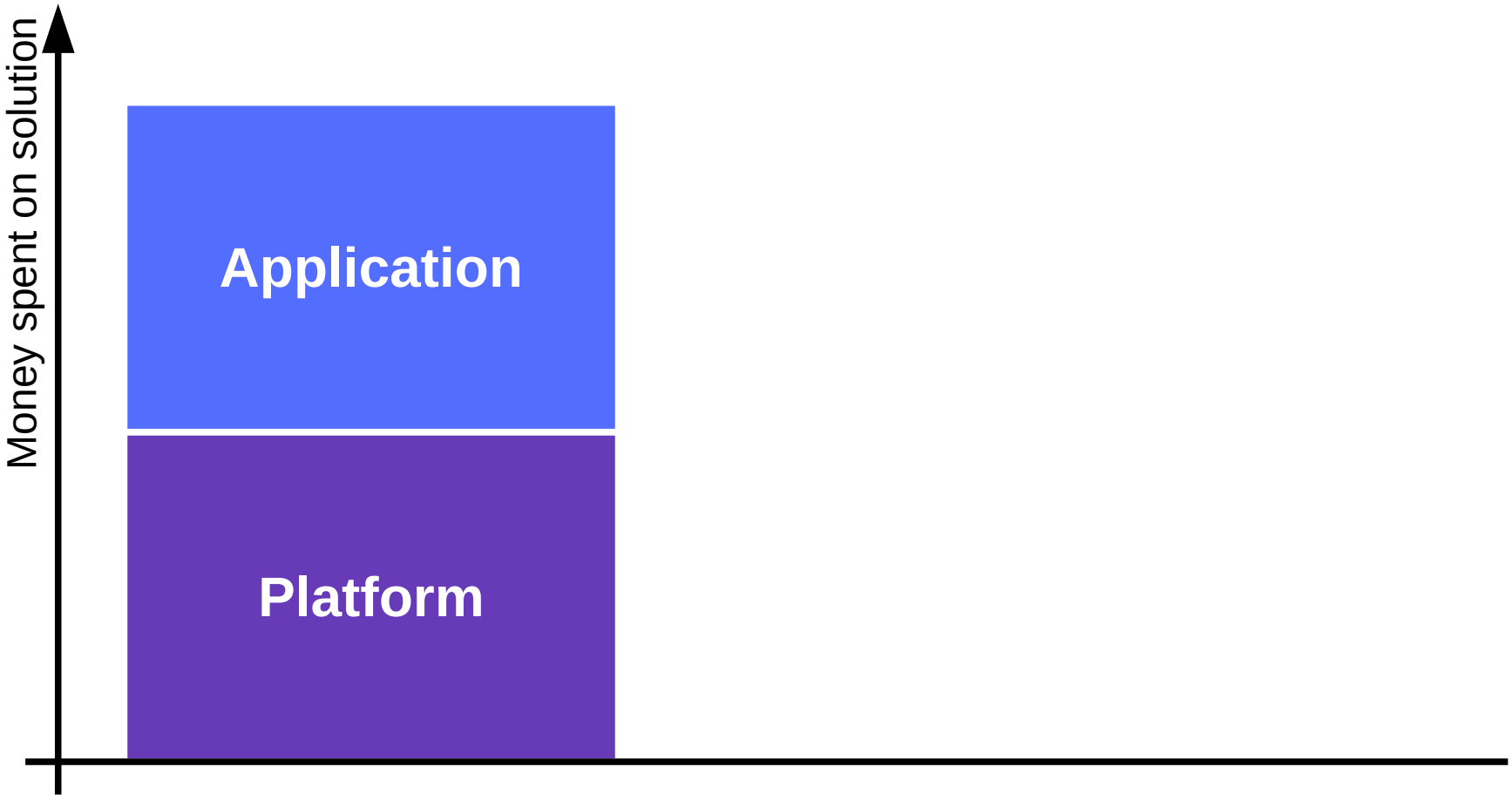
Software Platform 2 / 2

- Software platform
  - Is an environment for the development and deployment of applications
    - Implies split between applications on top of the platform
  - Provides a full set of application-independent life-cycle functions for applications
    - Among many components, the largest collection (i.e. not just a library)
- Customer (user) value of software platforms
  - By definition, a platform in itself is useless
  - Customer value is only created by applications

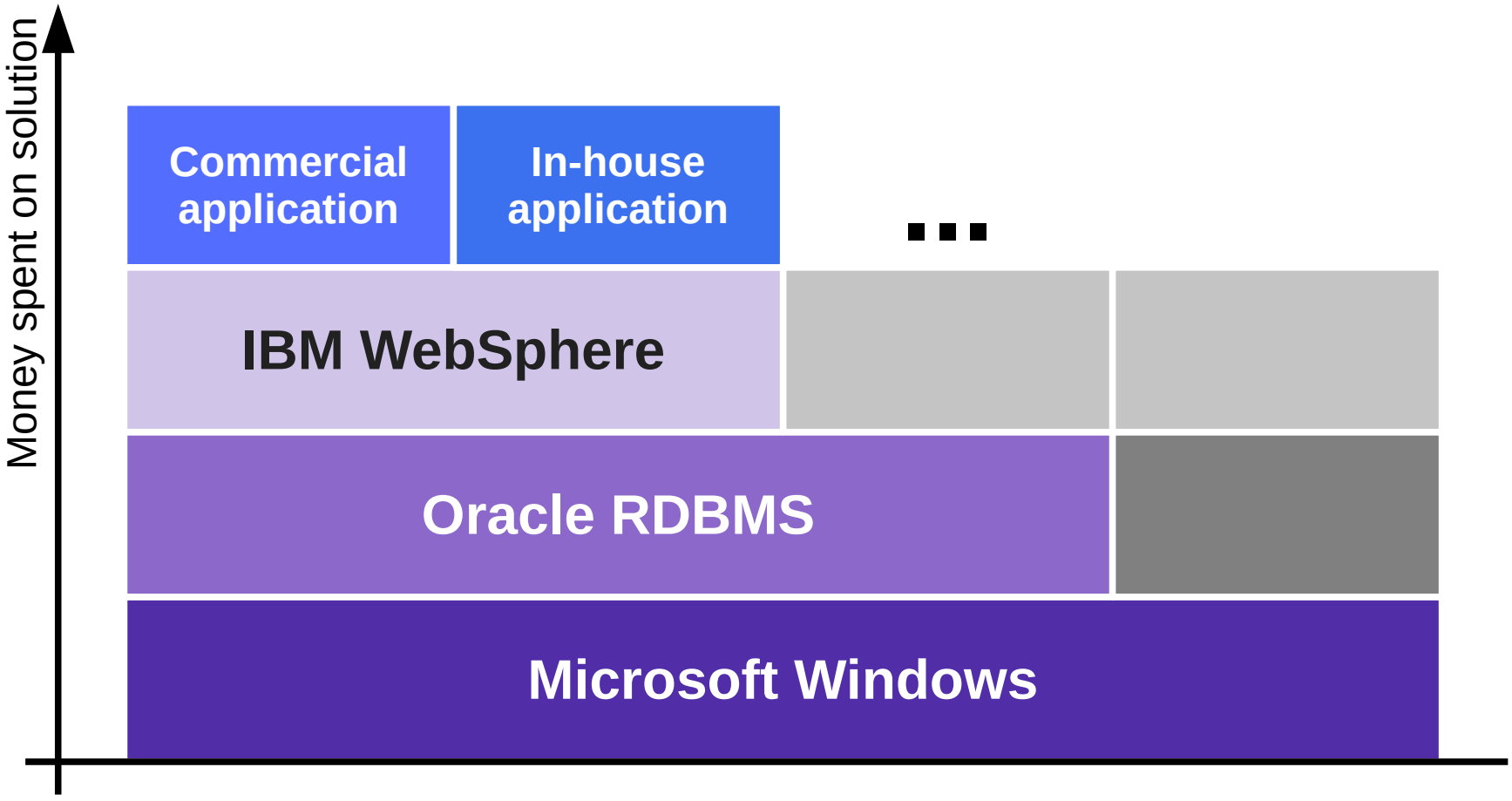
Software Platforms as a Product

- Platforms are valuable
  - Platforms are needed by the applications running on top of it
  - Platforms can simplify IT department operations costs
- An application license sale implies a platform sale

Pricing Power 1 / 2



Pricing Power 2 / 2 [1]



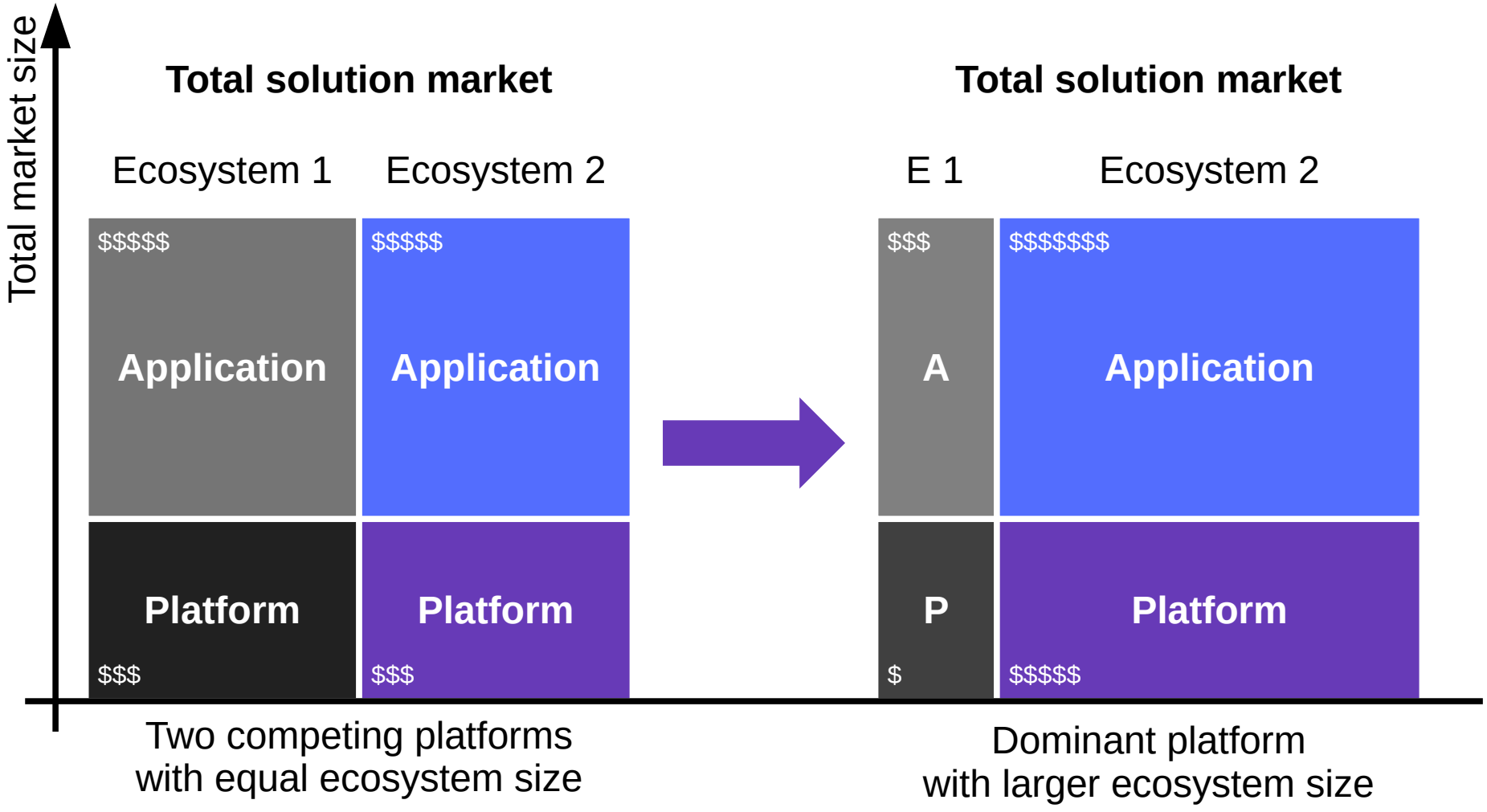
[1] Not drawn to scale

7. Software Ecosystems

Software Ecosystem

- A **software ecosystem**
  - Is the totality of actors (businesses and individuals),
  - Software applications and components, and
  - Their relationships and goals
  - On and around a software platform

The Software Ecosystem Wars



Summary

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2. The software industry
3. A (very) short history
4. The main players
5. Software products
6. Software platforms
7. Software ecosystems

Thank you! Questions?

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