Between (Data) Platforms, Ecosystems, and (Cloud-to-)Edge Computing.

An Architecture-Based Approach For Navigating the Terminology "Mess"
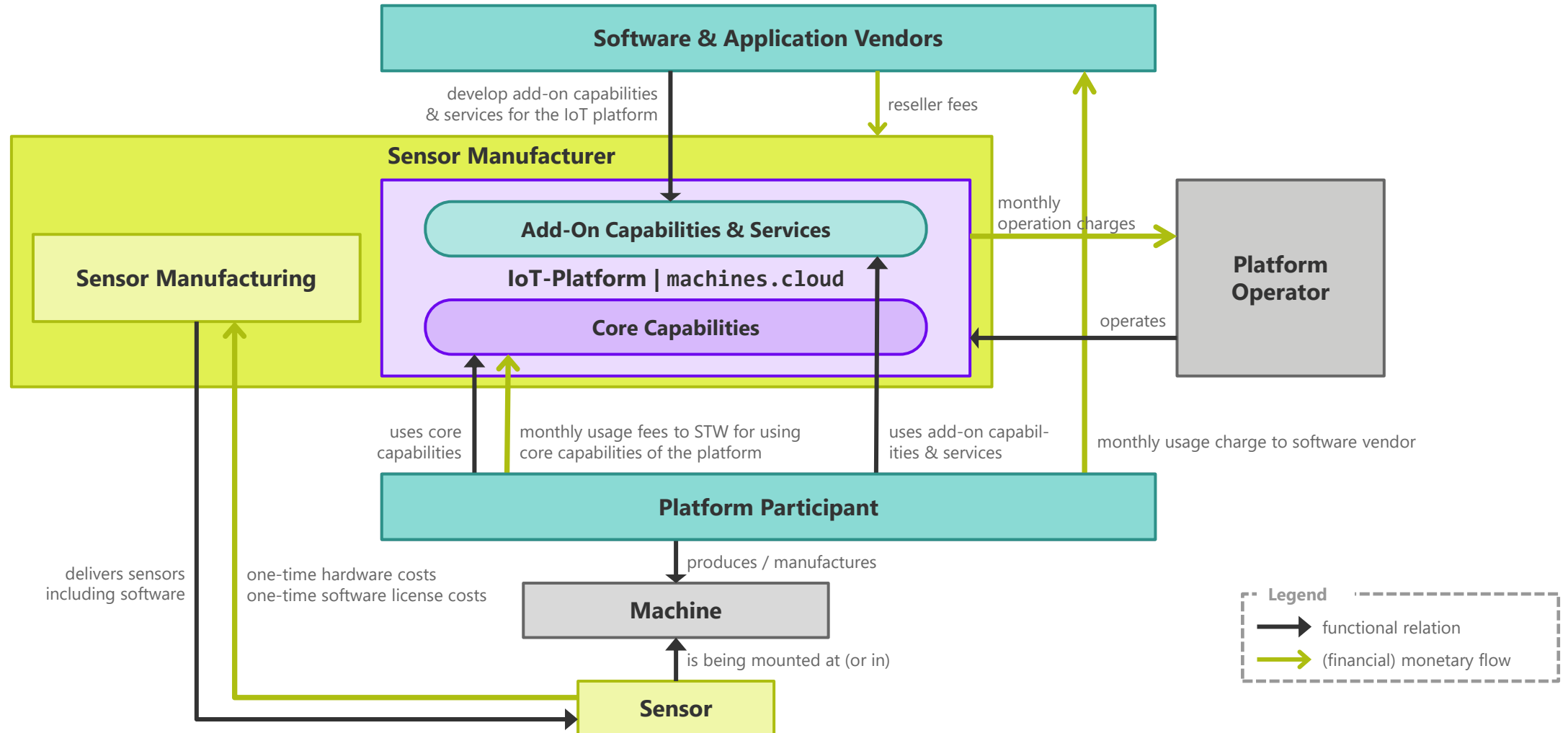
Christoph F. Strnadl | *Deputy CTO*

28 August 2023 | Gaia-X Hub Austria Meetup

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v1.01

Data Platforms

Business architecture & business model

Software & Application Vendors

develop add-on capabilities
& services for the IoT platform

reseller fees

Sensor Manufacturer

Add-On Capabilities & Services

IoT-Platform | machines.cloud

Core Capabilities

Sensor Manufacturing

monthly
operation charges

Platform
Operator

operates

uses core
capabilities

monthly usage fees to STW for using
core capabilities of the platform

uses add-on capabil-
ities & services

monthly usage charge to software vendor

Platform Participant

produces / manufactures

delivers sensors
including software

one-time hardware costs
one-time software license costs

Machine

is being mounted at (or in)

Sensor

Legend

→ functional relation

→ (financial) monetary flow

Source: Strnadl C.F. & Schöning H. (2023). Datenplattformen, Datenräume und (Daten-)Ökosysteme –
Einordnung und strategische Aspekte. In: Weber B. (Ed.), Data Governance. Springer, Kapitel 2.

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Ecosystems (1)

Biology examples

Tropical Forest

Wetland (10-20cm depth)

Tidal Pools

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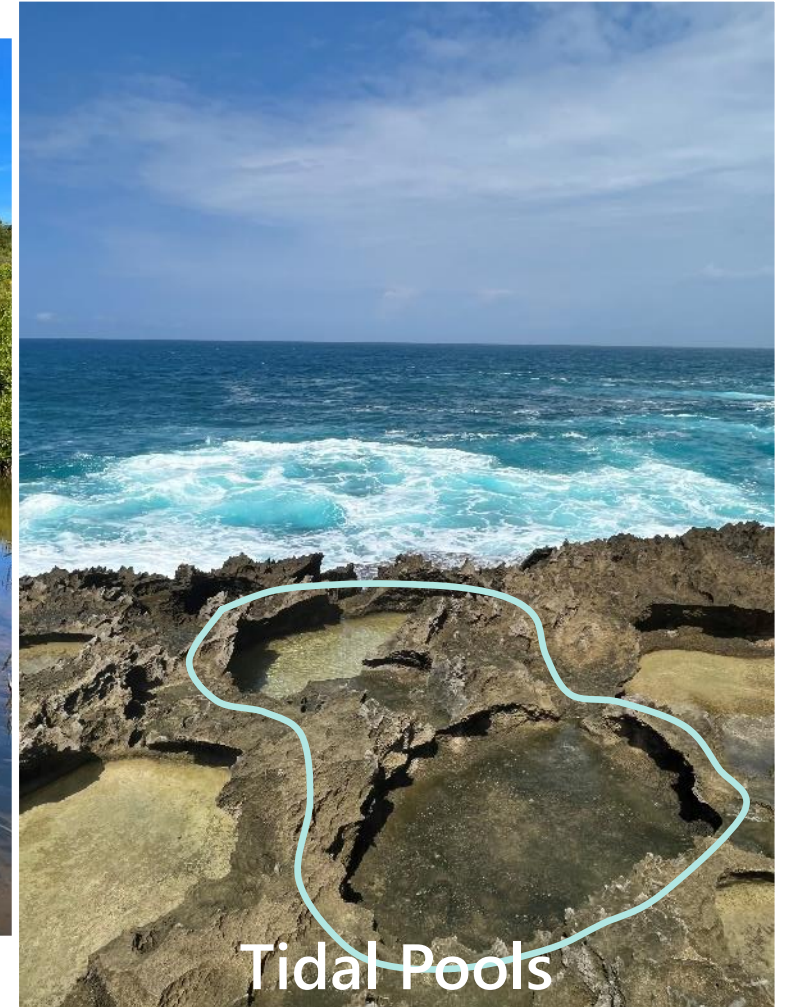
Ecosystems (2)

Biology definitions (... and what makes them relevant for business)

A geographic area where plants, animals, and other organisms (biotic, i.e., living parts), as well as weather and landscape (non-biotic factors), work together to form a bubble of life.

– National Geographic

All organisms in a certain area and the abiotic factors with which they interact.

– Campbell Biology

A single environment and every living (biotic) organism and non-living (abiotic) factor that is contain within it or characterizes it.

– Biology dictionary https://biologydictionary.net/ecosystem/

«Ecosystem» Key Defining Elements

- a specific geographic area
- all biotic factors (in that area)
- all relevant non-biotic factors (in or for that area)
- all their interactions
- for a certain (longer) time.

This is implicitly always understood by biologists, but economists sometimes construct one-time transactions...

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Ecosystems (3)

Good, failed, and intermediate examples of business ecosystems

100%

50%

FAILED

- Alibaba
- Apple iOS
- AWS
- Google Android
- Microsoft
- Tencent

- Intel + "Intel Inside" Partners
- Rio Tinto (Data Management)
- Novo Nordisk (Diabetes in China)
- Philips Healthcare (Innovation)
- Sustainable Fashion Alliance
- 3GPP
- Nike products & wearables
- Solar PV panel producers

- AirBnB
- Alphabet (??)
- Amazon Store
- eBay
- Facebook
- Uber
- Spotify

- Napster 2002
- Yahoo Search 2003
- Covisint 2004 $500M
- MySpace 2011
- Better Place 2013 $900M

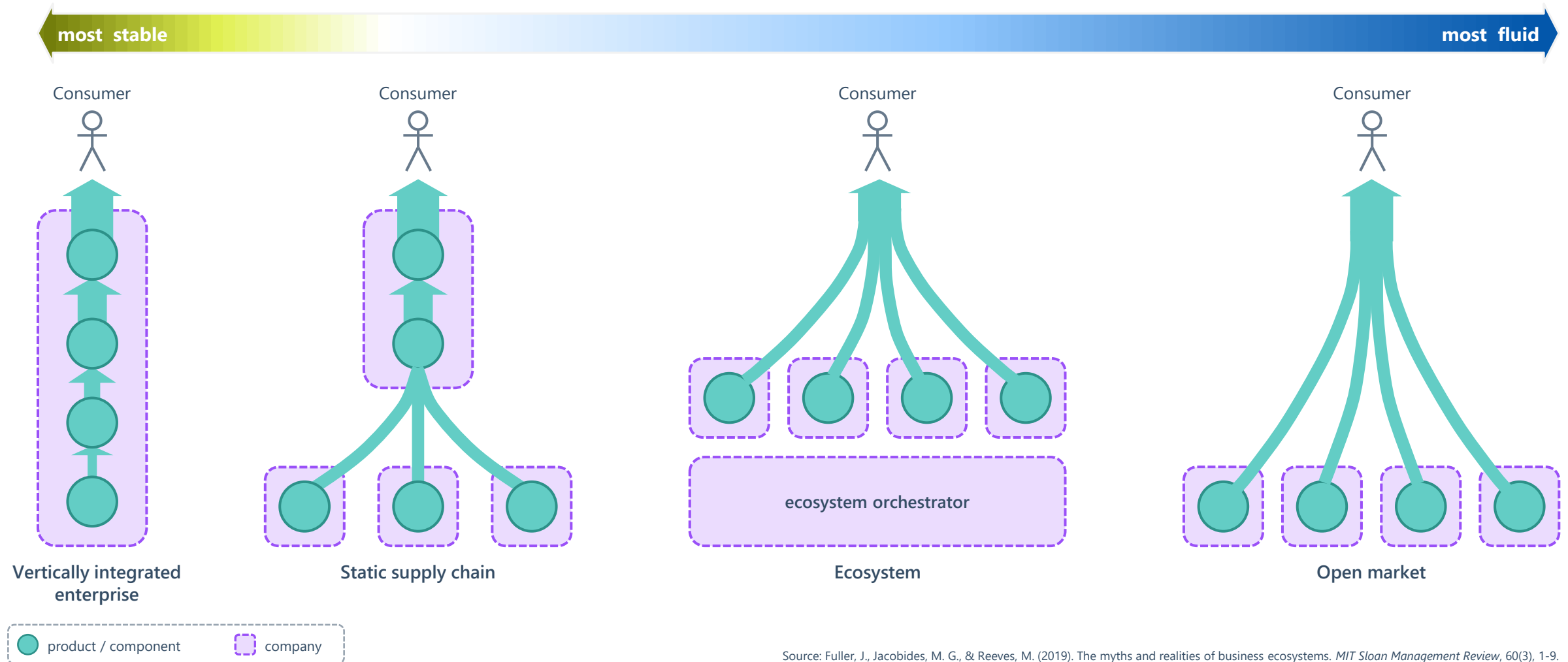> Many have, but not every ecosystem needs a central technical platform in the "middle".

> Multi-sided platforms are very weak examples of ecosystems as there is **no real coordination** between the different platform users (buyers, sellers, etc.).

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Ecosystems (4)

Business ecosystems as a "new [and unstable] dynamic multi-company way of organizing economic activity"

most stable → most fluid

Consumer — Consumer — Consumer — Consumer

Vertically integrated enterprise — **Static supply chain** — **Ecosystem** (ecosystem orchestrator) — **Open market**

● product / component ⬚ company

Source: Fuller, J., Jacobides, M. G., & Reeves, M. (2019). The myths and realities of business ecosystems. *MIT Sloan Management Review*, 60(3), 1-9.

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Ecosystems (5)

Two extremely good definitions albeit not for "1-minute managers": You have to study them diligently

"[An ecosystem is] the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize."

– Adner R. (2016). Ecosystem as structure: An actionable construct for strategy. *J. Manage.*, vol. 43, no. 1, 39–58
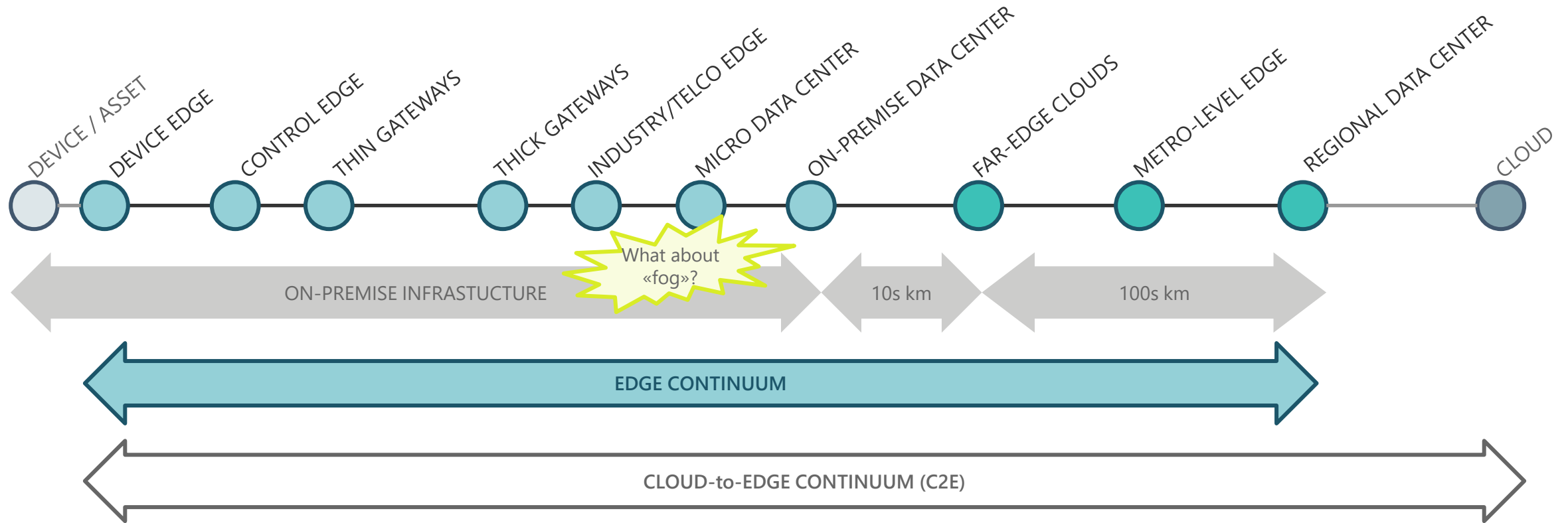
"An ecosystem is a set of actors with varying degrees of multilateral, nongeneric complementarities that are not fully hierarchically controlled."

– Jacobides M G, Cennamo C. & Gawer A (2018). *Strat Mgmt J.* 39, 2255-76.

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Edge Computing (1)

What is the «edge» & «edge computing», actually?

Edge computing refers to **any form of moving computing resources** (incl. applications) from the cloud **closer to devices** or assets.

DEVICE / ASSET · DEVICE EDGE · CONTROL EDGE · THIN GATEWAYS · THICK GATEWAYS · INDUSTRY/TELCO EDGE · MICRO DATA CENTER · ON-PREMISE DATA CENTER · FAR-EDGE CLOUDS · METRO-LEVEL EDGE · REGIONAL DATA CENTER · CLOUD

ON-PREMISE INFRASTUCTURE

What about «fog»?

10s km

100s km

EDGE CONTINUUM

CLOUD-to-EDGE CONTINUUM (C2E)

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Edge Concepts (2)

NFRs[1] determine position in the «Edge Continuum»

	DEVICE / MACHINE	THIN EDGE	THICK EDGE	REGIONAL PLATFORM	GLOBAL PLATFORM
LATENCY	High — Low (near Low)	High — Low (center-right)	High — Low (center)	High (near High) — Low	High (near High) — Low
BANDWIDTH	High (near High) — Low	High (near High) — Low	High (left) — Low	High (left) — Low	High — Low (near Low)
PROCESSING POWER	High — Low (near Low)	High — Low (center-right)	High — Low (center-right)	High (left) — Low	High (near High) — Low
SECURITY & SAFETY	High (near High) — Low	High (left) — Low	High (left) — Low	High — Low (center-right)	High — Low (center-right)
TYPICAL DEPLOYMENT	local	IoT gateway | "fog"	on-site server | "fog"	cloud | on premise	cloud

1) non-functional requirements

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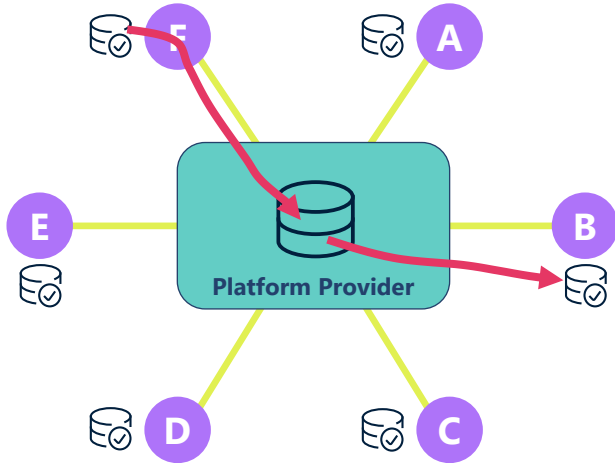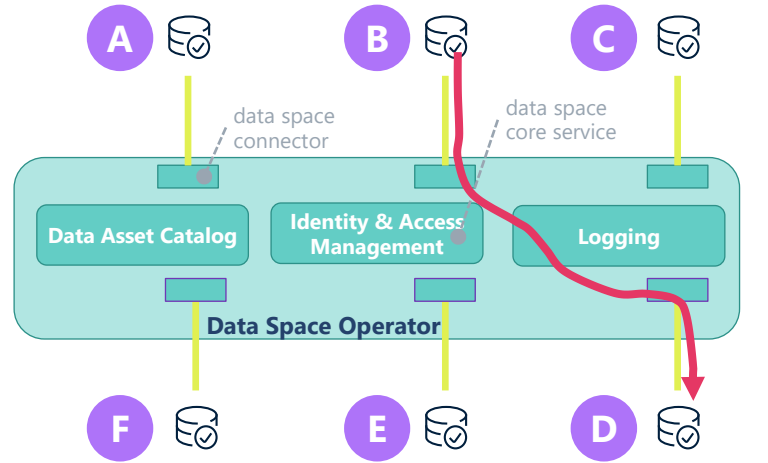
Ecosystem Realization (1)

Data platforms, data spaces, and (data) ecosystems

Data Platform

Data Space

(Data) Ecosystem
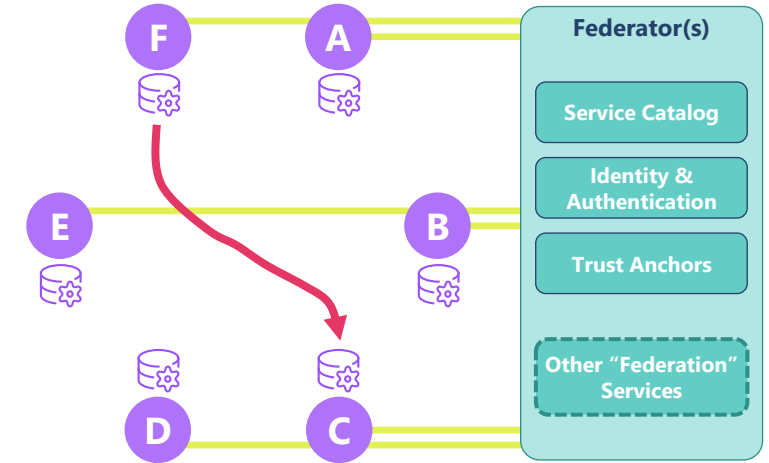
lead concepts: «API» «data asset» «service»

A **(product) platform** is a set of elements (components, roles, processes, relationships, and interfaces) with a uniform architecture serving an organization as the basis for products and services for different customers.

A **data space** is a coordinated set of (i) technical standards, (ii) organizational policies, and (iii) core services under a (iv) specified governance model to enable and facilitate data exchange between its participants.

An **ecosystem** is the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize.

data warehouse (DWH) • data lake • data lake house • cloud data warehouse • data mesh • data hub • industry platform • one/two-sided platforms

Source: Strnadl C.F. & Schöning H. (2023). Datenplattformen, Datenräume und (Daten-)Ökosysteme – Einordnung und strategische Aspekte. In: Weber B. (Ed.), Data Governance. Springer, Kapitel 2.

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Ecosystem Realization (2)

Gaia-X concepts – helicopter view

Gaia-X

Ecosystem participants

Gaia-X Ecosystem | «Federation»

Gaia-X | Organizational procedures & standards

Gaia-X | Technical procedures & standards

IT systems	IT systems	IT systems	IT systems	IT systems	IT systems
OT systems		OT systems			

Machine manufacturer — **Supplier** — **Machine user (Plant)** — **Service/maint. provider** — **IT service provider** — **other ecosystem participant**

EuProGigant project phase | 16 project partners (4 research partners – 12 industry partners)

Post-project phase

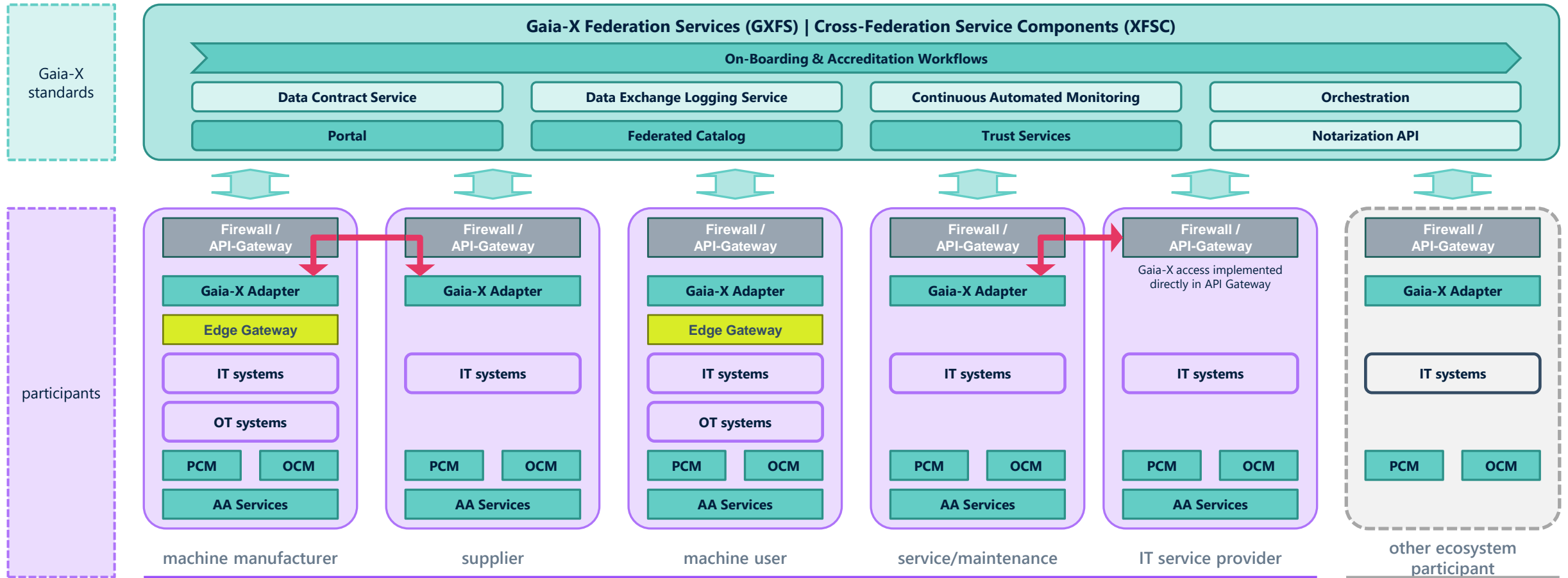OT systems – operational technology systems (shop floor)   ↔ effective data exchange & service invocation between participants

Ecosystems Realization (3)

Gaia-X concepts – capabilities architecture view

Gaia-X standards

Gaia-X Federation Services (GXFS) | Cross-Federation Service Components (XFSC)

On-Boarding & Accreditation Workflows

Data Contract Service	Data Exchange Logging Service	Continuous Automated Monitoring	Orchestration
Portal	Federated Catalog	Trust Services	Notarization API

participants

machine manufacturer
- Firewall / API-Gateway
- Gaia-X Adapter
- Edge Gateway
- IT systems
- OT systems
- PCM / OCM
- AA Services

supplier
- Firewall / API-Gateway
- Gaia-X Adapter
- IT systems
- PCM / OCM
- AA Services

machine user
- Firewall / API-Gateway
- Gaia-X Adapter
- Edge Gateway
- IT systems
- OT systems
- PCM / OCM
- AA Services

service/maintenance
- Firewall / API-Gateway
- Gaia-X Adapter
- IT systems
- PCM / OCM
- AA Services

IT service provider
- Firewall / API-Gateway
- Gaia-X access implemented directly in API Gateway
- IT systems
- PCM / OCM
- AA Services

other ecosystem participant
- Firewall / API-Gateway
- Gaia-X Adapter
- IT systems
- PCM / OCM

- OT systems – operational technology (shop floor) systems
- PCM – Gaia-X Personal Credential Manager
- OCM – Gaia-X Organizational Credential Manager
- AA services – Gaia-X authentication & authorization services

Legend:
- ⬌ effective data exchange between participants (incl. services)
- ▮ Gaia-X core component/capability for EuProGigant
- ▮ component to be developed by EuProGigant
- ▮ IT component to securely expose internal services
- ▮ Gaia-X capability/component optional for EuProGigant
- ▢ internal IT/OT component or system of an ecosystem participant

Source: Strnadl & Schöning (2023). Data platforms, Data Spaces, and (Date-) Ecosystems. in: Weber (Ed.), Data Governance. Springer

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Ecosystem Realization (4)

Creation and offering of AI-Algorithm-as-a-Service

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