



“Why the Digital Twin – standardized by means of the **Asset Administration Shell** – is a THE booster for Industry 4.0”

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About me

Rüdiger Fritz

with SAP since 2001

Industrial Engineer → Developer → Architect → Product Manager

today:

→ Innovation Scout → Industry Standards roll-in

Industry 4.0- and IT/OT Convergence-enthusiast and -evangelist



Status Quo – “system landscape and daily workarounds” of a manufacturing company

Disconnected Silos

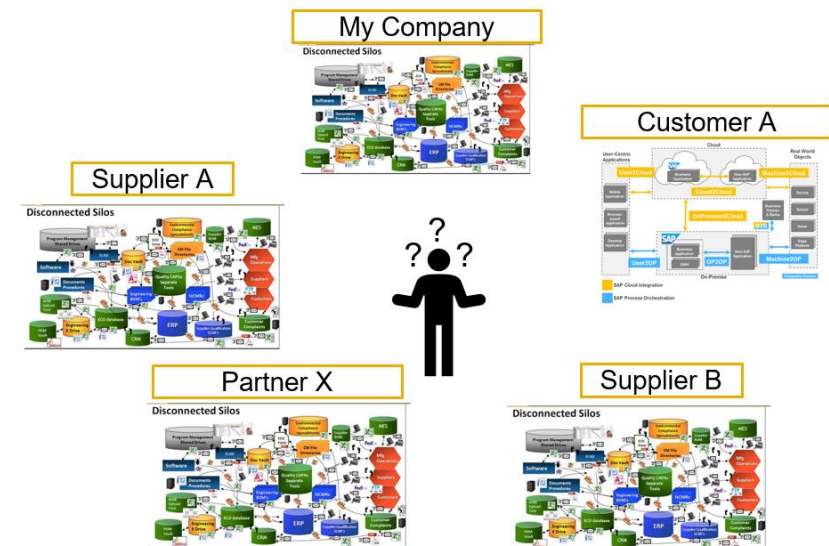
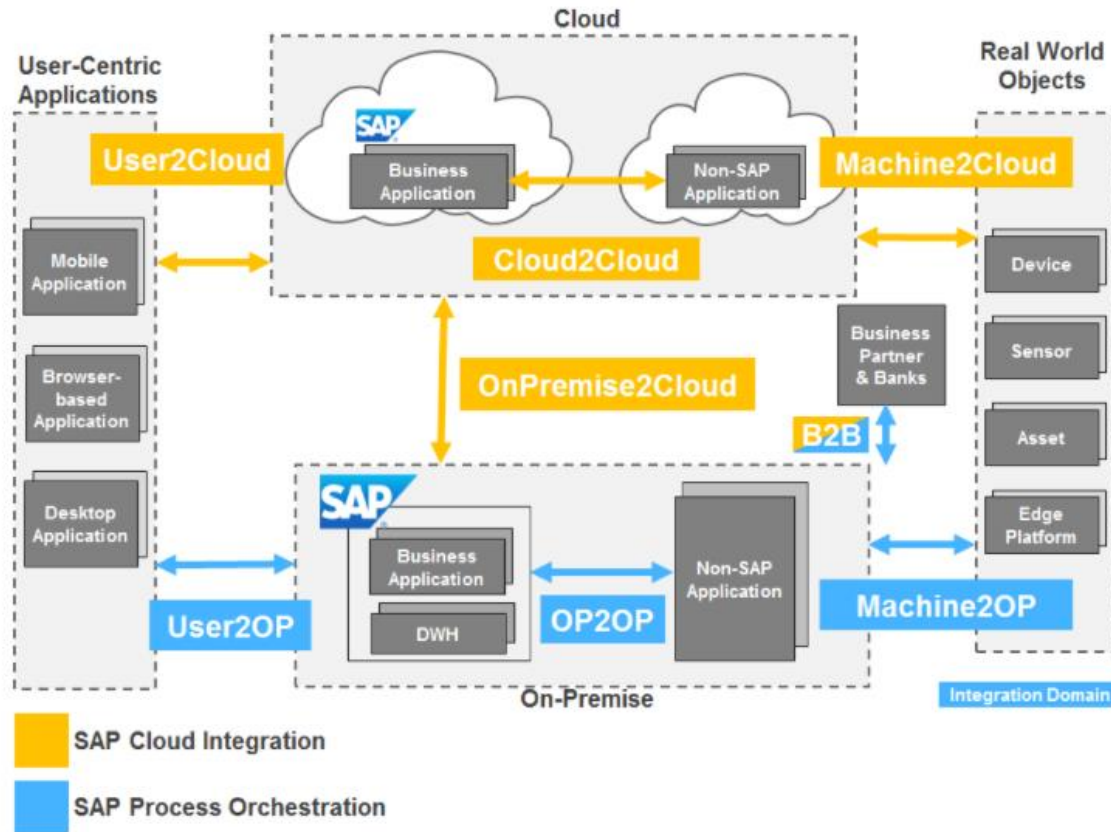


(source: [API for Digital Thread - PROSTEP INC - North America \(webinarsbyproststep.com\)](https://webinarsbyproststep.com))

Even worse when thinking about data exchange in company networks ...

→ there are proper integration tools (like SAP CI and SAP PO), but ...

... still often complex and individual integration projects

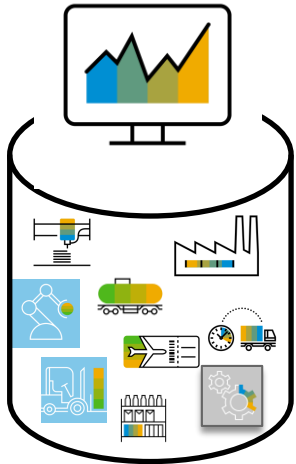


source: <https://www.linkedin.com/pulse/sap-cloud-integration-vs-process-orchestration-lucas-m-gon%C3%A7alves>

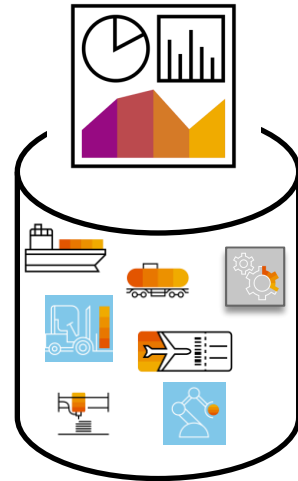
Rationale and Vision

Status Quo

Business Application(s) Partner A
(i.e. Transaction, Analytics,
Simulation-/Optimization ...)



Business Application(s) Partner B
(i.e. Transaction, Analytics,
Simulation-/Optimization ...)



- **Local** Master Data and configuration for each relevant asset in each required application
 - high effort for set-up and maintenance
 - fading accuracy and transparency
- **No standardized,** application independent **data model**
- Data sharing based on **peer-to-peer configuration only**

Future?!

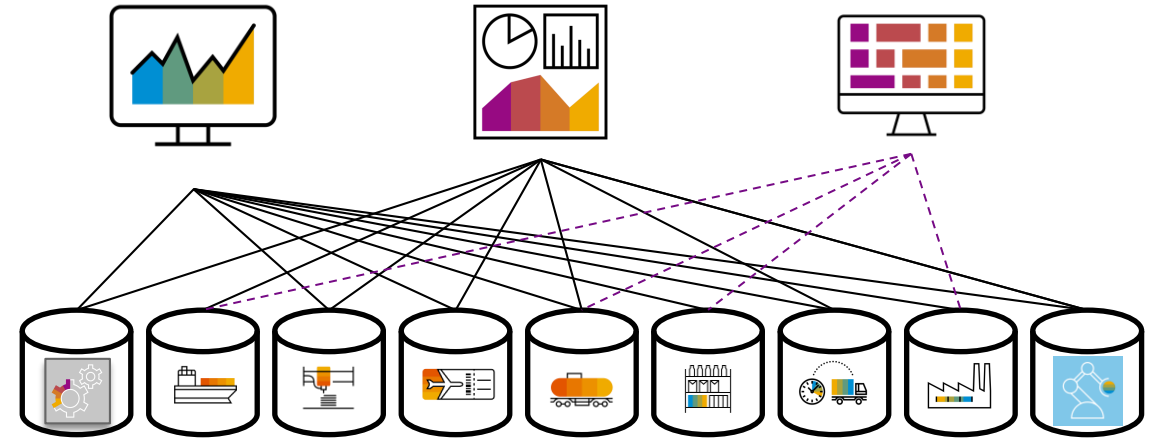
Business Application
Partner A



Business Application
Partner B



Business Application
(future Partner C)



- Standardized, self-descriptive, self-contained and software application independent representation of each relevant asset
→ i.e. (cloud enabled resp. any-premise) digital twin
- Single source of truth
→ accurate data at any time for each party
- Easy (re-)configuration of (partner specific) access

*The concepts of the **Asset Administration Shell (AAS)** and of the **International Data Spaces (IDS)** provide already essential pillars for this new architecture*

Asset Administration Shell (AAS)

Quick introduction

Asset Administration Shell → self contained, standardized entity = Digital Twin

The Asset Administration Shell of an electrical drive...

 **PLATTFORM INDUSTRIE 4.0**



...*knows properties and capabilities* of the electrical drive and makes it usable.

...*knows where to find the information* from and about the drive and provides it.

...has a specific *standardised syntax and semantic*.

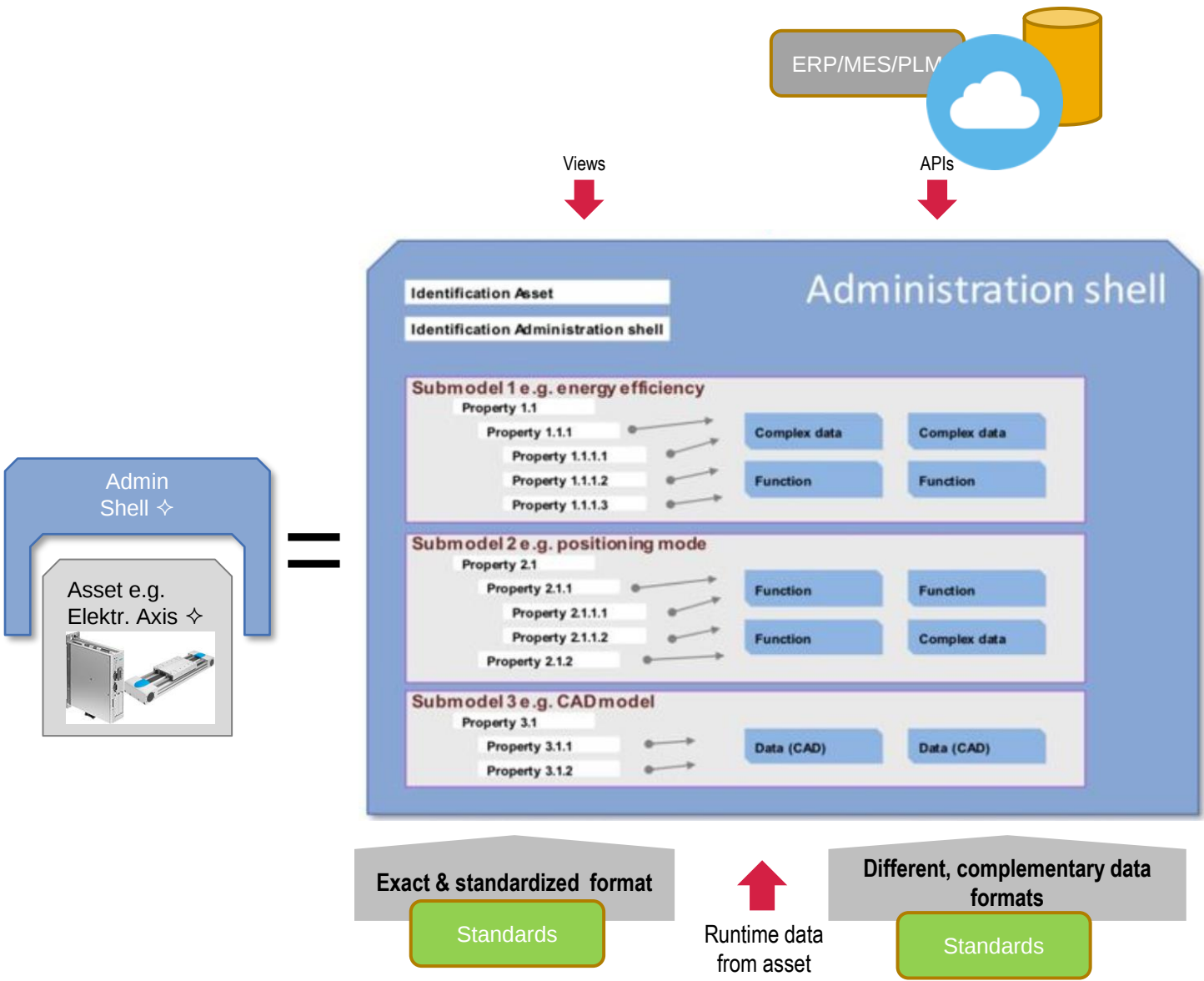
...can be *realised in different ways*:

- ▶ as a simple static information source ("HTML file"), e.g. for a screw
- ▶ on a field device
- ▶ on a gateway that serves multiple devices
- ▶ as a connected IT solution with different information sources ("cloud solution")

[Plattform Industrie 4.0 - Downloads & News \(plattform-i40.de\)](https://plattform-i40.de)

Since 12/2020 the Industrial Digital Twin Association (IDTA) is in place <https://idtwin.org/en/>

Asset Administration Shell = Digital Twin



An asset is anything of value: pump, vehicle, plan, ...

The Asset Administration Shell (AAS), a key concept of Industrie 4.0, describes an asset in a standardized manner

Purpose:

- **Share asset-related data for all phases of the asset lifecycle**
- Vision: incl. autonomous communication and interaction between assets

The AAS consist of **submodels**.

Submodels are like a view on the asset.
Typical standard submodels of classical assets are Identification, Documentation, Technical data sheet

The AAS can be deployed on the asset, the edge, or in the Cloud.

The AAS enables even passive assets (cup, chair ...) to communicate.

How does an AAS “look and feel”?

See open source project “AAS Package Explorer” → [Home of AAS \(admin-shell-io.com\)](http://admin-shell-io.com)

AASX Package Explorer - 34_Festo.aasx
File Workspace Help

http://smart.festo.com/aas/0545_1132_4002_6765

Submodel

Submodel element

Submodel element

pk.festo.com/574337



- 4 AAS "Festo_579071" V0.1 [IRI, http://smart.festo.com/aas/0545_1132_4002_6765] of [IRI, pk.festo.com/574337, Instance]
 - 3 SM "Nameplate" [IRI, smart.festo.com/demo/sm/instance/1/1/19319DB561C9E160]
 - 3 SM "Identification" [IRI, smart.festo.com/demo/sm/instance/1/1/21B86740D7B05573]
 - 4 SM "TechnicalData ZVEI" [IRI, smart.festo.com/demo/sm/instance/1/1/51DB0240FDD97511]
 - TED Technical Data Viewer ready
 - 4 SMC "GeneralInformation" (7 elements)
 - Prop "ManufacturerName" = Festo SE & Co. KG
 - File "ManufacturerLogo" -> /aasx/VDI2770/FestoLogo_ba43692f.png
 - Prop "ManufacturerProductDesignation" = Proximity SMT-8M-A for t-slot
 - Prop "ManufacturerPartNumber" = 574337
 - Prop "ManufacturerOrderCode" = SMT-8M-A-PS-24V-E-0,3-M12
 - File "ProductImage01" -> /aasx/VDI2770/thumbnail_594ff872.png
 - File "ProductImage02" -> /aasx/VDI2770/00991153_c14f51f5.png
 - 3 SMC "ProductClassifications" (1 elements)
 - 3 SMC "TechnicalProperties" (7 elements)
 - 3 SMC "FurtherInformation" (2 elements)
 - 3 SM "Documentation" [IRI, smart.festo.com/demo/sm/instance/1/1/F54D99840F2B6596]
 - 3 SM "MCAD" [IRI, smart.festo.com/demo/sm/instance/1/1/1D4C5291B7465879]
 - 3 SM "ECAD" [IRI, smart.festo.com/demo/sm/instance/1/1/88B12000A4151642]

Element	Content
Asset Administration Shell	
Referable:	
idShort:	Festo_579071
HasDataSpecification (Reference):	
Identifiable:	
idType:	IRI
id:	http://smart.festo.com/aas/0545_1132_4002_6765
version:	0
revision:	1
Asset Reference	
assetRef:	(Asset) (local) [IRI] pk.festo.com/574337
Asset	
Referable:	
idShort:	Festo_574337
description:	[de] Näherungsschalter SMT-8M für T-Nut [en] Proximity SMT-8M for t-slot
HasDataSpecification (Reference):	
Identifiable:	
idType:	IRI
id:	pk.festo.com/574337
Kind:	
kind:	Instance
Submodel references with special meaning	
assetIdentificationModel - Reference to describing Submodel:	

Please note: this is not a commercial tool as such – the package explorer shall help to understand the concept of the AAS

AAS “wrapping” existing standards and open for enhancements



Engineering data – majority is important for design time, documentation and look-up of technical data (down to CAD, BoM ...)

Majority is run-time related and close to the physical data.
Origin often the PLC.
But OPC UA information model is open to hold also other properties (e.g. current production order number)

Static description and standardized classification of components

FUTURE?!
asset related information from other domains e.g. purchase process, sales process, financial accounting process, production planning process, end-of-life process ...

Key element: openness of submodels

→ open but standardizable information modelling

examples/ideas

Sub Model
Financial
Accounting

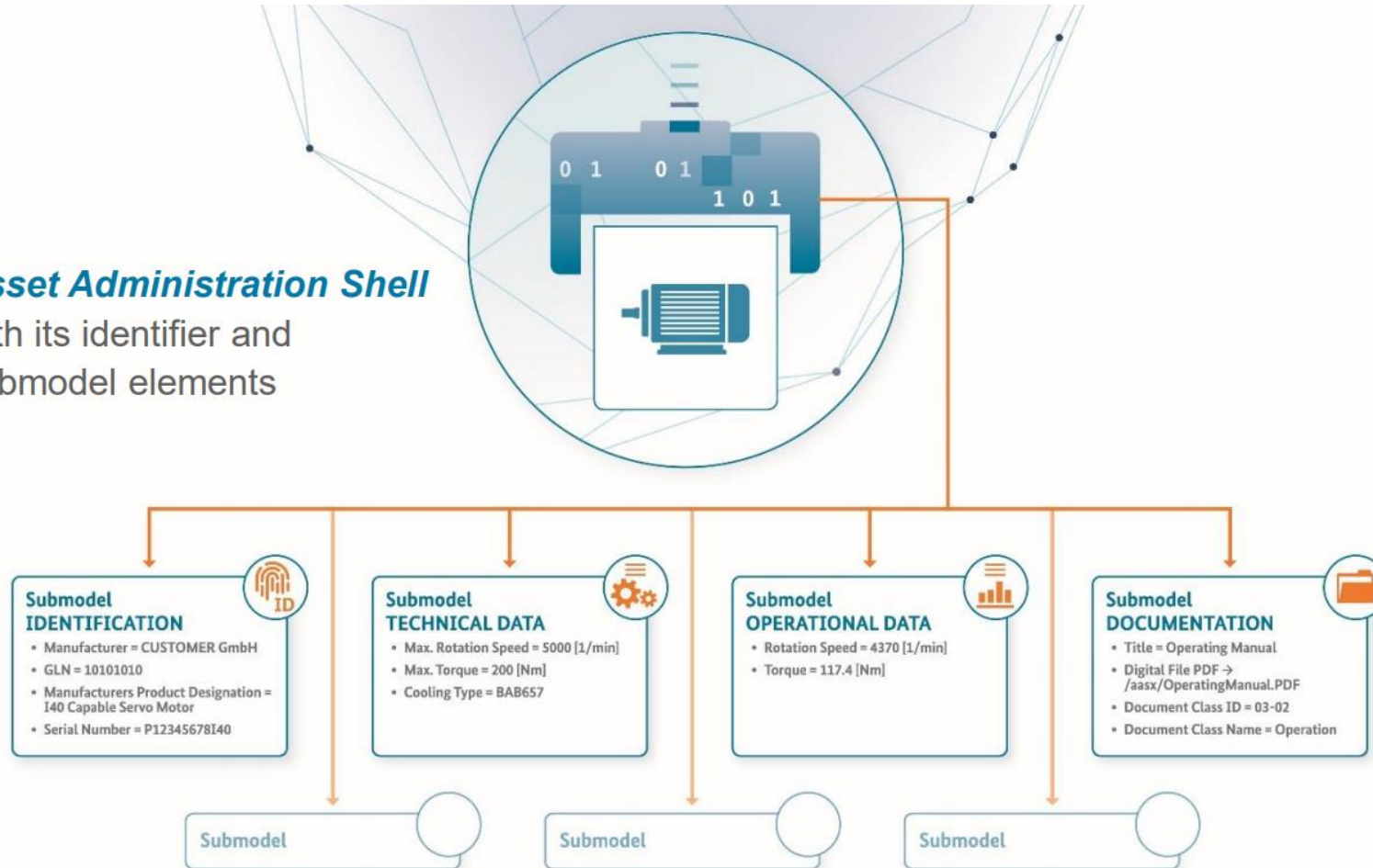
Sub Model
Leasing

Sub Model
Maintenance
History

Sub Model
Purchase
History

Sub Model
...

Asset Administration Shell
with its identifier and
submodel elements



Sub Model
Healthcare/inpatient:
surgery plan

Sub Model
Healthcare/inpatient:
medication

Sub Model
Product: assembly
sequence (routing)

Sub Model
machine end-of-
life procedure

Sub Model
Worker: Skills

Sub Model
Worker:
Vacation

Sub Model
Worker: Salary

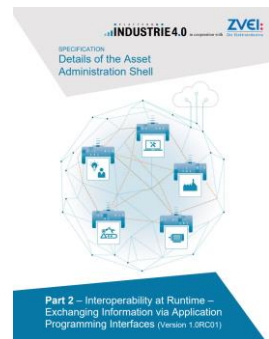
Sub Model
Contract:
Approval Flow

Sub Model
Contract: Dates

Sub Model
Contract: legal
entities involved

AAS Interoperability at Runtime – Exchanging Information via Application Programming Interfaces (November 2020: v1.0)

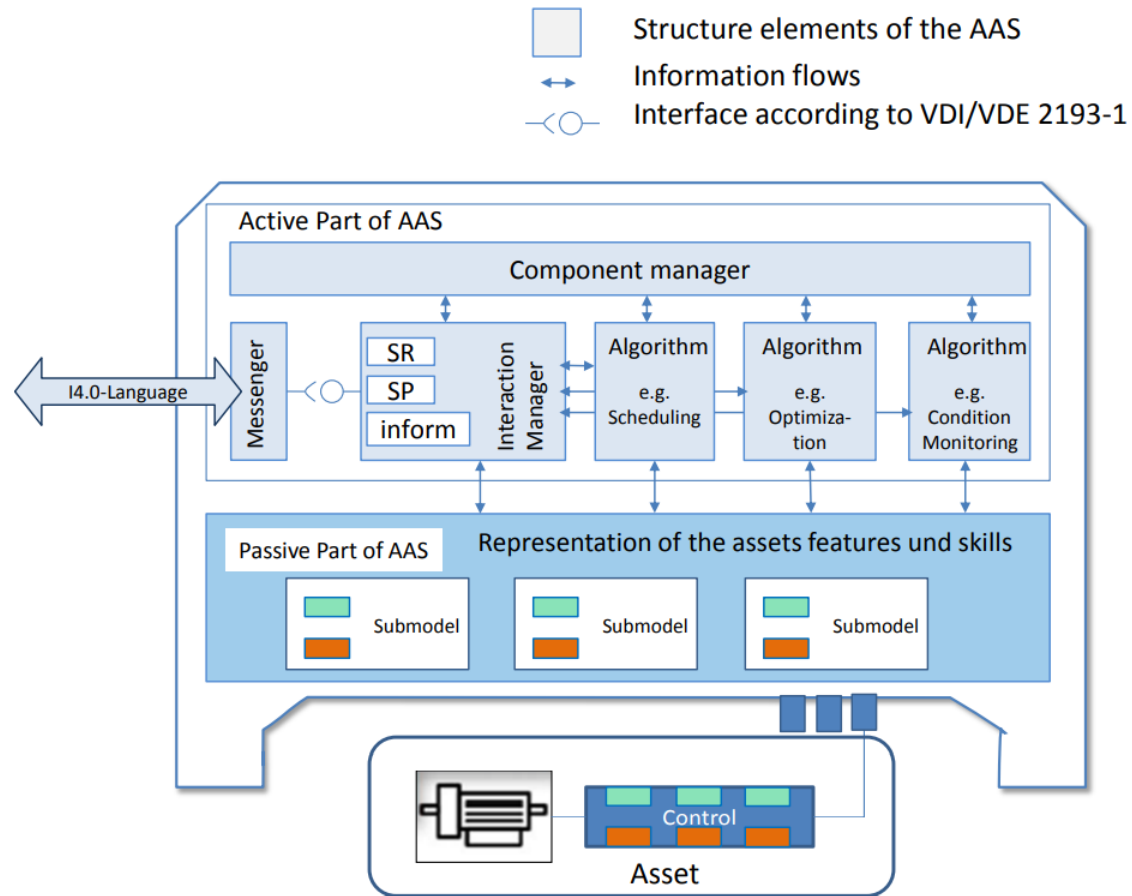
[Details of the Asset Administration Shell - Part 2](https://plattform-i40.de) (plattform-i40.de)



Game changer:
standardized access to any
relevant asset data
(in first instance:
master data
but also near real time data and status)

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The AAS foresees to model also an active part which makes an asset a smart self-contained entity (**i.e. ready for acting as autonomous agent**)



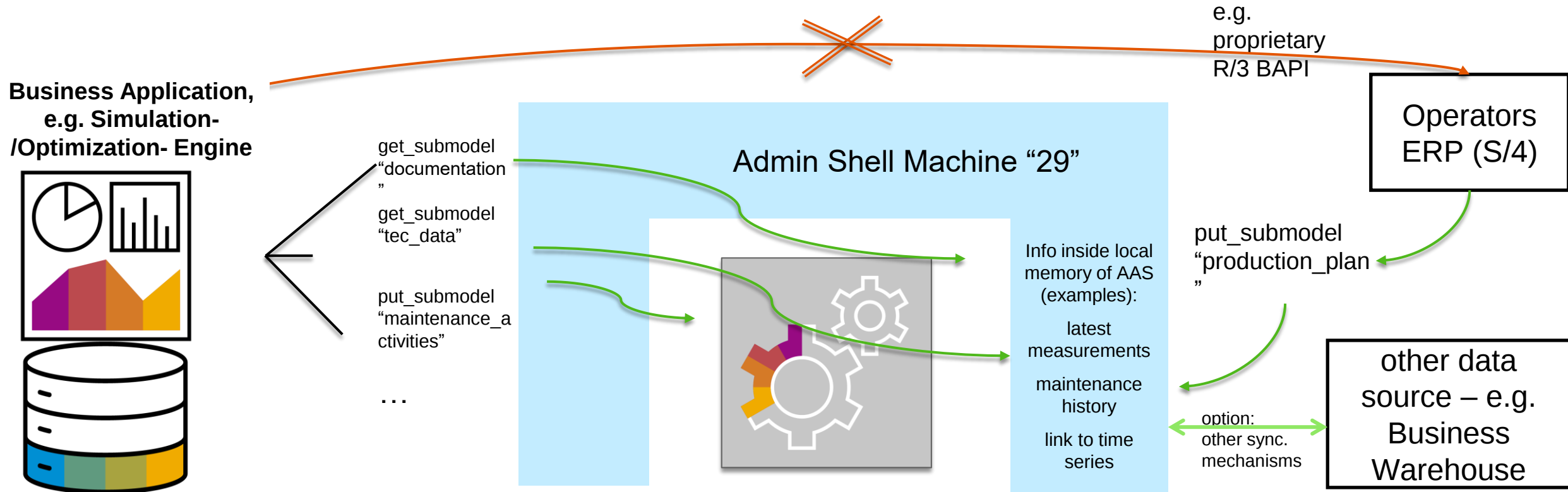
Simplified logical comparison:

each asset has it's own website and can be reached via

<http://myassetid.com>

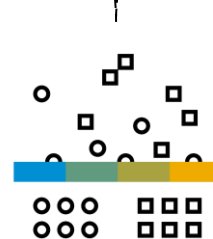
Business applications and other assets (AAS as a client) can access this "website" for getting information about the asset or for updating it's data or for triggering a process.

Idea for a single access



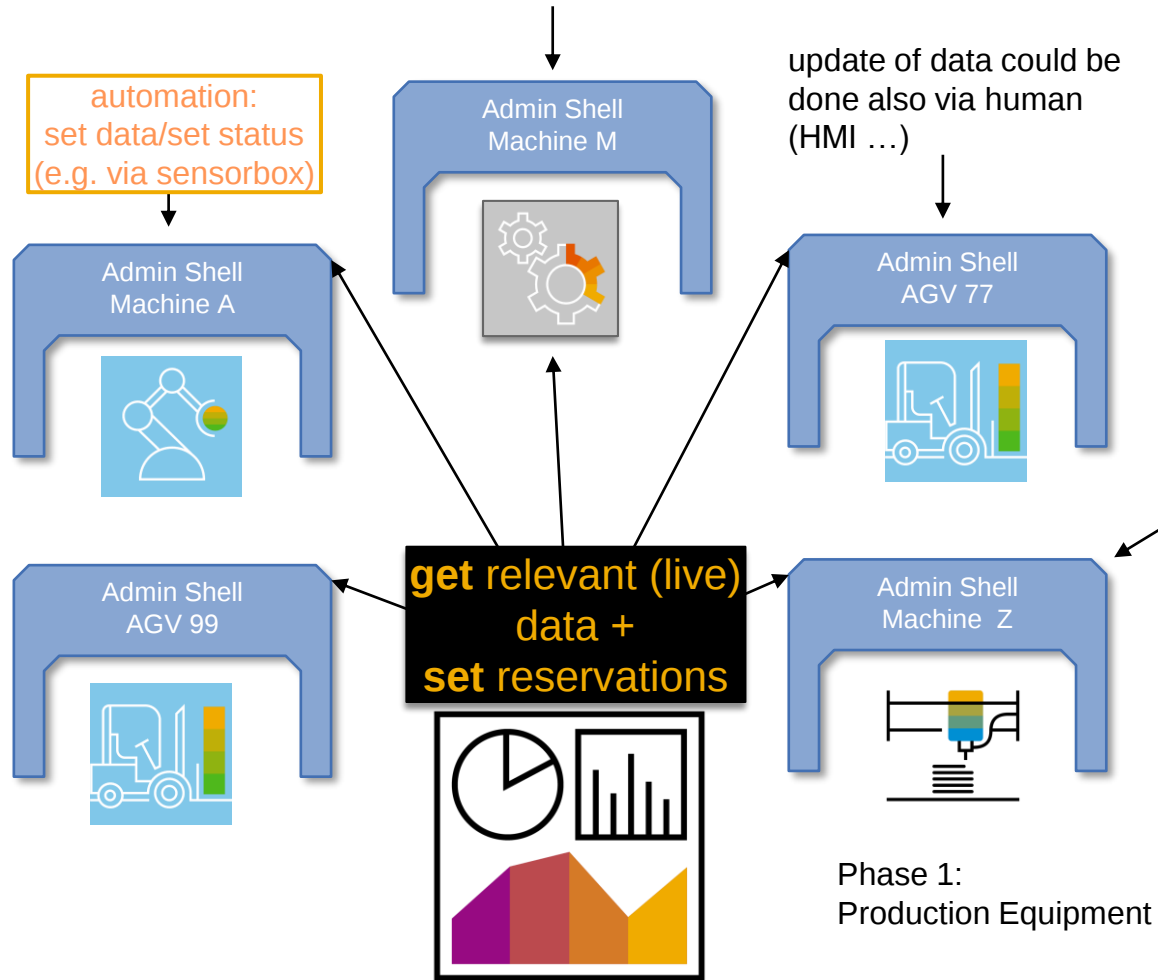
The business application needs to know the technical endpoints of each AAS

Option: containerized implementation for any-premise

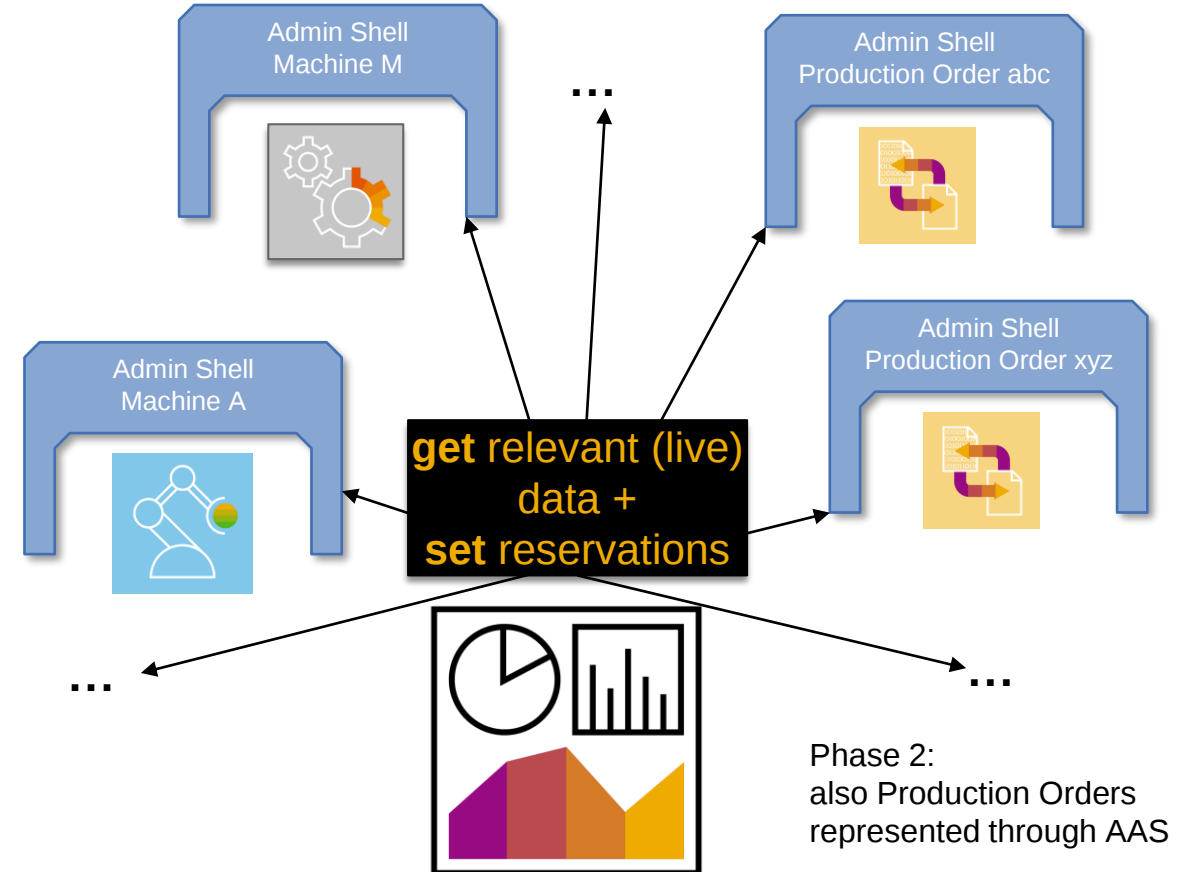


Example: Modular Production:

the AAS as self-contained and standardized single source of truth for real time asset availability, status and order assignment



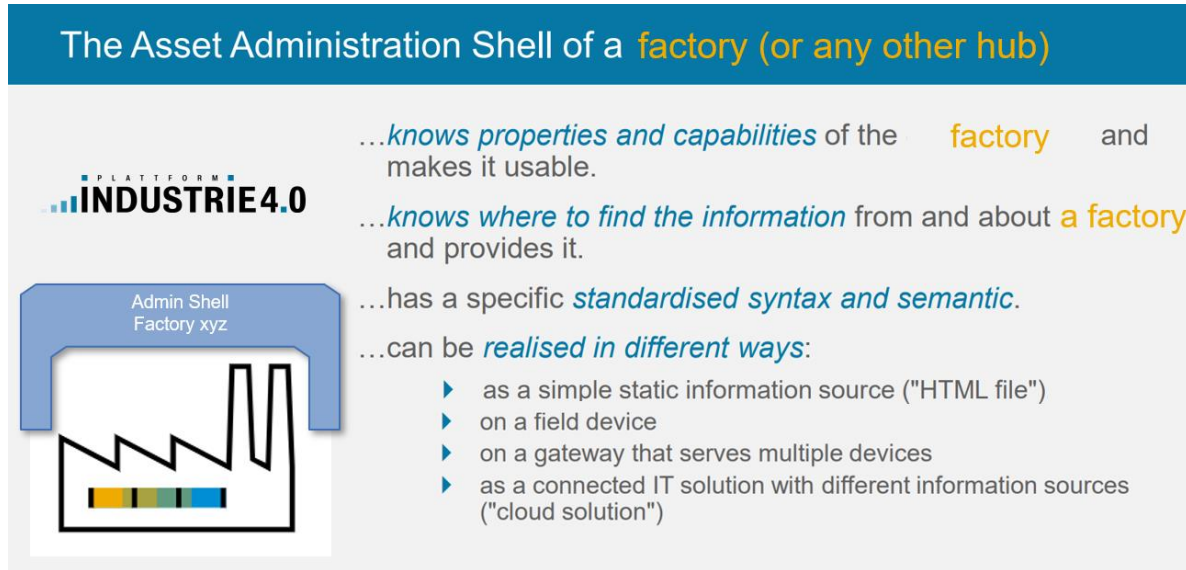
Ad Hoc Decision/Simulation Engine



Ad Hoc Decision/Simulation Engine

Supply Chain resilience:

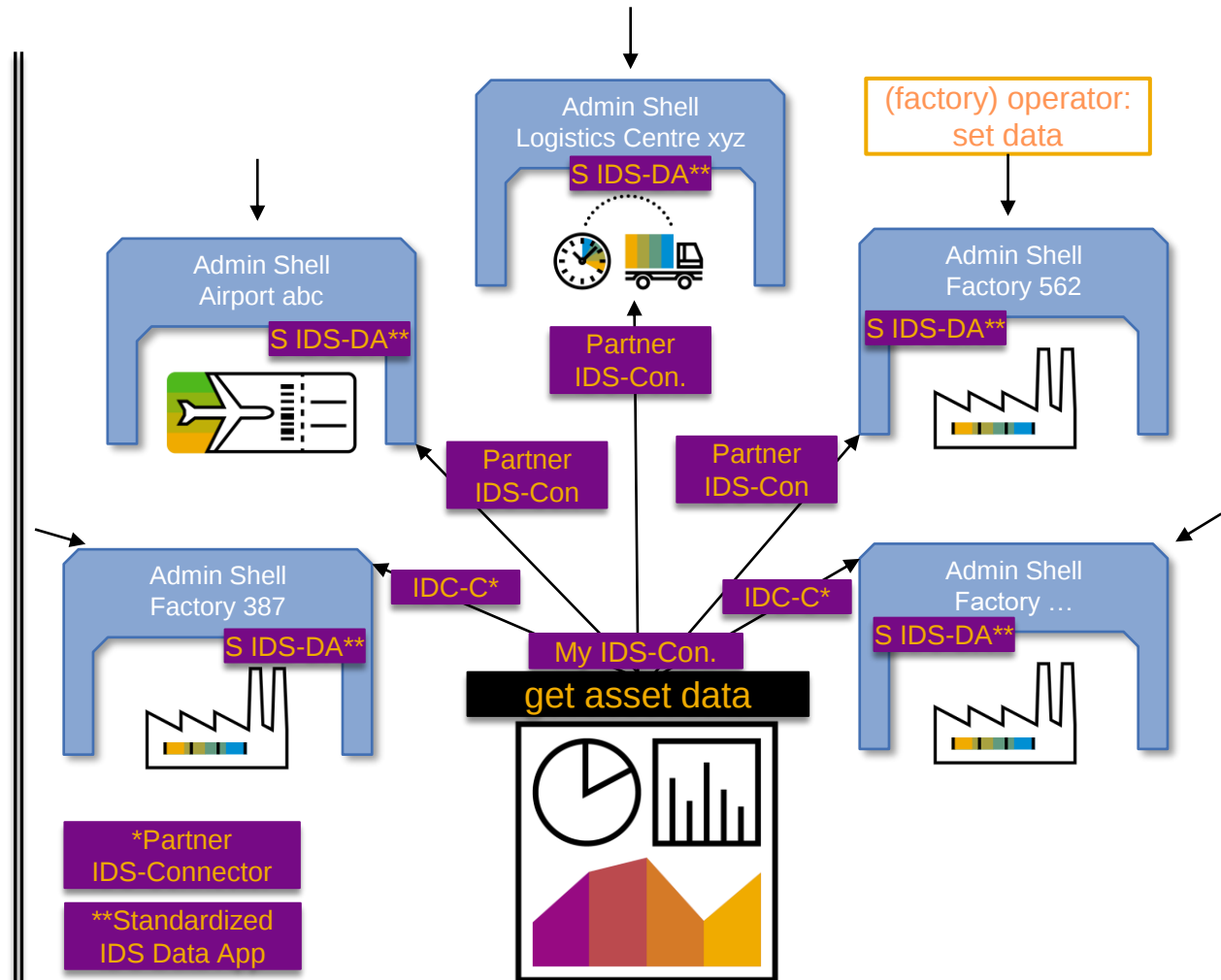
The AAS as self-contained and standardized single source of truth for planning related master-data of Supply Chain Hubs with access control by means of IDS



e.g.

- Forecast
- SKU replenishment Points by Site/SKU
- Starting SKU on each line
- WHSE capacity + cost
- Current Inventory
- Transit Lane Times, Cost, Capacity
- Preferred Sourcing Lanes
- Changeover Information
- Line Module Assignments
- Module Resource Availability
- Etc.

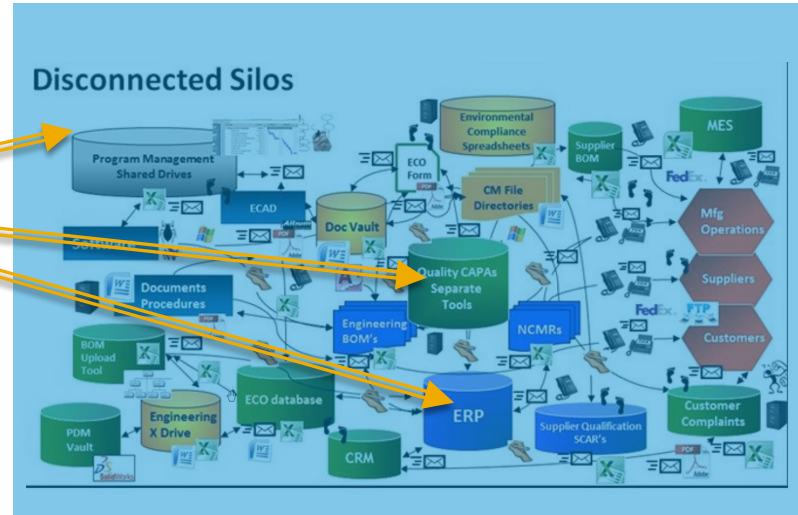
- Travel times, Arrival times, Reliability, Lead times, Line Rates
- Truck capacity? Pallets/Truck ?



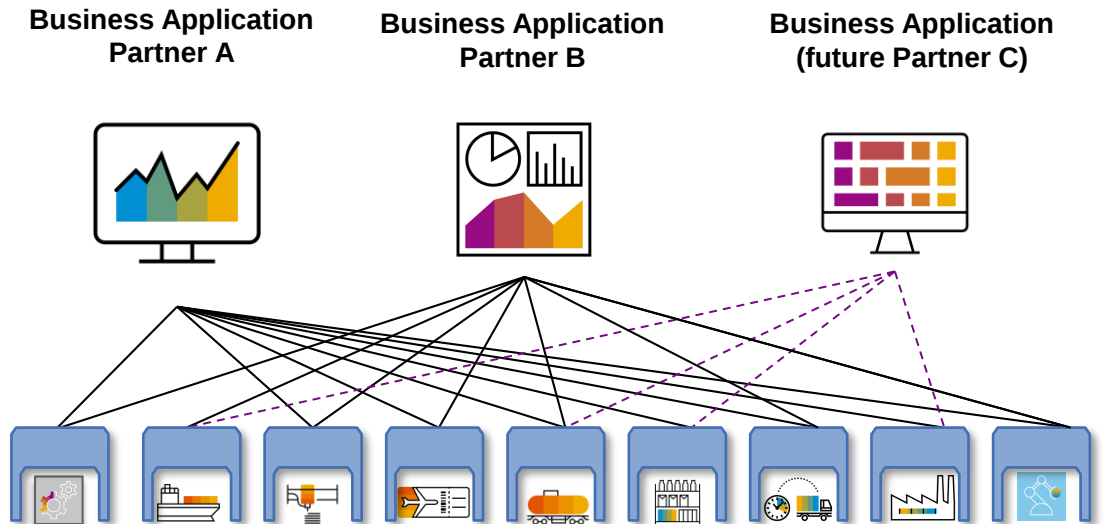
Simulation-/Optimization Engine

Vision: AAS as future “center of gravity”!

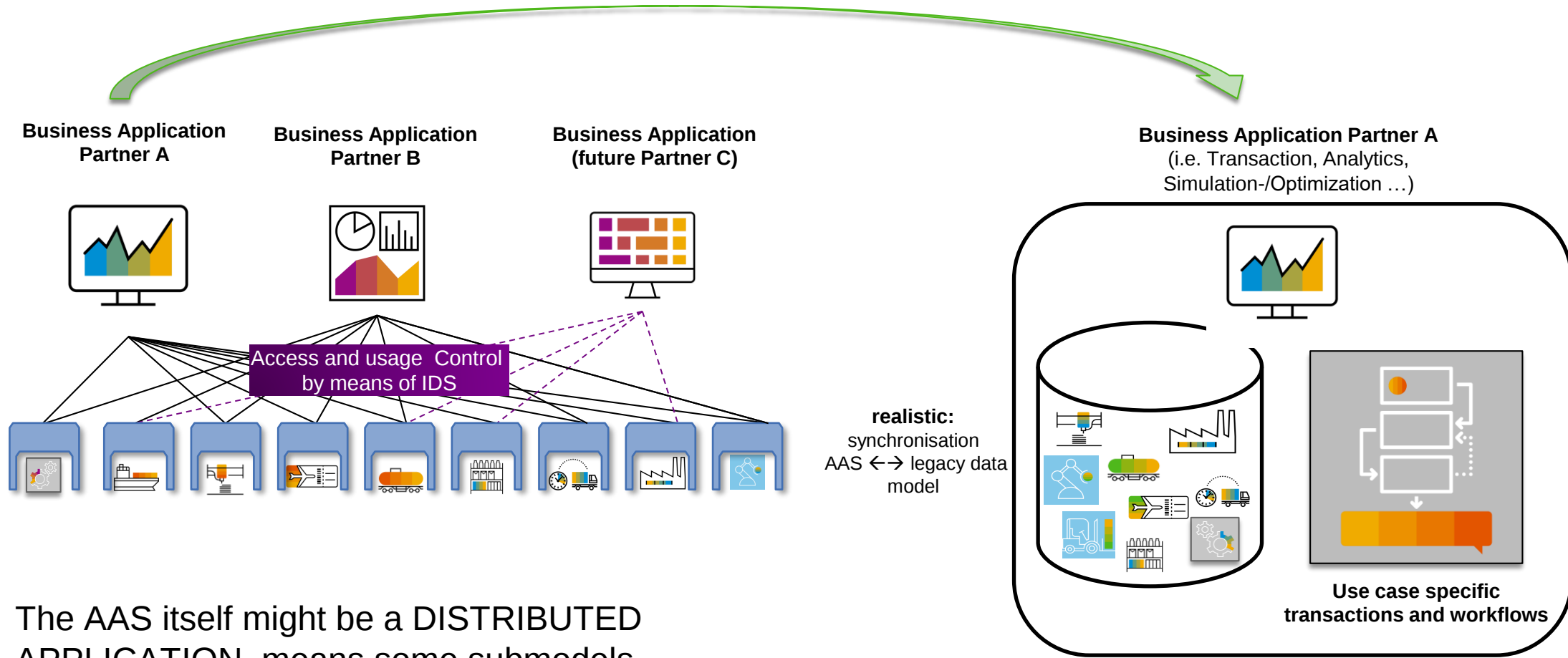
new
“hide” mess
and mid-term
“clean-up” mess



please note: the AAS/Digital Twin concept as of today will certainly require corresponding Business Applications for asset repositories, process sequences/transactions etc.



Nobody can boil the ocean, but adapters/proxies can be developed



The AAS itself might be a DISTRIBUTED APPLICATION, means some submodels “exist”/“are manifested” in a cloud space, others “exist” on the edge (e.g. the OPC UA Server)

Thank you.

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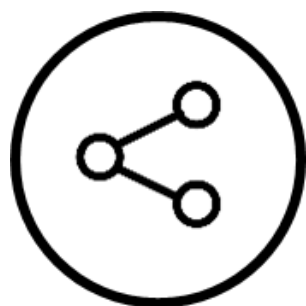
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Appendix

International Data Spaces

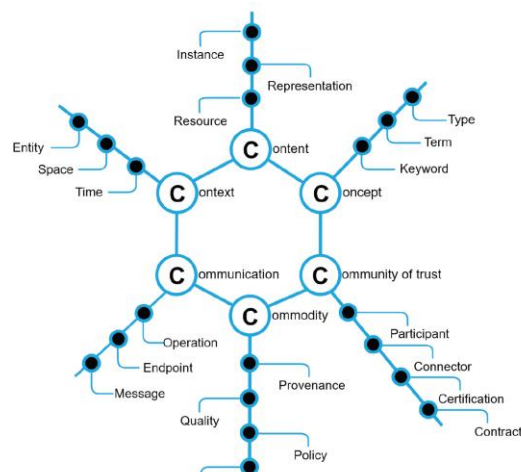
Quick introduction

INTERNATIONAL DATA SPACES APPROACH: SELF DETERMINED CONTROL OF DATA FLOWS



**Unlimited
Interoperability**

Enabled by semantic data
descriptions



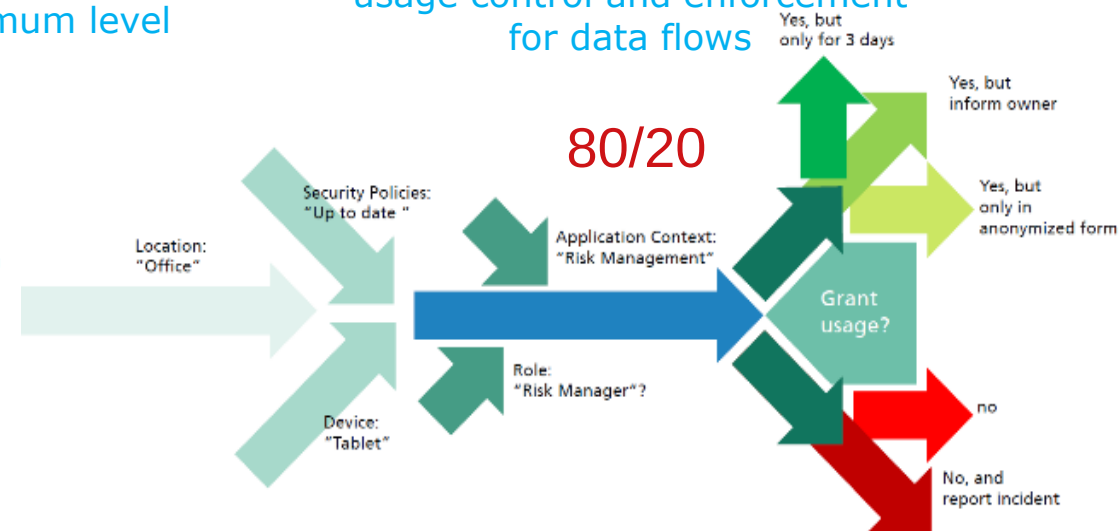
Trust between different
security domains

Certified, comprehensive security
functions providing a maximum level
of trust

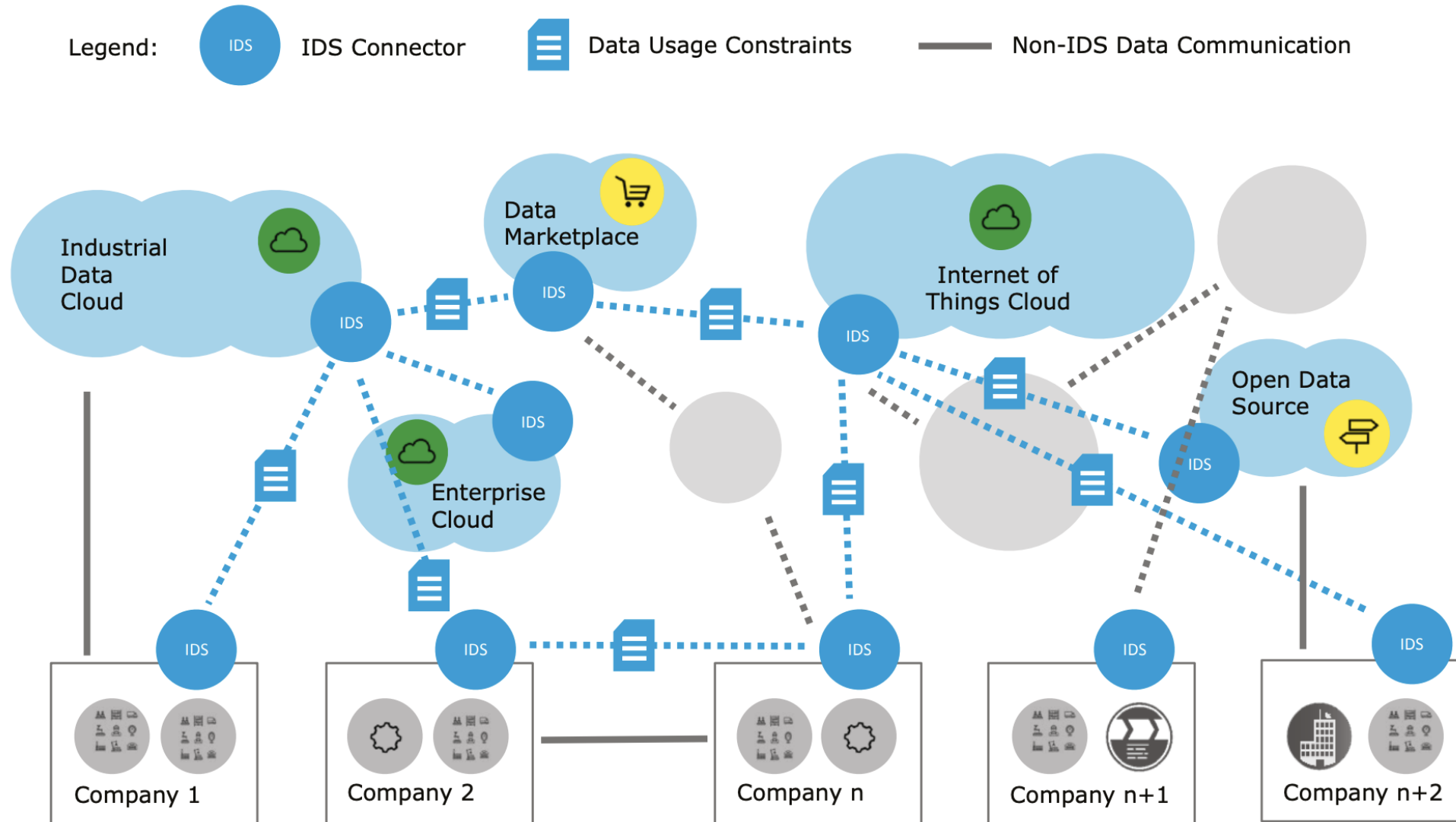


Governance for the
data economy

usage control and enforcement
for data flows



International Data Spaces (IDS) connect different cloud platforms



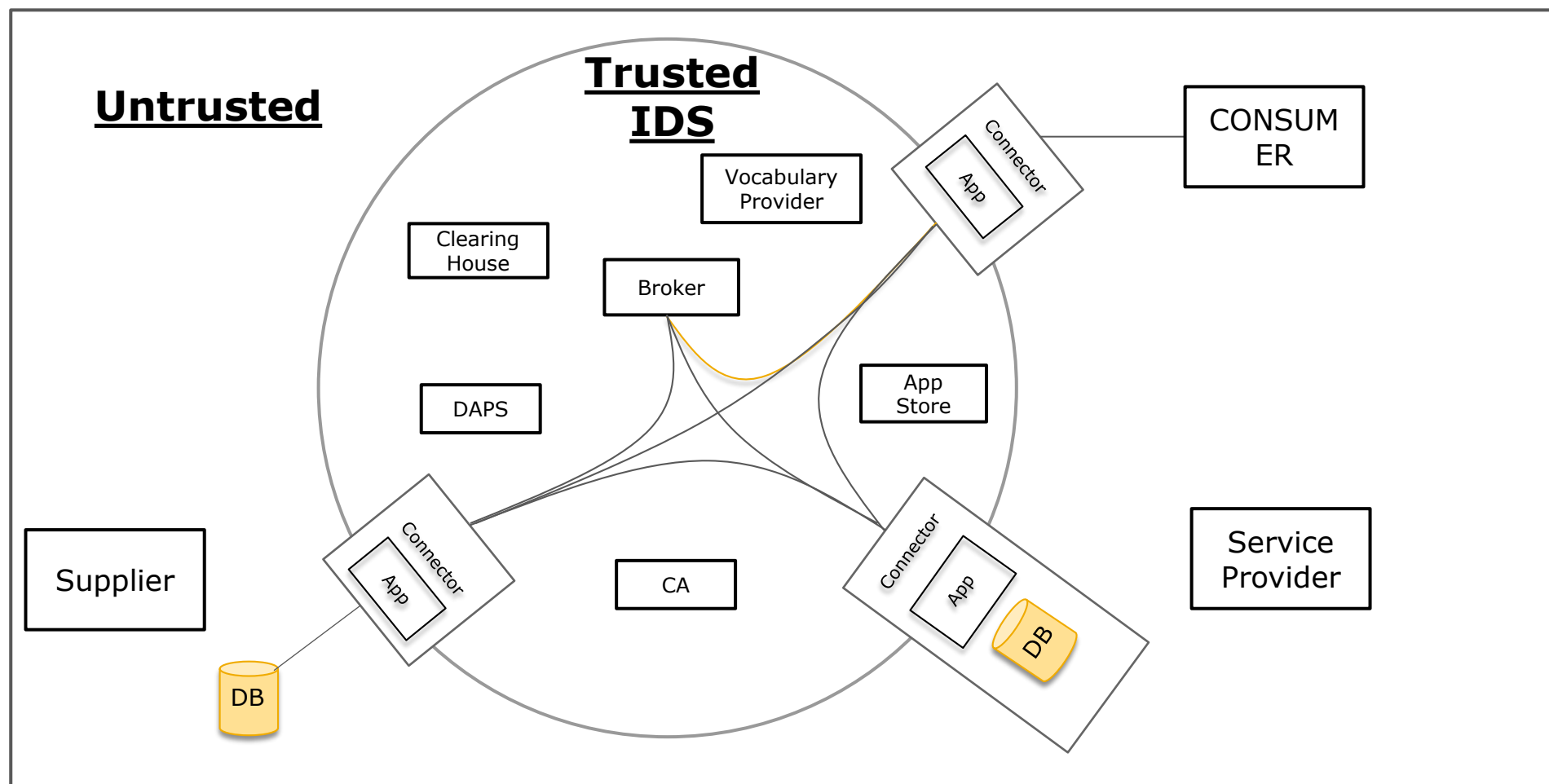
What's special about IDS?

Enable data sharing **irrespective of membership in a central network**

Enable **specific usage contracts** on data, e.g.

- Data can only be accessed for x days
- Data may only be viewed, must not be copied
- Data can only be used for a special purpose or within a special app

THE IDS ECOSYSTEM - TRUSTED VS. UNTRUSTED



International Data Spaces

→ sharing data subject to

&



use data only for 2 weeks

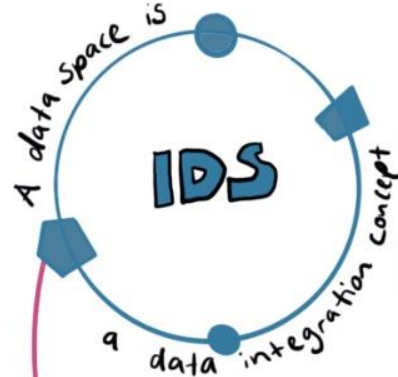
use only for analysis

...

Leave data where it is

Integration on semantic level

PRINCIPLES



IDS Connector



gateway



trusted container



IDS certified

data app runtime

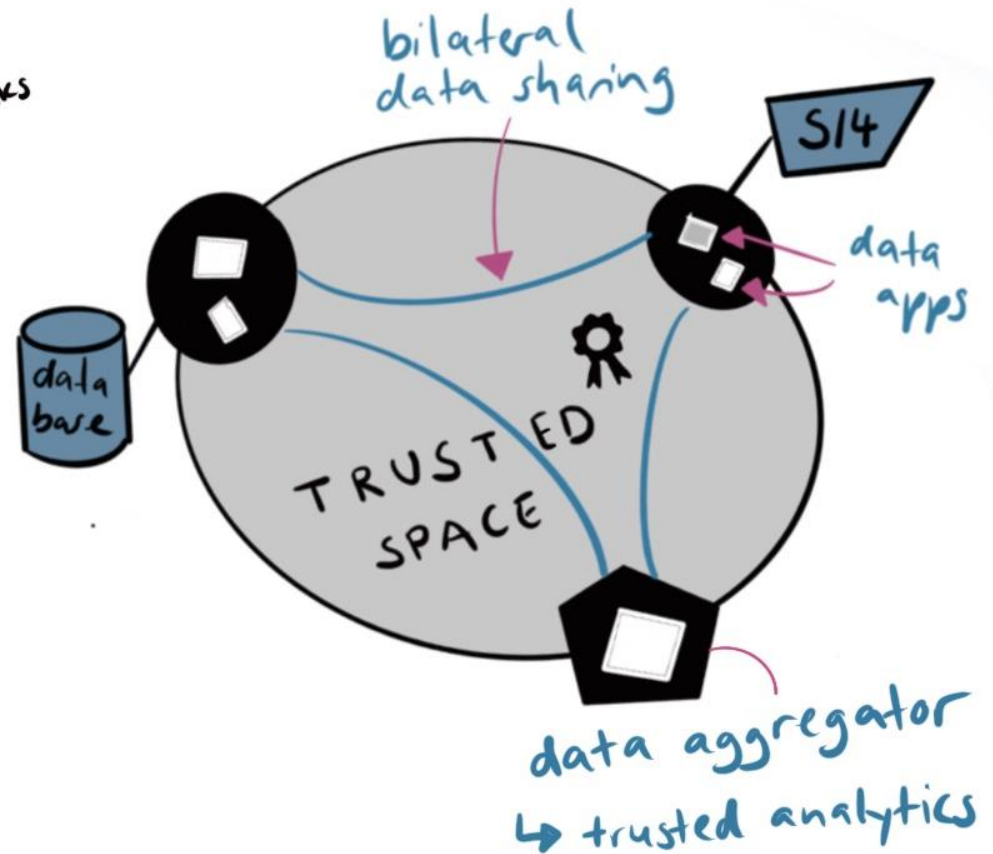


USE CASES

- data driven services
- business process synchronization

Furthermore:

- information model
- clearing house



What are the Differences and Benefits with Data Sovereignty?

Customer

- Can decide whom to share data with and controls/monitors data usage
- Can sell data
- Can buy data

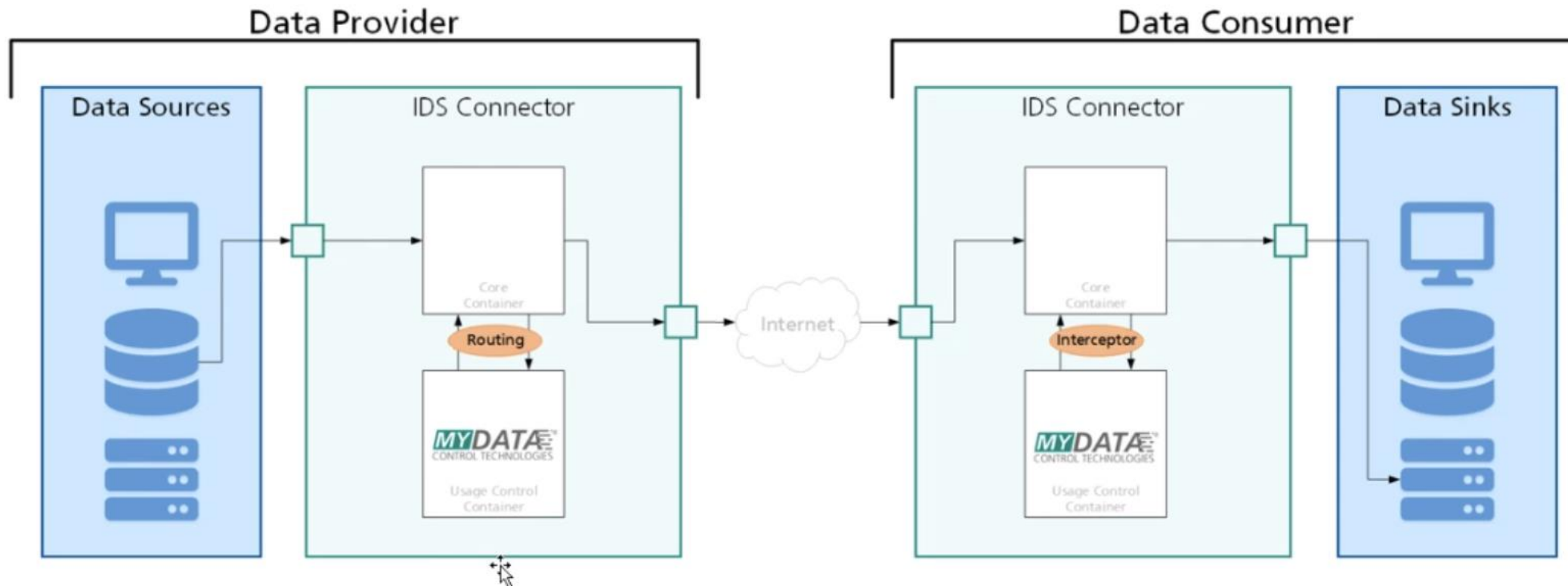
Business

- New data governance capabilities
- Data driven applications easier to accomplish
- Decentralized networks applicable organized in data federates

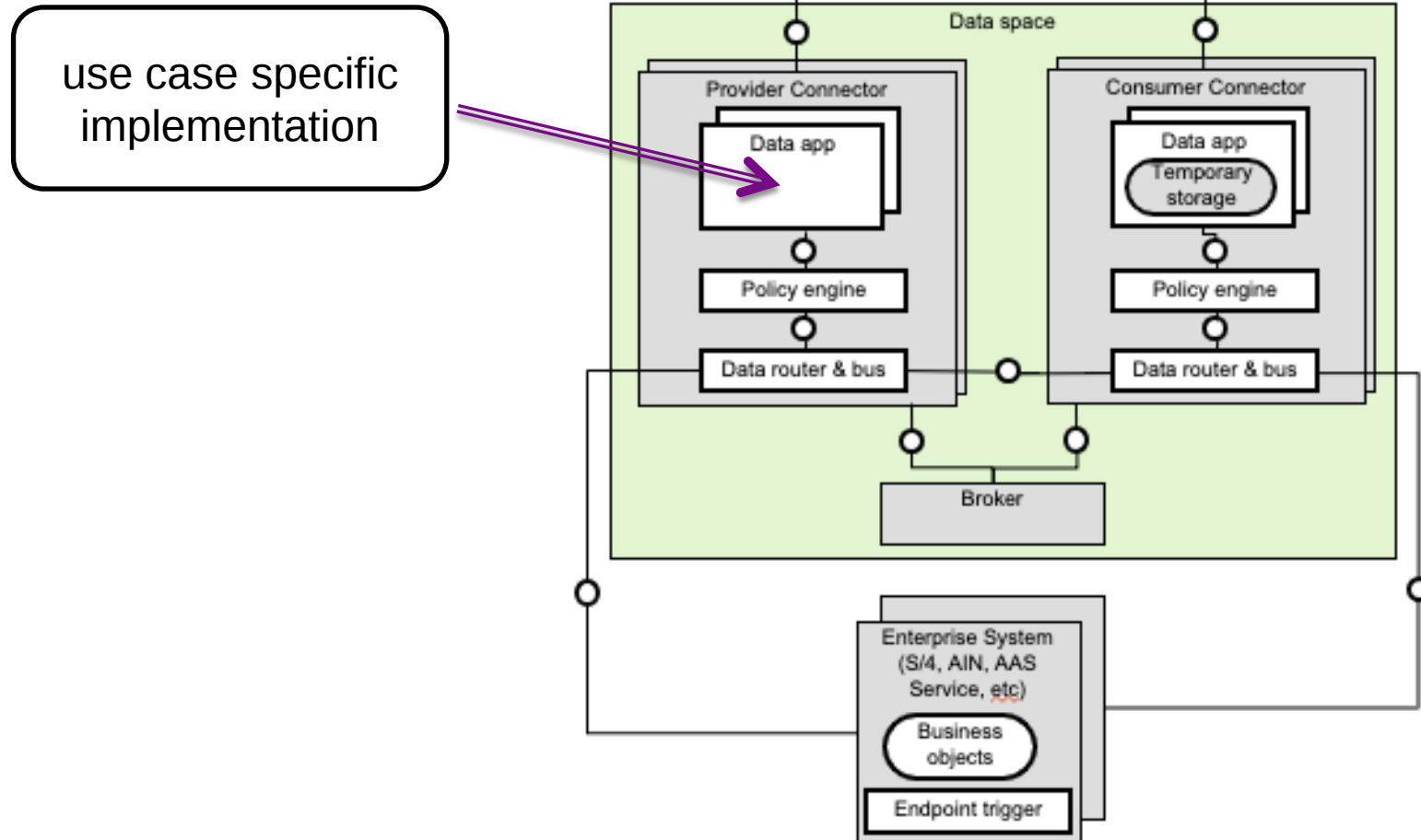
Developer

- Data driven architecture and application design
- More contextual intelligent applications possible
- Security, trust, and governance standardized

USAGE CONTROL @ IDS ROUTE AND INTERCEPTOR



IDS Architecture – K8S ready



Joint:

IDS + AAS =

**Cross Company Interoperability
Framework**

Cross Company Business Applications shall access relevant (partner-) asset data through IDS

