PLATTFORM INDUSTRIE 4.0

Basics of Industrie 4.0

The digital twin in Industrie 4.0

A short introduction to properties, submodels & Asset Administration Shells (AAS)

Kai Garrels, ABB

Hard shell, soft core?
Asset Administration Shell: The digital twin in Industrie 4.0

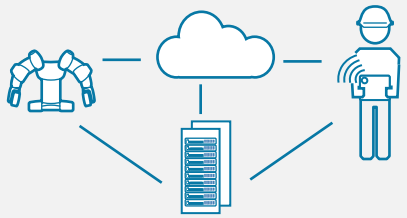
- clear form
  clear rules

- flexible content

Industrie 4.0
What‘s new, really?

That’s already possible today

- the cloud
- networks
- automation devices with Internet access
- internet-based services



Industrie 4.0: New Ingredients

- **added value** by exchanging information between value chain partners
- from **intranet** to **internet**
- **neutral and common standards** for communication, services and semantics across companies and sectors

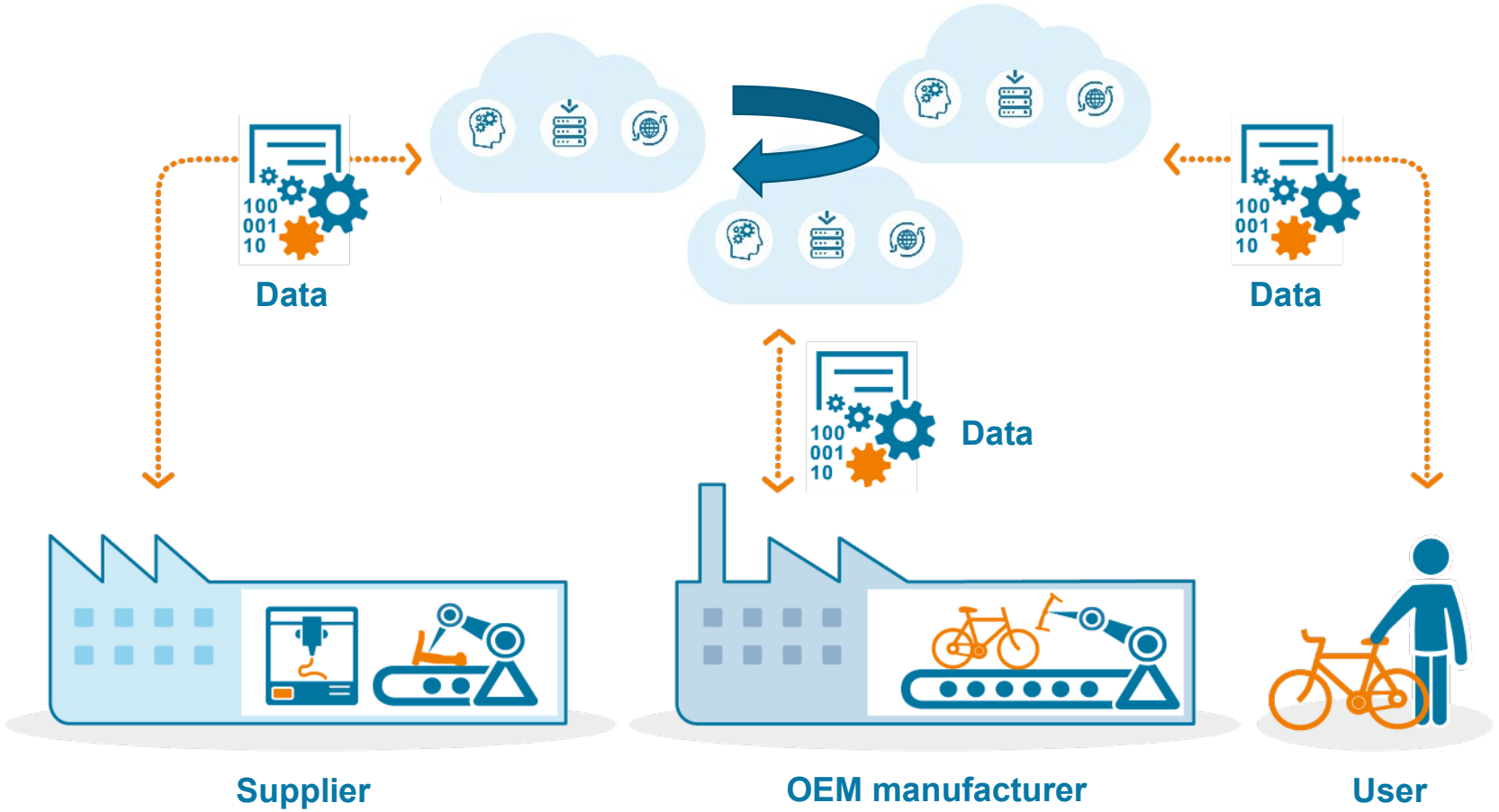
A large number of new **applications** and **business models** will emerge.

Industrie 4.0
B2B-Platform-Economy

The current focus of Plattform Industrie 4.0 is the exchange of information...

... along the value chain,

... between partners in the value chain.

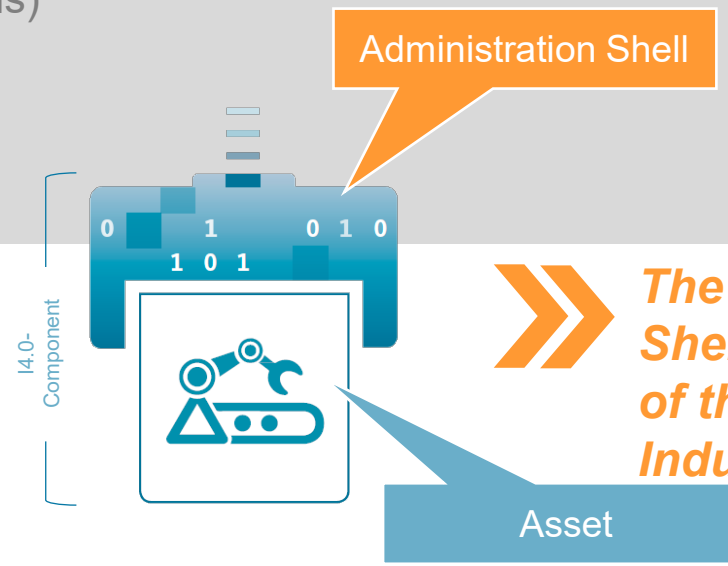


Industrie 4.0 Components
Assets integrate into the IT world

Integration of *assets* into the world of information

Asset = everything that requires a "connection" for an Industrie 4.0 solution

- machines and their components
- supply materials, parts and products
- exchanged documents
  (e.g. drawings, wiring diagrams)
- contracts
- orders
- …



The Asset Administration Shell is the implementation of the digital twin for Industrie 4.0.

Overview

- Identifiers
- Submodels and Asset Administration Shells
- Semantics
- Reduction of integration costs

PLATTFORM INDUSTRIE 4.0

Basis of Industrie 4.0

Identifiers

Identification

Erika Mustermann and an identifier

Identification

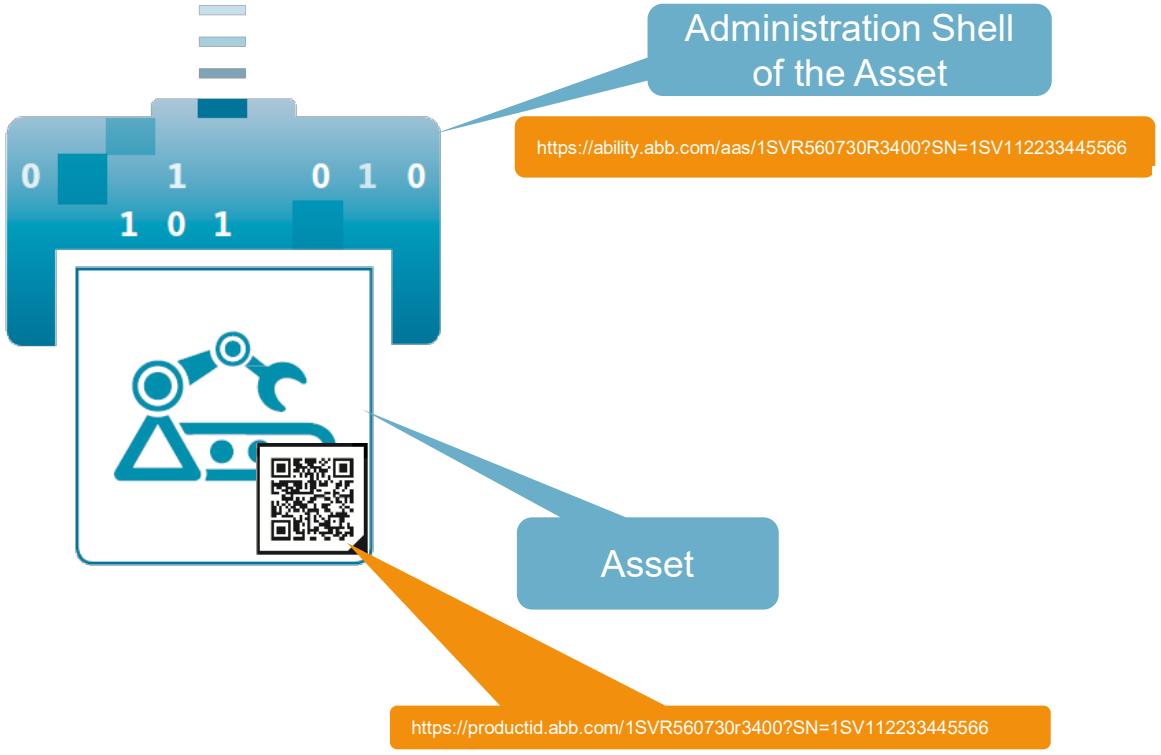
Erika Mustermann and her ID card – Context: Federal Republic of Germany

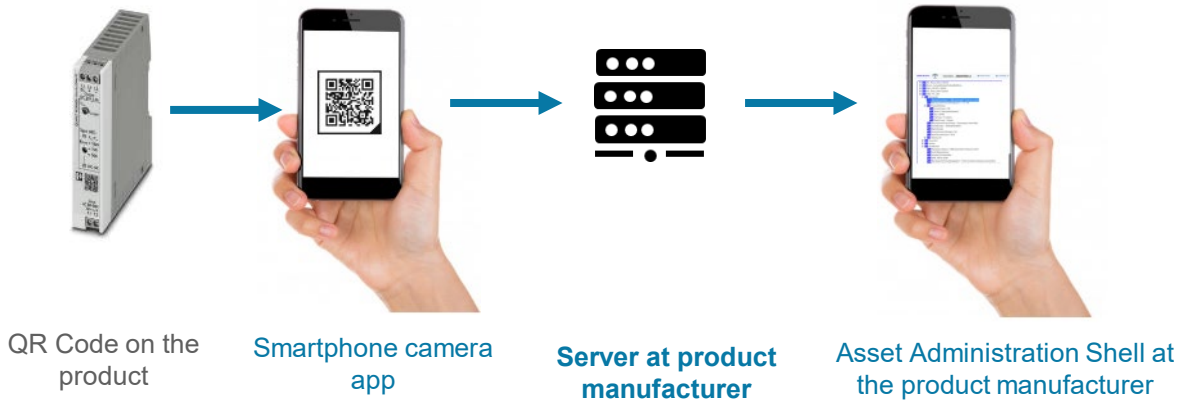
Identification

Erika Mustermann and her identity card

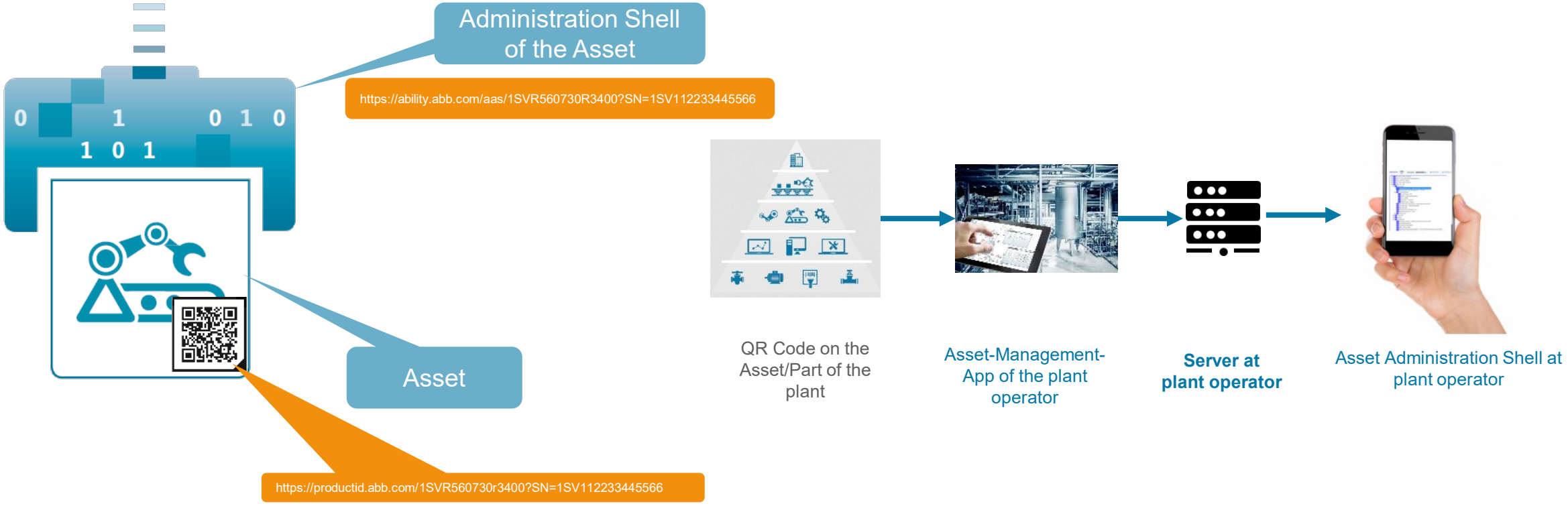
- unique **identifier**, here: ID number
- identifying properties of Mrs Mustermann
- further properties of Mrs Mustermann

Access to the Asset Administration Shell
Example: product manufacturer





Access to the Asset Administration Shell
Example: plant operator



PLATTFORM INDUSTRIE 4.0

Basis of Industrie 4.0

Submodels and Asset Administration Shells

Use-Case and submodel
Erika Mustermann wants to live healthily

- health status 30.12.2019
  - blood values
  - stress ECG
  - body weight

- nourishment situation „actual“
- nourishment situation „target“
- plan for exercise and sport

- health status 15.6.2020

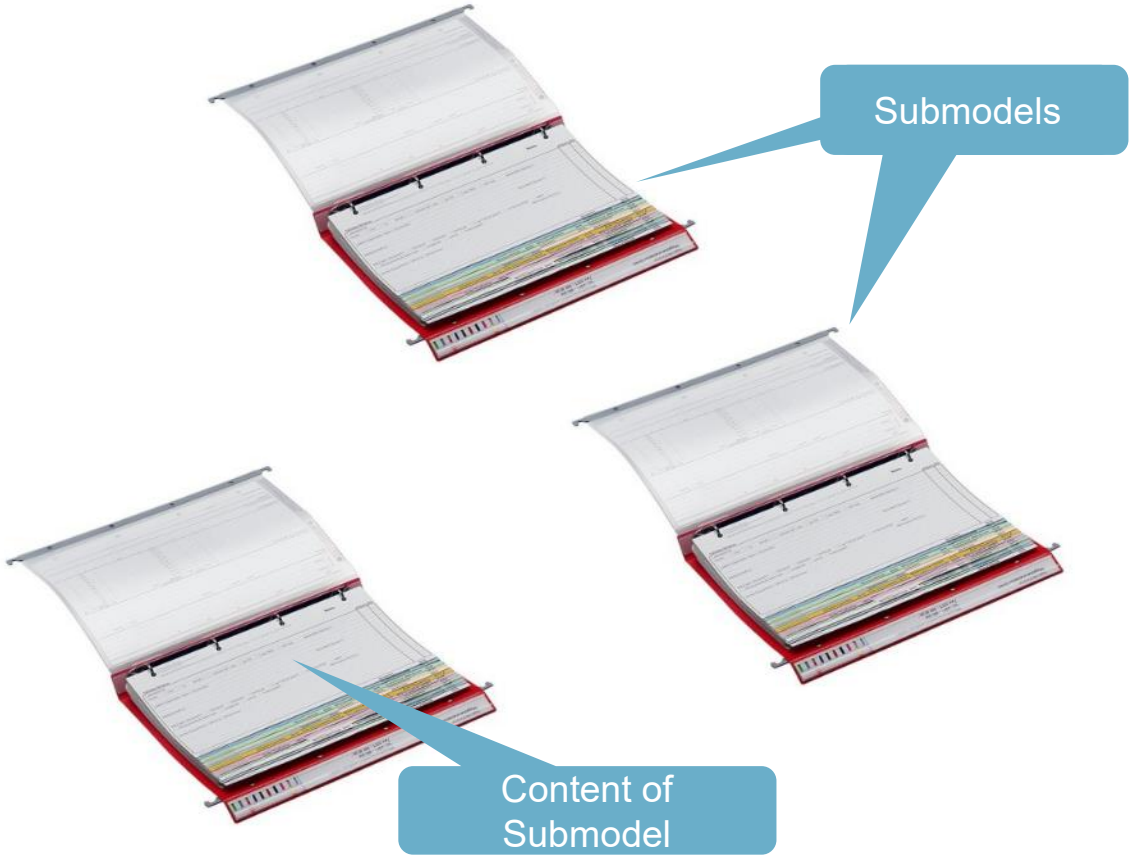
Use-Case and submodel
Erika Mustermann wants to save money

- Income
  - salary
  - child support from state
  - bitcoin earnings ☺
- Spendings
  - shopping
  - rent
  - insurances
  - saving for holidays

Use-Case and submodel
Erika Mustermann visits Berlin

- itinerary
- train ticket
- hotel booking
- packing list
- sightseeing list
- tickets for the opera
- travel budget

Asset Administration Shell
Container for submodels



Asset Administration Shell
=
Digital Twin

Submodels
Group of properties

Assets have properties

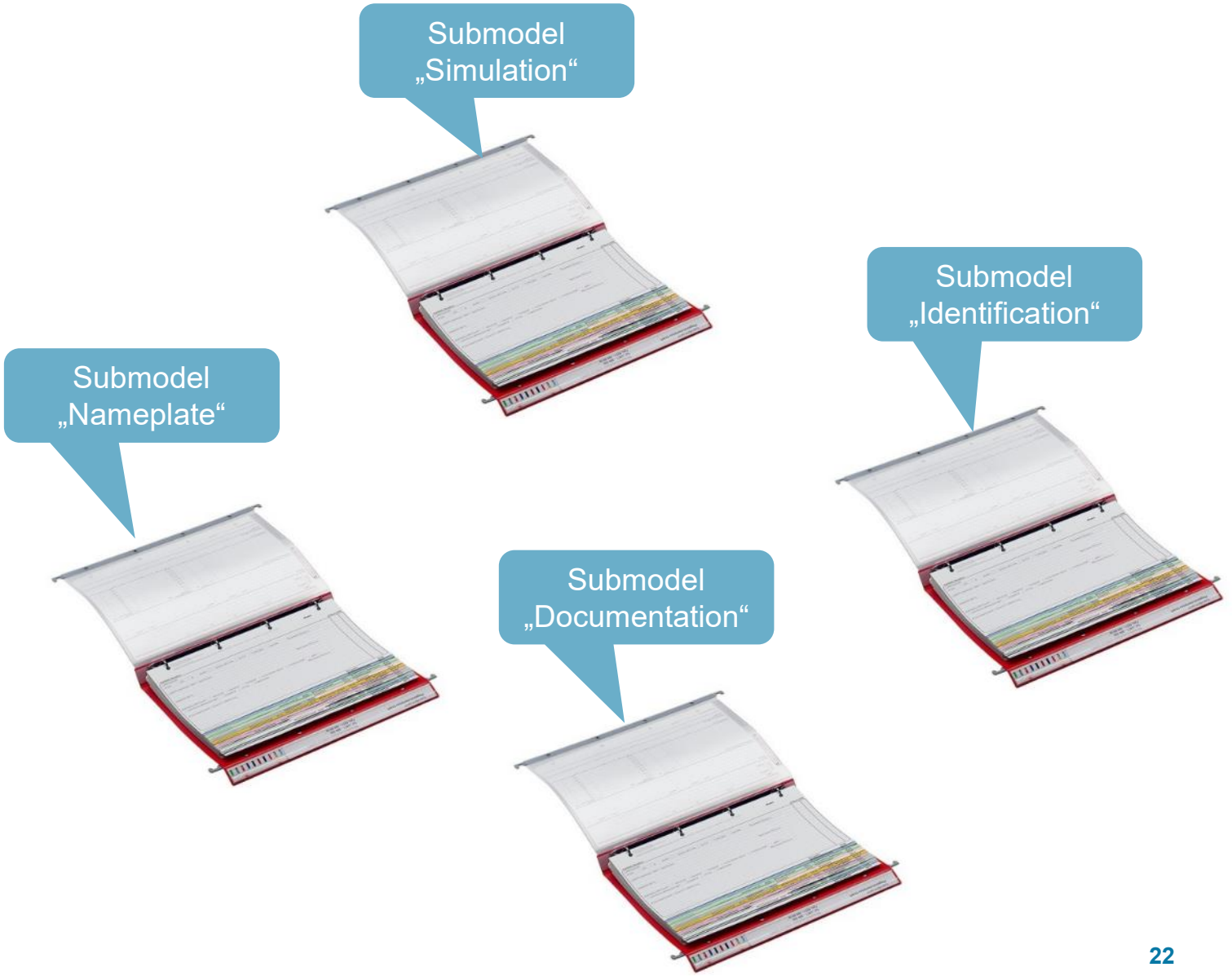
- weight, price, order number, dimensions

In I4.0, we combine properties into groups, suitable for use cases:

- logistical properties
- order features
- technical data
- properties for documentation
- ...

We call these submodels.

- Submodels are groups of properties for a use case.



PLATTFORM INDUSTRIE 4.0

Basis of Industrie 4.0

Semantics

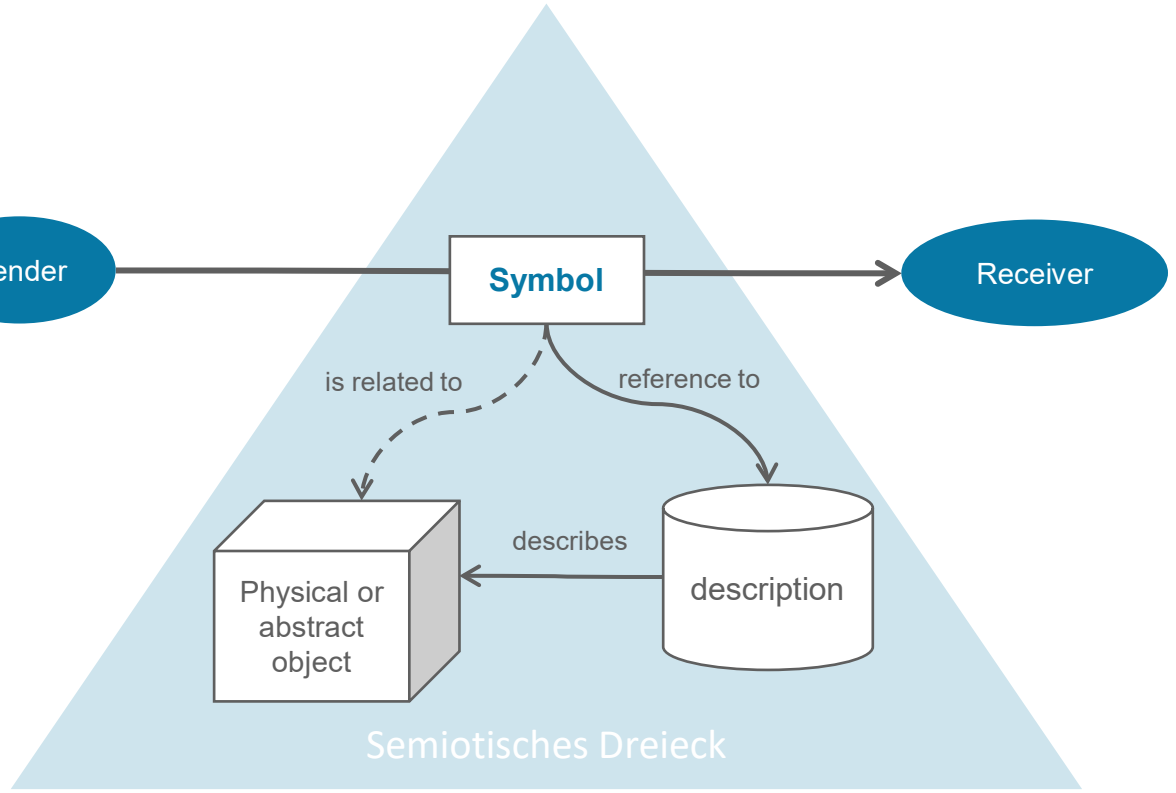
Semantics
“The Jaguar is in the garage.”

„Jaguar“

Symbol

Starting point semantics
Exchange symbols with previously defined meaning

- Symbol
  - refers to an object
  - The meaning is known to both sender and receiver.
  - Anyone can look up the meaning of the symbol in a dictionary.
- Symbols in Industrie 4.0 are machine-readable, they are made for communication between machines.



„M8“

„green yellow“

„Ich bin ein Berliner!“
Dictionary Human <-> Machine

Code:	0123/4///46789_1#ABC001
Version:	001
Revision:	04
Preferred name:	Berliner
Synonymous name:	Pfannkuchen, Kreppel
Definition:	Traditional German pastry similar to a doughnut with no central hole, made from sweet yeast dough fried in vegetable oil, with a marmalade or jam filling.

for machines

for humans

…

© DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

Dictionary: ECLASS 10.0.1
27-20-02-06 Temperature Transmitter (0173-1#01-AAC063#016)

- 21 Manufacturing facility, workshop equipment, tool
- 22 Construction technology
- 23 Machine element, fixing, mounting S
- 24 Office product, facility and technic, papeterie
- 25 General service
- 26 Energy, extraction product, secondary raw material and residue
- **27 Electric engineering, automation, process control engineering** S
  - 27-01 Generator
  - 27-02 Electrical drive
  - 27-03 Transformer, converter, coil
  - 27-04 Power supply devices
  - 27-05 Accumulator, battery
  - 27-06 Cable, wire
  - 27-07 Medium voltage switchgear, system
  - 27-08 High voltage switchgear, system
  - 27-10 Network control technology
  - 27-11 Lighting installation, device
  - 27-13 Protection installation, device (electric)
  - 27-14 Electrical installation, device
  - 27-15 Analysis technology, device
  - 27-16 Overhead line technology
  - 27-18 Electrical cabinet, housing, rack
  - **27-20 Measurement technology, process measurement technology**
    - 27-20-01 Measuring appliance, time S
    - **27-20-02 Measuring instrument, temperature** S
      - 27-20-02-01 Hand thermometer S
      - 27-20-02-03 Temperature gauge S
      - 27-20-02-04 Temperature (machine) S
      - 27-20-02-05 Digital temperature gauge S
      - **27-20-02-06 Temperature transmitter** S

0173-1#02-AAQ326#002 - address of additional link
0173-1#02-AAD931#005 - customs tariff number (TARIC)
0173-1#02-AAO663#003 - GTIN
0173-1#02-AAO677#002 - Manufacturer name
0173-1#02-AAO676#003 - product article number of manufacturer
0173-1#02-AAU734#001 - Manufacturer product description
0173-1#02-AAU732#001 - Manufacturer product root
0173-1#02-AAU733#001 - Manufacturer product order suffix
0173-1#02-AAU731#001 - Manufacturer product family
0173-1#02-AAW338#001 - Manufacturer product designation
0173-1#02-AAU730#001 - Supplier product description
0173-1#02-AAM551#002 - Supplier product designation
0173-1#02-AAU729#001 - Supplier product root
0173-1#02-AAU728#001 - Supplier product family
0173-1#02-AAO057#002 - Product type
0173-1#02-AAO735#003 - name of supplier
0173-1#02-AAO736#004 - product article number of supplier
0173-1#02-AAO742#002 - Brand
0173-1#02-AAW337#001 - Supplier product order suffix
0173-1#02-AAW336#001 - Supplier product type
0173-1#02-AAN173#003 - average influence of ambient temperature in relative units
0173-1#02-AAQ328#002 - AWG-number
0173-1#02-BAA629#005 - characteristic curve
0173-1#02-AAM789#006 - approval for general usage
0173-1#02-AAN337#001 - Connector identification
0173-1#02-BAB427#006 - style of galvanic isolation

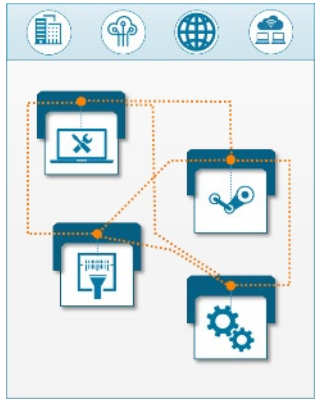
Exemplary representation

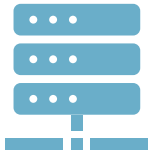
PLATTFORM INDUSTRIE 4.0

Basis of Industrie 4.0

Cybersecurity
Establishing a secure connection

Cybersecurity – Overview, example plant operator



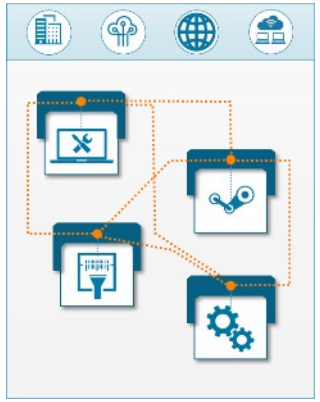


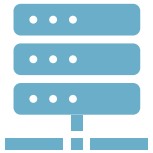
Plant operator

Internet

Business partner

Cybersecurity – Overview, example plant operator



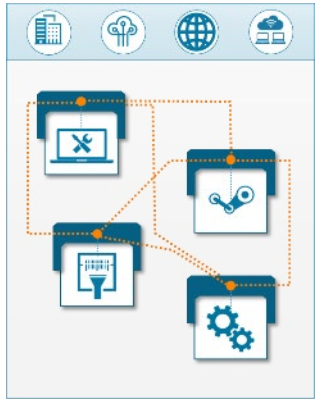


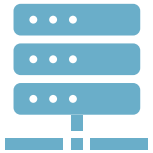
Plant operator

Internet

Business partner

Cybersecurity – Overview, example plant operator





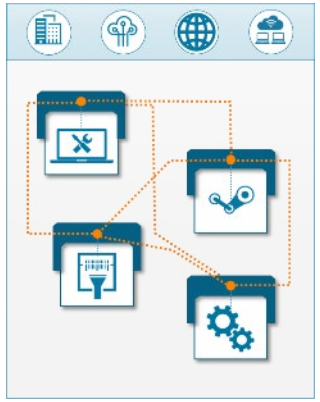
Shared authentication service

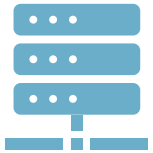
Plant operator

Internet

Business partner

Cybersecurity – Overview, example plant operator





trusts

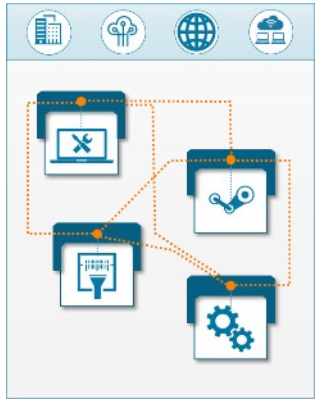
Shared authentication service

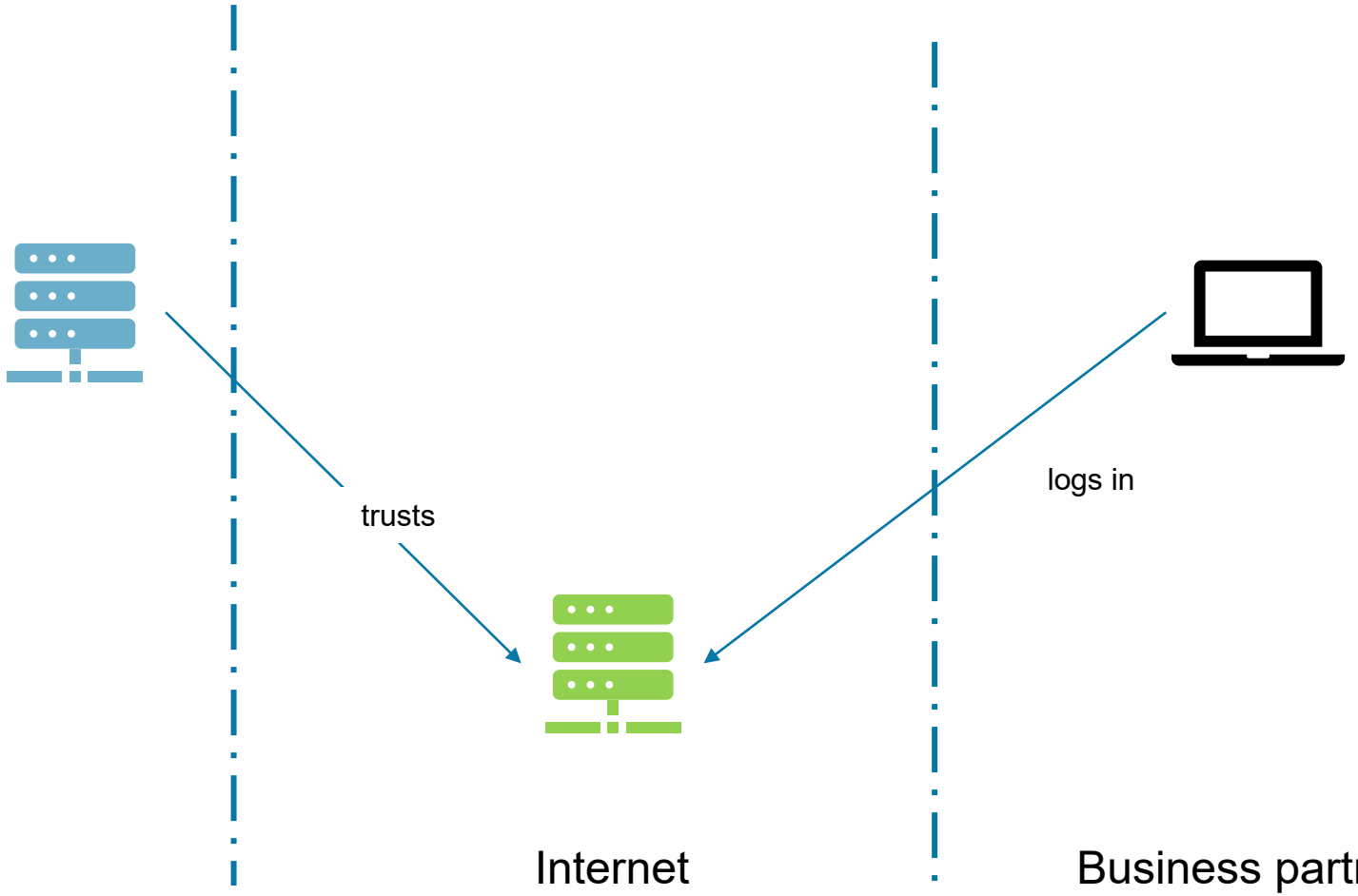
Plant operator

Internet

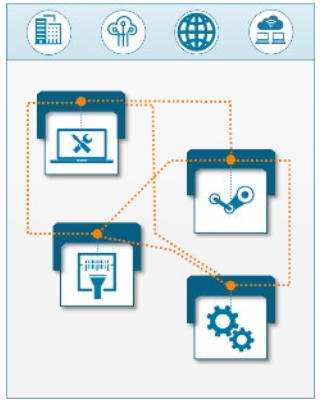
Business partner

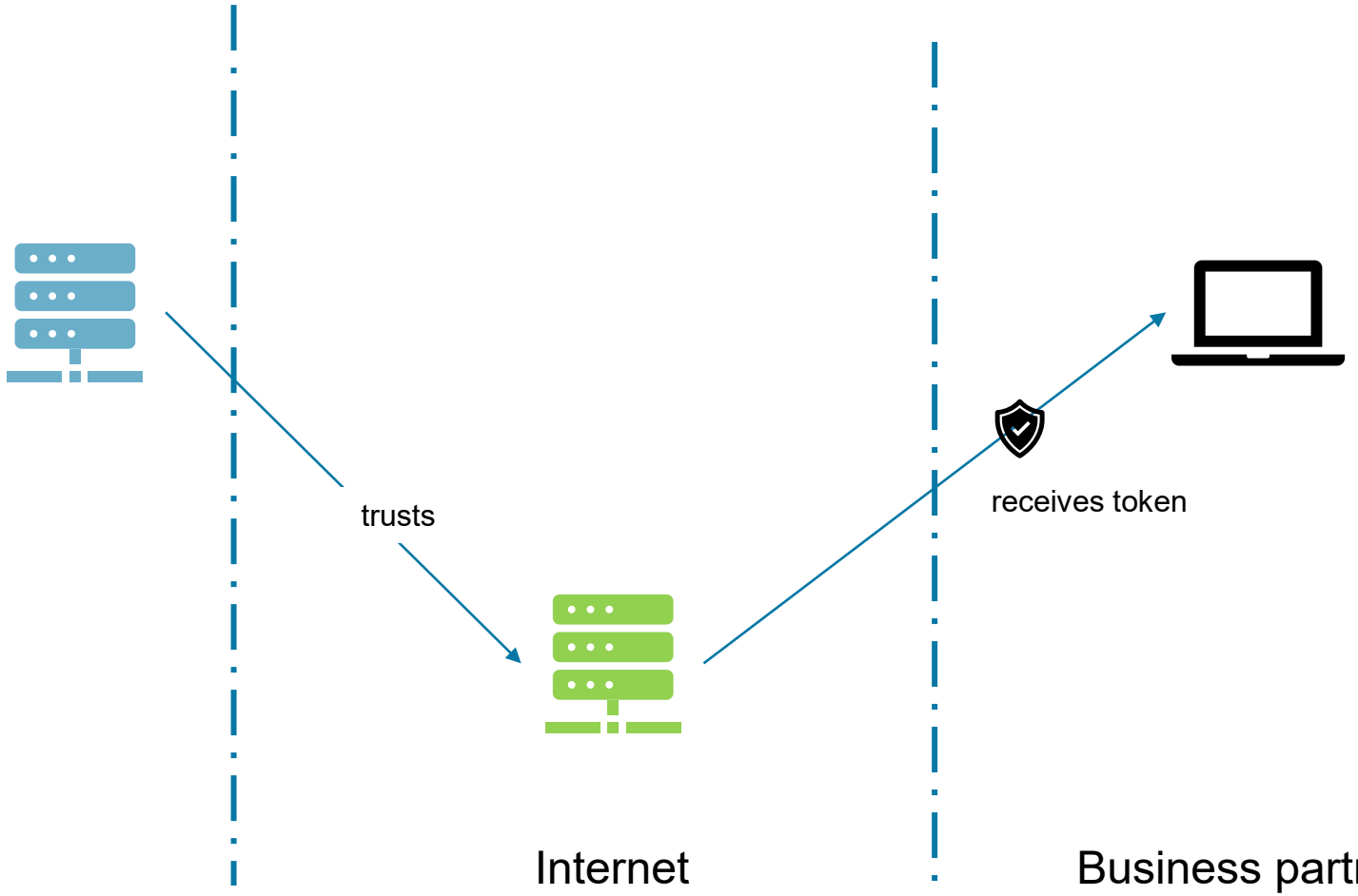
Cybersecurity – Overview, example plant operator



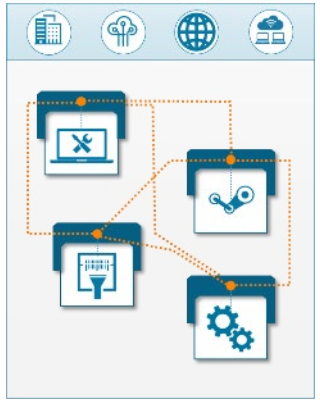


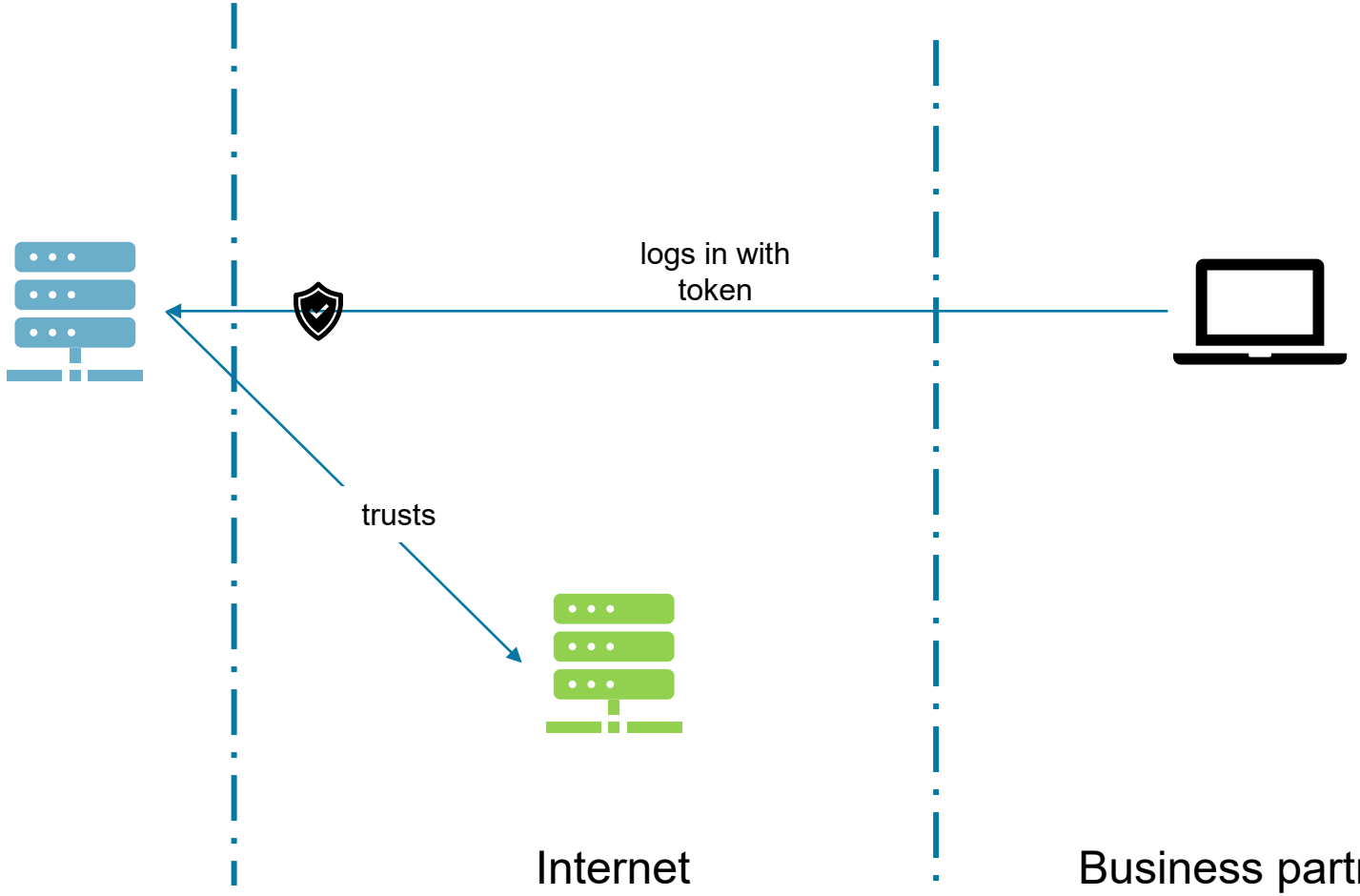
Cybersecurity – Overview, example plant operator



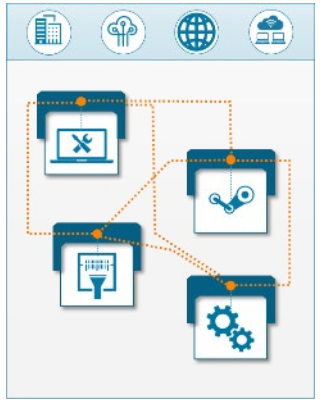


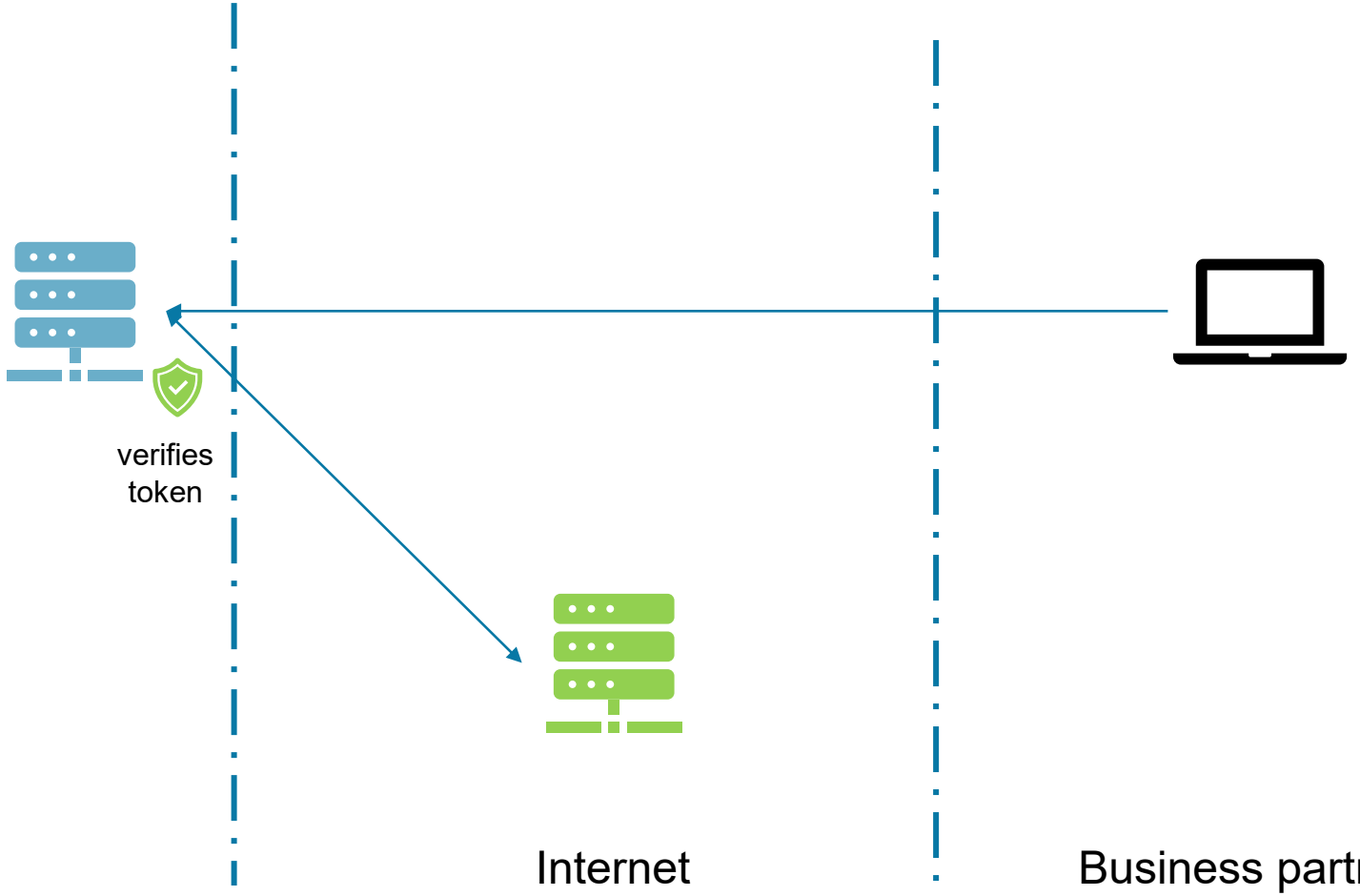
Cybersecurity – Overview, example plant operator



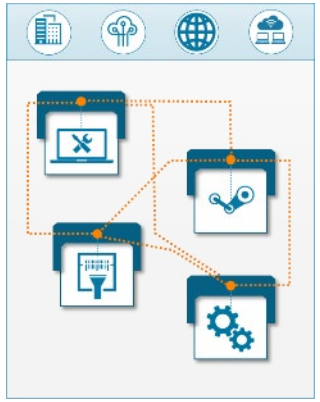


Cybersecurity – Overview, example plant operator





Cybersecurity – Overview, example plant operator



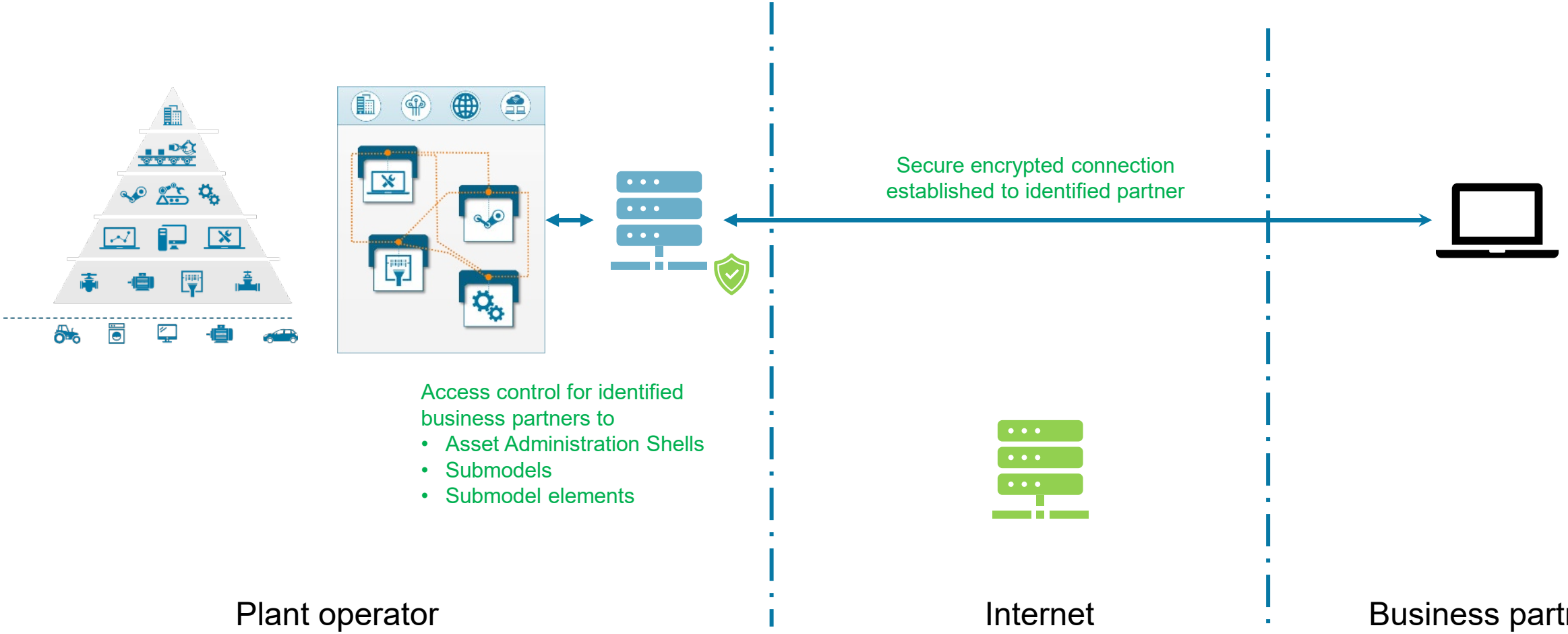
Secure encrypted connection
established to identified partner

Plant operator

Internet

Business partner

Cybersecurity – Overview, example plant operator



PLATTFORM INDUSTRIE 4.0

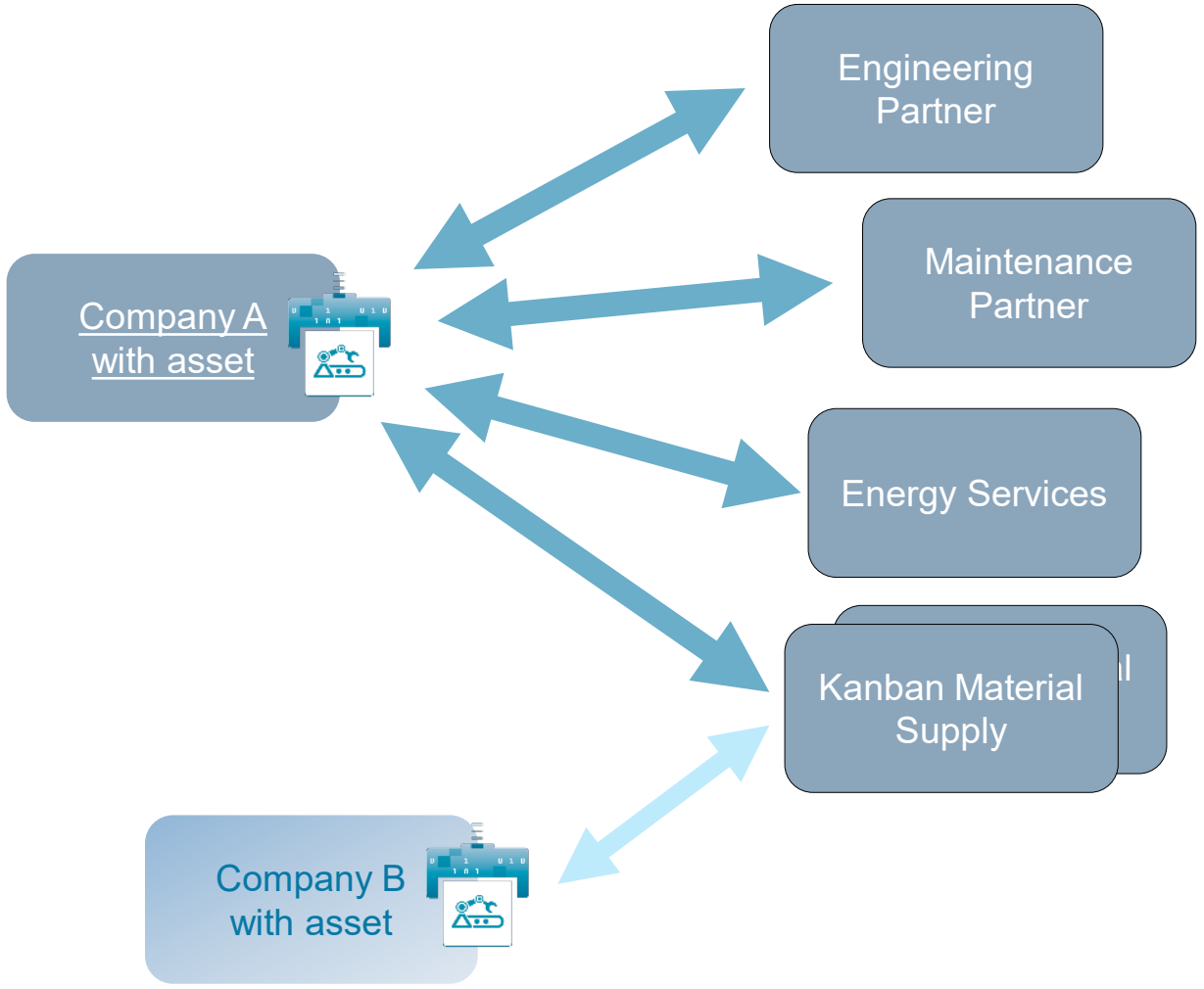
Asset Administration Shell

Reduction of integration costs

- Integration of external partners
- Integration of data sources and systems of a company

Reduction of integration costs
External partners

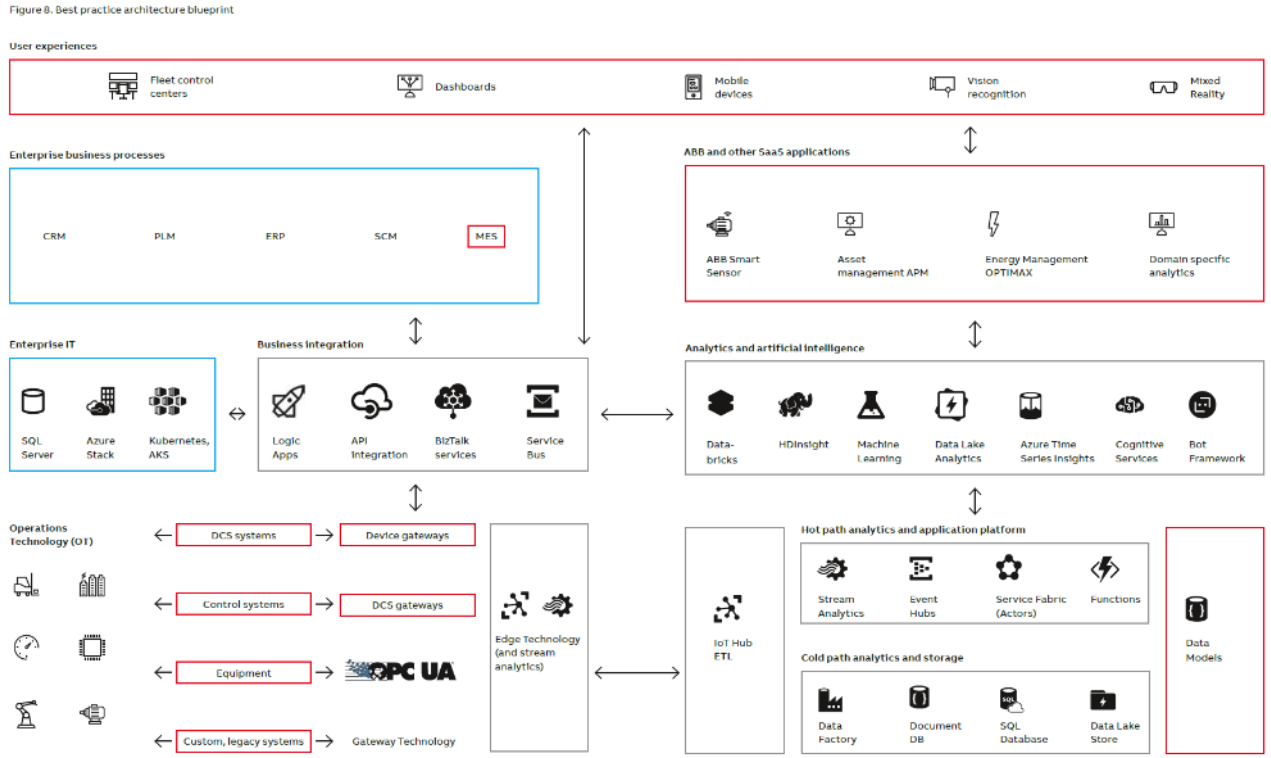
- standardised AAS reduces number of for interfaces, m:n → 1:n
- AAS can be extended by new use cases at any time, along the entire life cycle of an asset, AAS "grows with" it
- new partners can be integrated at any time



Reduction of integration costs
Integrating data sources

IT landscapes in companies have a huge complexity and diversity:

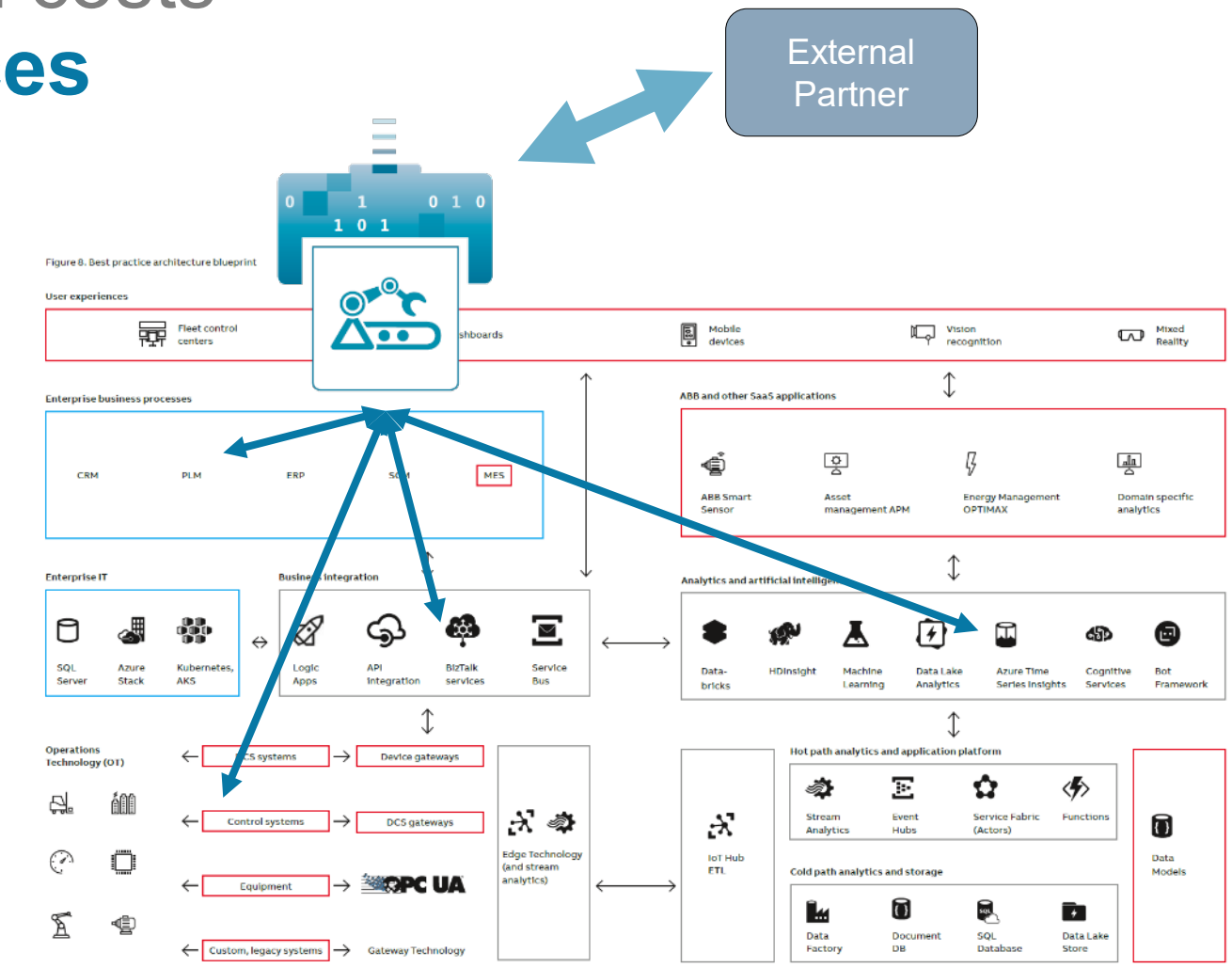
- user systems
- systems for business processes
- IoT and SaaS
- PLM and ERP systems
- analytics and artificial intelligence
- systems for integration, e.g. in a corporate group
- systems in production



© ABB

Reduction of integration costs
Integrating data sources

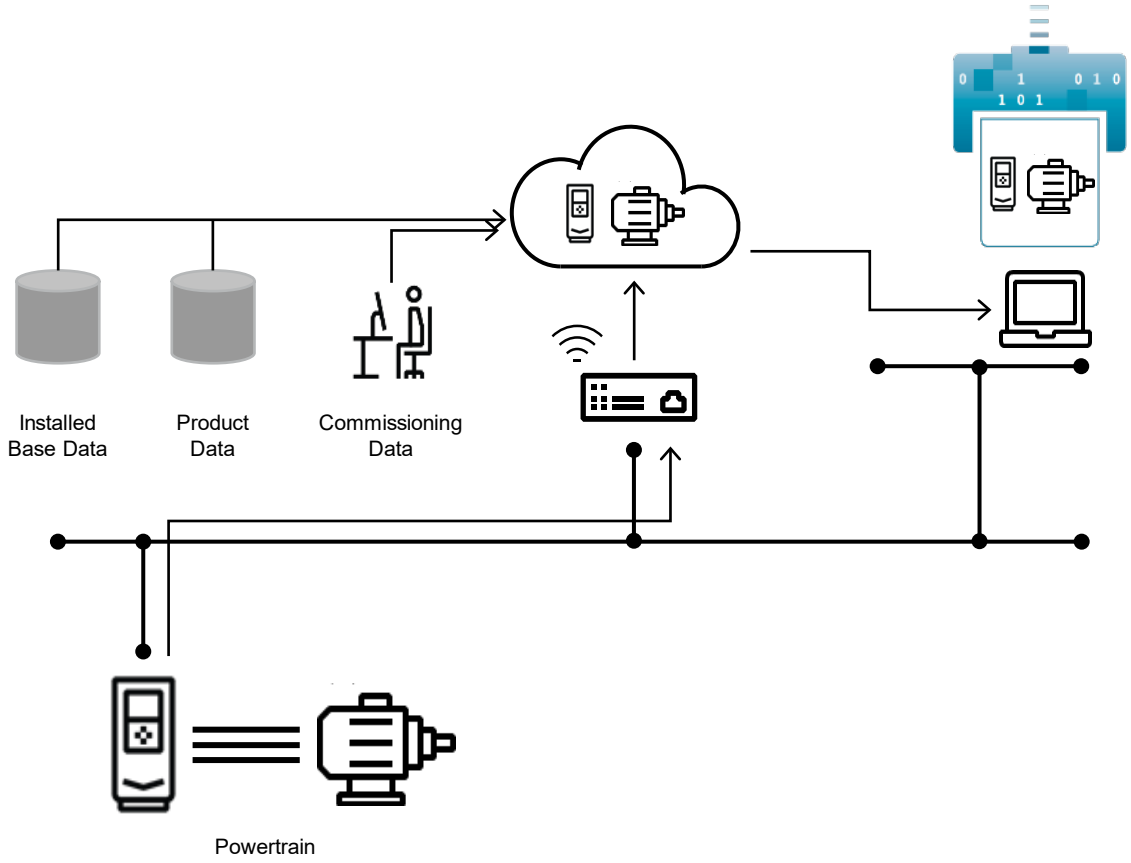
- AAS can integrate information on an asset from a wide range of systems, e.g. PLM, ERP, CRM, MES, etc.
- active submodel modules realise data access and model transformation for enterprise systems
- data access from external sources via AAS standardised
- There is no "single source of truth".



© ABB

Reduction of integration costs
Use case: Integration for power trains

- assets in the example: frequency inverter, motor and complete drive (powertrain)
- automatic identification of assets, automatic communication setup
- integration of information from engineering, devices (online data frequency converter), database for installed base and product information
- external data access by customer via AAS



Hard shell, soft core?
Asset Administration Shell: The Digital Twin in Industrie 4.0

- clear form
  clear rules:
  - information model and data formats
  - semantics
  - online API and cybersecurity
- flexible content
  - use cases that can grow
  - flexibility for new partners in the value chain
  - throughout the entire life cycle

The digital twin as a flexible "data socket".