

# Plattform Industrie 4.0

---

## Package file format

for the exchange of information in the value chain of Industrie 4.0

Dr. Marco Mendes

Schneider Electric Automation GmbH

Forum Industrie 4.0 / Hannover  
Messe 2019

# Dr. Marco Mendes

Email: marco.mendes@se.com



- Senior Principle Technical Expert
- Industrial Automation Business
- Topics: System consistency/architecture, technical invariants, anticipation, device integration, semantic interop, digital twins, Industrie 4.0
- Member ZVEI - "Models and Standards" (Industrie 4.0 Mirror Group SG2)
- Member Industrie 4.0 / ZVEI Joint WG „Dokument Verwaltungsschale im Detail“
- PhD in Computer Science, University of Porto

Disclaimer: This presentation refers to results and currently discussed applications of the Platform Industrie 4.0 and ZVEI.

# Agenda

- ▶ Motivation / Industrie 4.0
- ▶ Recap: Asset Administration Shell
- ▶ Details of the Asset Administration Shell
- ▶ AASX package format - Overview
- ▶ AASX process & security
- ▶ Outlook
- ▶ Q & A

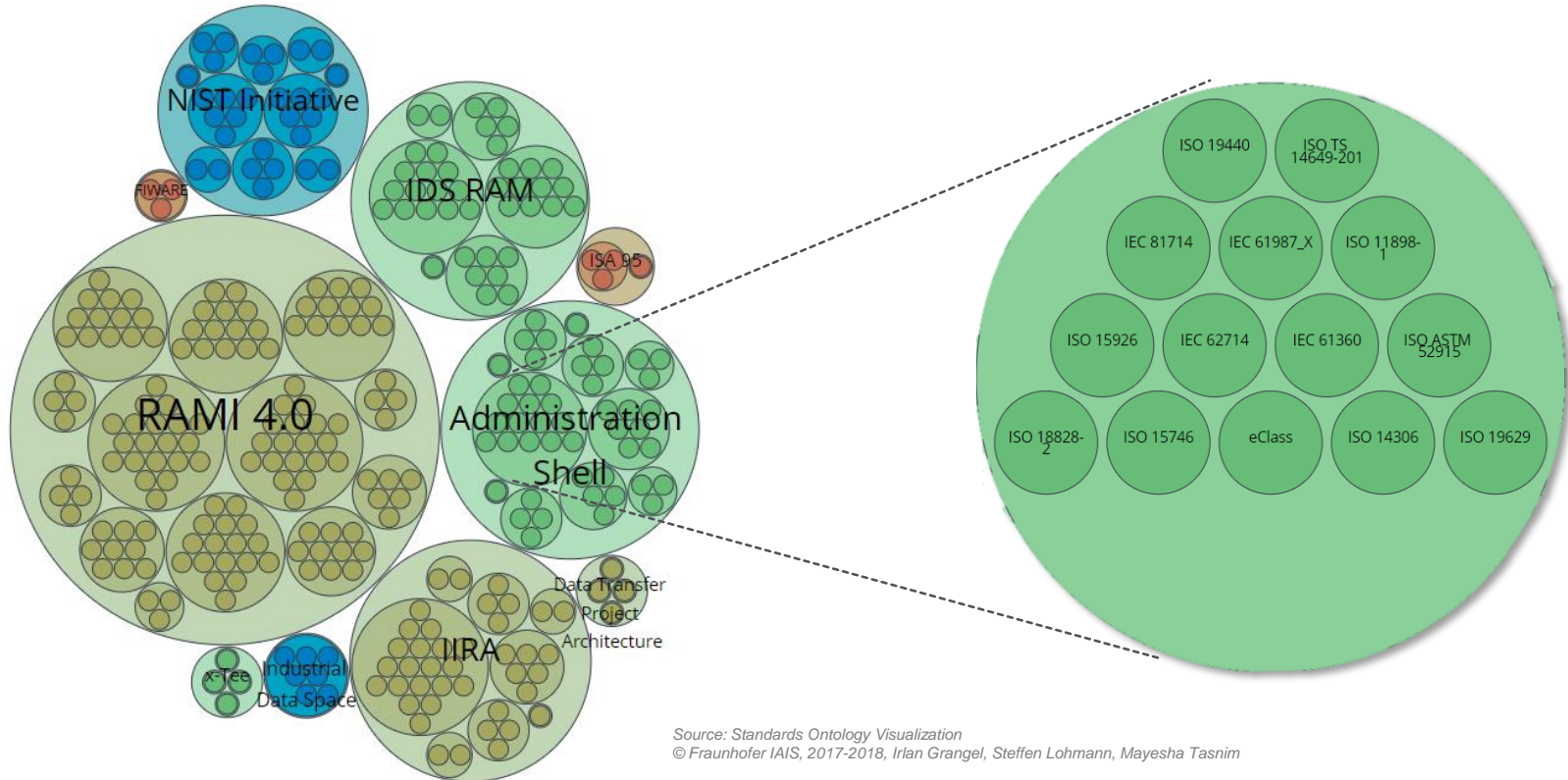
# Industrie 4.0 - Connecting business processes across company borders



Graphic © Anna Salari, designed by freepik

- Digital is the only real growth driver → “Large” companies and SMEs increasing their Digital Offer
- Added value by exchanging information between value chain partners
- New business models: flexible & customer-oriented production
- AI and Data analysis → most demanding jobs in manufacturing
- Need: Not just the digitalization of assets, but “semantic digitalization”

# Standards Ontology

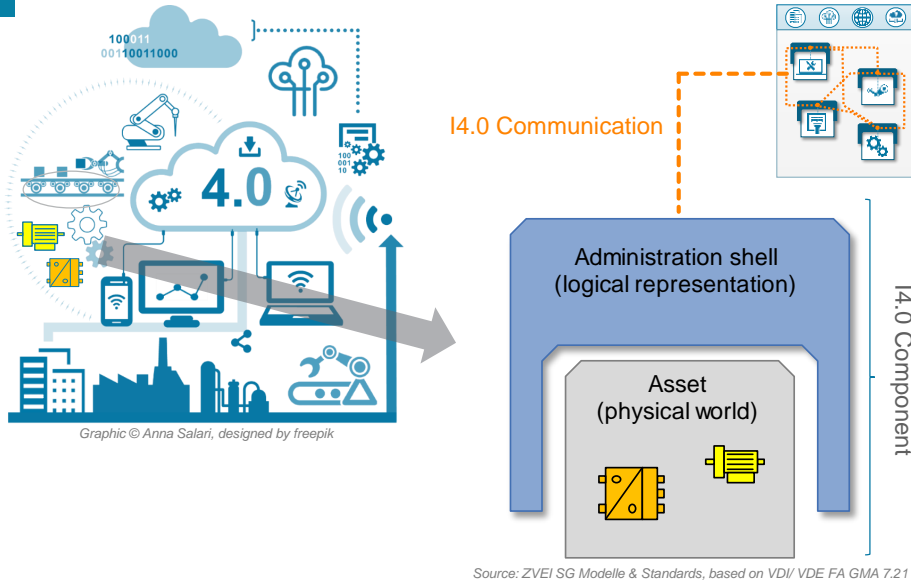


Source: Standards Ontology Visualization  
 © Fraunhofer IAIS, 2017-2018, Irlan Grangel, Steffen Lohmann, Mayesha Tasnim

# Agenda

- ▶ Motivation / Industrie 4.0
- ▶ [Recap: Asset Administration Shell](#)
- ▶ Details of the Asset Administration Shell
- ▶ AASX package format - Overview
- ▶ AASX process & security
- ▶ Outlook
- ▶ Q & A

# Application of Industrie 4.0 → Asset Administration Shell



Integration of products in an Industrie 4.0 system using Asset Administration Shells

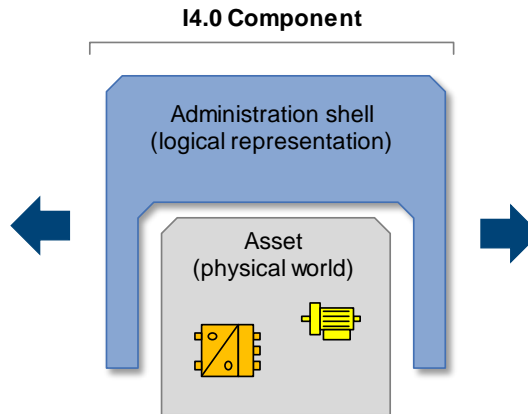
## The Administration Shell...

- Generic medium to compose information for I4.0 use cases
- Traversing company and sector borders
- Spans all phases of asset lifecycles, from design to operations to maintenance
- Standardized and secure communication interface
- Addressable in the network and identifies the asset unambiguously

# What contains the Asset Administration Shell?

Type of (semantic) data, e.g.

- Properties
- Parameters
- Process values
- Files
- Documents
- Description of functions to allow e.g. operations
- Function blocks
- Vendor-specific aspects
- ...



Source: ZVEI SG Modelle & Standards, based on VDI/ VDE FA GMA 7.21

Organized in Submodels

Separation of concerns

Administration shell, exemplary



Source: ZVEI SG Modelle & Standards

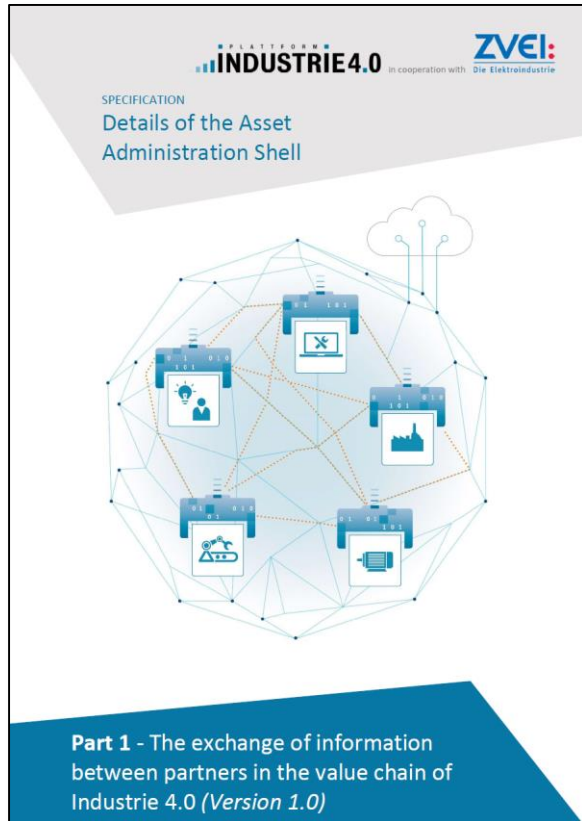
AAS isn't just description...  
...but also functional realization!



# Agenda

- ▶ Motivation / Industrie 4.0
- ▶ Recap: Asset Administration Shell
- ▶ [Details of the Asset Administration Shell](#)
- ▶ AASX package format - Overview
- ▶ AASX process & security
- ▶ Outlook
- ▶ Q & A

# Details of the Administration Shell – PART 1...



## Included:

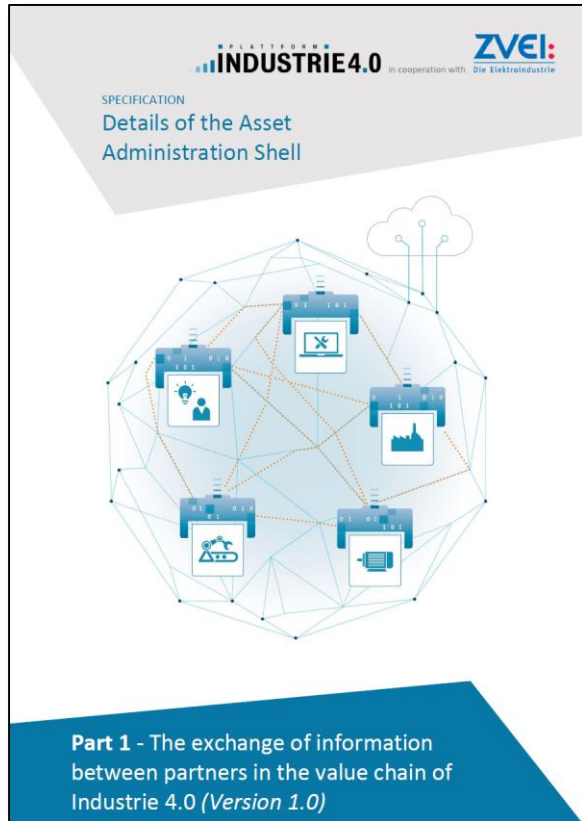
- ✓ Requirements & Approaches
- ✓ Technology independent Metamodel of the Administration Shell (UML)
- ✓ Mappings to data / serialization formats (e.g. XML, JSON)
- ✓ Attribute Based & Role Based Access
- ✓ Package File Format (AASX), including some security aspects

## The first developer-ready specification of the Industrie 4.0 Asset Administration Shell!

This working paper has been elaborated in the working group "Models and Standards" of the ZVEI in cooperation with the Working Groups "Reference Architectures, Standards and Norms" (Plattform Industrie 4.0), "Security of networked Systems" (Plattform Industrie 4.0) and "Security" (ZVEI).



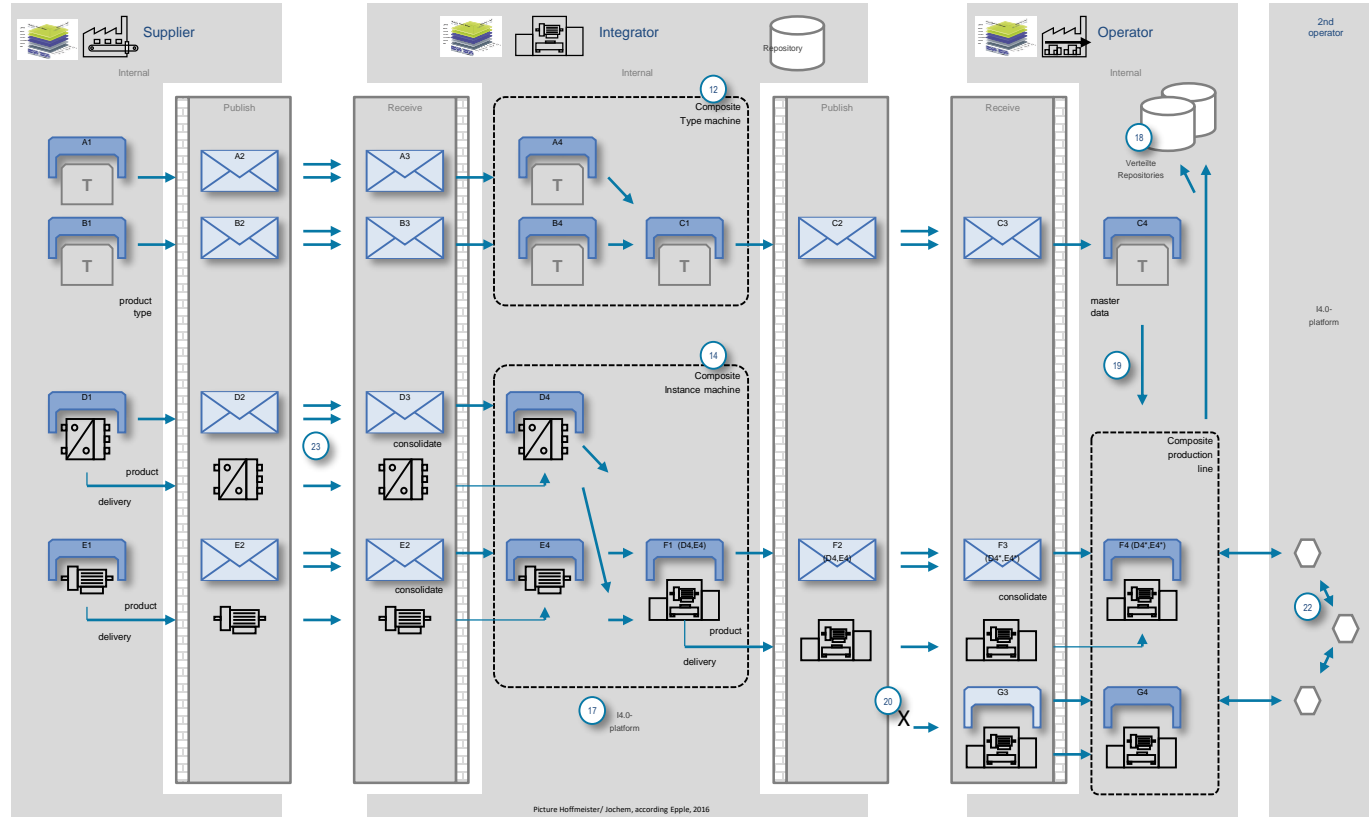
# What is possible with Part 1?



## What is possible with Part 1?

- ✓ Asset Administration Shells can be exchanged as a file
- ✓ Implementations can be done (respecting Asset Administration Shell information model, use of AASX package format, ...)
- ✓ Mapping to XML, JSON, ...
- ✓ Prepare your systems!
- ✓ Knowledge collection!

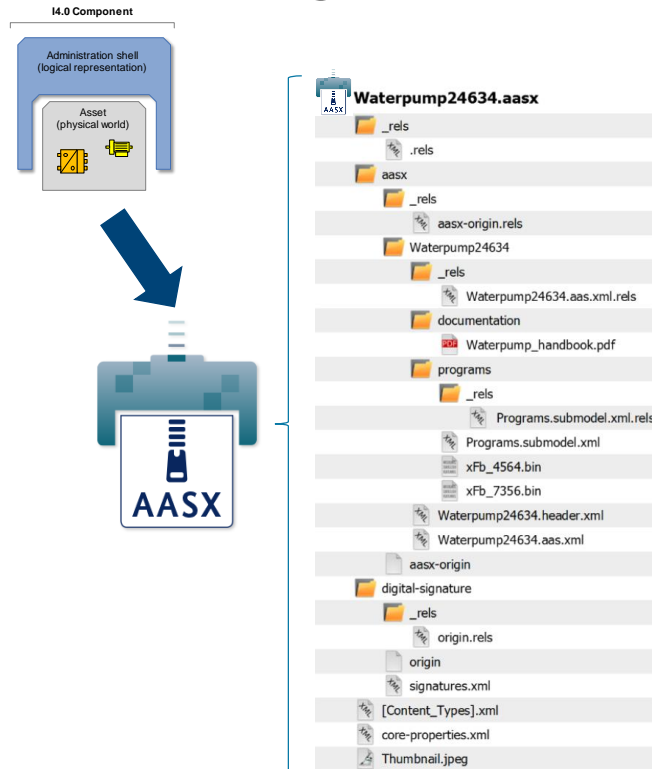
# Leading picture for Use Cases: a three-step value chain



# Agenda

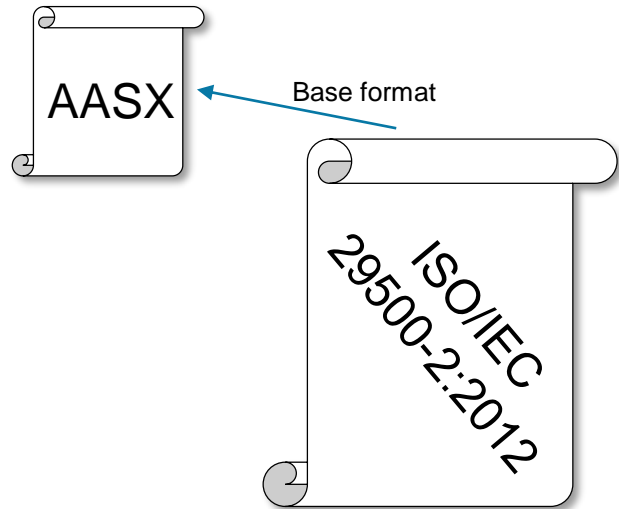
- ▶ Motivation / Industrie 4.0
- ▶ Recap: Asset Administration Shell
- ▶ Details of the Asset Administration Shell
- ▶ [AASX package format - Overview](#)
- ▶ AASX process & security
- ▶ Outlook
- ▶ Q & A

# AASX – Package File Format for the Asset Administration Shell



- ✓ Content package as file collection (similar to a ZIP file, Open Office XML File Formats/Open Packaging Conventions [ISO/IEC 29500-2](#))
- ✓ All Administration Shell aspects (e.g. properties, their values) are [packed together](#).
- ✓ Several Administration Shells can be put in [one package](#).
- ✓ Submodels and properties can be stored as [separate files](#).
- ✓ Each file can be [signed and encrypted](#).

## AASX – General requirements



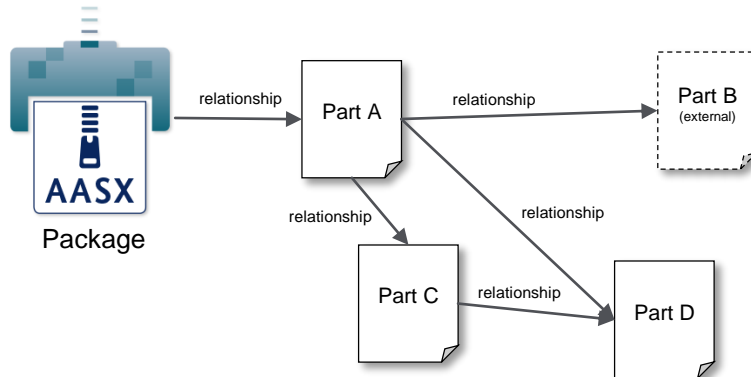
Choice of ISO/IEC 29500-2:2012  
(Open Packaging Conventions) as a  
reference for AASX!

- ✓ Generic package file format to include the AAS structure, data and other related files
- ✓ Main use cases → exchange between organizations and storage/persistence of the AAS' information
- ✓ Without any legal restriction and no royalties. Preferably based on an international standard with high guarantees of future maintainability
- ✓ Existence of APIs to use this format
- ✓ Digital signatures & encryption capabilities must be provided
- ✓ Policies for authenticity and integration of package files
- ✓ Based on ZIP and XML → most widely used, long-term archiving
- ✓ Experience from existing Industry standards: FDI, MTP

# AASX – Basic concepts and conventions

## Basic concepts of ISO/IEC 29500-2:2012:

- [Packages](#), [parts](#), and [relationships](#)
- [URI](#)-addressable resources and file names
- Content-type expressed in the form of a [MIME](#) media type
- [Logical Model](#) (how parts/files are related to each other)
- [Physical Model](#) (how parts/files are stored in ZIP)



## Conventions for AASX:

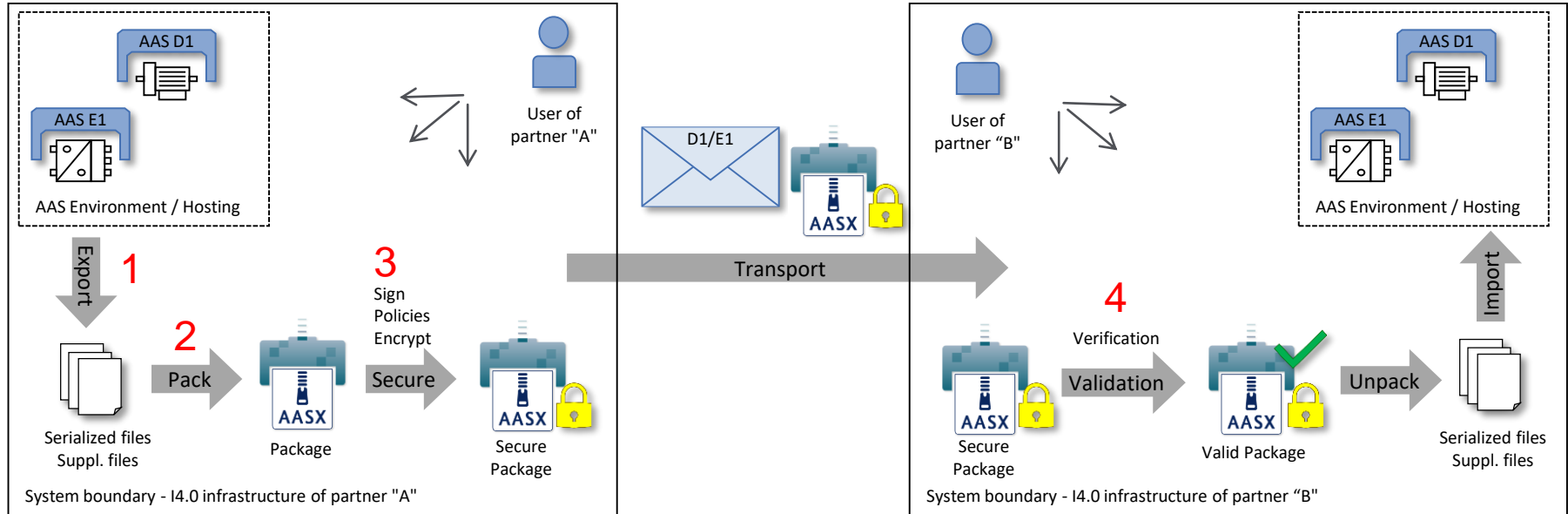
- Rules according to [ISO/IEC 29500-2:2012](#)
- Definition of a [logical model](#), [physical model](#) and a [security model](#) for the AASX
- [Best practice guidelines](#)
- File extension for the AASX format: [.aasx](#)
- MIME-type for the AASX format: [application/asset-administration-shell-package](#)
- Root relationship URI: <http://www.admin-shell.io/aasx/relationships/aasx-origin>



# Agenda

- ▶ Motivation / Industrie 4.0
- ▶ Recap: Asset Administration Shell
- ▶ Details of the Asset Administration Shell
- ▶ AASX package format - Overview
- ▶ [AASX process & security](#)
- ▶ Outlook
- ▶ Q & A

# AASX - process overview

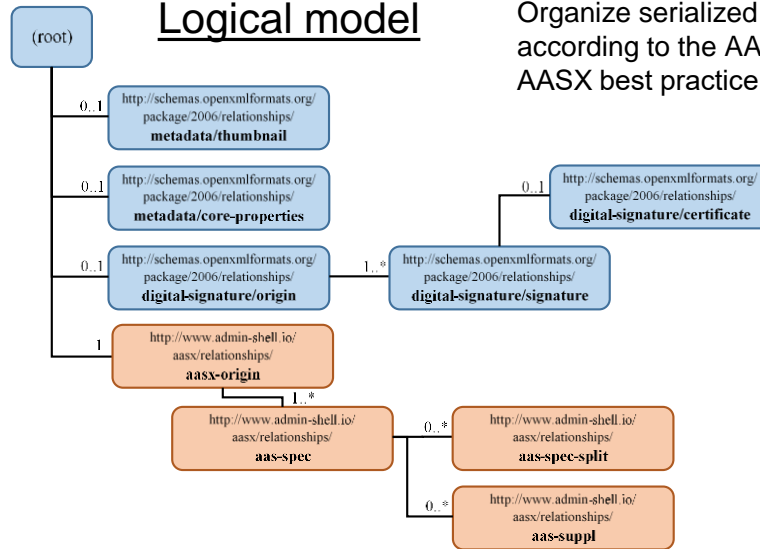




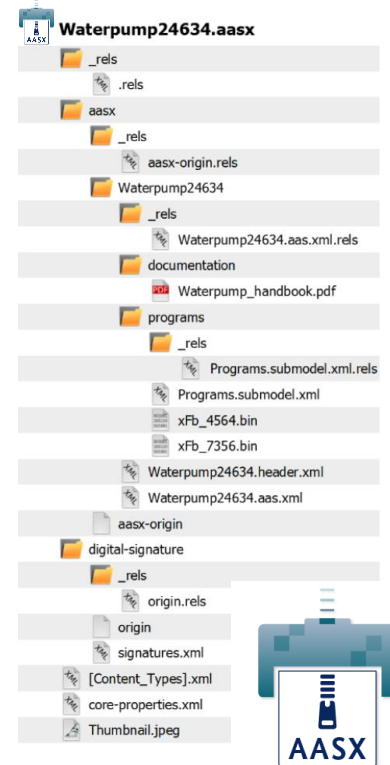
## 2 – Pack

### Logical model

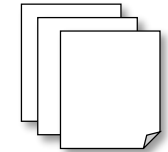
Organize serialized and suppl. files according to the AASX logical model and AASX best practice guidelines ...



### Physical model



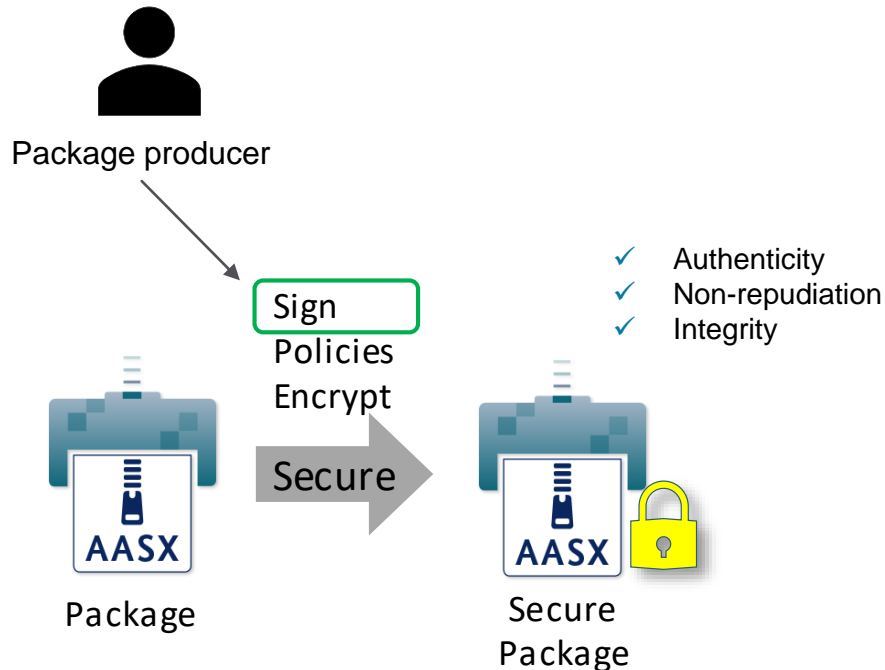
Pack



Serialized files  
Suppl. files

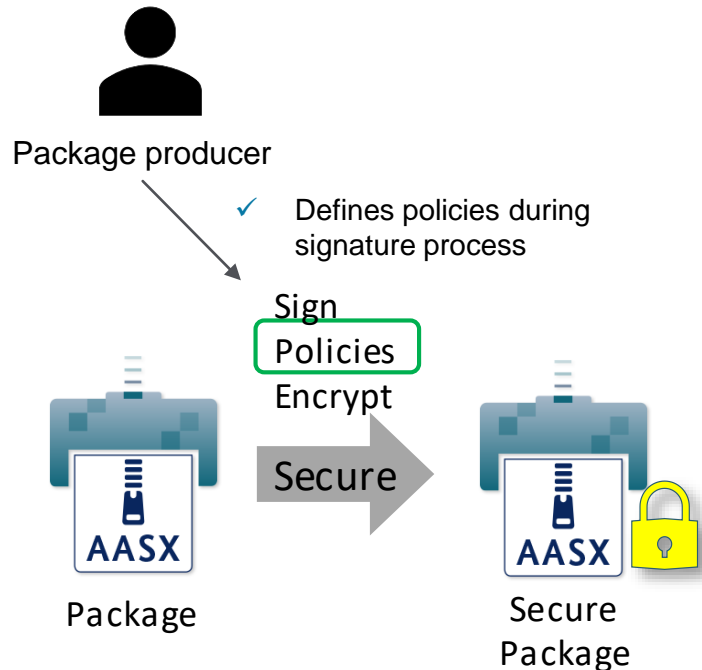


### 3 – Secure – Digital signatures



- ✓ Uses W3C Recommendation XML-Signature Syntax and Processing
- ✓ Additional parts/files are stored which contains the digital signature / certificate information
- ✓ Individual files and relationships can be independently signed
- ✓ More than one certificate can be used to sign files and relationships

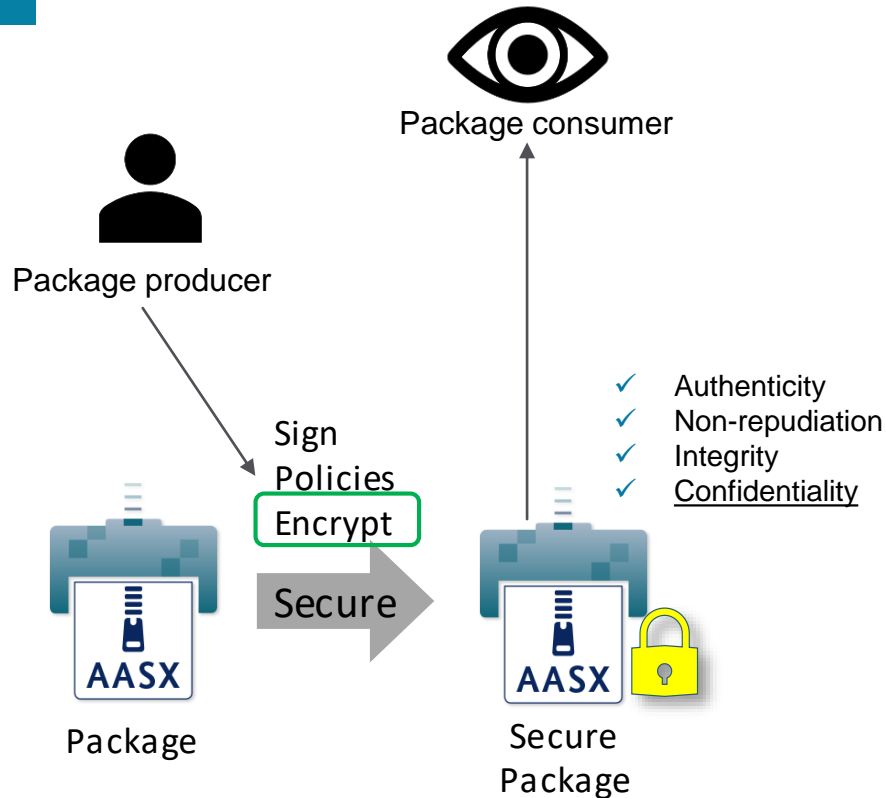
### 3 – Secure – Defining digital signing policy by producer



- Digital signatures define policies that are intended by the signers or in agreement with the package consumers
  - ▶ Impacts which operations can be verified
  - ▶ Signing a specific file in the package will implicitly express the intention of the signer
- A package producer shall follow a digital signing policy based on the following options:
  - ▶ Sign nothing
  - ▶ Sign everything
  - ▶ Custom signing according to one or more policies of Table 16 in Details of the AAS Part 1 V1.0 document

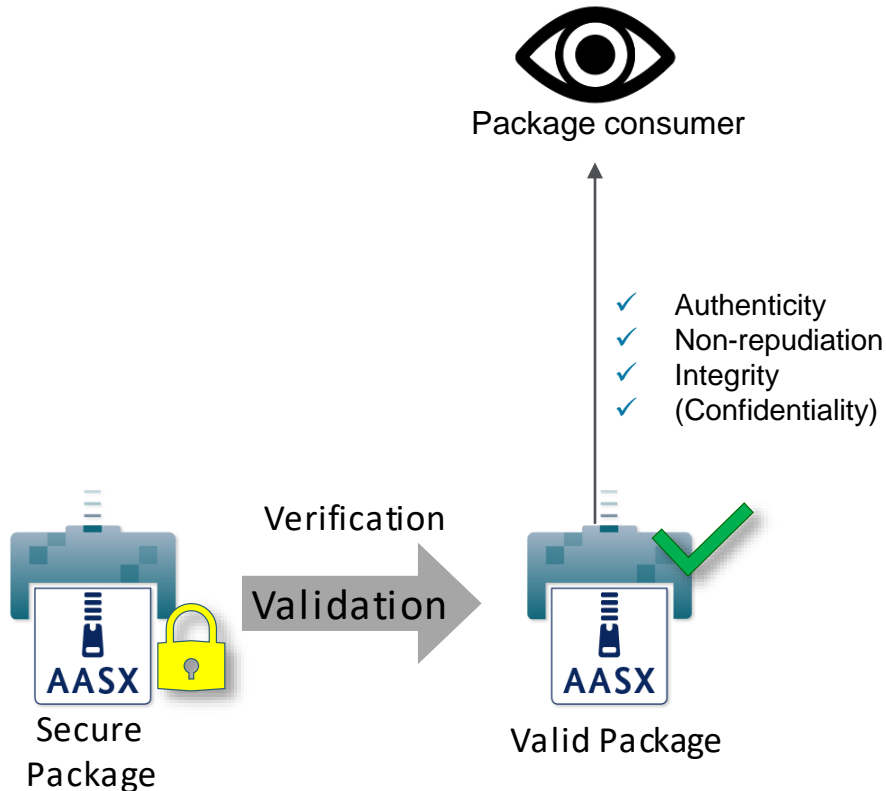
e.g. signing the aasx-origin relationship file → intention not to add new AAS to the package

### 3 – Secure – Encryption



- ISO/IEC 29500-2:2012 → “ZIP-based packages shall not include encryption as described in the ZIP specification. Package implementers shall enforce this restriction. [M3.9]”
- MS Office Formats use MS-OFFCRYPTO (covered by patents) → not an option for us!
- Basic rules:
  1. If there is no reason, then confidential content should not be included (obvious)
  2. Use encryption depending on the usage:
    - Temporary communication act (e.g. e-mail exchange, ...) → e.g. use S/MIME for exchanging encrypted e-mails between entities.
    - Storage → e.g. use BitLocker when storing the AASX in Windows-based systems
  3. All other cases: standard encryption methods can be used for individual files in the AASX package and/or the full package

## 4 – Validation process by consumer



- The package consumer may follow a [validation](#) process based on the policy of the signer(s) or an [internal verification](#) of the package according to its own rules.
- [Process for validation:](#)
  - Check package according to the Open Packaging Conventions and AASX logical model
  - Files that aren't source or target of any relationship, aren't allowed (besides the Open Packaging Conventions specific files).
  - Trust certificates that were used by the signer(s)
  - Validate all signed content against certificate information
  - Follow policies when changing the package without invalidating it (see Table 16 in in Details of the AAS Part 1 V1.0 document)
  - Any change done to the package by the consumer requires a revalidation of the package

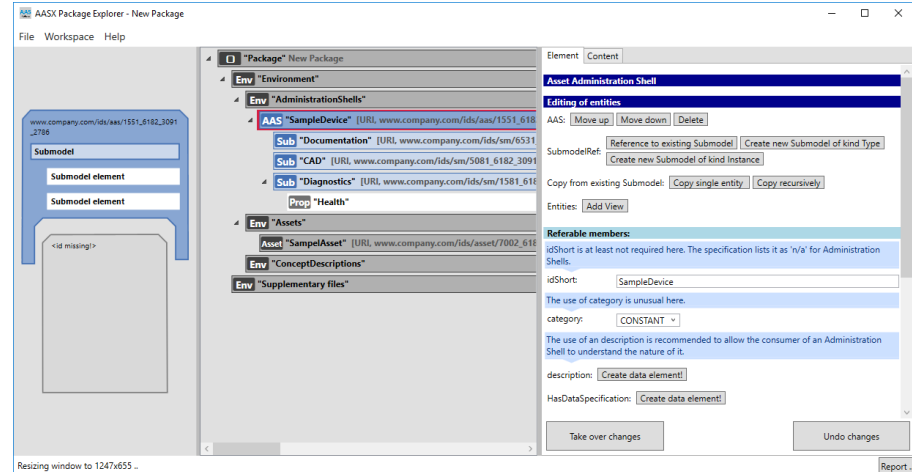


# Agenda

- ▶ Motivation / Industrie 4.0
- ▶ Recap: Asset Administration Shell
- ▶ Details of the Asset Administration Shell
- ▶ AASX package format - Overview
- ▶ AASX process & security
- ▶ [Outlook](#)
- ▶ Q & A

# Outlook

- Asset Administration Shells are now usable: thanks to the collaborative effort for “Details of the Asset Administration Shell”, Part 1, V1.0!
- [First specification of the AASX](#) package format
- Already allows several [practical use-cases](#)
- Existing Editor: [AASX Package Explorer](#)
- [TODOs](#) for next version (v1.1):
  - ▶ Enhance the description of the logical model in respect to the AASENV, ConceptDictionaries, ...
  - ▶ Add additional option for the encryption
  - ▶ Improve tools and public availability
  - ▶ ...



# Agenda

- ▶ Motivation / Industrie 4.0
- ▶ Recap: Asset Administration Shell
- ▶ Details of the Asset Administration Shell
- ▶ AASX package format - Overview
- ▶ AASX process & security
- ▶ Outlook
- ▶ [Q & A](#)

Email: [marco.mendes@se.com](mailto:marco.mendes@se.com)