

OPC UA for Industrial Joining Technologies (IJT)

Joining and Tightening System Overview

Agenda



- » OPC UA Overview
- » Industrial Joining Technologies (IJT) Overview
- » IJT Use Cases
- » Technical Overview of Models
- » Demonstration
- » Questions

Getting Started

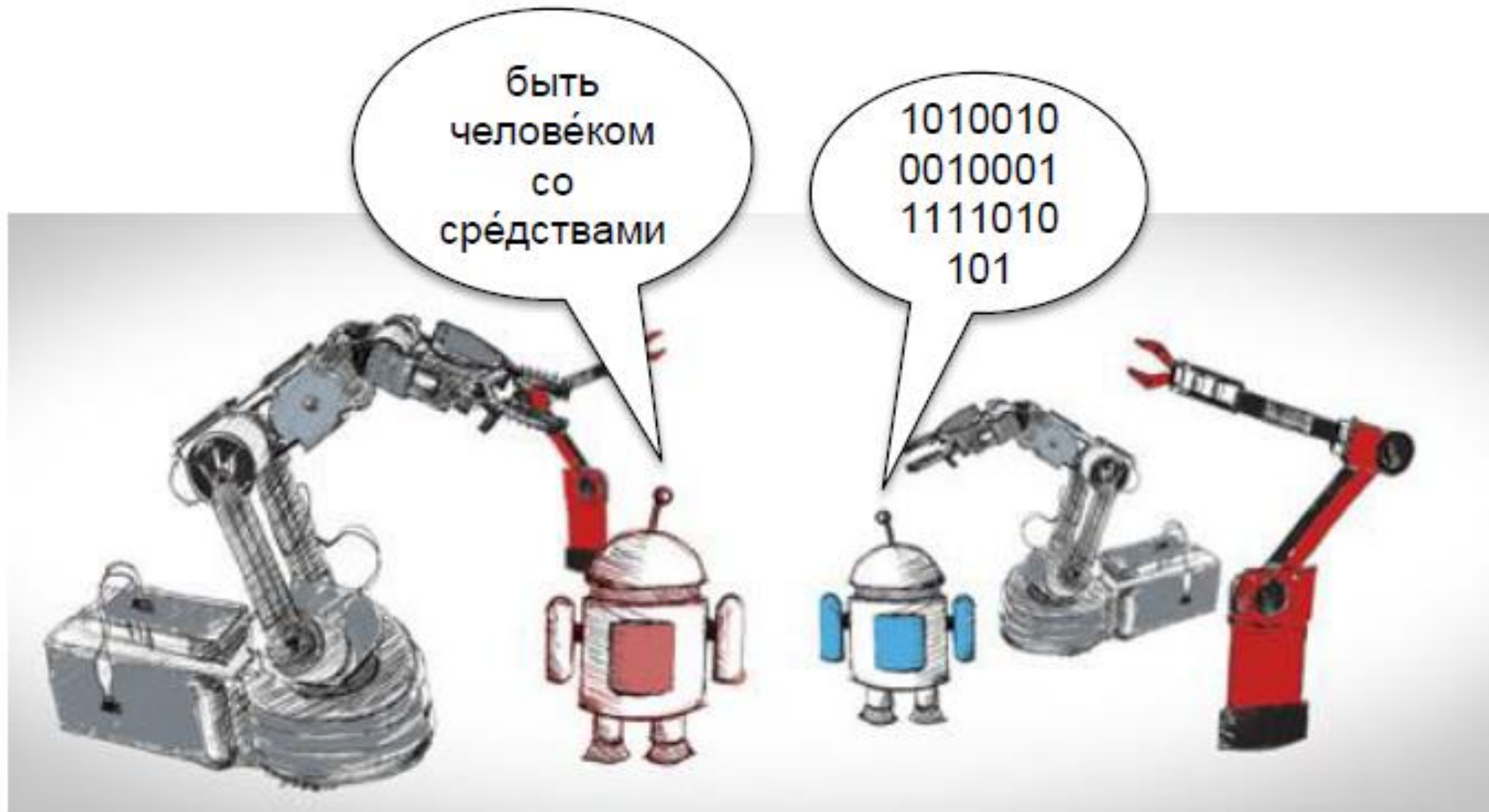
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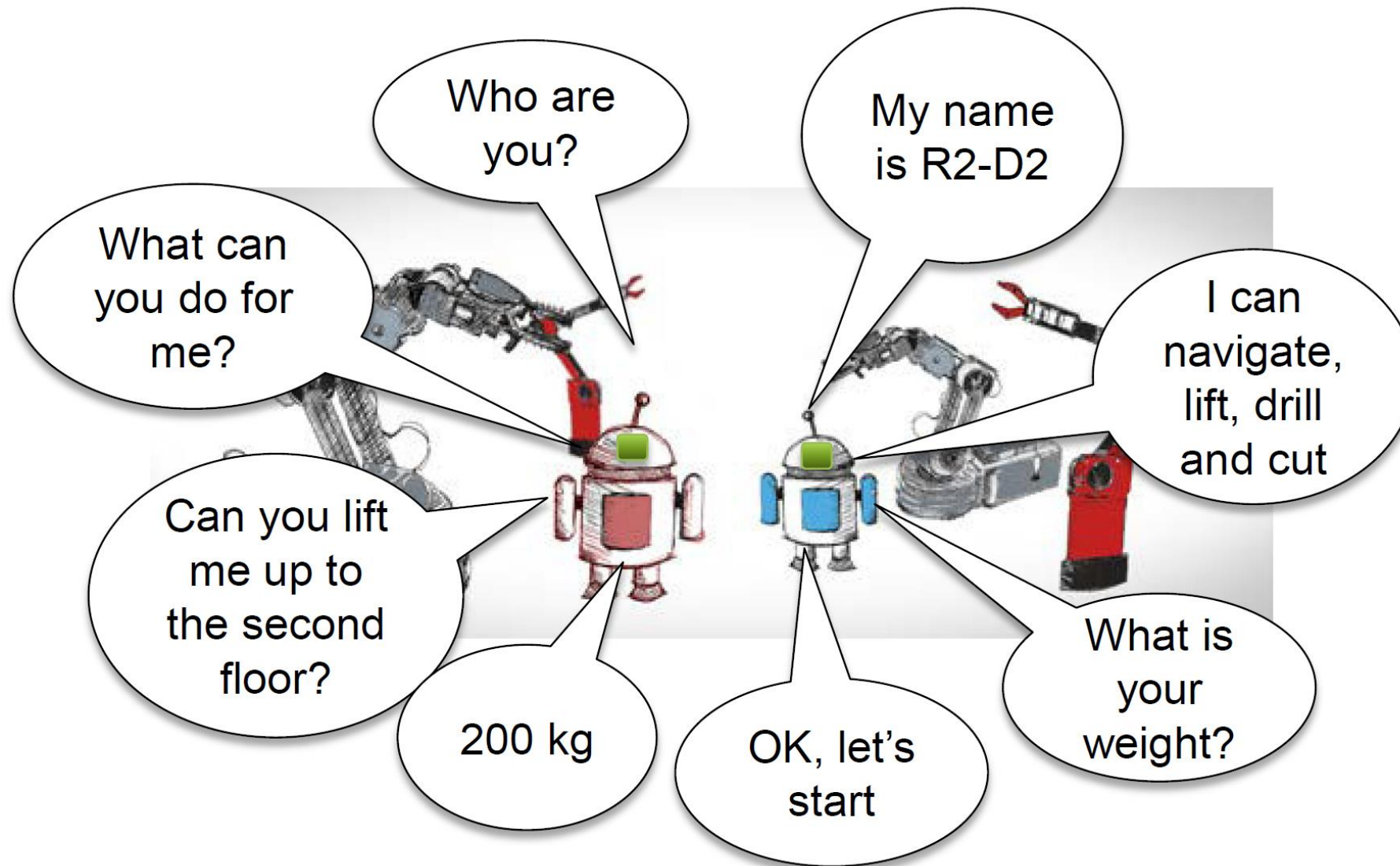
- **Overview of OPC Foundation and OPC UA**
 - <https://opcfoundation.org/about/opc-technologies/opc-ua/>
- **OPC UA and IJT Overview**
 - Refer to the **OPC UA IJT Group Presentation.pdf/pptx**.
 - <https://opcfoundation.org/markets-collaboration/IJT/>
- **Specifications**
 - <https://opcfoundation.org/developer-tools/documents/view/343>
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- **OPC UA IJT Prototypes/Reference Implementations**
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- **OPC UA Online Reference**
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Quick OPC UA and IJT Overview

Today's Interoperability Issues

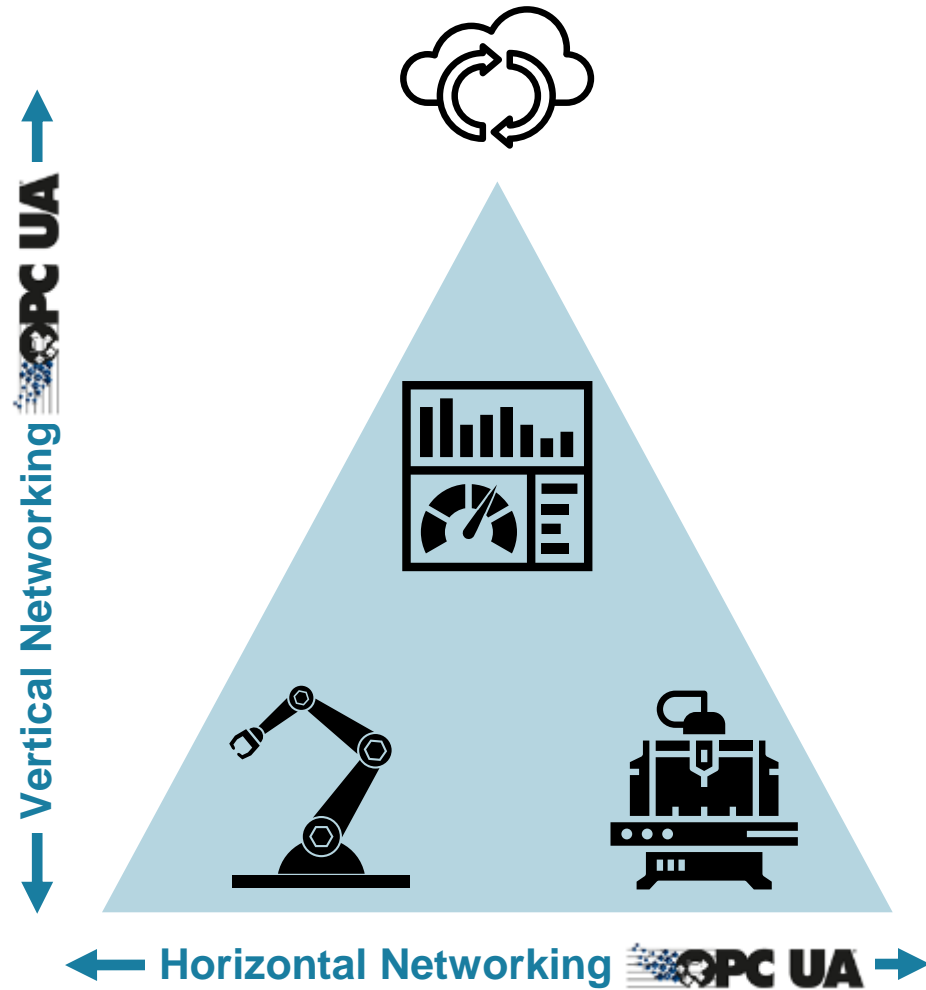


Today's Interoperability Solution



Source: OPC Foundation

OPC UA – Field to Cloud



Open source



Security



Two transport mechanism with various protocols



Scalable



Global acceptance



Semantic information models

Interoperability Solution Summary

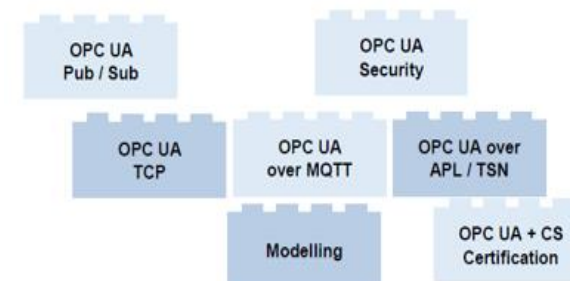
(OPC UA + Companion Specs) = Promise for Interoperability



- **OPC UA: Collection of technology bricks**

- Connectivity, different protocols
- Security
- ...

HOW to communicate
"speak the same language"



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- **Companion Specifications: Collection of bricks for different markets**

- Information modelling to describe the specific market
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- **OPC UA + Companion Specification drives towards Interoperability**

- Mandatory bricks guarantee interoperability
- Optional bricks allow flexibility
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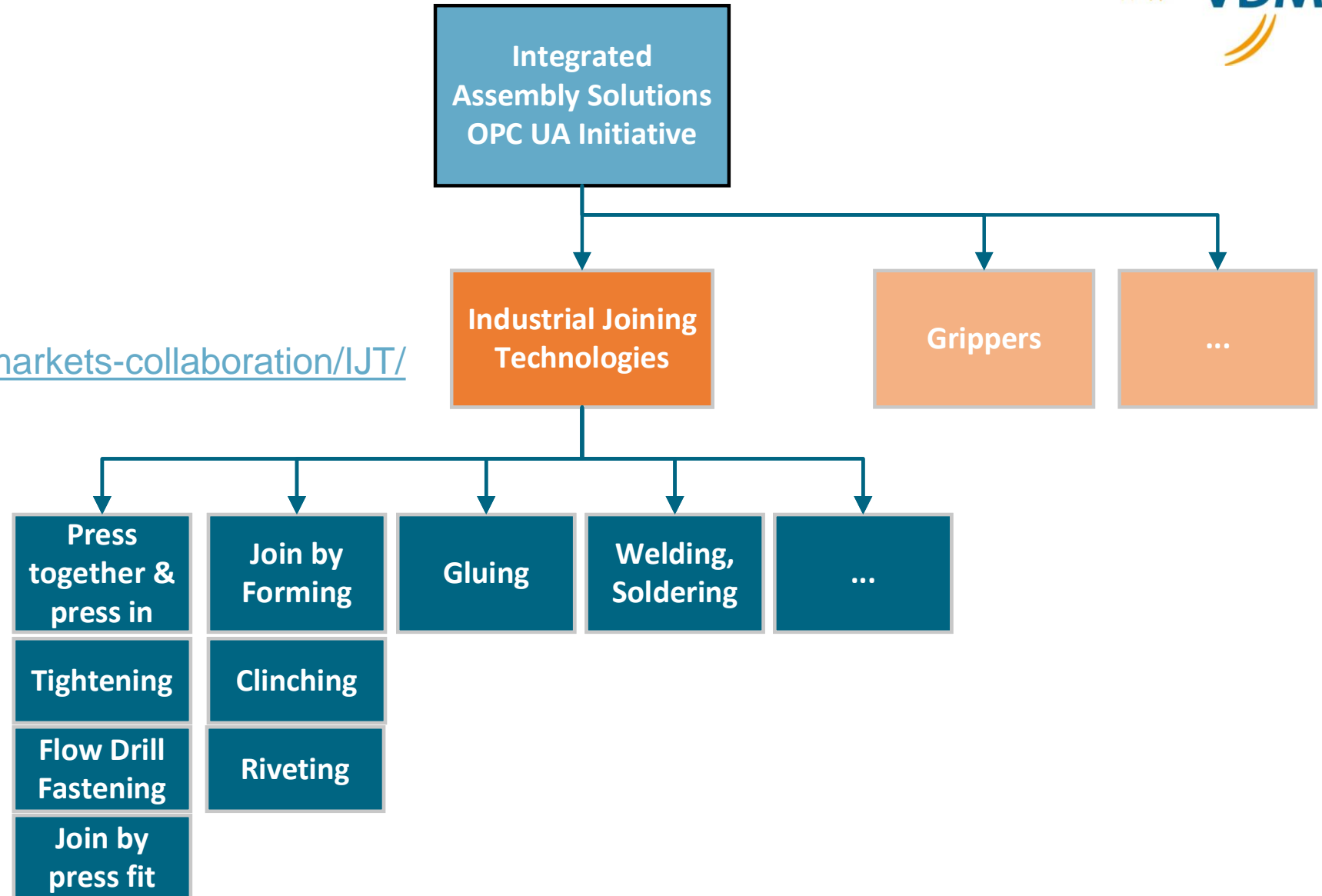


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Industrial Joining Technologies (IJT) Overview



- History
- Long term vision
- Status
- Taxonomy
- <https://opcfoundation.org/markets-collaboration/IJT/>



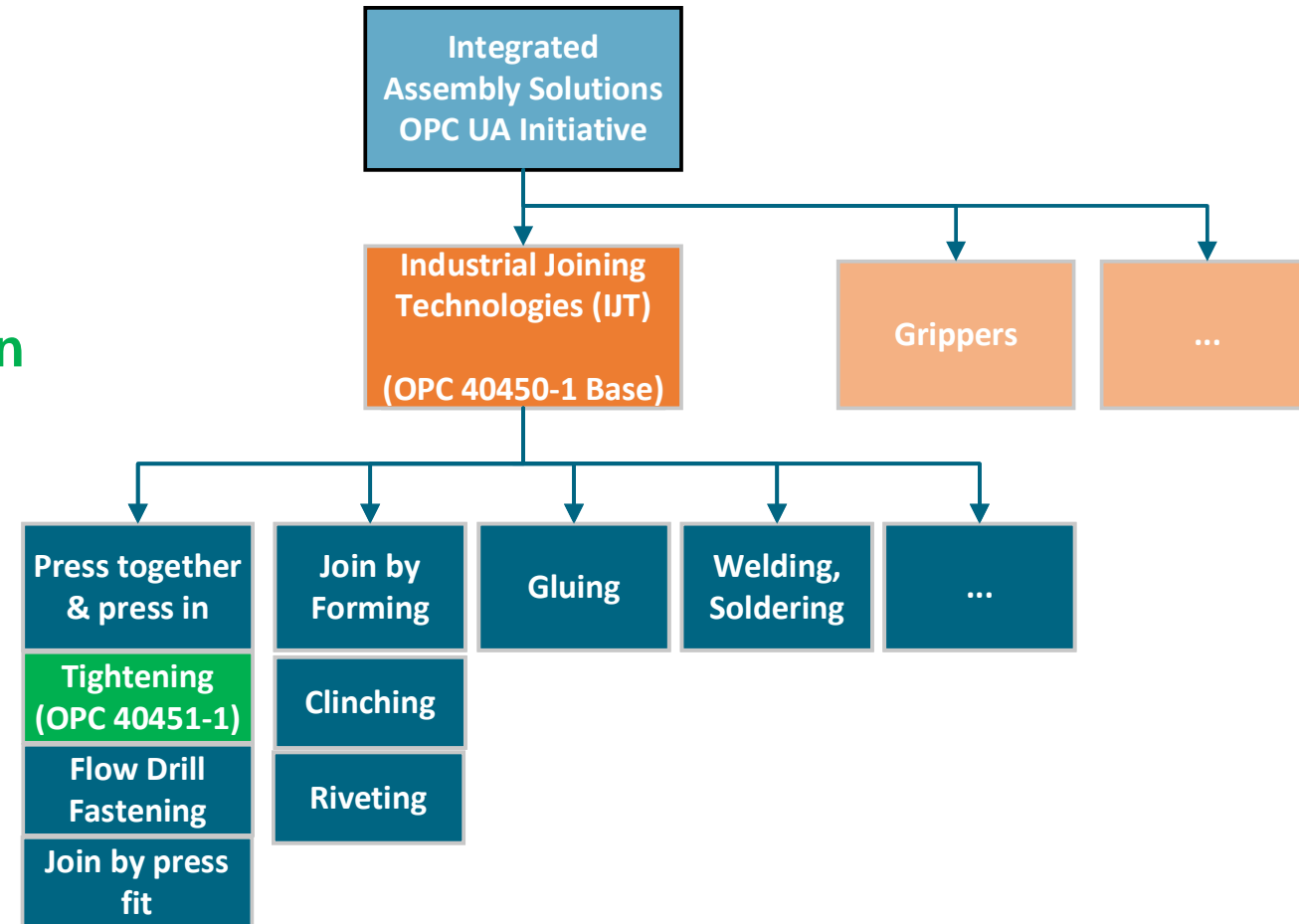
IJT Working Group Members



IJT Specification(s) Overview



- **OPC 40450-1** for Joining Systems **version 1.0**
 - Common elements of various joining technologies.
 - <http://opcfoundation.org/UA/IJT/Base/>
 - `Opc.Ua.Ijt.Base.NodeSet2.xml`
- **OPC 40451-1** for Tightening Systems **version 2.0**
 - **Version 1.0** was published in October 2021.
 - Moved common models to the base specification.
 - <http://opcfoundation.org/UA/IJT/Tightening/>
 - `Opc.Ua.Ijt.Tightening.NodeSet2.xml`



IJT Release 1 Use Cases



Asset Management

Overview and Identification of physical assets in the given system.

Example:

Manufacturer, Serial number, Software Revision...



Tightening Results

Primary process output of the tightening operation.

Example:

Measurement values, status, timestamp, linked traces, cyclic counter...



Condition Monitoring

Acquisition and processing of information that indicate the state of an asset over time.

Example:

Health status, temperature...



Basic Events

Events represent specific transient occurrences.

Example:

Tool disconnected, Tool overheated, Controller started...



IJT Release 2 Use Cases and Extensions



Result Management

Extending the Result model to include consolidated results.

Example:

Batch Result, Job Result, Multi-spindle Result, etc.



Event Management

Extension of Release 1 events to include more system scenarios.

Example:

Tool Connected, Maintenance Events, etc.



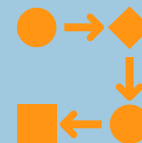
Commands

Asset Management control mechanisms.

Joining Process Management.

Example:

Select Program, Send Program, Enable Tool, etc.

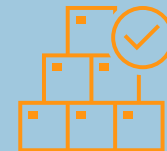


Joint Management

Provides joint data.

Example:

Joint with associated Programs, etc.



Summary



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OPC UA Overview (IEC 62541)

Problem Statement



- **I4.0 Challenges for Communication**
 - Interoperability
 - Security
 - ...

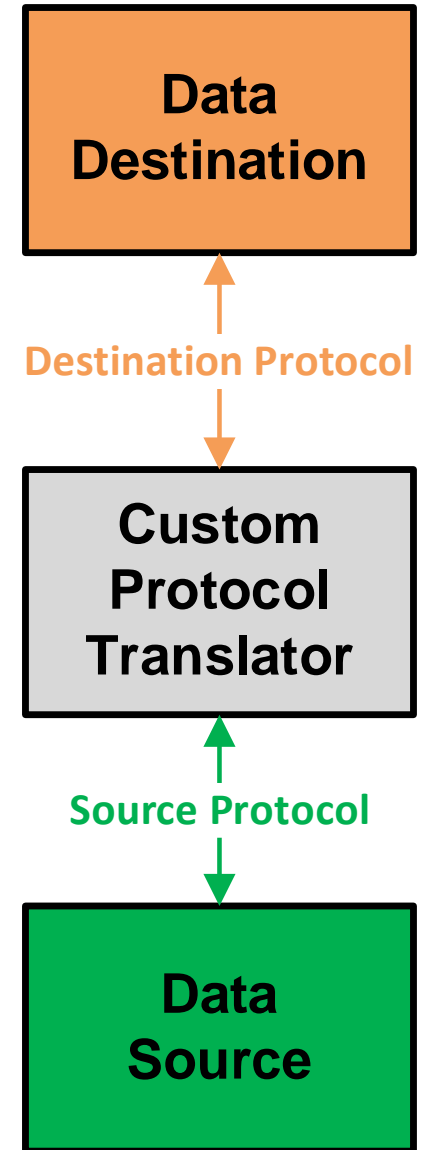
Traditional Solution – Custom Protocol Converter – Before OPC

Custom software is built through an extensive collaboration of both system's vendors.

- » Enabled tightly controlled communication between the source and destination regardless of complexity.

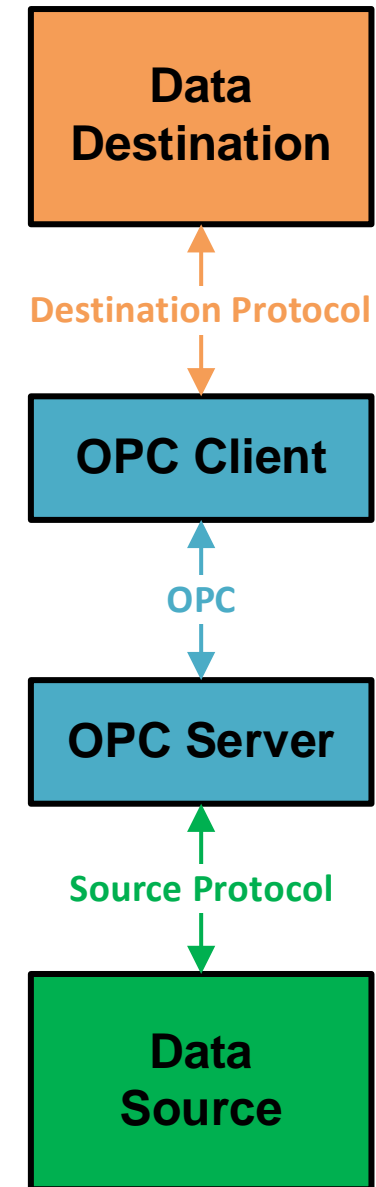
But it has the following limitations:

- Vendor Specific
- Costly to produce
- Costly to manage
- Proprietary Data Paths
- Little Integration
- Each application had custom drivers

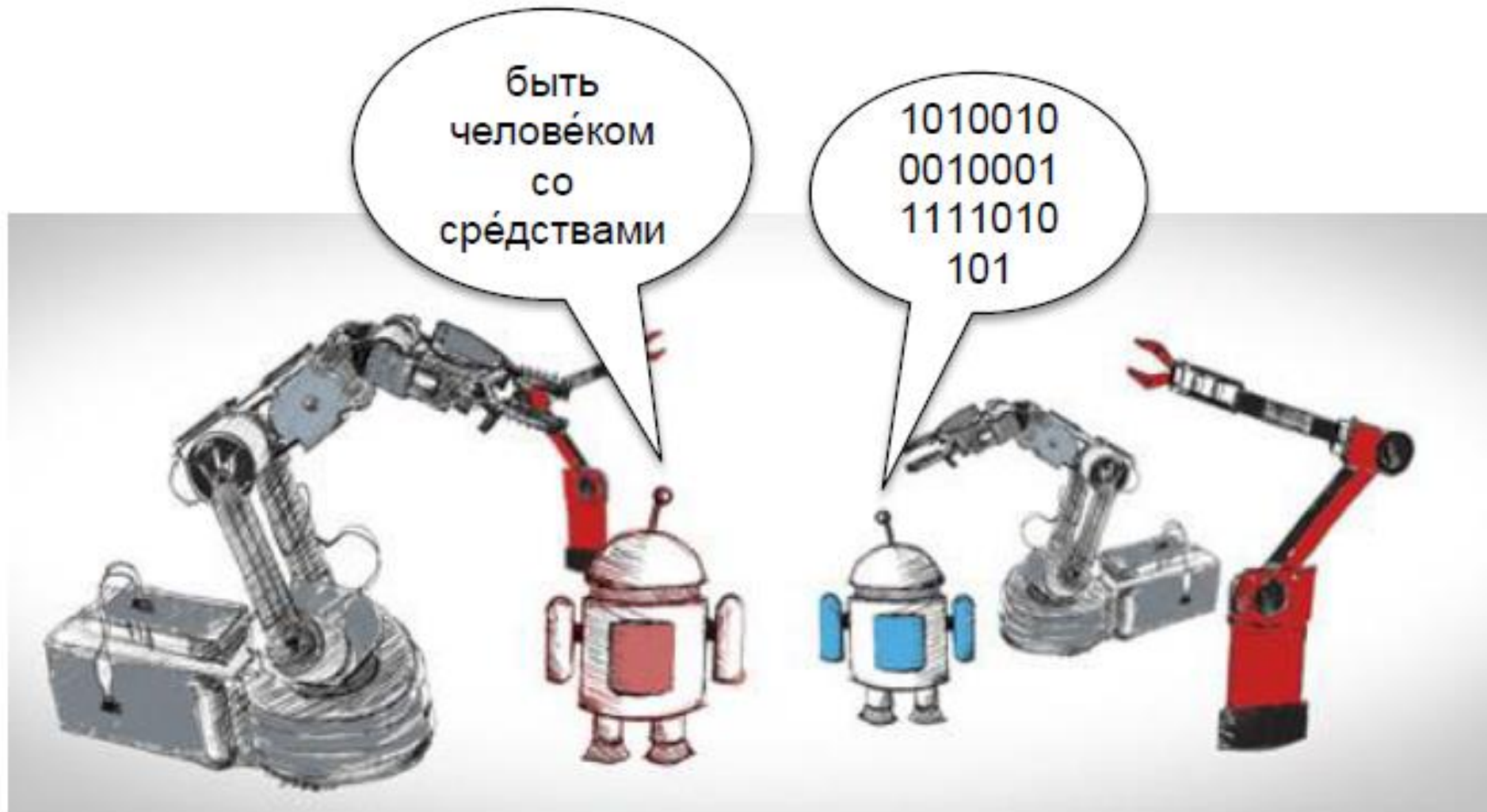


OPC Connectivity – OPC Classic Data Path

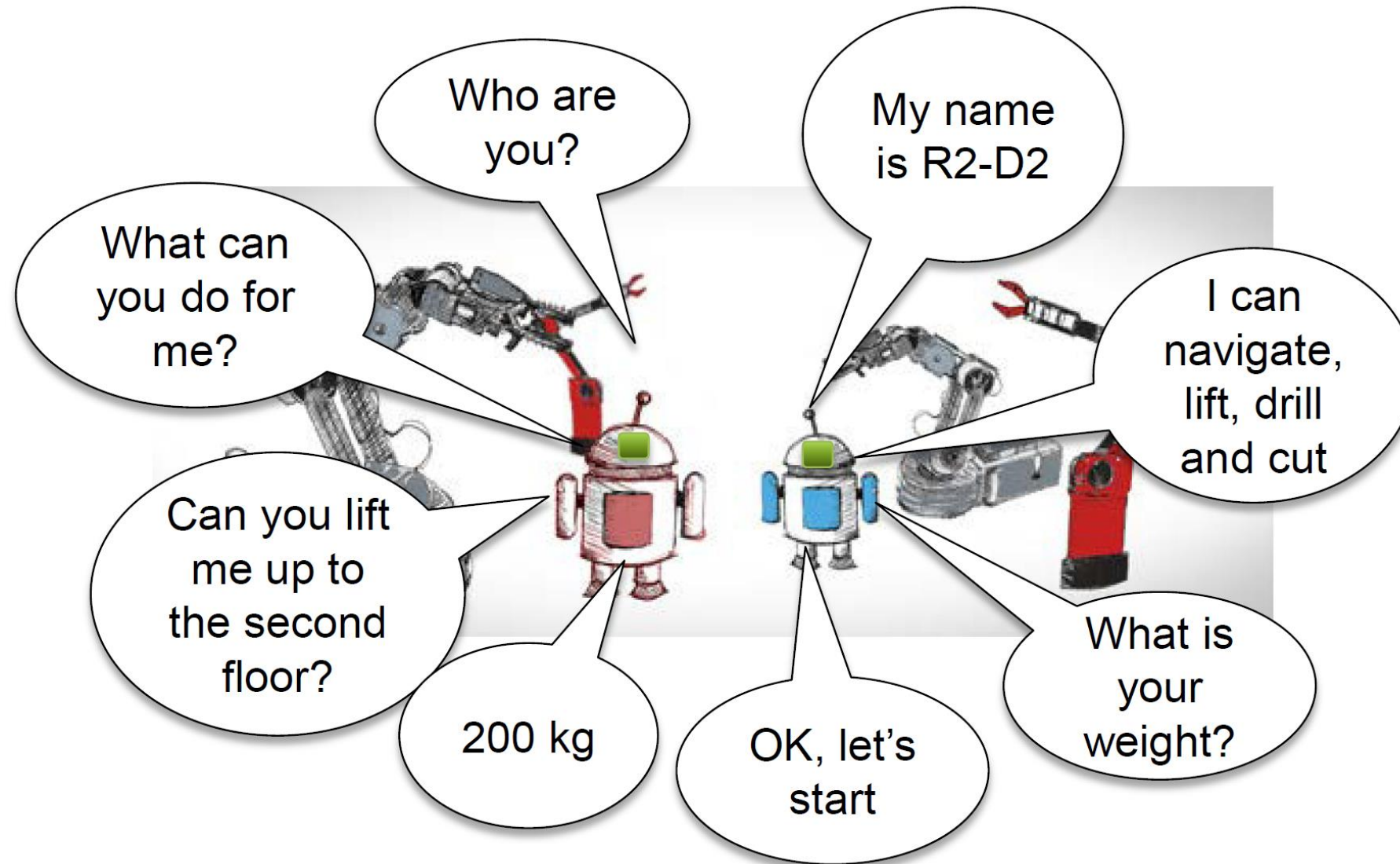
- All OPC Data Paths will consist of these four components.
- More complex architectures will consist of many OPC Data Paths.
- Understanding the OPC Data Path will enable understanding all OPC Solutions
 - Architecting
 - Implementing
 - Troubleshooting



Today's Interoperability Issues

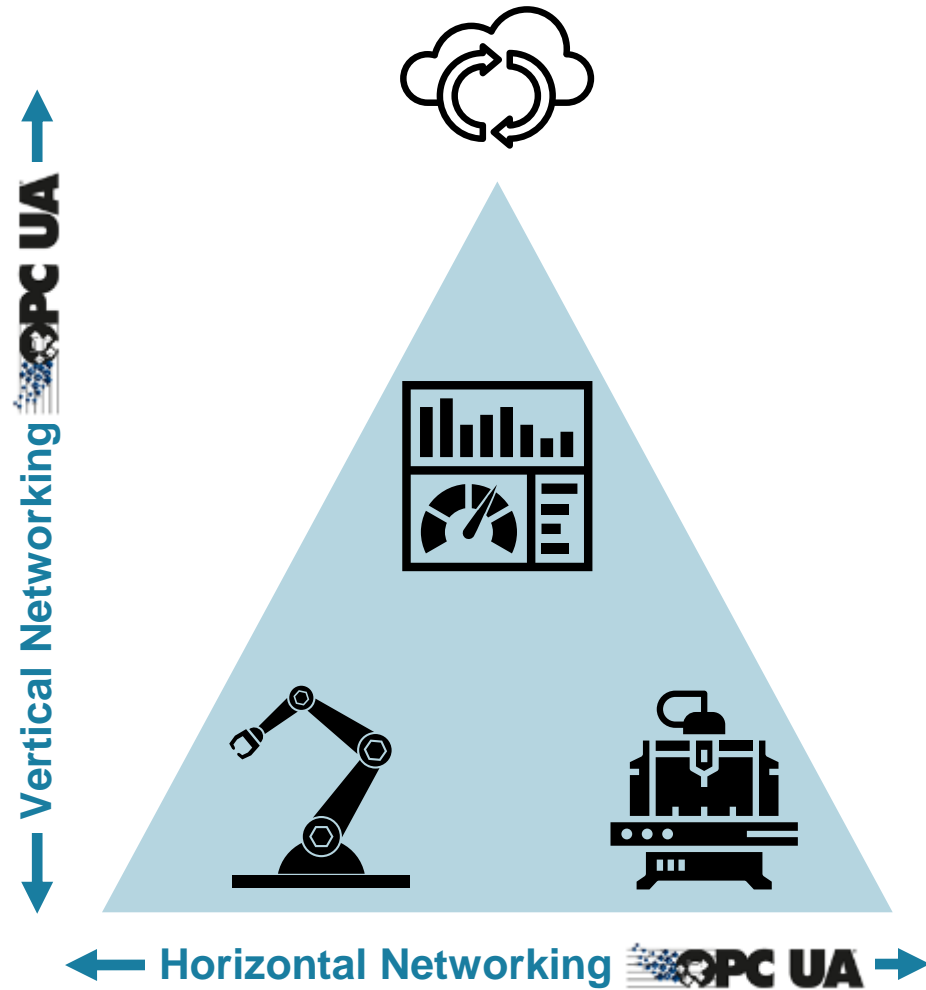


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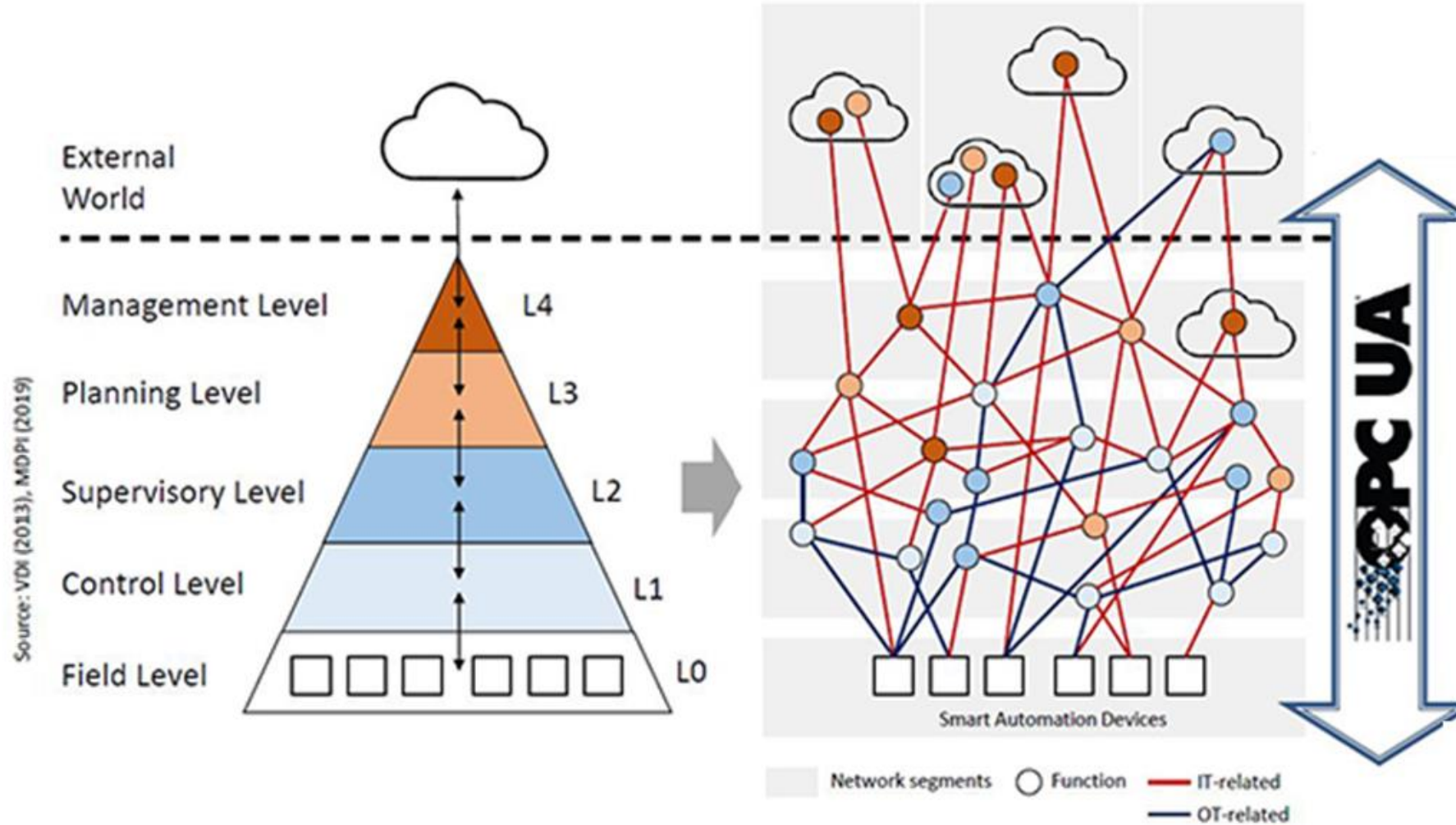


Global acceptance

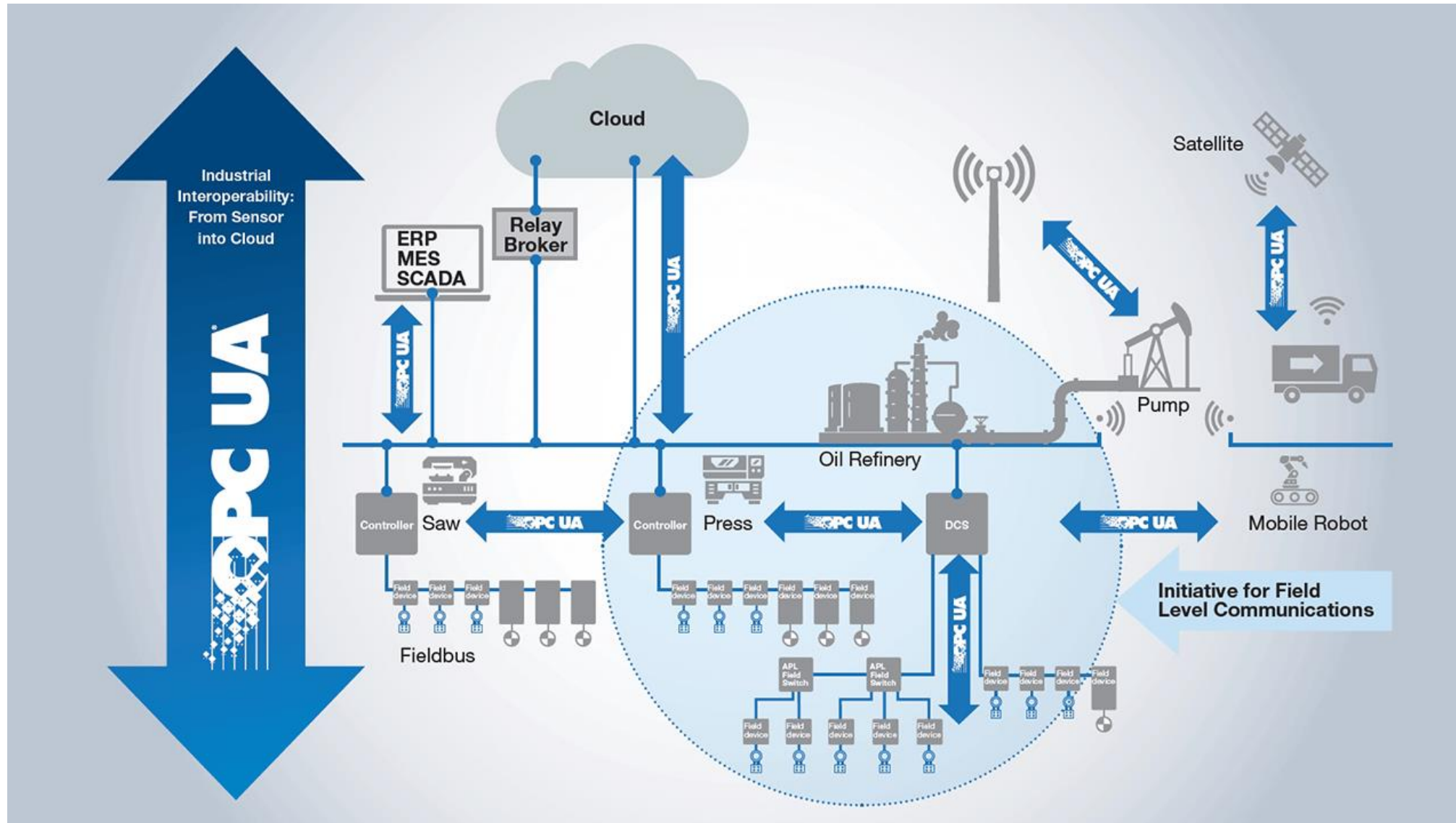


Semantic information models

From Automation Pyramid to Information Network



OPC UA Factory Network

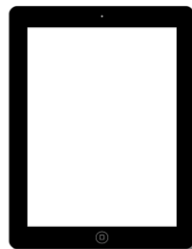
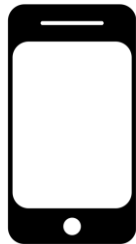
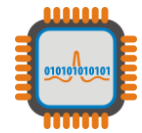


Source: OPC Foundation

OPC UA Deployment Scenarios

OPC UA Client/Server Architecture

Hardware



Operating Systems



Real Time
Operating
System



UNIX

OPC UA Client/Server Architecture



Device 1
OPC UA Client



Device 2
OPC UA Server

Client/Server

- » Client accesses information from the server via a permanently configured connection

Example: Request → Response

- » Device 1 requests information from Device 2
- » Device 2 replies to Device 1

Analogy

- » Letter service with registered mail and advice of receipt.

OPC UA – Client/Server Architecture

Communication via Subscription Notify



Client/Server

- » Client accesses information from the server via a permanently configured connection

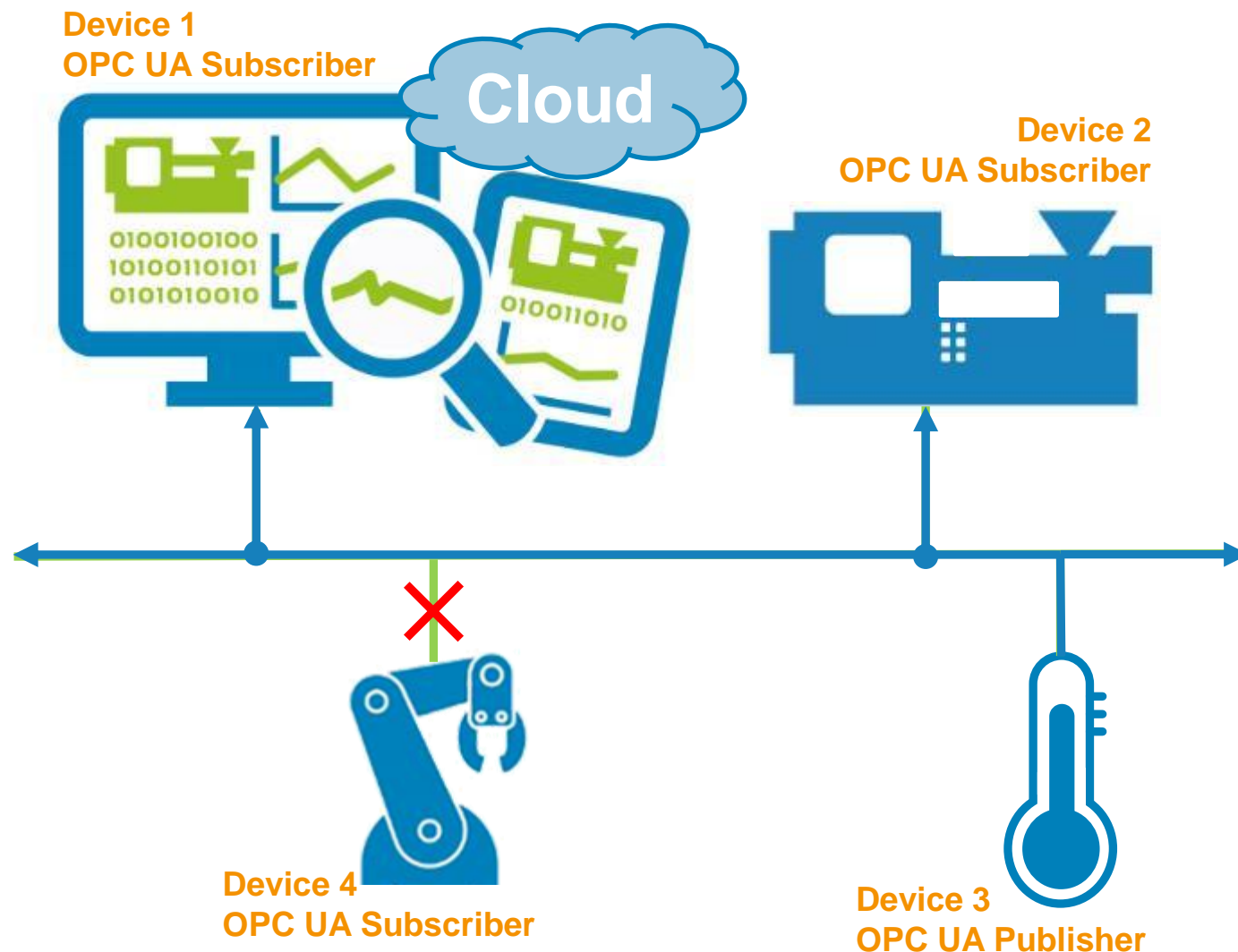
Example: Subscription → Notify

- » Device 1 subscribes to the information from Device 3
- » Device 3 informs Device 1 as soon as information changes

Analogy

- » Registration to football live ticker with feedback on special events via SMS

OPC UA Pub/Sub Architecture



Publisher/Subscriber

- » Publisher sends to unknown subscribers without a fixed connection
- » Application example:
 - 1:n - Sensor publishes data used by different systems

Example: Pub/Sub

- » Device 3 continuously sends information to the network
- » Device 1 and 2 have subscribed to the information
- » Device 4 has not subscribed to the information

Analogy

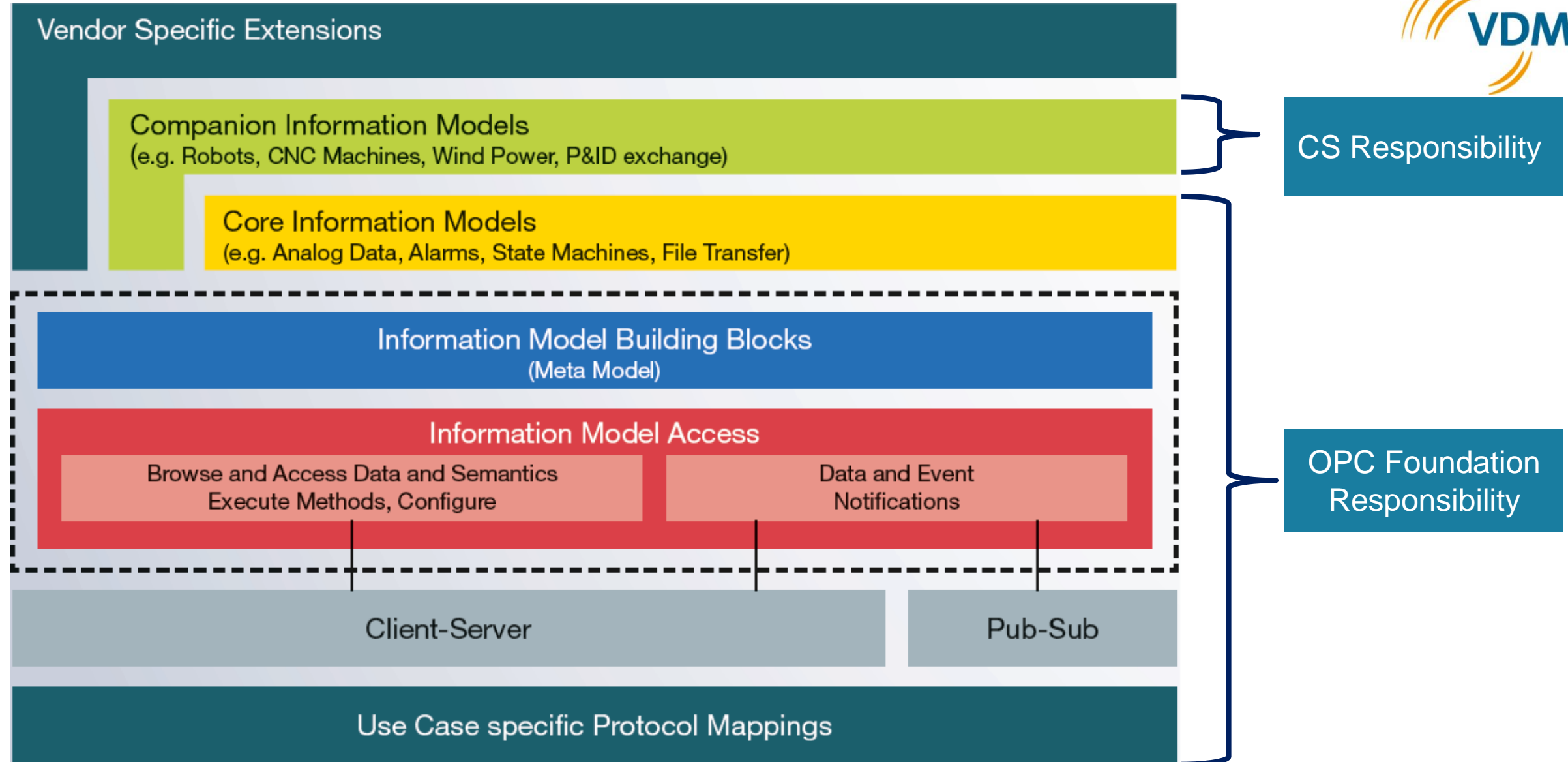
Setting a radio frequency

OPC UA Overview Summary

- **ONE – Information Model**
 - Object-oriented, flexible, and extendable.
 - Domain-specific models.
- **TWO – Communications**
 - Client/Server – service-oriented, request/response, on demand.
 - Publish/Subscribe – multicast, unidirectional, cyclic.
- **THREE – Protocols**
 - UA-TCP – TCP/IP based, HTTP/HTTPS, UA Binary, Port 4840 (LDS).
 - UADP – UDP based, UA Binary, TSN deterministic.
 - UADP – MQTT/AMQP based, JSON, Cloud, optional broker.
- **PLUS – Discovery and Security**

OPC UA Stack/SDK

Layered Architecture



Source: OPC Foundation

OPC UA Stack and SDKs



- OPC UA SDKs are available in various programming languages.
 - Ansi C, C++, C#, Java, Python, JavaScript, etc.
- The core functionality of OPC UA is handled as part of OPC UA SDK.
- OPC Foundation and other organizations provide various frameworks.
 - Open Source
 - Commercial

OPC UA Companion Specifications

Purpose of Companion Specification



- OPC UA Companion Specifications are developed for various reasons:
 - To publish specific information models (e.g., for specific industries, specific devices, specific use cases).
 - To specify how to use OPC UA in specific environments.
 - **Examples:**
 - OPC UA standard for Robotics (OPC 40010), Vision Systems (OPC 40100), Joining Systems (OPC 40450 and 40451), etc.
- **New Information Models** can be created based on the OPC UA Data Model and eventually derived from OPC UA **Base** Information Models.
 - Companion specifications of such Information Models are often called “**Industry standard models**” because they typically address a dedicated industry problem.
 - The synergy of the OPC UA infrastructure to exchange such industry information models enables interoperability at the semantic level.

Harmonization and Reuse



- The purpose of harmonization is to ensure that several companion standards reuse common building blocks. Several use cases could be common for various domains.
 - **Examples:** Asset Identification, Asset States, etc.
- OPC Foundation and partner organizations such as VDMA enable the reuse of common elements across domains.
- There are several OPC Harmonization groups where representatives of different companion specifications participate and harmonize the information models.
 - **Examples:** Device Integration, Machinery Building Blocks, Machinery Result Transfer, Asset Management Basics, Relative Spatial Location, and many more...
- Any new companion specification planned to be developed is recommended to be reviewed in the OPC Harmonization Group.
- This approach helps in avoiding reinvention of the wheel.

Ways to produce companion specifications



OPC Foundation differentiates **three** ways of producing companion specifications:

- **INTERNAL:** These are specifications created by OPC-internal working groups.
- **JOINT:** These are specifications that are created in a joint working group between the OPC Foundation and another organization.
 - These joint specifications represent the majority. The JOINT working group program is defined here: <https://opcfoundation.org/joint-working-groups/>
 - **Example:** IJT Working Grouping is a Joint Working Group of OPC Foundation, VDMA and various vendors. VDMA hosts the IJT Working Group.
- **EXTERNAL:** Companion specifications can also be created independent of the OPC Foundation.

Interoperability Solution Summary

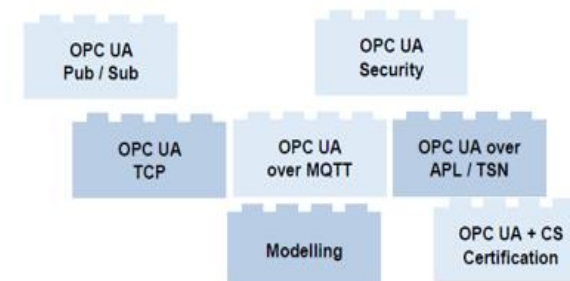
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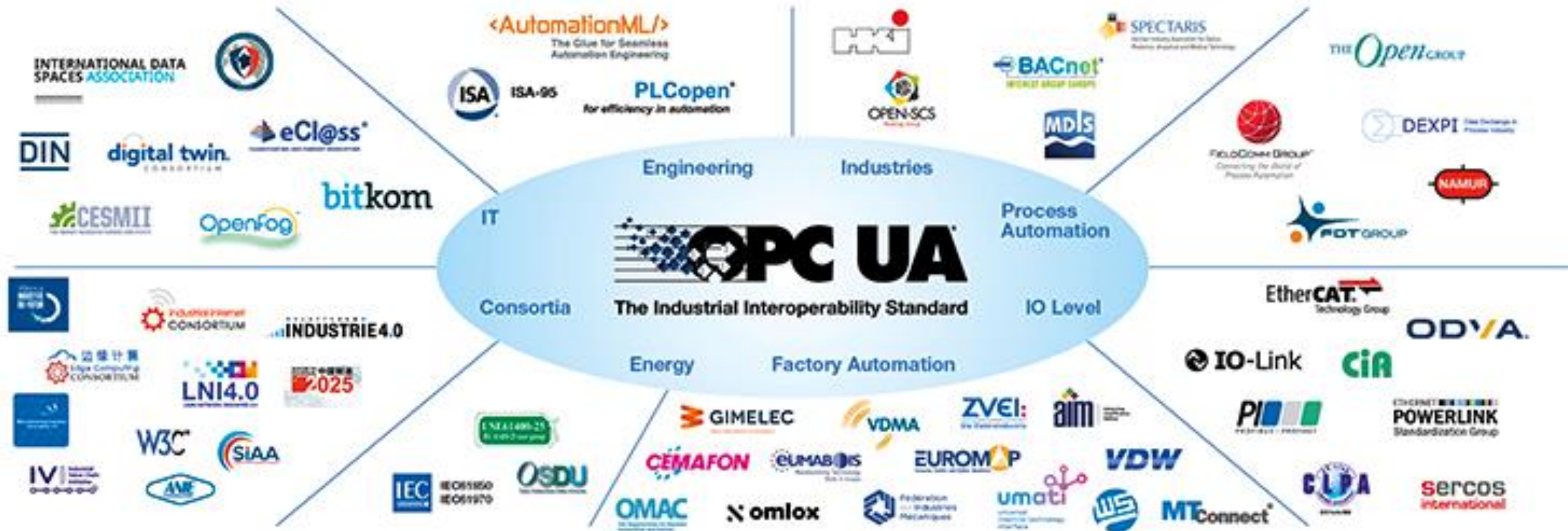


Source: OPC Foundation

Collaboration Domain Specific Information Models

Collaboration Domain Specific Information Models

The OPC Foundation closely cooperates with organizations and associations from various branches. Specific information models of other standardization organizations are mapped onto OPC UA and thus become portable.



Source: OPC Foundation

OPC UA Profiles and Certification

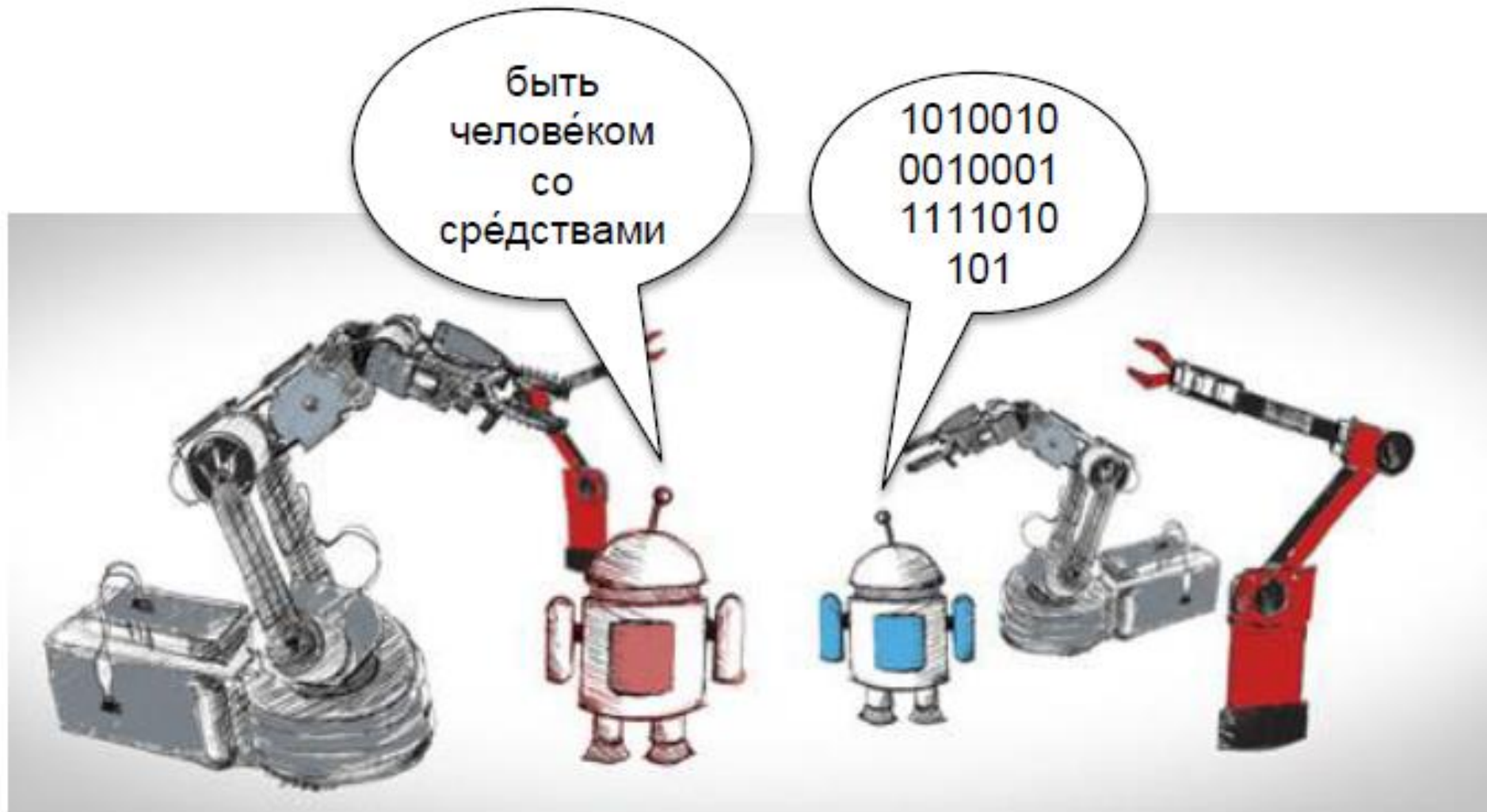
OPC UA Profiles and Certification



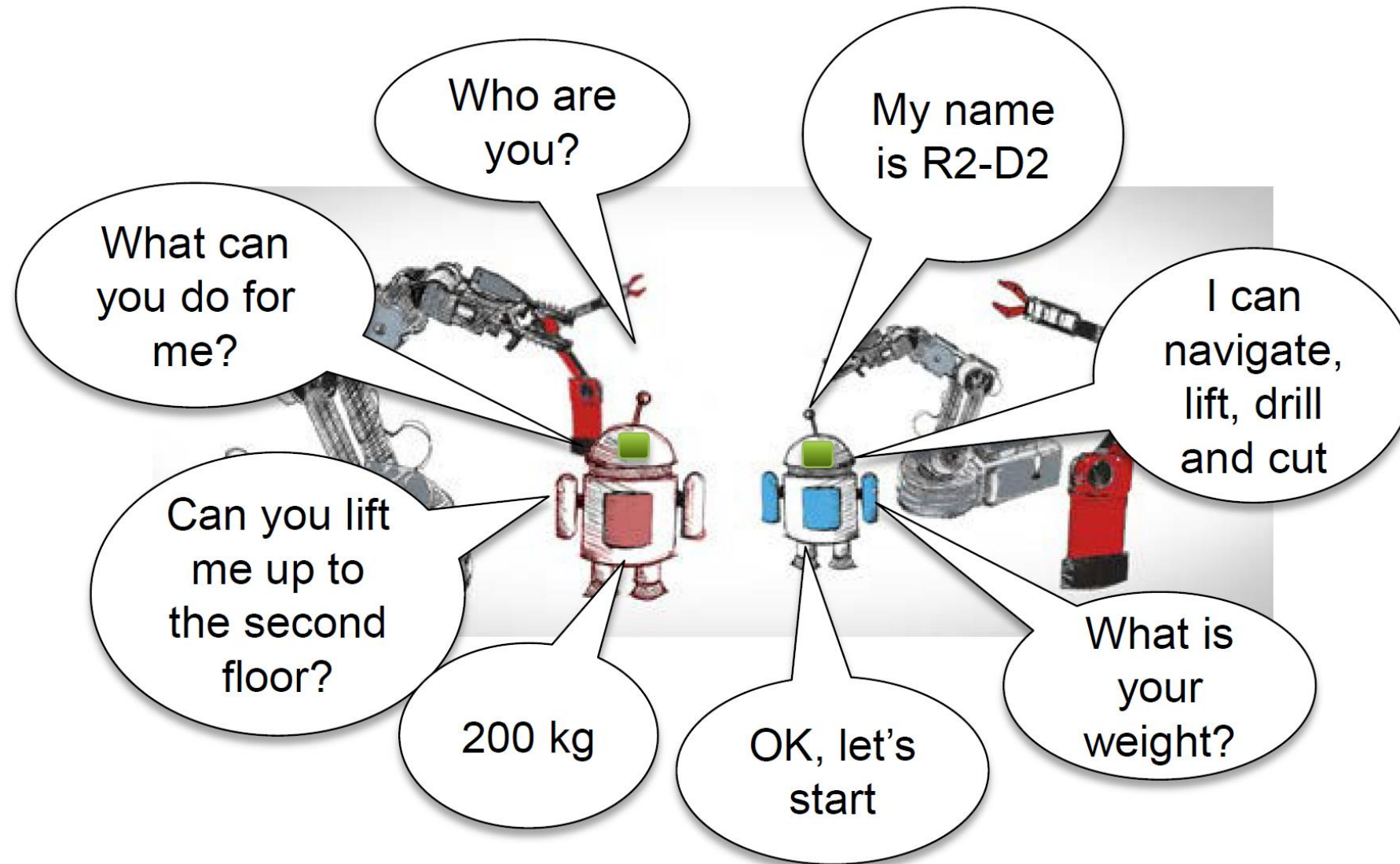
- **What is OPC Certification?**
 - <https://opcfoundation.org/certification/overview-benefits/>
 - <https://opcfoundation.org/products/?certified=yes>
- **Compliance Test Tools (CTT)**
 - OPC Foundation provides tools which can validate OPC UA Core functionality.
 - <https://opcfoundation.org/developer-tools/certification-test-tools>
- **Companion Specification Certification**
 - OPC Foundation provides support in testing CS manually or also helps in defining the automated test cases based on collaboration.
 - **Working Group Responsibility:** Definition of Profiles, CUs, Facets, and Test Cases.
- **OPC UA Profiles**
 - Terms and Definitions: <https://reference.opcfoundation.org/Core/Part7/v105/docs/3.1>
 - Profile reporting tool: <https://profiles.opcfoundation.org/>

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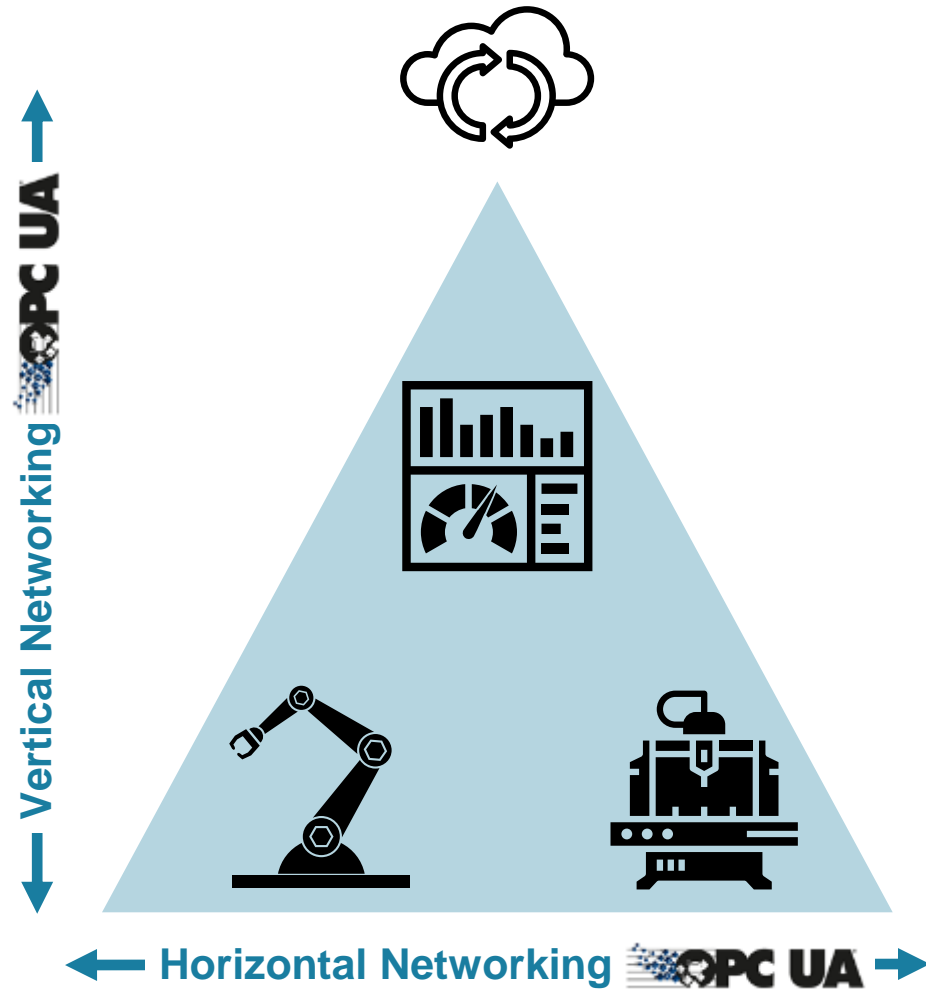
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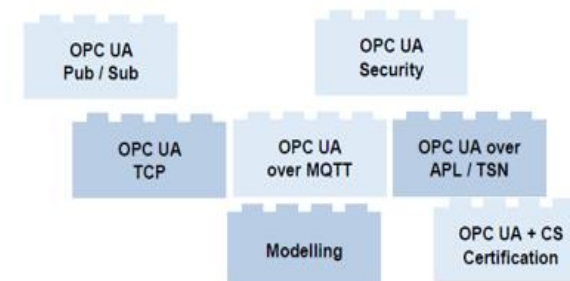
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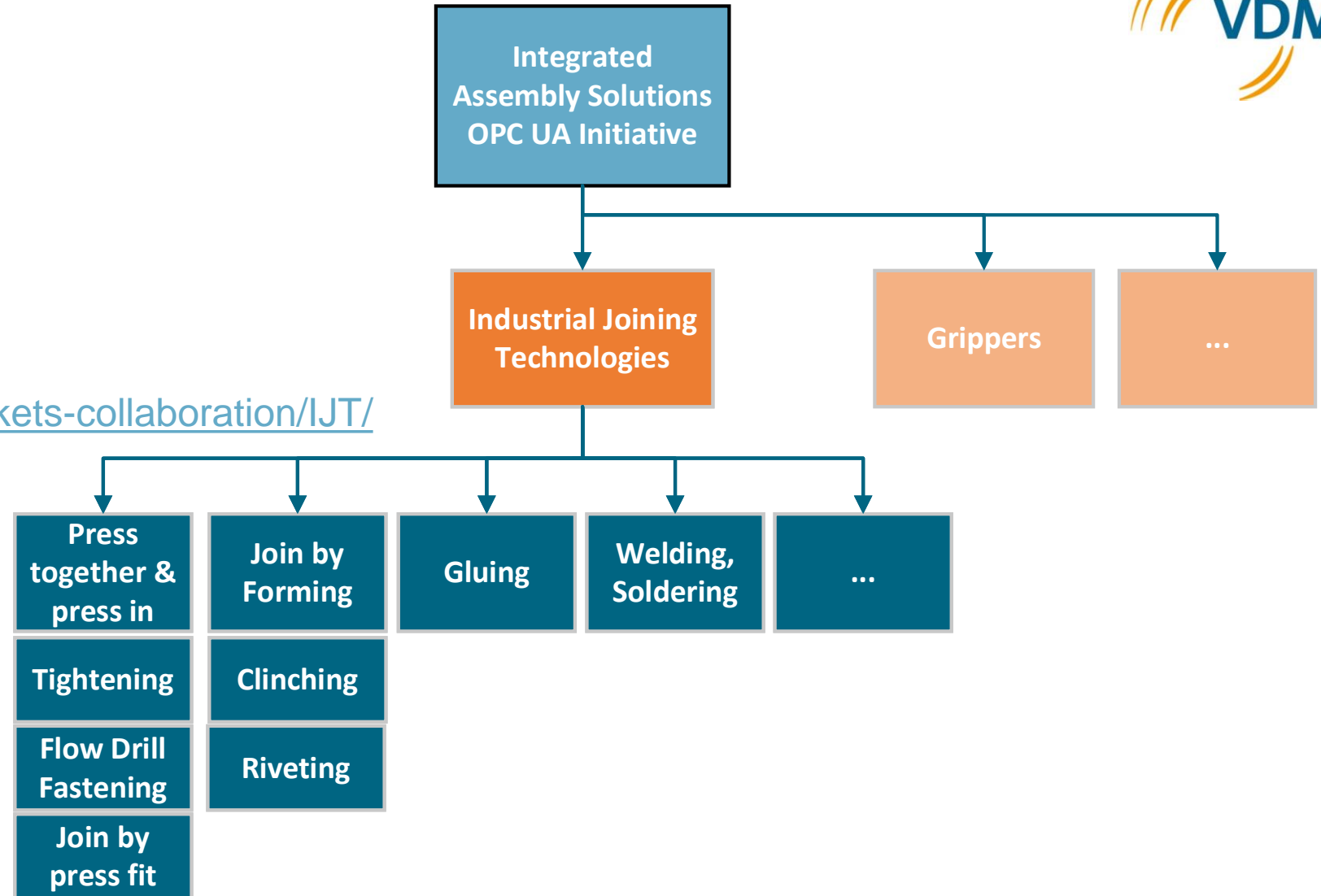
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Industrial Joining Technologies (IJT) Overview

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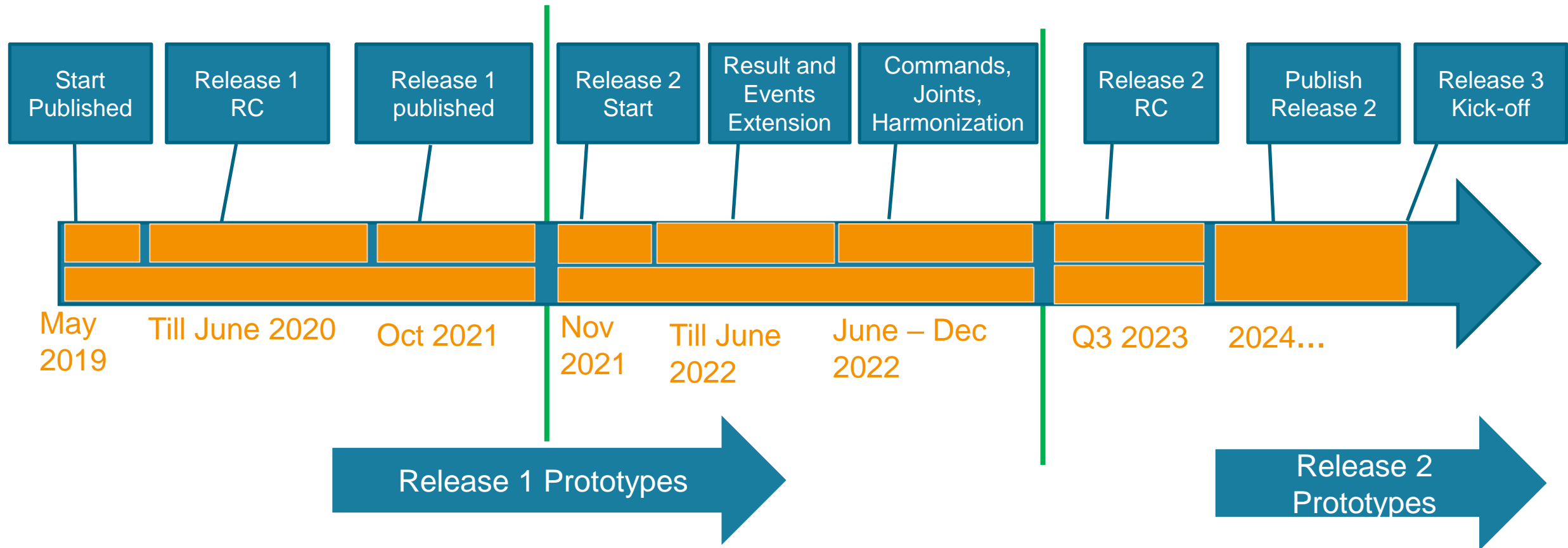
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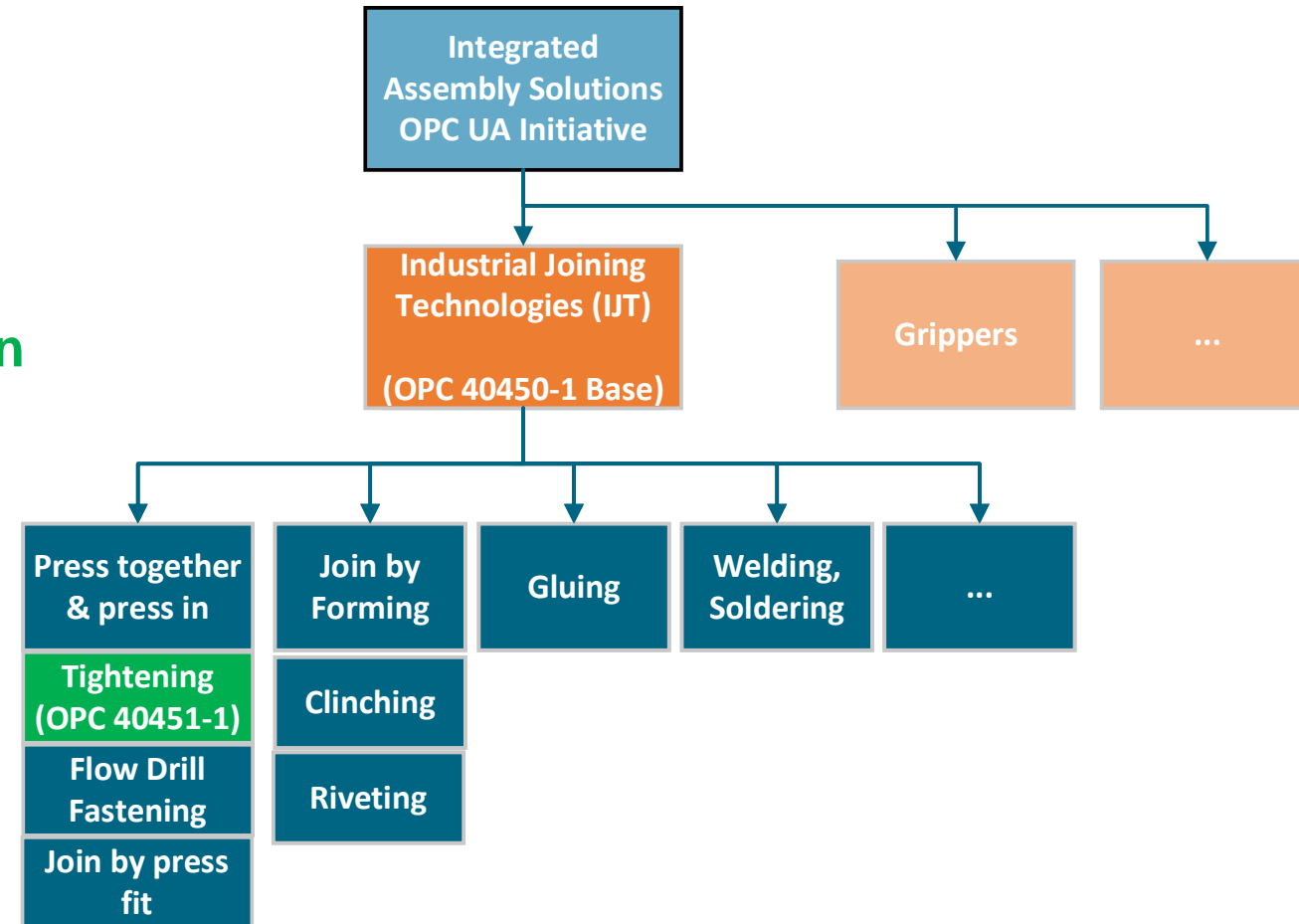
History and Milestones



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Reuse of Harmonized Specifications



NamespaceUri	Description	Use	Namespace Index	Example
http://opcfoundation.org/UA/	OPC UA Base	Mandatory	0	0:EngineeringUnits
http://opcfoundation.org/UA/DI/	OPC UA for Devices (OPC 10000-100).	Mandatory	2	2:DeviceRevision
http://opcfoundation.org/UA/AMB/	OPC UA for Asset Management Basics (OPC 10000-110).	Mandatory	3	3:IRootCauseIndicationType
http://opcfoundation.org/UA/Machinery/	OPC UA for Machinery Basic Building Blocks (OPC 40001-1).	Mandatory	4	4:MachineIdentificationType
http://opcfoundation.org/UA/Machinery/Result/	OPC UA for Machinery Result Transfer (OPC 40001-101).	Mandatory	5	5:ResultManagementType

IJT Use Cases

IJT Release 1 Use Cases



Asset Management

Overview and Identification of physical assets in the given system.

Example:

Manufacturer, Serial number, Software Revision...



Tightening Results

Primary process output of the tightening operation.

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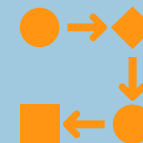
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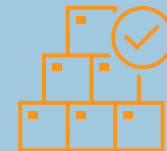


Joint Management

Provides joint data.

Example:

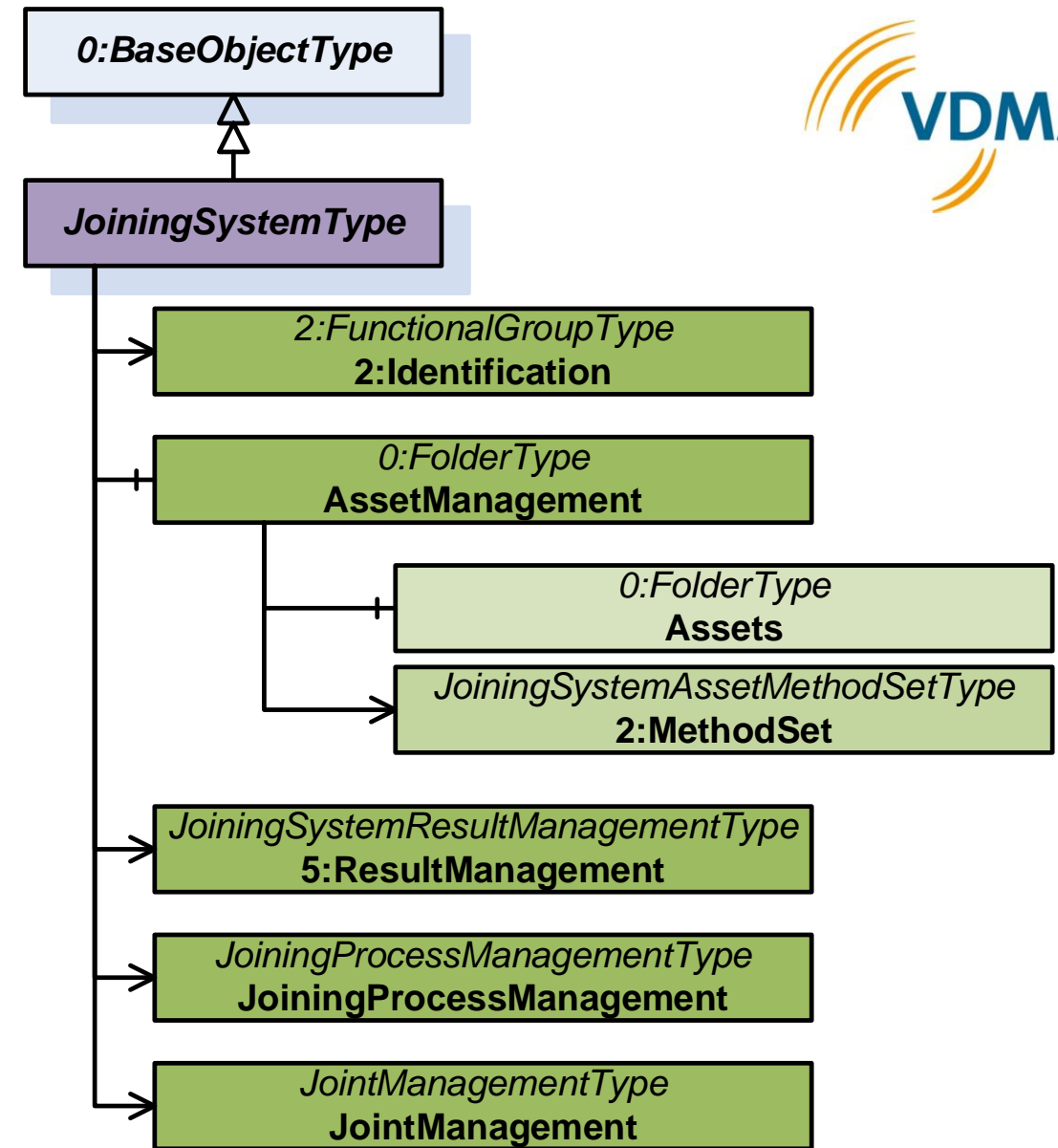
Joint with associated Programs, etc.



Technical Overview of Models

Joining System Overview

- Standard entry point for a joining system.
- Common interface for any joining system.
- Top-level structure with building blocks for the **use cases** discussed such as:
 - Asset Management
 - Result Management
 - Joining Process Management
 - Joint Management
 - ...



Asset Management

Asset Management Overview



- Definition of assets building blocks.
- Diverse systems – Flexible asset management model to build different systems.
 - Fixtured, Handheld, Pneumatic, Multi-Channel, Single Channel
- Reuse of Machinery Building Blocks and Asset Management Basics.
- Future Extensibility with the usage of Interfaces and Add-Ins instead of concrete types.

Joining System

Controller

Tool

Servo

Feeder

Battery

Software

Accessory

Memory
Device

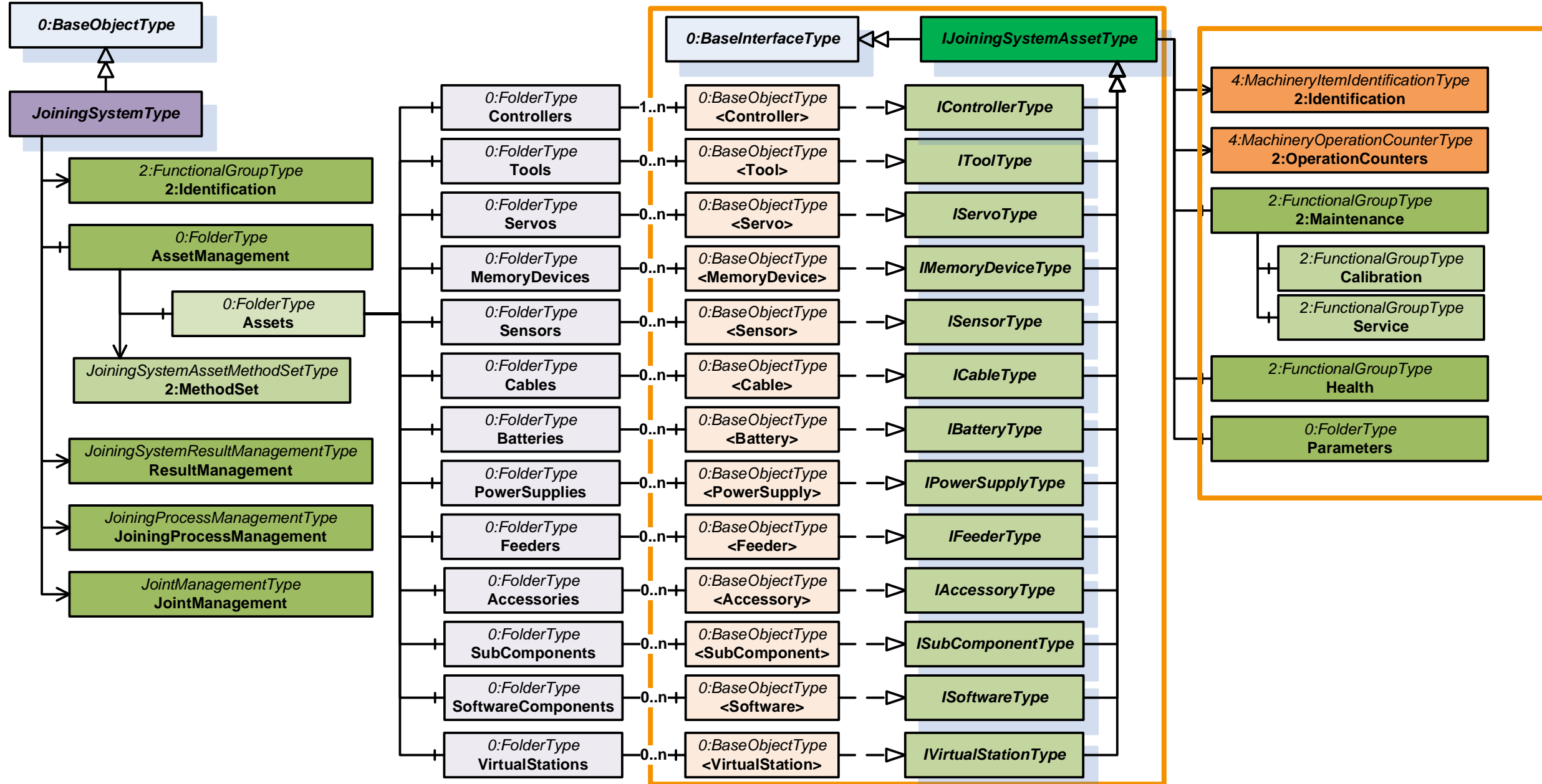
Cable

Power
Supply

Sub-
Component

Virtual
Station

Asset Management

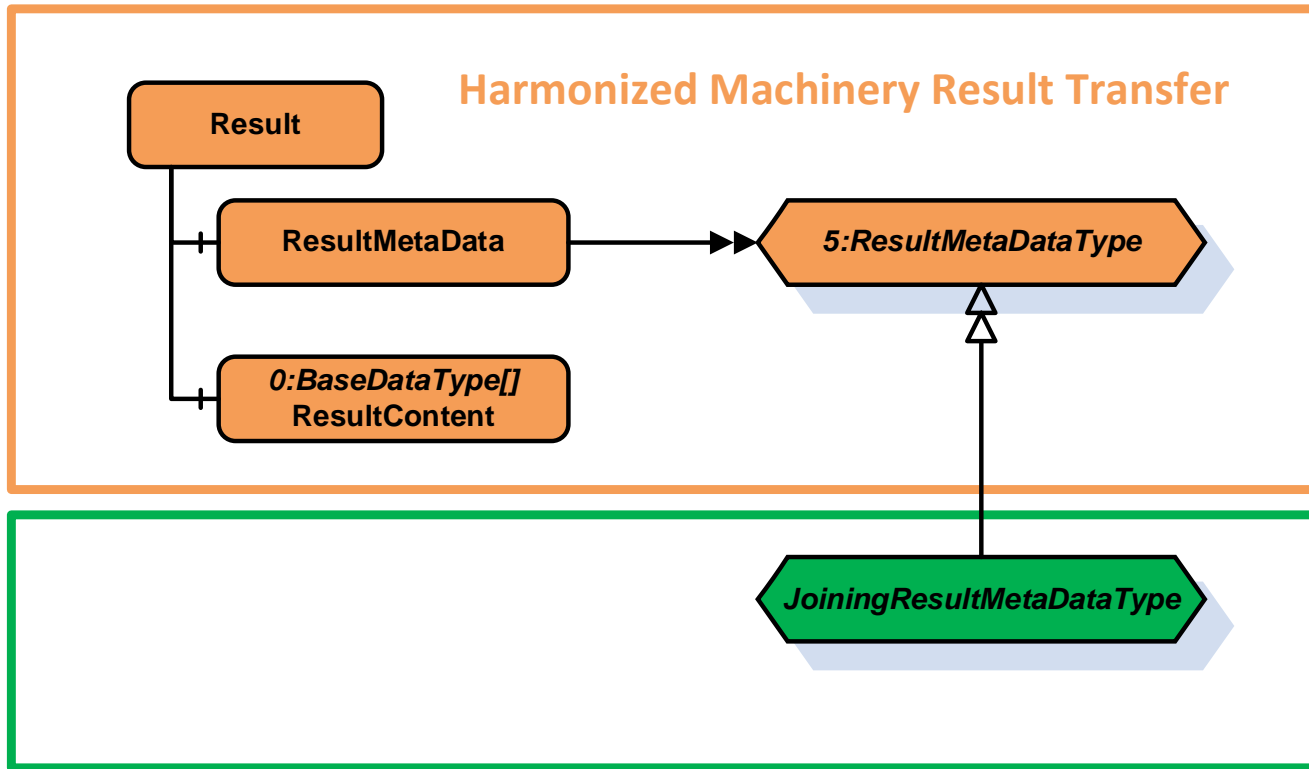


Result Management

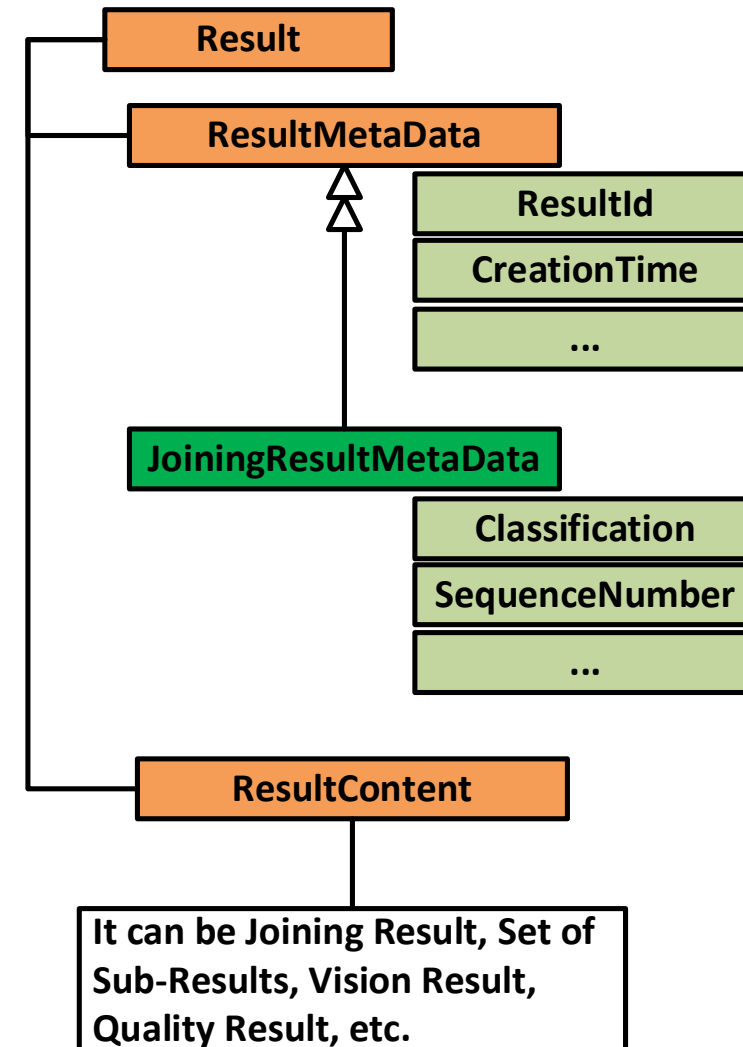
Result Overview



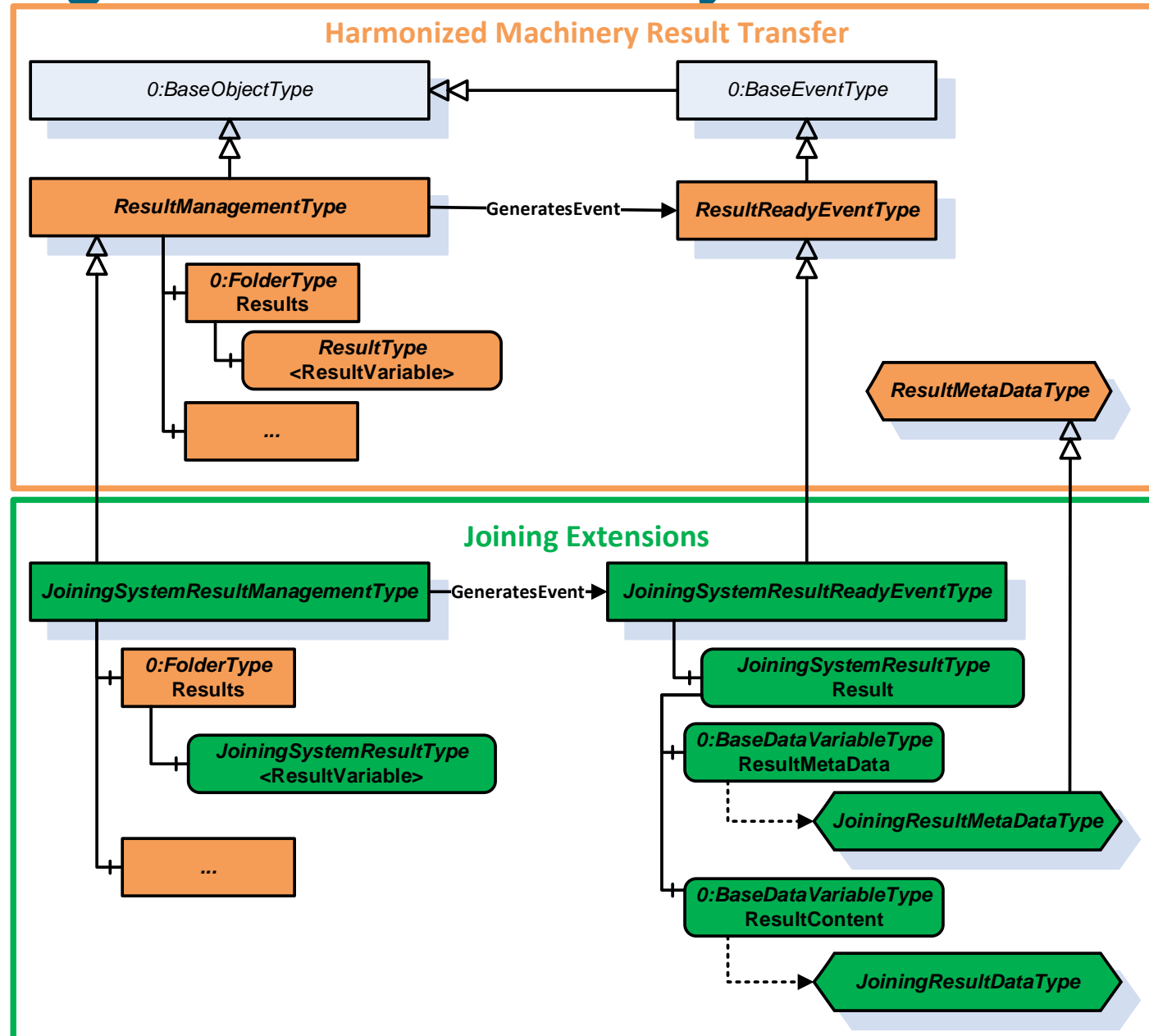
Structure



Example



Result Management – Machinery Result Extension

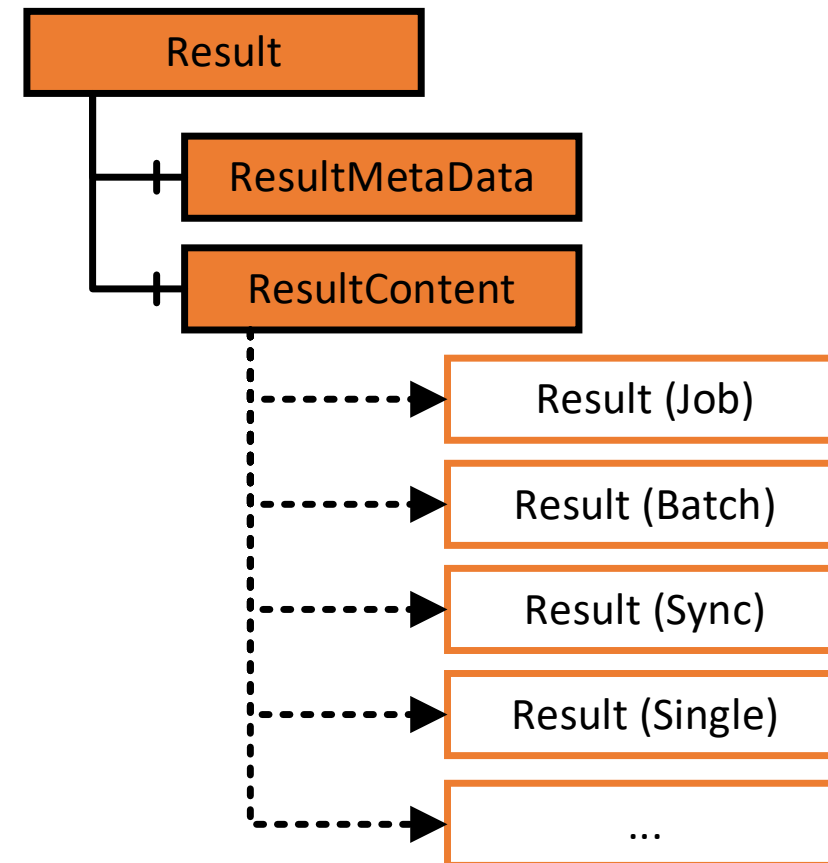


Result Classification – Multiple Use Cases



- Result
 - Common Joining Meta Data
- Result Content
 - Single Result
 - Batch Result
 - Job Result
 - Sync (Multi-spindle) Result
 - Stitching Result

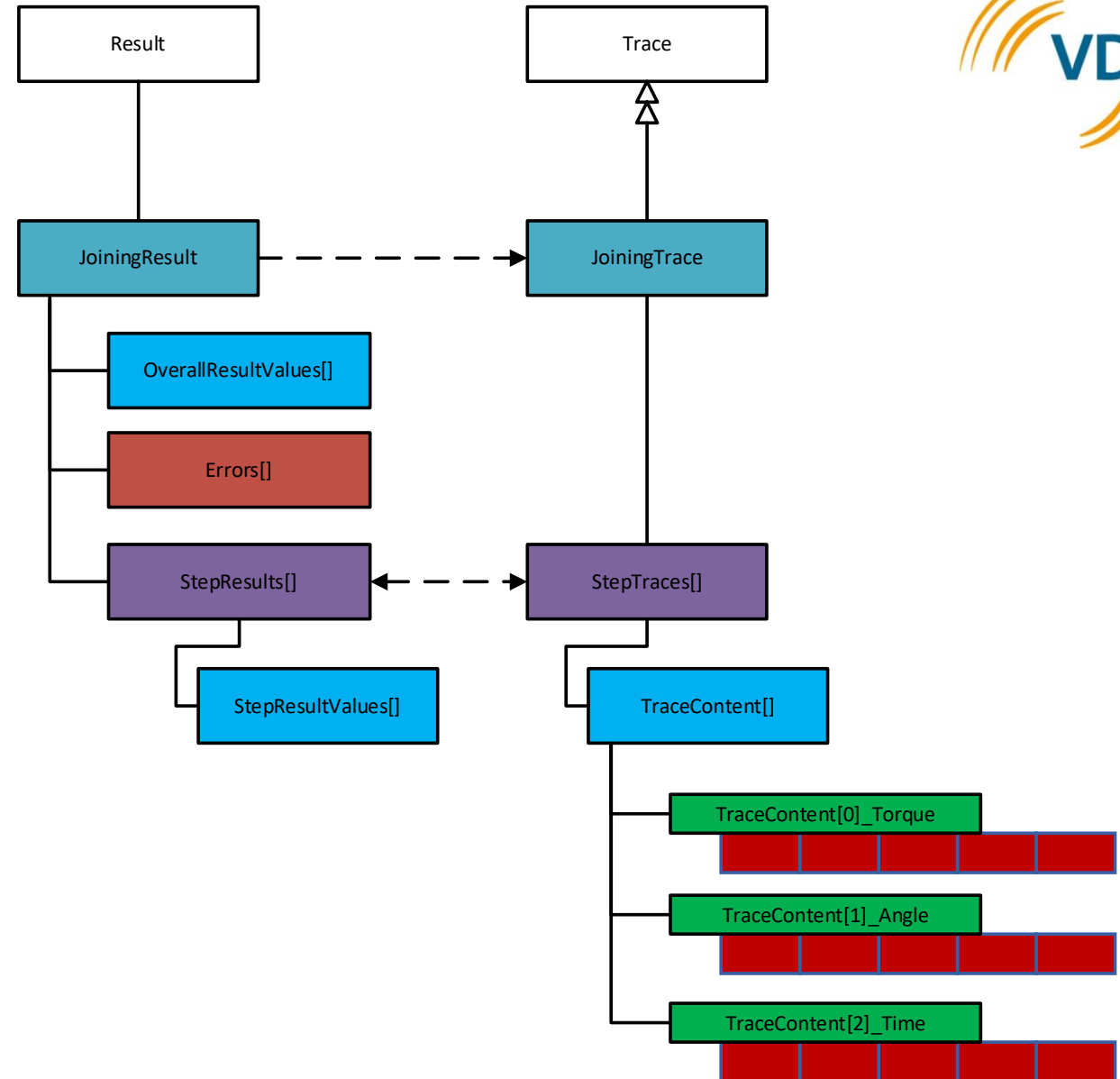
RESULT MODEL



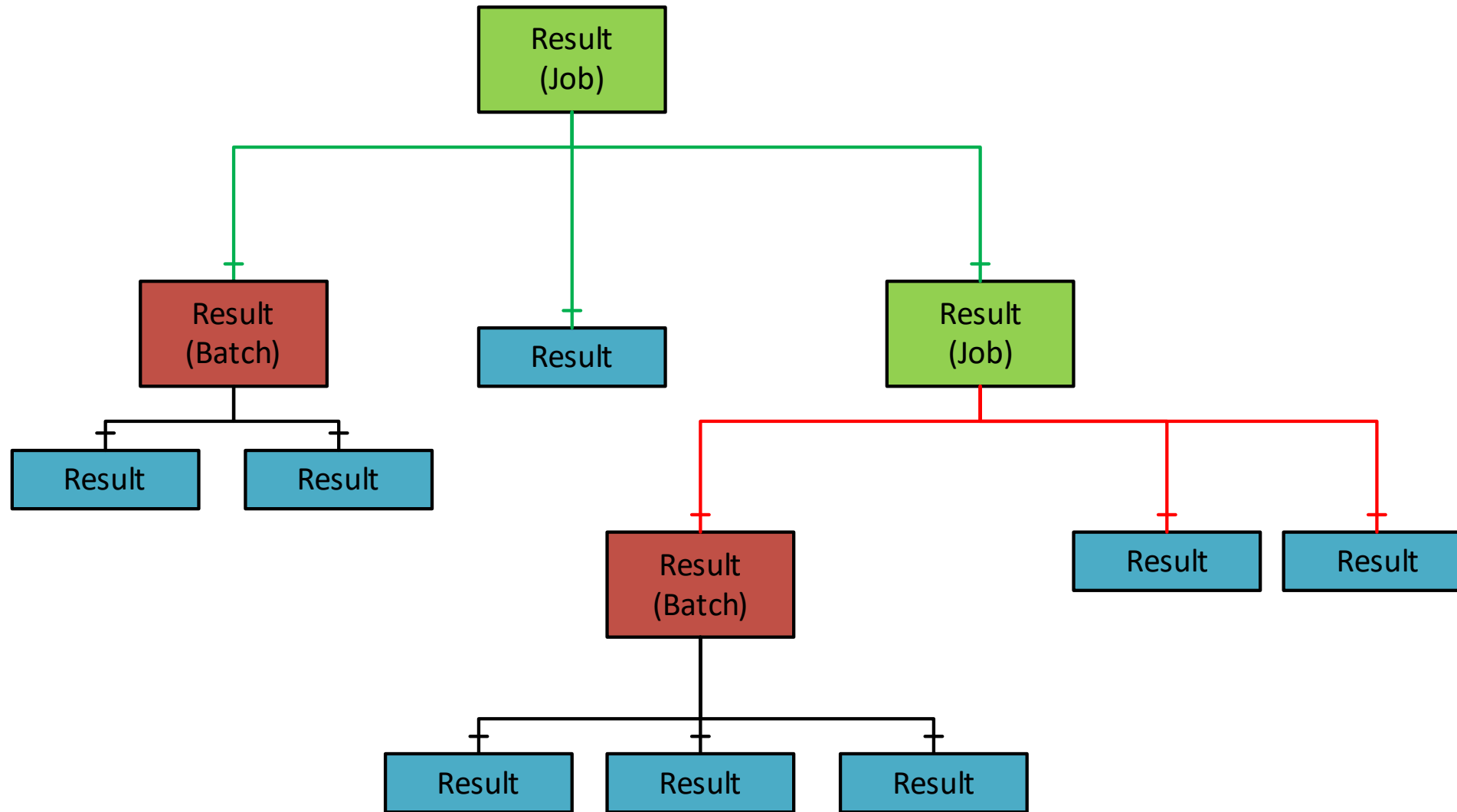
Single Joining Result Content



- Joining Result
 - Global values
 - Step Results
 - Errors
 - Traces



Combined Results – Job Result Example



Partial and Complete Results

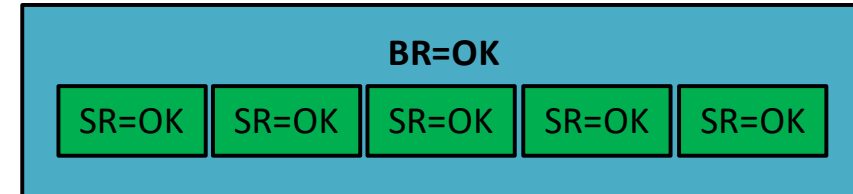


- Results can be sent in different ways:
 - Case 1: Complete result
 - Storage and analytics.
 - Case 2: Partial results
 - Track intermediate progress.

Batch Result Example

SR - SINGLE RESULT
BR - BATCH RESULT

Case 1: Batch Result and Single Results together



Case 2: Batch Result and Single Results separately.
Single Result with reference to parent Batch Result



Event Management

Event Management

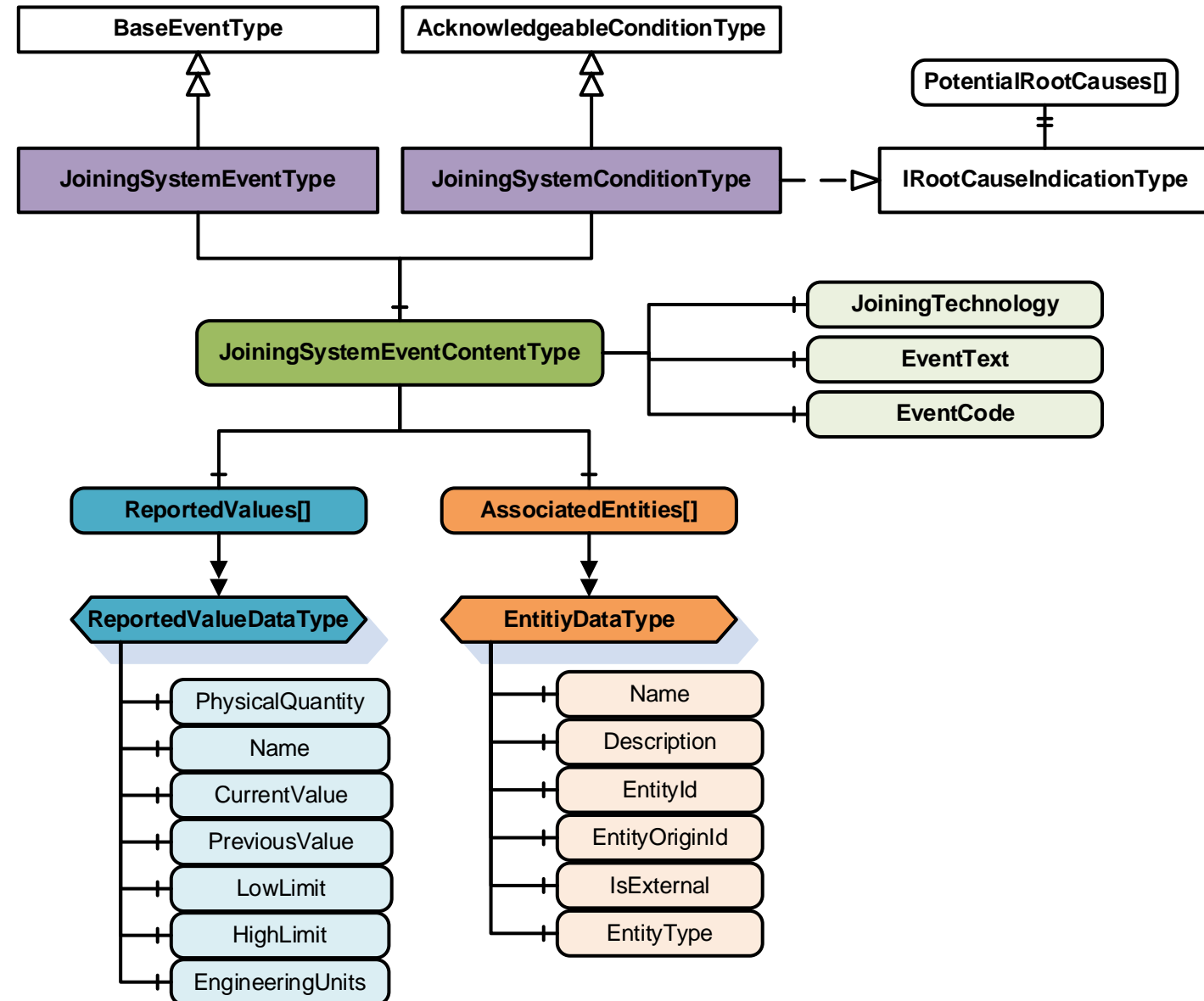
Event and Condition with **standard payload** from a joining system.

- **Event**

- Simple transient information sent from the underlying system.
- Fire and forget from the sender's perspective.

- **Condition**

- Have a State associated.
- Can be acknowledged by the client.



Condition Classes

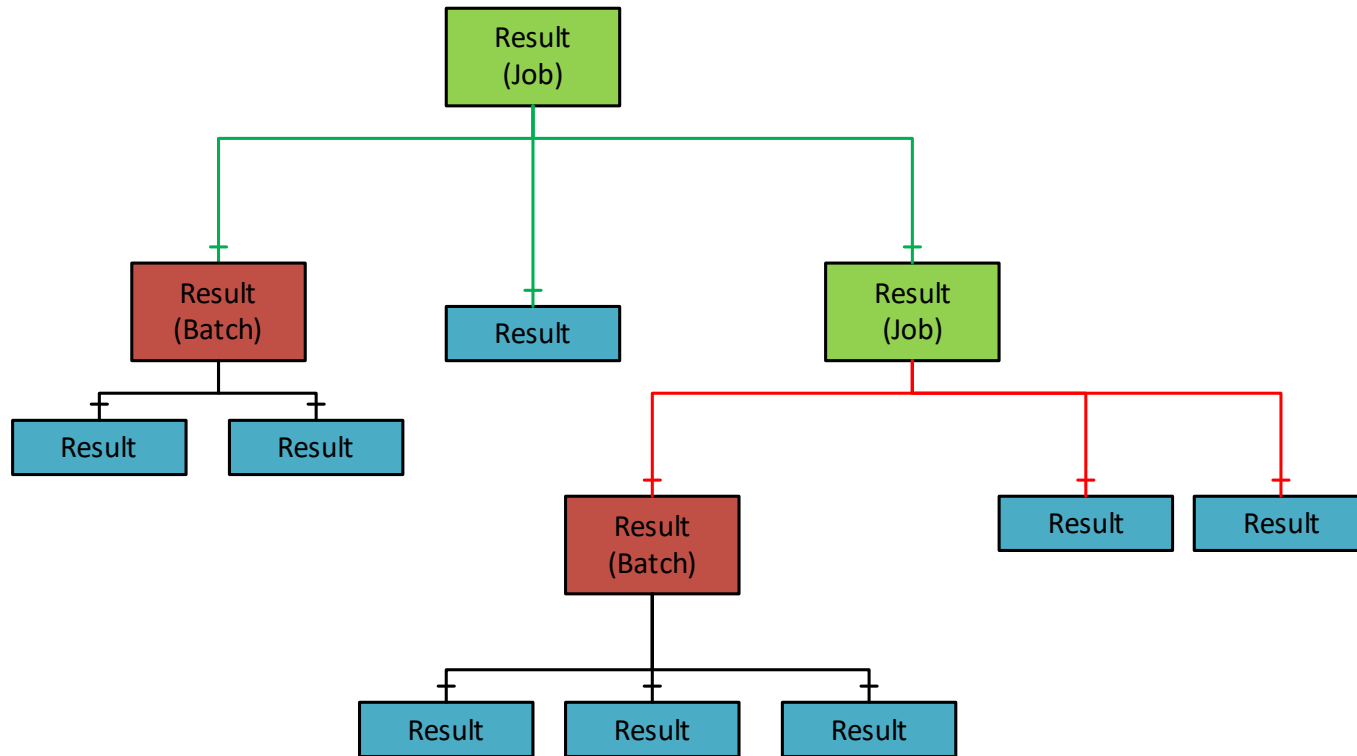
- **Condition Classes**
 - Reuse from base specifications.
- **Condition Sub Classes**
 - Defined in the IJT Working Group.
- **Example 1: Tool Disconnected**
 - **ConditionClass** = SystemConditionClass
 - **ConditionSubClass** = AssetDisconnectedConditionClass
- **Example 2: The tool is out of range from the station.**
 - **ConditionClass** = SystemConditionClass
 - **ConditionSubClass** = LocationOutOfZone
- **Example 3: Software Expired**
 - **ConditionClass** = SystemConditionClass
 - **ConditionSubClass[0]** = SoftwareConditionClass

Condition Classes in Base Specifications	Condition Classes in IJT Specification(s)
OPC UA Base	
BaseConditionClass	AssetConnectedConditionClass
ProcessConditionClass	AssetDisconnectedConditionClass
MaintenanceConditionClass	AssetEnabledConditionClass
SystemConditionClass	AssetDisabledConditionClass
SafetyConditionClass	ThresholdViolationConditionClass
HighlyManagedAlarmConditionClass	ThresholdViolationResolvedConditionClass
TrainingConditionClass	JoiningSystemUserLoggedInConditionClass
StatisticalConditionClass	JoiningSystemUserLoggedOutConditionClass
TestingConditionClass	LocationInRangeConditionClass
Asset Management Basics	LocationOutOfRangeConditionClass
ConnectionFailureConditionClass	AssetLocationConditionClass
OverTemperatureConditionClass	DataValidationFailureConditionClass
CalibrationDueConditionClass	InputValidationFailureConditionClass
SelfTestFailureConditionClass	ConfigurationChangeConditionClass
FlashUpdateInProgressConditionClass	ErrorConditionClass
FlashUpdatedFailedConditionClass	SoftwareConditionClass
BadConfigurationConditionClass	HardwareConditionClass
OutOfResourcesConditionClass	CertificateConditionClass
OutOfMemoryConditionClass	LicenseConditionClass
InspectionConditionClass	MissingEntityConditionClass
ExternalCheckConditionClass	ExpiredEntityConditionClass
ServicingConditionClass	InvalidEntityConditionClass
ImprovementConditionClass	IncompatibleEntityConditionClass
RepairConditionClass	AcceptedEntityConditionClass
	RejectedEntityConditionClass
	AddedEntityConditionClass
	UpdatedEntityConditionClass
	RemovedEntityConditionClass
	ReceivedEntityConditionClass

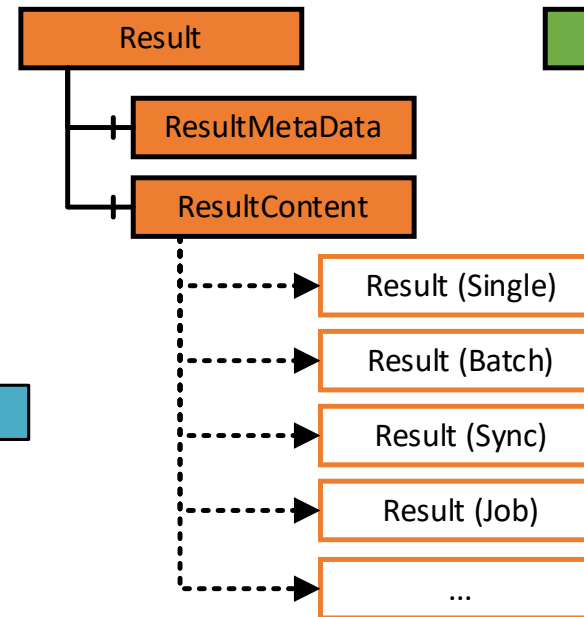
Joining Process Management

Joining Process

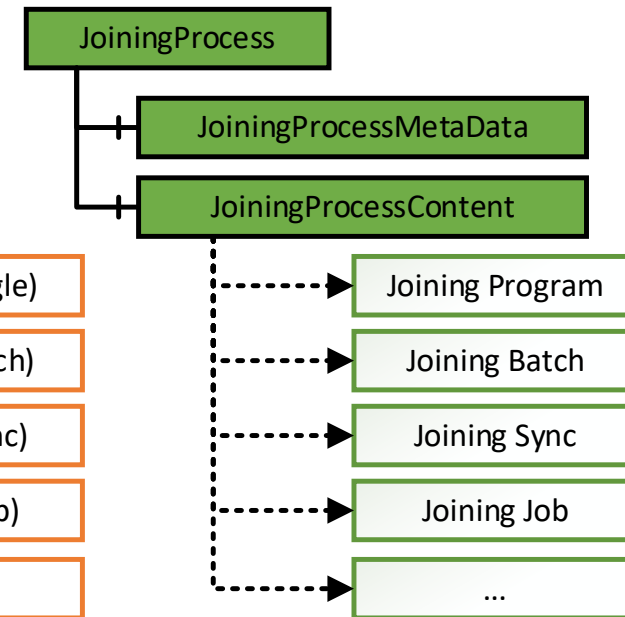
- Generic container for any type of Joining Process.
 - **Examples:** Joining Program, Joining Batch, Joining Job, etc.
- A concrete definition of the process is vendor-specific.
- The specification defines the interface to access the required processes.



RESULT MODEL



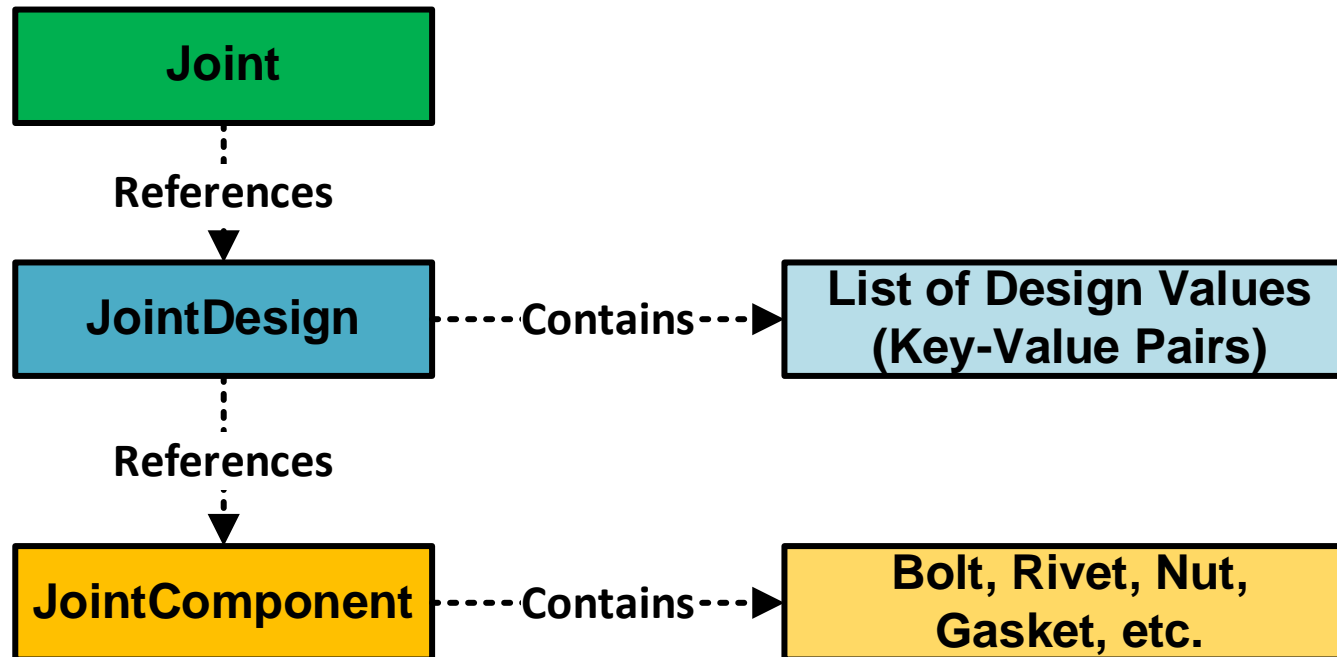
JOINING PROCESS MODEL



Joint Management

Joint Management

- **Use Case:** The user could send information on **what** type of joint needs to be done instead of **how** the joining operation should be executed.
- Definition of Bolt, Rivet is vendor-specific.



Joining System Method List (Commands)

Joining System Method List

Note: Result Management Methods are reused from **Machinery - Result Transfer**.

Asset Management	Result Management	Joining Process Management	Joint Management
SetCalibration	GetLatestResult	SendJoiningProcess	SendJoint
EnableAsset	GetResultById	GetJoiningProcess	SendJointDesign
DisconnectAsset	GetResultIdListFiltered	GetJoiningProcessList	SendJointComponent
RebootAsset	ReleaseResultHandle	GetJoiningProcessRevisionList	GetJointList
SendFeedback		SetJoiningProcessMapping	GetJointRevisionList
GetFeedbackFileList		SelectJoiningProcess	GetJointDesignList
SetOfflineTimer		DeselectJoiningProcess	GetJointComponentList
SetTime		IncrementJoiningProcessCounter	GetJoint
SendIOSignals		DecrementJoiningProcessCounter	GetJointDesign
GetIOSignals		SetJoiningProcessCounter	GetJointComponent
SendIdentifiers		SetJoiningProcessSize	SelectJoint
SendTextIdentifiers		ResetJoiningProcess	
GetIdentifiers		AbortJoiningProcess	
ResetIdentifiers		ResumeJoiningProcess	
ExecuteOperation		SuspendJoiningProcess	
GetErrorInformation		StartJoiningProcess	
StartSelectedJoining			
StopJoining			

IJT Profiles Overview

IJT Certification Overview

- OPC UA Specifications define a set of rules that are needed for a product to be certified.
 - It is done using the definition of Conformance Units, Facets and Profiles.
- The following image provides an overview of profiles defined in IJT specifications.

CU/Facet	Facet/Profile
Joining System Base	Basic Joining System Facet
Result Server Facet	
Asset Management Assets Server Facet	
Basic Joining System Facet	General Joining System Facet
Joining Result Server Facet	
Trace Server Facet	
Identifiers Methods Server Facet	
Event Management Server Facet	
Joining Process Base Server Facet	
Result Content	
Result Internal Identifiers	
Result External Identifiers	
Method Input Argument	

Independent Selectable Features
RESULTS
Batch Result Server Facet
Sync Result Server Facet
Job Result
Partial Consolidated Result
Self Contained Consolidated Result
Consolidated Result with references
Result Value FINAL Tag
ASSET METHODS
Asset Connection Server Facet
Enable Tool Server Facet
JOINTS
Joint Server Facet
Joint Design Server Facet
Joint Component Server Facet
JOINING PROCESS
General Process Operations Server Facet
Sequential Process Operations Server Facet
Start Joining Process
MISC.
Engineering Units

Status



- **Release Candidate** of the following specifications **published** in **September 2023**.
- OPC 40450-1 UA CS for Joining Systems **RC 1.00.0**
 - **Link:** <https://opcfoundation.org/developer-tools/documents/view/343>
- OPC 40451-1 UA CS for Tightening Systems **RC 2.00.0**
 - **Link:** <https://opcfoundation.org/developer-tools/documents/view/341>
 - Release 1 was published in **October 2021**.

Prototypes / Simulators and Demonstration

Prototypes / Simulators / Reference Implementation



- The following portal contains simulators and prototypes for both Clients and Servers.
 - <https://github.com/umati/UA-for-Industrial-Joining-Technologies>
 - **OPC-UA_Servers/Release1**
 - Available
 - **OPC-UA_Servers/Release2**
 - Available
 - **OPC-UA_Clients/NodeOPCUA_IJT_Client**
 - A client to connect to the OPC UA IJT CS model.
- The reference implementations are updated regularly.

Demonstrations



- Demonstrations are done using umati infrastructure.
- **What is umati?**
 - It is a common dashboard connected to several machines from various vendors using a standard information model.
 - Refer to <https://umati.org/> for more information.
- Demonstration: <https://umati.app/>
 - Done in automata 2022 and 2023.

Release 1 and Release 2 Differences

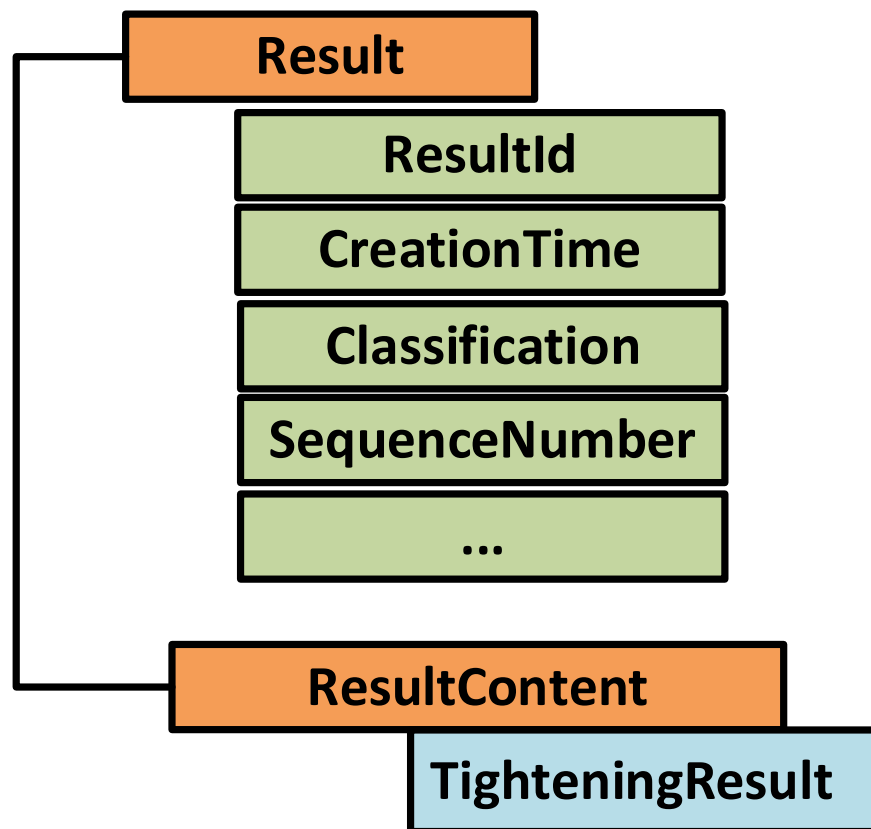
Overview



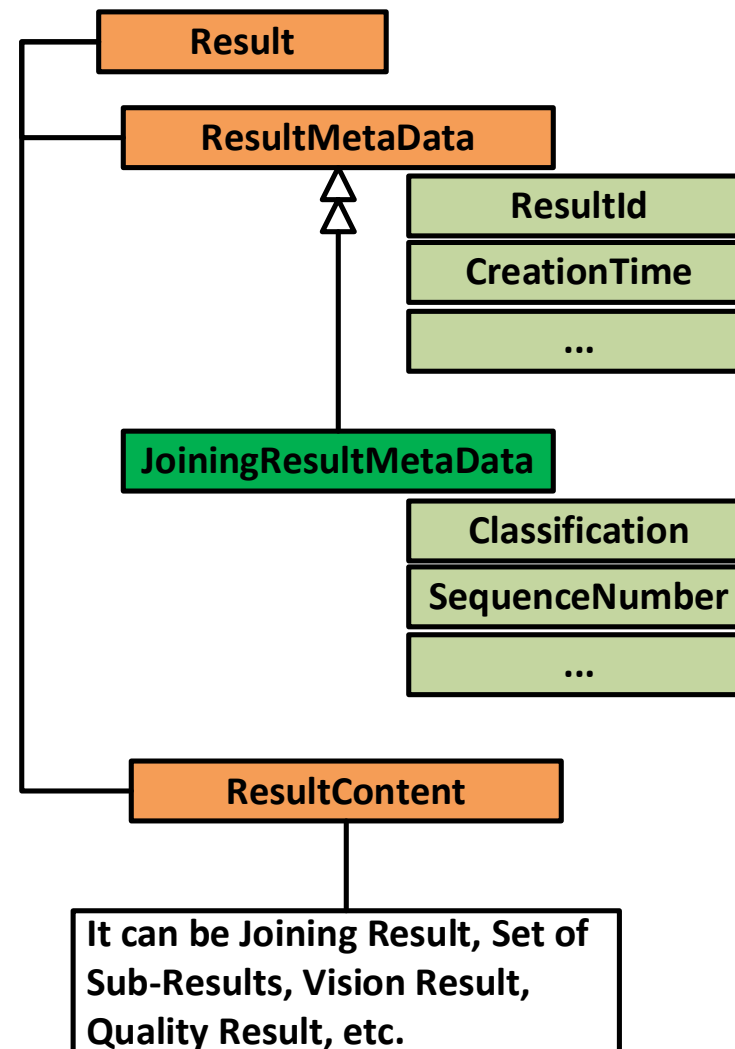
- **Release 1** was **only** for Tightening Domain.
 - OPC 40451-1 UA CS for Tightening Systems **1.00.0**.
- During **Release 2** work, most of the use cases are generalized for various joining systems. Hence, the models were **extended** and **moved** to a new **base** specification.
 - OPC 40450-1 UA CS for Joining Systems **1.00.0**.
 - Tightening Specification is upgraded to OPC 40451-1 UA CS for Tightening Systems **2.00.0**.
- **Why is it a major version release?**
 - Most of the models from the Tightening Specification are generalized and moved to a new base specification.

Result Structure Changes

Release 1

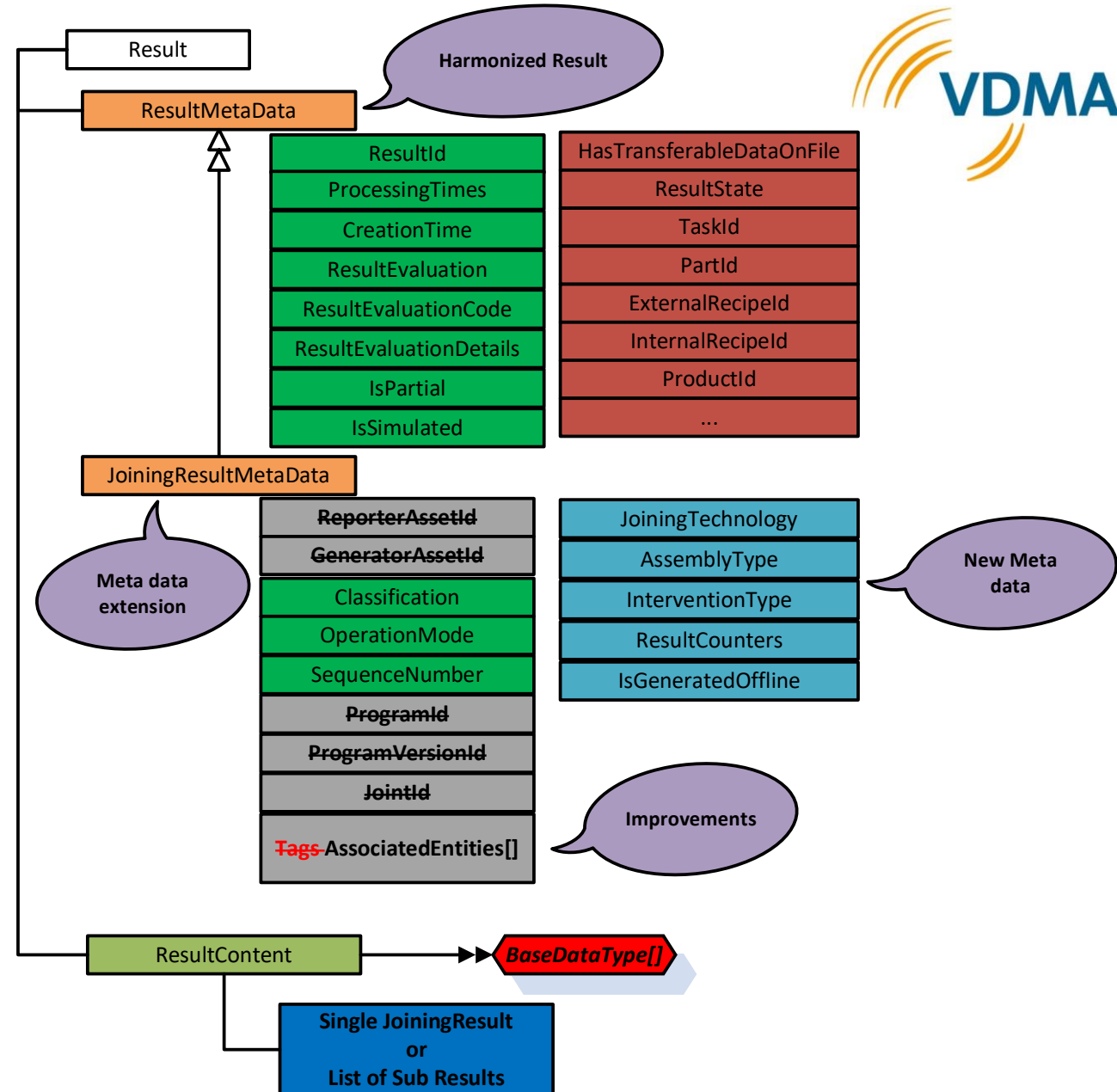


Release 2



Result Data Changes

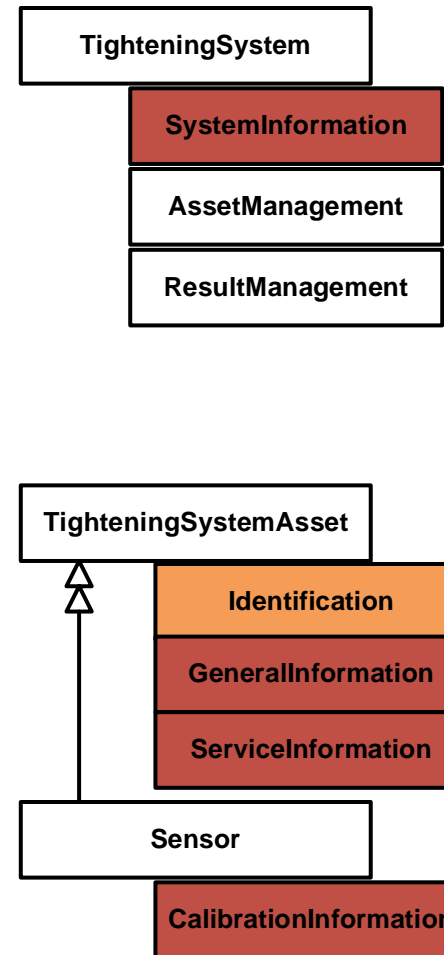
- **Machinery Result** Usage from Harmonization Group.
 - **Result** properties **grouped** as **ResultMetaData**.
- **Additional** set of properties to cover the use cases for Batch/Job/Sync Result, etc.
- **Generalization of Tightening Result** to **Joining Result**.
- **Uses** UA 1.05.02 Structures.



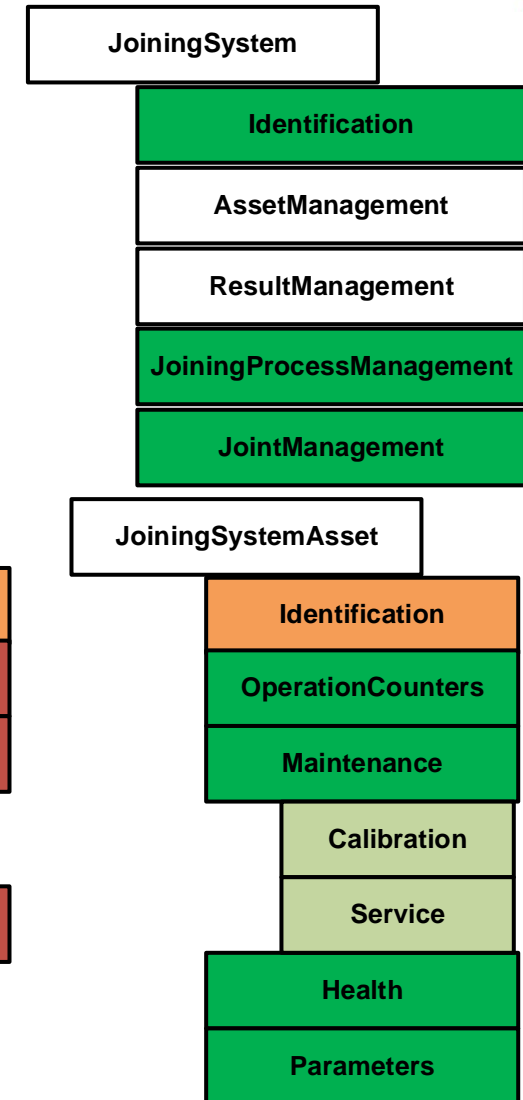
System, Asset and Event Changes

- **Improvement** in the Joining System for Identification AddIn.
- **Extension** of Joining System to include newer models.
- **Reorganization** and **Extension** of Asset Management Model.
 - Software and Virtual Station as new assets.
- **Extension** of Event model by **common joining payload** and **filtering** mechanism.

Release 1



Release 2



Maintenance, Migration, Extensions

Extensions, Maintenance and Other Specifications



- The long-term vision to have a common base for various joining technologies is in place.
- In future, if there are very specific use cases needed for Riveting, Gluing, etc. which are not covered in the joining base specification, the specification can be defined.
- **Possible Future Use Cases**
 - Reuse of Network Structure for Assets from other harmonization groups.
 - Reuse of Location models.
 - Definition of Part, Product, etc.
 - Definition of Threaded Fastener/Bolts.
 - Issues in the existing specification.
 - ...

Greenfield vs Brownfield in Joining Domain



- For **brownfields**, a phased migration can be done. It **depends** on the use case and other factors.
 - **Example:** For control mechanisms, existing legacy protocols can be used and OPC UA can be deployed for data acquisitions.
- For **greenfields**, it is recommended to use OPC UA with IJT Companion Standard.
- **OPC UA** and **other** protocols can **coexist** together.

Reference Links



- **OPC UA IJT Overview**
 - <https://opcfoundation.org/markets-collaboration/IJT/>
- **Joining Specification**
 - <https://opcfoundation.org/developer-tools/documents/view/343>
- **Tightening Specification**
 - <https://opcfoundation.org/developer-tools/documents/view/341>
- **OPC UA IJT Reference Implementation**
 - <https://github.com/umati/UA-for-Industrial-Joining-Technologies>
- **Access to Specification Documents:**
 - **Formally** released specifications can be accessed for free from the OPC Foundation Portal Links given above.
 - It requires the registration of an account which is free of cost.
 - **Release Candidate (DRAFT)** is **only** accessible for an OPC Foundation Member Company. The alternative is to download a VDMA copy of the specification from the VDMA portals: <https://vdma.org/der-verband>
 - Search the portal with the specification number.
 - **Examples:** 40450, 40451, etc.

Additional Slides

OPC Legacy and OPC UA History

- Refer to the following link which explains the Before and After OPC Scenarios:
- <https://www.ia.omron.com/product/special/sysmac/nx1/opcua.html>

Source: <https://www.ia.omron.com/product/special/sysmac/nx1/opcua.html>

OPC UA Overview and Benefits

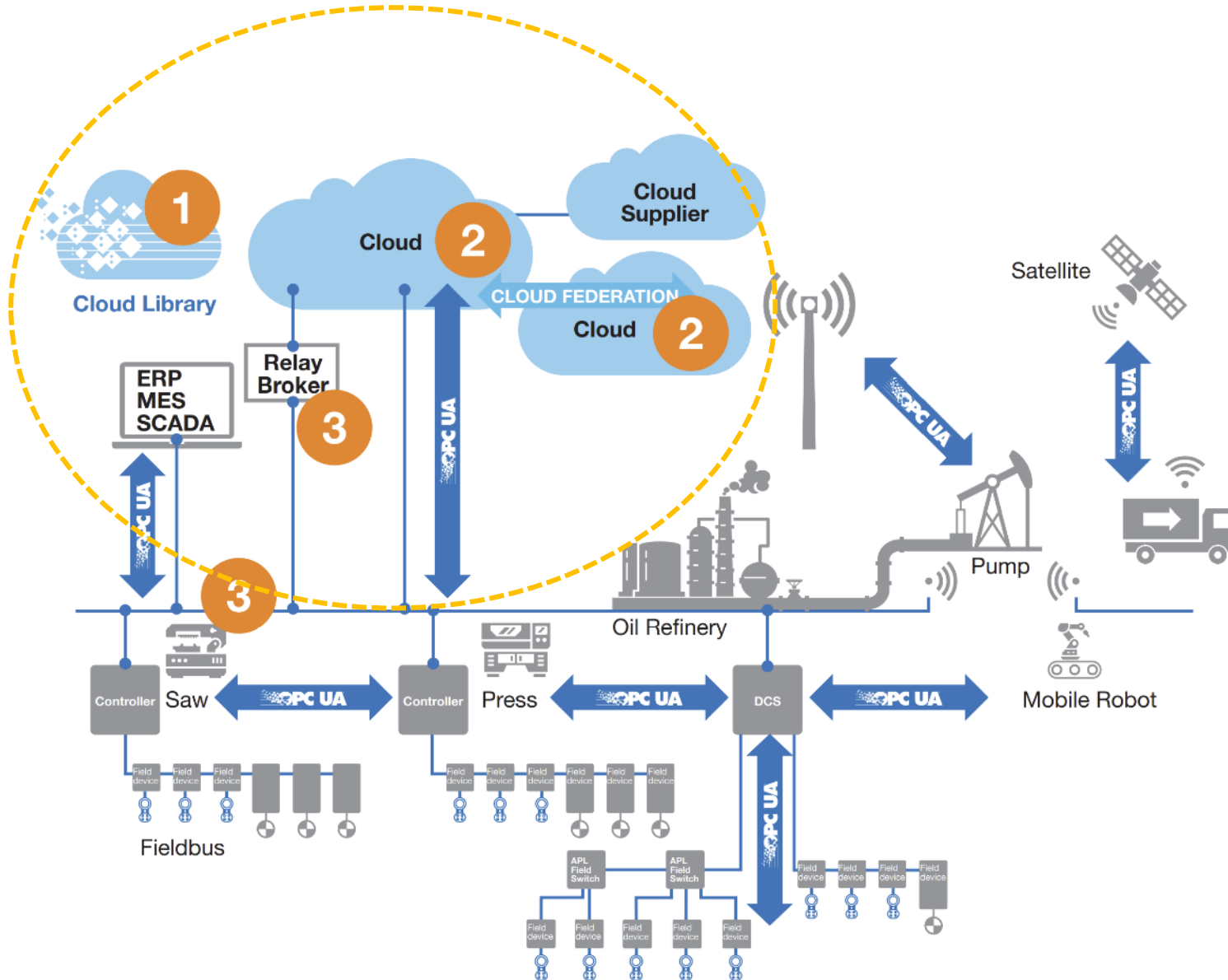


Industry 4.0 main contender for industrial interoperability standard

Core Characteristics:

- Service Oriented Architecture (Subscription, Methods, Events, etc.)
- Platform independent (Any hardware - operating system - programming language)
- Integrated security mechanisms (Message Encryption, Authentication, User Rights, Certificates)
- Standard discovery mechanisms (Discovering devices and management of certificates)
- Comprehensive information model

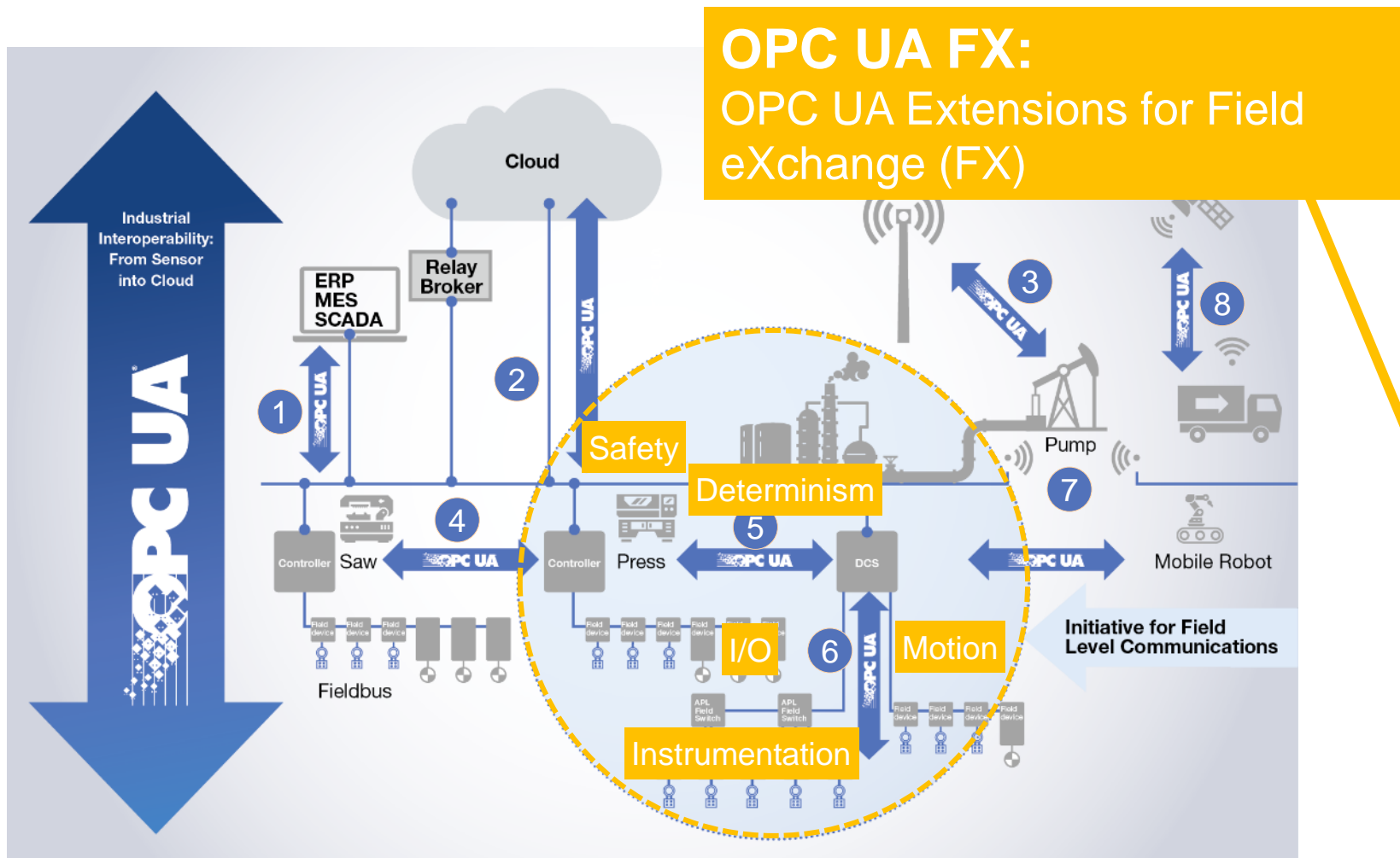
UA Cloud Initiative



- 1 Cloud Library**
 - Repository for OPC UA based information models (IMs)
 - Upload, store, search, download IMs
- 2 Cloud Federation**
 - Standardized communication
 - Cloud to Cloud
- 3 Asset / Edge / Cloud**
 - Standardized communication
 - Field to Cloud
 - Cloud to Field
- 4 Education, IIOT Starter Kit**
 - Success stories

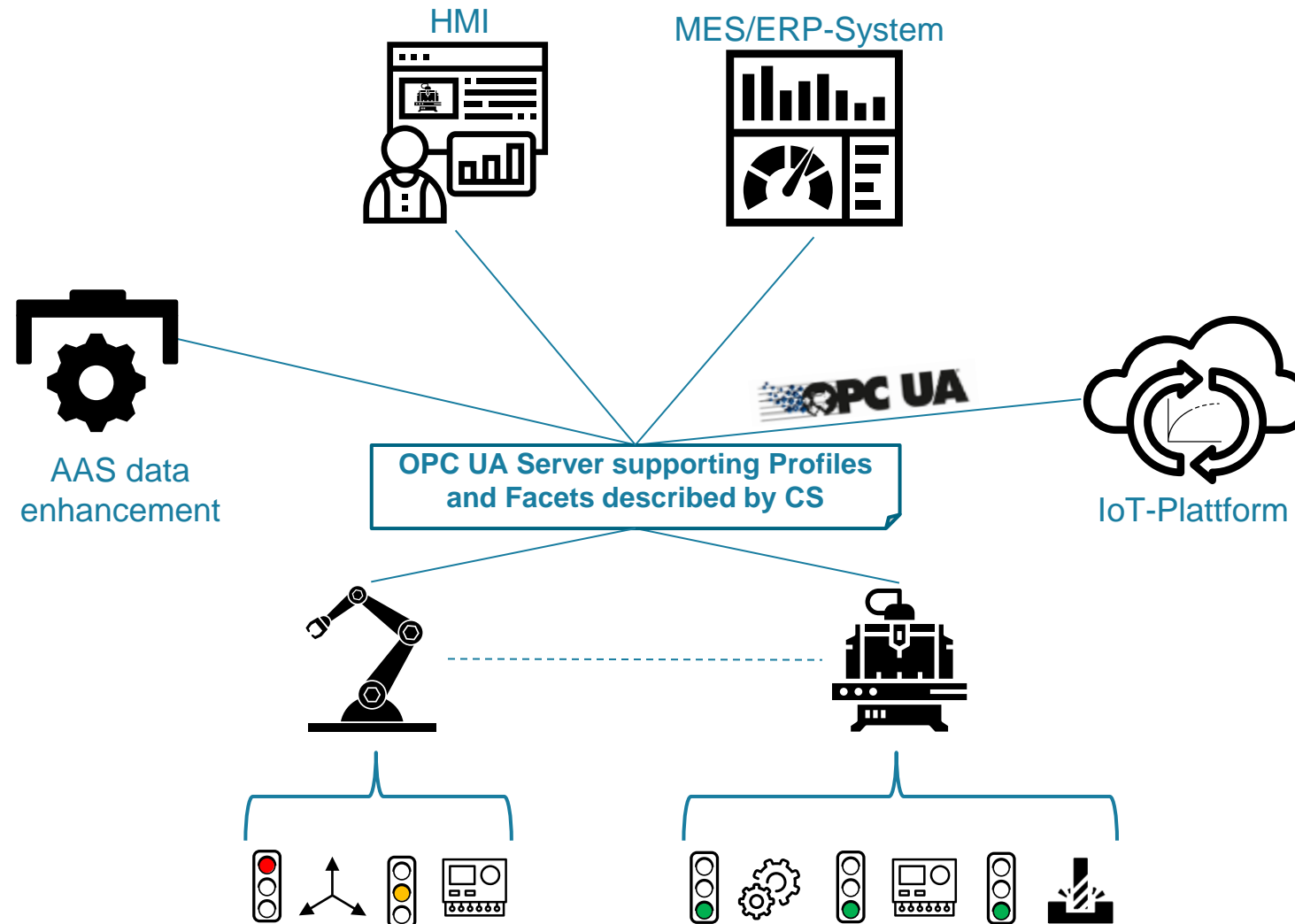
Source: OPC Foundation

OPC UA for Field eXchange (FX): Extending OPC UA to the field incl. Determinism, Safety & Motion



- 1 IT / OT Communication
- 2 Cloud Integration
- 3 Secure Remote Access
- 4 Local OT Communication
- 5 Controller to Controller
- 6 Controller to Device incl. Device to Device
- 7 Wireless Integration (5G)
- 8 Future Ready

OPC UA as the standardized communication interface of machines & components



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Questions

Few Example Questions...



- Can we run a reference implementation?
 - Yes, refer to the link to the simulator in the presentation.
- When is the formal release available?
 - Planned in Q1 2024.
 - The commenting phase ends in Dec 2023.
- When is the implementation planned for the Devices?
 - The respective device supplier could provide the plan.
- ...