Under the hood

A look into technical details of umati

New Technologies Forum
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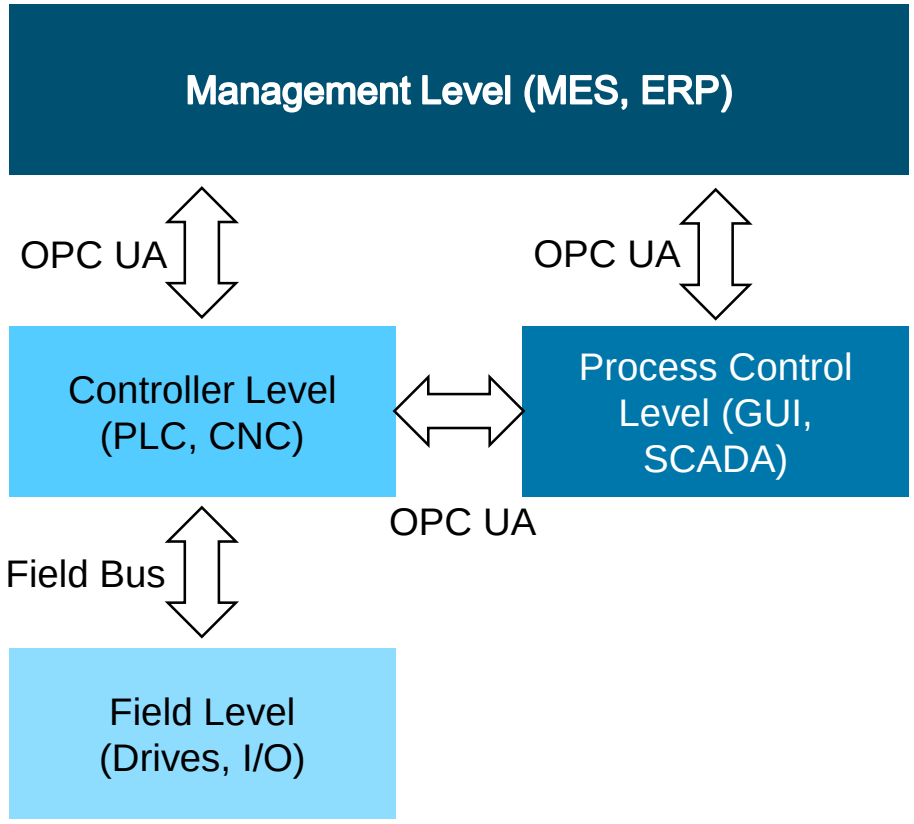
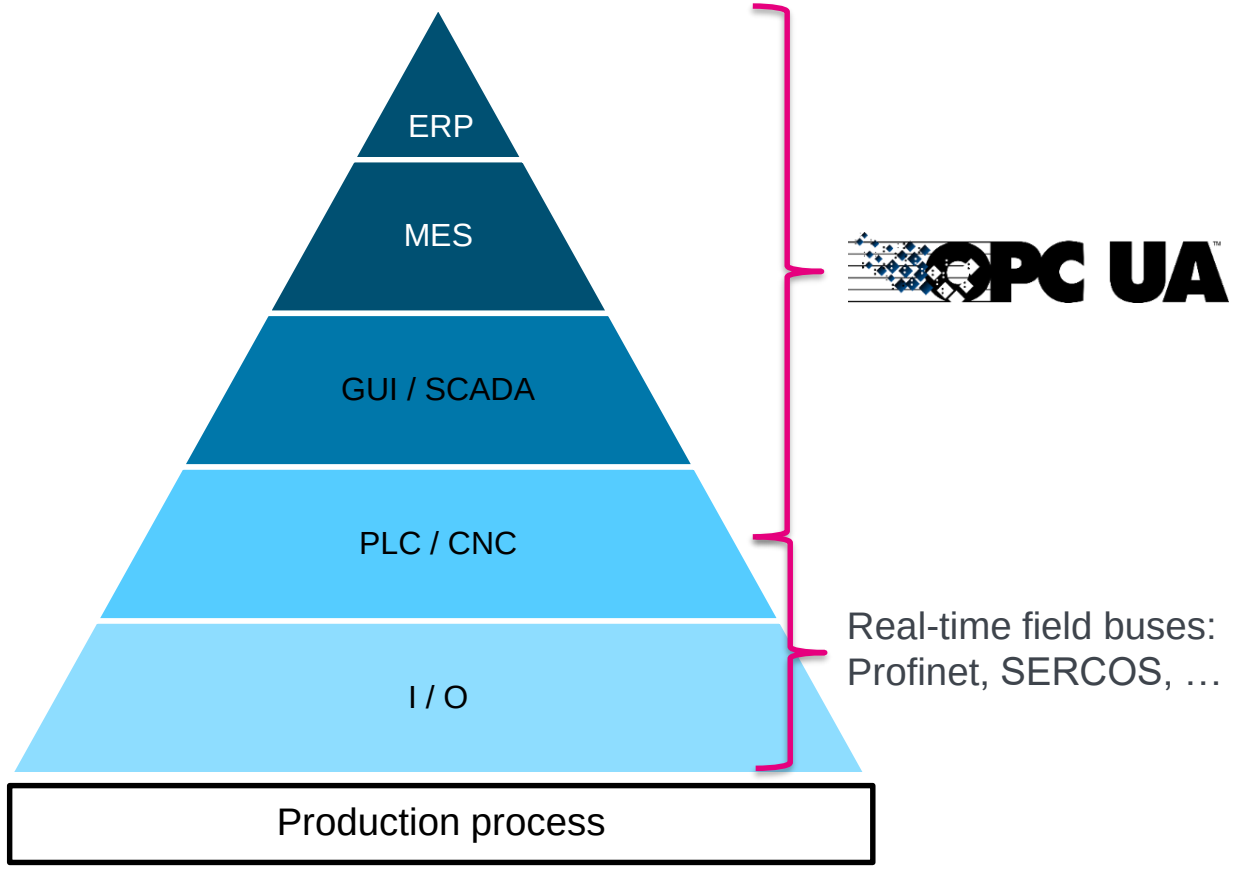
www.umati.info

Eine Initiative des
An Initiative by VDW

OPC UA basics for umati

System architectures in Industry 4.0





Today's position on OPC UA in the VDMA organizational units

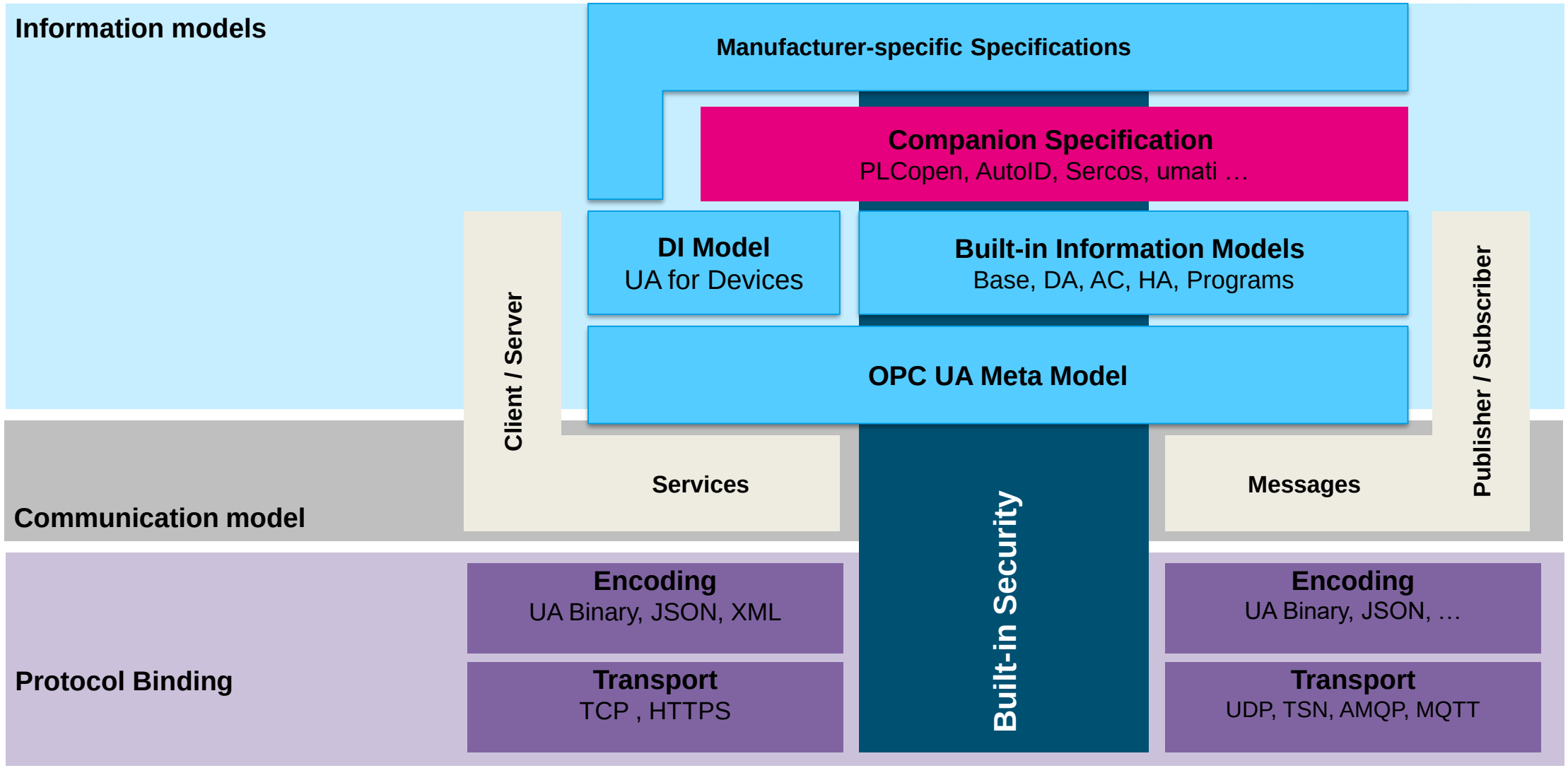
- Agricultural Machinery
- Air Conditioning and Ventilation
- Air Pollution Control
- Air-handling Technology
- Building Control and Management
- Cleaning Systems
- Compressors, Compressed Air and Vacuum Technology
- Construction Equipment and Building Material Machines
- Drying Technology
- Electrical Automation
- Electronics, Micro and Nano Technologies
- Engine Systems for Power and Heat Generation
- Engines and Systems
- Fire Fighting Equipment
- Fluid Power
- Food Processing Machinery and Packaging Machinery
- Foundry Machinery
- Gas Welding
- Glass Industry
- Hydro Power
- Integrated Assembly Solutions
- Large Industrial Plant Manufacturing
- Lifts and Escalators
- Machine Tools and Manufacturing Systems
- Machine Vision
- Materials Handling and Intralogistics
- Measuring and Testing Technology
- Micro Technologies
- Mining
- Plastics and Rubber Machinery
- Power Systems
- Power Transmission Engineering
- Precision Tools
- Printing and Paper Technology
- Process Plant and Equipment
- Productronic
- Pumps + Systems
- Refrigeration and Heat Pump Technology
- Robotics
- Security Systems
- Software and Digitization
- Surface Treatment Technology
- Textile Care, Fabric and Leather Technology
- Textile Machinery
- Thermal Process Industry
- Thermal Turbines and Power Plants
- Valves
- Waste Treatment and Recycling
- Wind Energy
- Woodworking Machinery

OPC UA CS Release (Candidate)

OPC UA CS under development

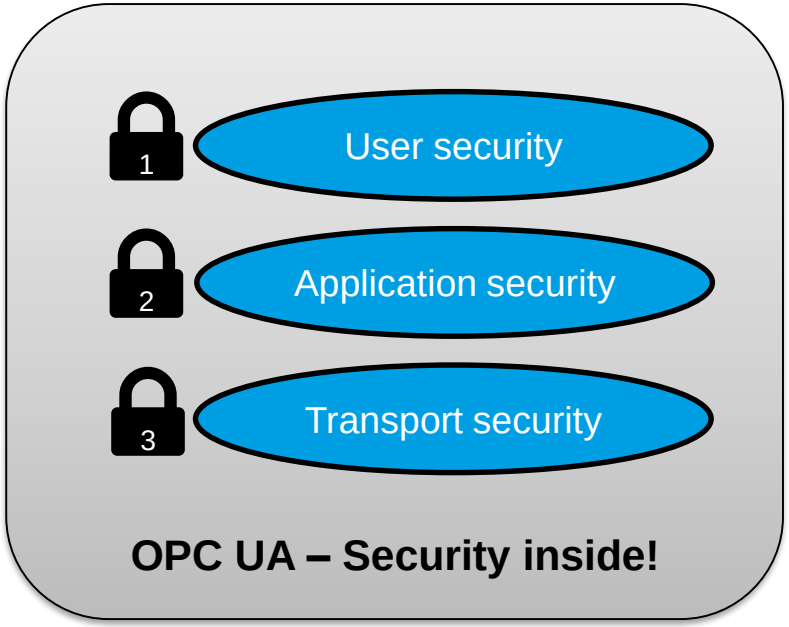
Awareness existent

Overview of OPC UA



OPC UA protocol security and encryption

- Security and encryption are integral elements of OPC UA („security by design“)
  - User security
  - Application security
  - Transport security
- The extension level of the stack, as well as your own implementation („make it secure by default“) determine the use of existent security and encryption concepts



OPC UA information model

- Data

e.g.

Strings of characters

- Context

e.g.

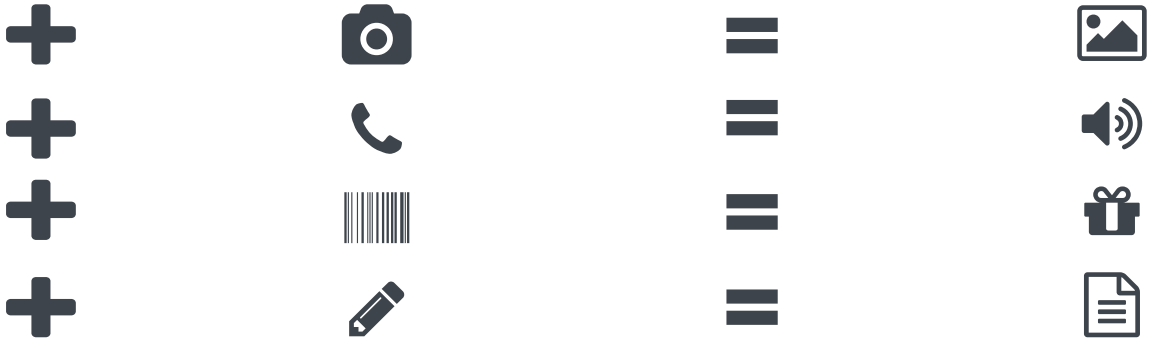
File format, storage location

- Information

e.g.

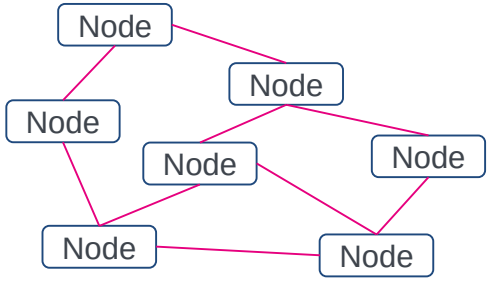
image, sound, packet, text file

00110000 00110111 00110001
00110001 00111000 00110010
00110111 00110001 00110001
00110001 00110010 00110010
00110101 00110100

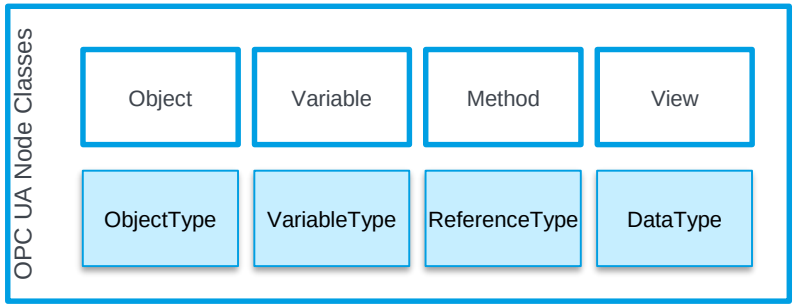


OPC UA Nodes and Datatypes

- OPC UA defines a network of nodes
- Nodes are interconnected by references
  - hierarchical references
  - non-hierarchical references
- 8 types of nodes
  - Object – structures information
  - Variable – contains information
  - Method – offers a functionality
  - View – groups nodes for easier access
  - ObjectType, VariableType – prototype of the respective element, the type-system enhances reuse of specific kinds of node
  - ReferenceType – defines the reference type
  - DataType – defines the data type

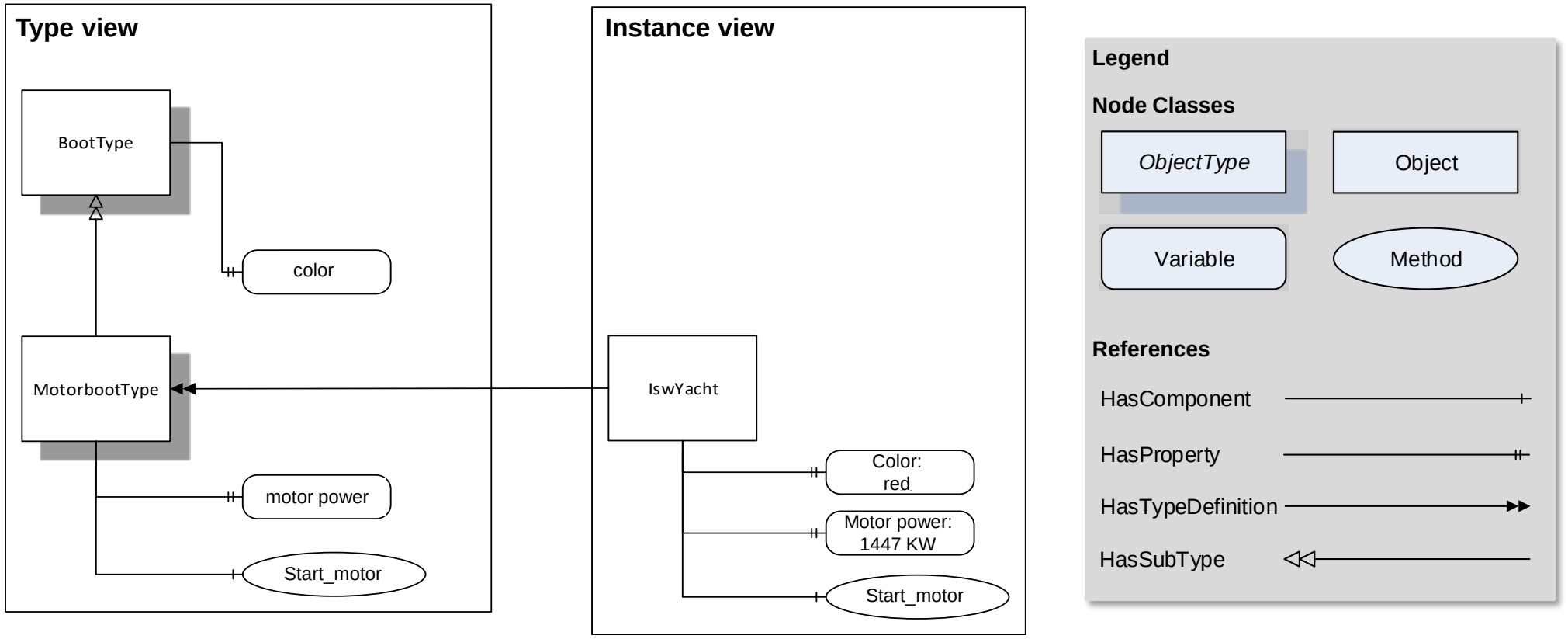


Node Classes



OPC UA types and instances

ISW Yacht

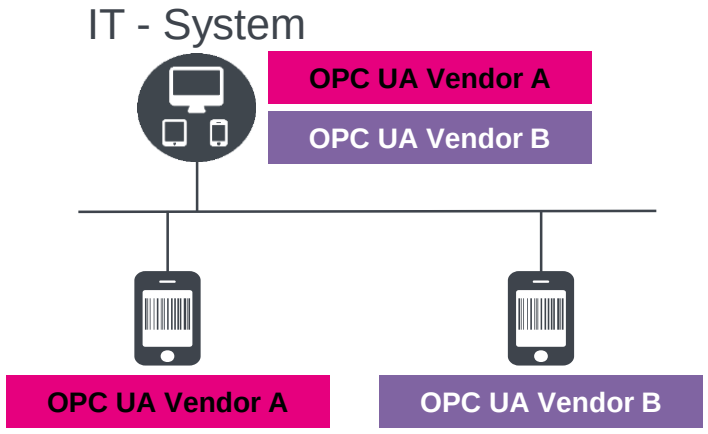


Why are Companion Specifications necessary?

OPC UA - Communication…

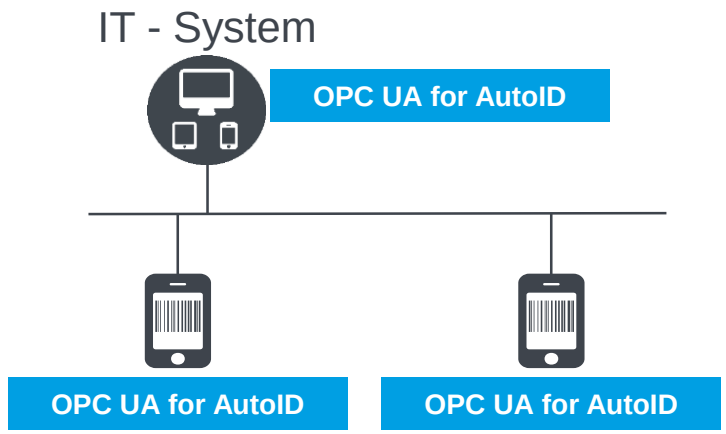
… WITHOUT Companion Spec.

- Each device has own model
- Adaption necessary for each device



… WITH Companion Spec.

- Each device has same base model
- Adaption costs minimized



Structure of a Companion Specification

OPC UA Introduction

- Goal of the specification
- References to other standards
- Abbreviations
- Overview of terms and figures

OPC UA in Context

- Explanation of the specification‘s topic
- Introduction and basics „What is OPC UA?“
- Usage of graphical notation and references
- Use-Cases

Information model

- Overview of the information model
  - Type view and example instance view
- Description of the ObjectTypes
  - Explanations for each ObjectType
  - ObjectType definition (Table)
  - Parameter definition
- Description of the EventTypes
- Description of the VariableTypes
- Description of the DataTypes

Profiles/ Namespaces

- Description of system architecture and namespaces
- Description of profiles

Scope of the umati information model

Umati content scope

- Overall top level parameter clusters for OPC UA Companion Specification were iterated (May 2018)
  - Machine information
  - Machine status / operational status
  - Counters (working hours, workpieces, …)
  - Job information
  - Energy information
  - Tools
  - Workpieces
  - Storage systems (tools, workpieces, pallets, …)

umati Companion Specification

Umati design procedure

Core working group preparation phase

Use Cases → **Parameters** → **Information Model**

- Identification of desired purposes of umati
- The definition focus on use cases which need information from the machine

- Results of the phase:
  - 10 core use cases

Process:

- Definition of roles in the factory
- Finding typical activity of the roles in the factory
- Identifying possible shop floor display options

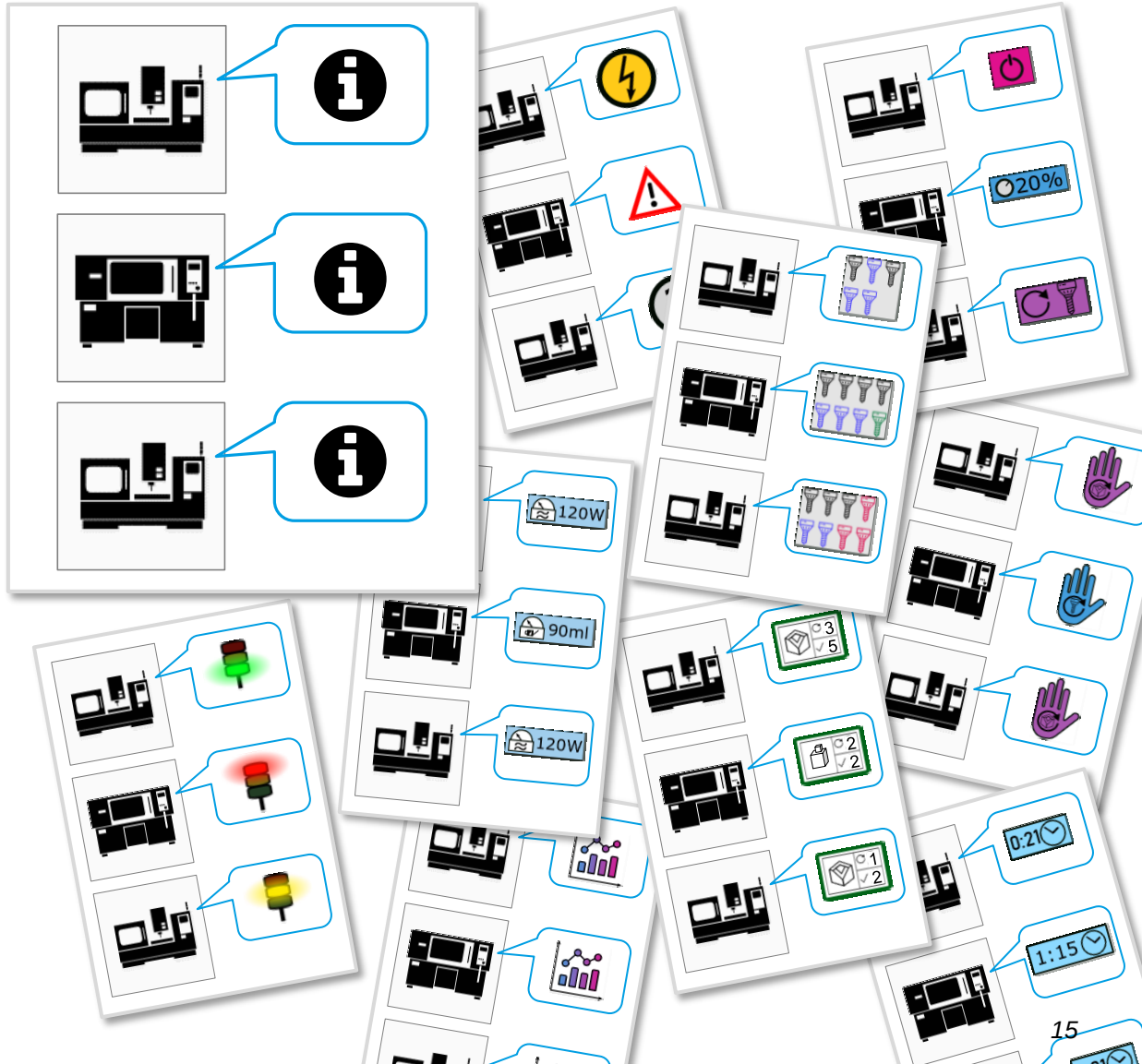
- Core Question: Who does what on which system?
- 27 Use Cases

Filter

- 10 core use cases

umati Use Cases

1. **Identify machines of different manufacturers**
2. **Overview if production is running**
3. **Overview of parts in a job**
4. **Overview of runtimes for a job**
5. **Overview of machine tool state**
6. **Overview of upcoming manual activities**
7. **Overview of errors and warnings**
8. **Providing information for KPI calculations**
9. **Providing data for media and energy usage statistics**
10. **Providing an overview of tool data**



umati Companion Specification

Umati design procedure

Core working group preparation phase

Use Cases	Parameters	Information Model
Identification of desired purposes of umati	Identification of parameters needed to serve the particular use case.	
The definition focus on use cases which need information from the machine	Technology- and vendor specifics in the parameters	
	Only explicit definable parameters are used	
Results of the phase:	Results of the phase:	
➢ 10 core use cases	➢ 100 parameters	

Process:

- Defining the parameters for every use case itself
- Describing the behavior of the parameters
- No OPC UA specifics in this phase

umati Companion Specification

Umati design procedure

Core working group preparation phase

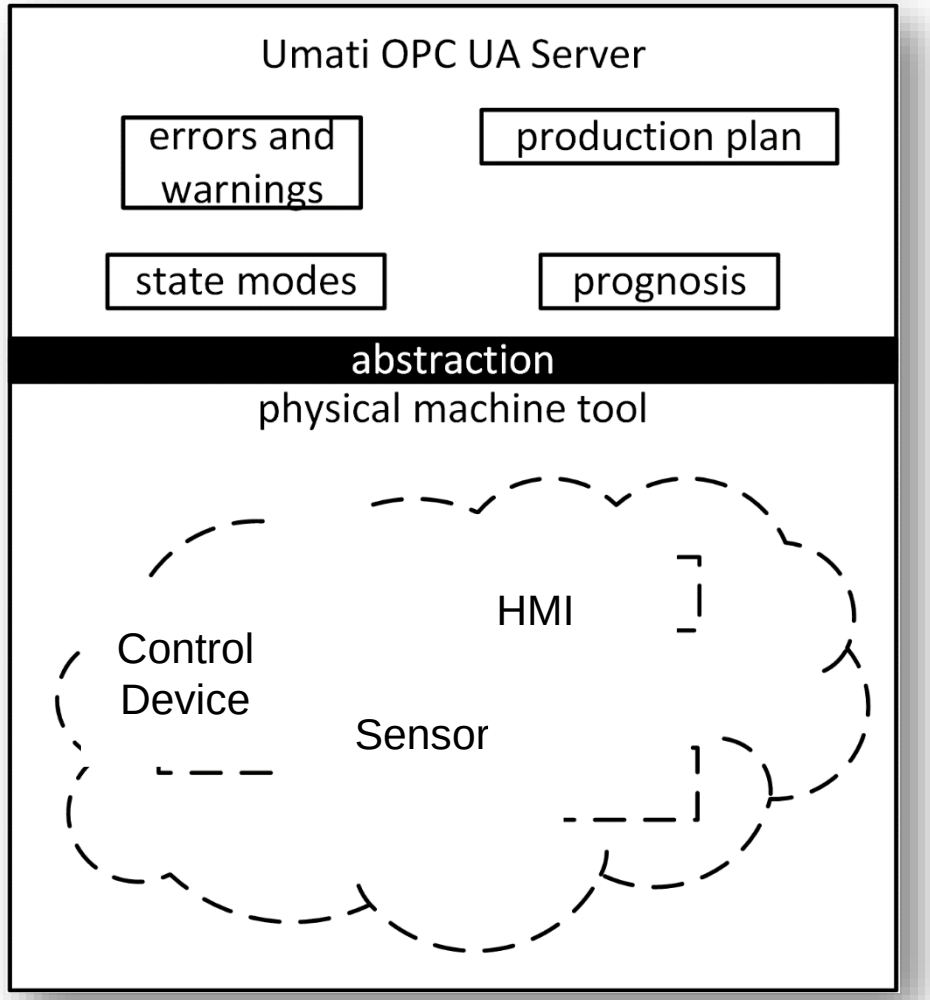
Use Cases	Parameters	Information Model
Identification of desired purposes of umati	Identification of parameters needed to serve the particular use case.	Information modelling based on the OPC UA modelling principles and rules
The definition focus on use cases which need information from the machine	Technology- and vendor specifics in the parameters	Expressing information through OPC UA methods
	Only explicit definable parameters are used	Object and type definitions for umati
Results of the phase:	Results of the phase:	Result of the phase:
➢ 10 core use cases	➢ 100 parameters	➢ 1 information model

Process:

- Defining core object types, variable types and needed data types
- Forming objects for umati
- Building a whole address space for umati

Structural and functional decisions in the Information Model

- Function based approach: Grouping the information by functions, instead of (physical) components
  - e.g. errors and warnings are provided at one place, not per machine tool component
  - e.g. jobs are not organized per controller
- Read only data (in version 1)
- Datatype usage limited to
  - Objects
  - Data
  - Variables
  - Events



umati Companion Specification

Umati design procedure

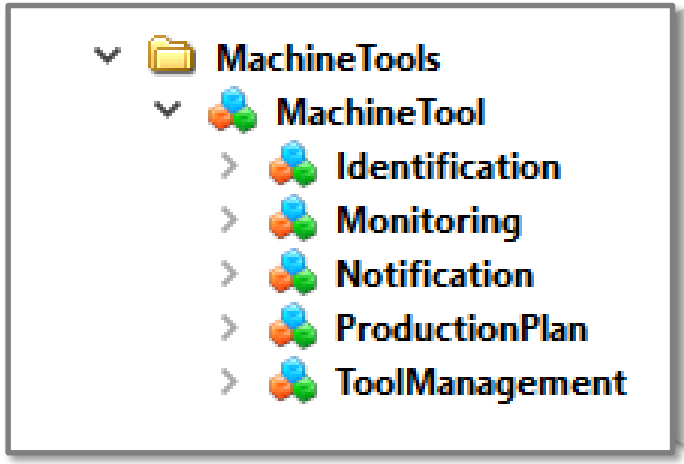
Core working group preparation phase | **Joint working group**

Use Cases	Parameters	Information Model	JWG phases
Identification of desired purposes of umati The definition focus on use cases which need information from the machine	Identification of parameters needed to serve the particular use case. Technology- and vendor specifics in the parameters Only explicit definable parameters are used	Information modelling based on the OPC UA modelling principles and rules Expressing information through OPC UA methods Object and type definitions for umati	Standardization process together with other members of the OPC Foundation Documentation of the information model according the OPC Foundation requirements
Results of the phase: ➢ 10 core use cases	Results of the phase: ➢ 100 parameters	Result of the phase: ➢ draft information model	Results of the phase: ➢ final information model

Work after umati V1: incrementally incorporate more use cases into further versions of the umati interface

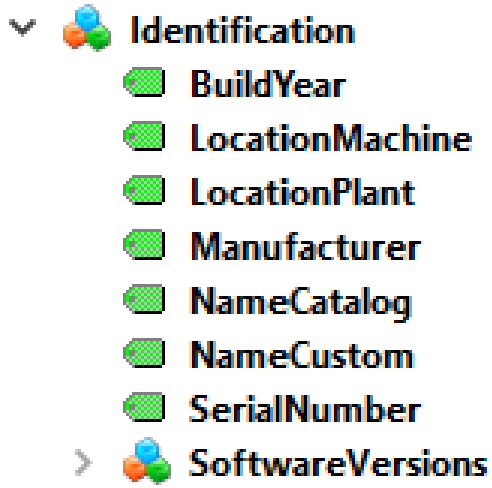
A look into the draft information model

- 5 main branches

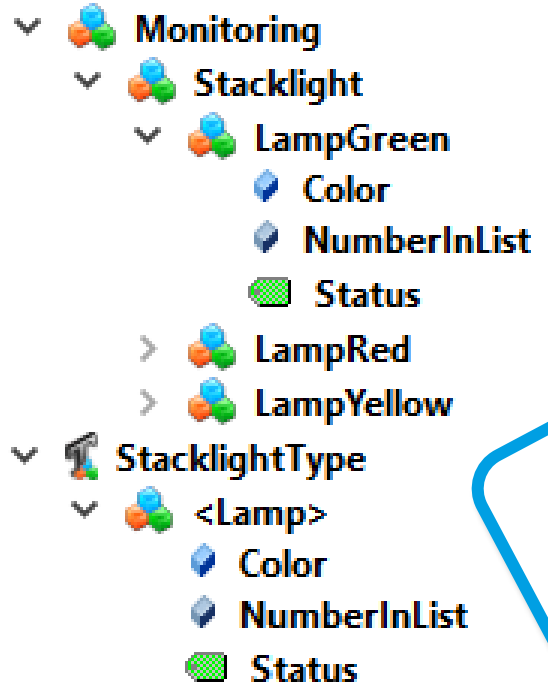


- Subbranches define datastructures

➢ Identification



➢ Stacklight



<...>

WORK IN PROGRESS

umati@EMO2019 showcase: behind the scenes

Showcase participants

70 companies

110 machines

28 software solutions

10 countries

umati

a network of strong partners

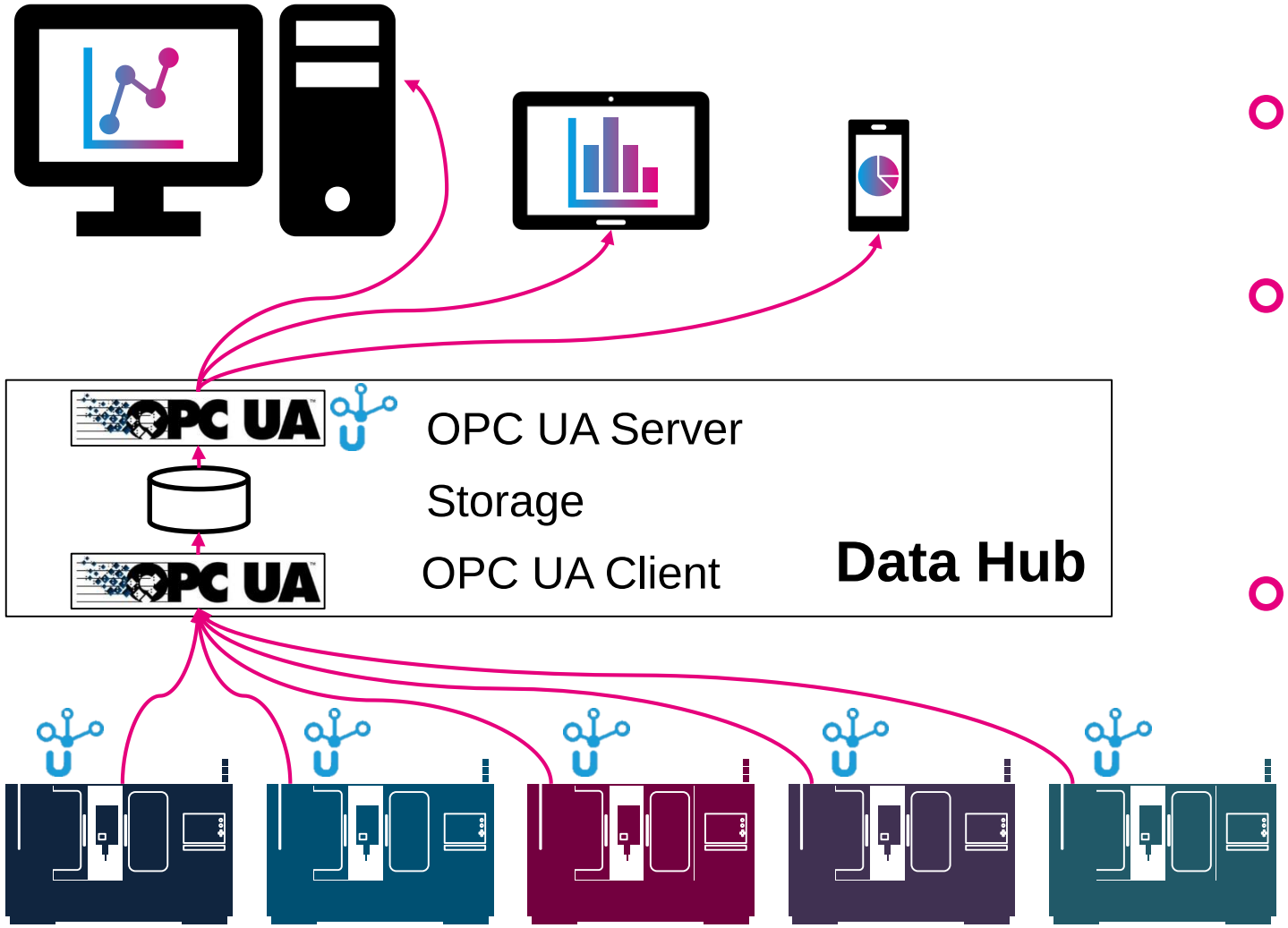
core partners

association partners

consortium partners

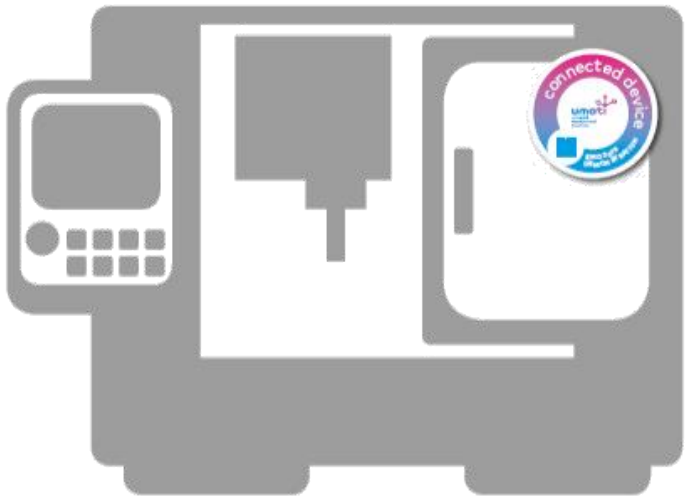
research partners

EMO showcase connectivity scheme



- All connected machines support the OPC UA Specification „umati for EMO“
- The Data Hub gathers and stores the machine data and makes it available via an OPC UA Server using the OPC UA specification „umati for EMO“
- All software using the showcase data connects to the Data Hub with an OPC UA Client

QR Codes to reach dashboard for each machine

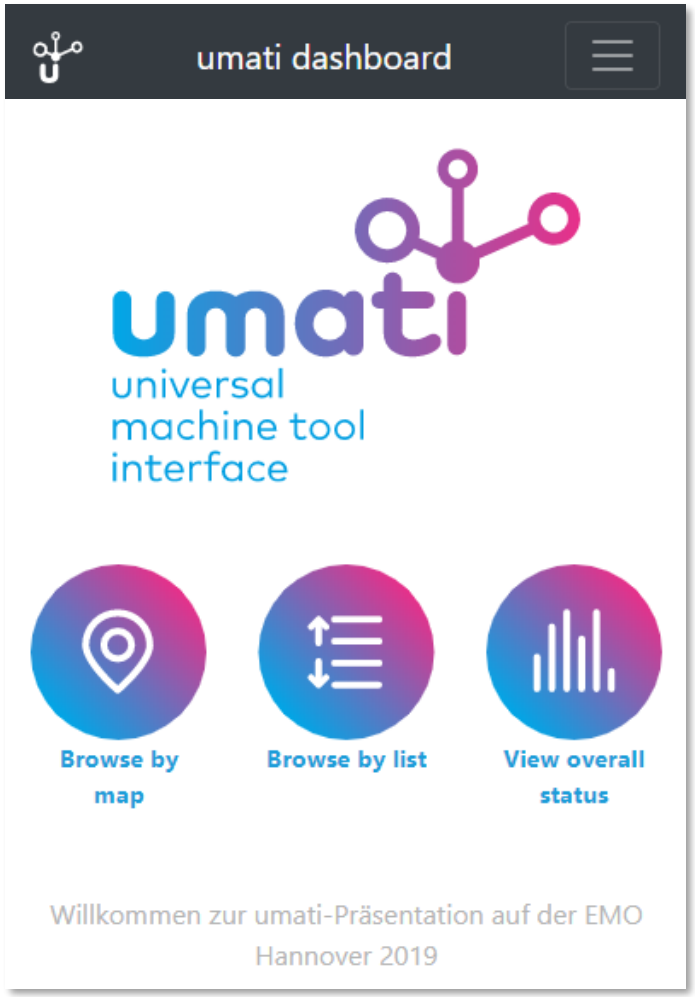


Every connected machine features a sticker.

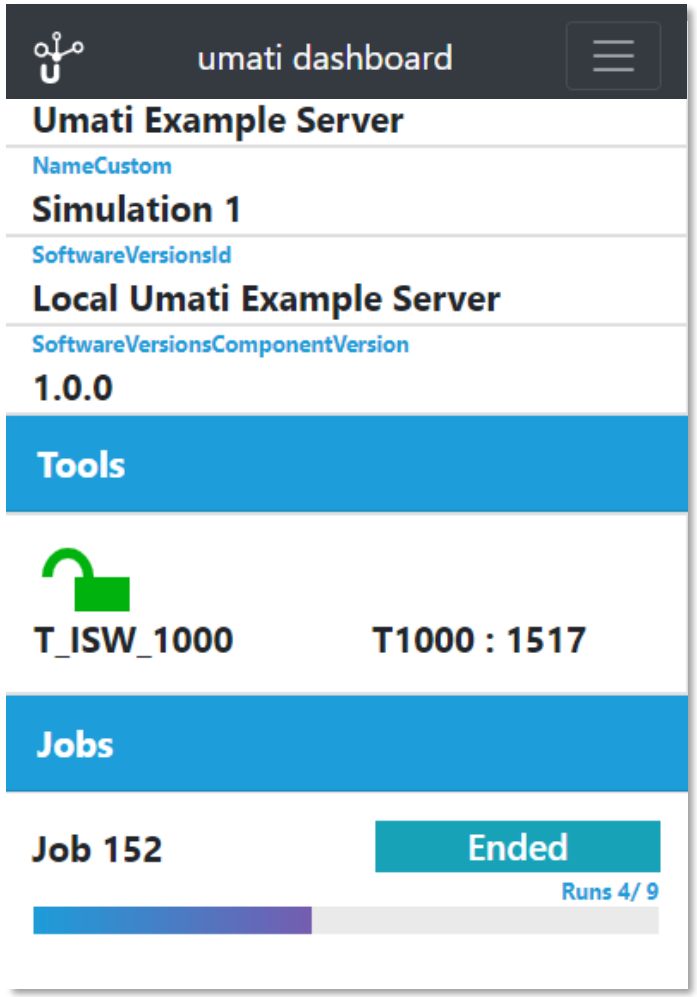
Scan the QR code or type the shortcut link to access the live data streaming from the machine.

Get an overview of all the connected machines at https://umati.app

Dashboard

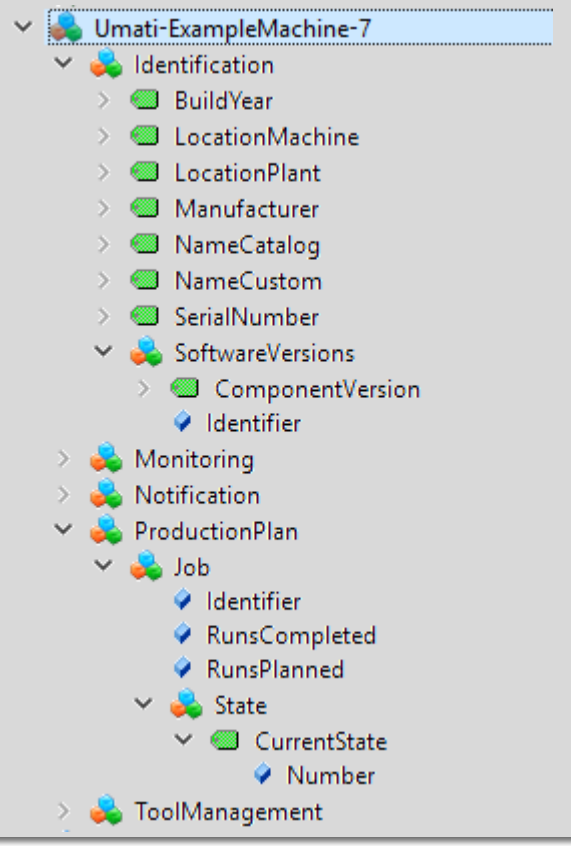

umati dashboard
umati
universal
machine tool
interface
Browse by map
Browse by list
View overall status
Willkommen zur umati-Präsentation auf der EMO Hannover 2019


umati dashboard
Machine
Umati Example Server
Manufacturer
ISW Christian von Arnim
Hall/Booth
X DE
Status overview
10:00
10:05
10:10
10:15
10:20
10:25


umati dashboard
Umati Example Server
NameCustom
Simulation 1
SoftwareVersionsId
Local Umati Example Server
SoftwareVersionsComponentVersion
1.0.0
Tools
T_ISW_1000
T1000 : 1517
Jobs
Job 152
Ended
Runs 4/ 9

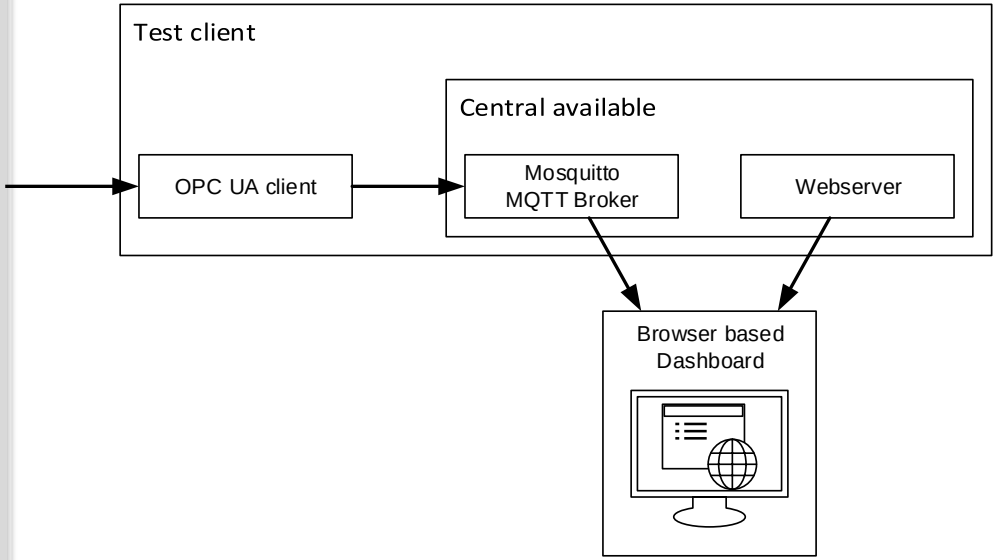
Data View behind the showcase

Datahub
OPC UA Server



Data Access View

#	Server	Node Id	Display Name	Value	Datatype	Source Timestamp	Server Timestamp	Statuscode
1	UMATI OPC-U...	NS20|Numeric|...	UniqueId	T_ISW_1000	String	07:59:34.366	10:48:21.556	Good
2	UMATI OPC-U...	NS20|Numeric|...	Locked	true	Boolean	10:49:01.926	10:49:02.808	Good
3	UMATI OPC-U...	NS20|Numeric|...	RunsCompleted	3	UInt32	10:48:59.920	10:49:00.807	Good
4	UMATI OPC-U...	NS20|Numeric|...	RunsPlanned	9	UInt32	07:59:34.366	10:48:35.820	Good
5	UMATI OPC-U...	NS20|Numeric|...	Identifier	Job 168	String	10:48:41.905	10:48:42.592	Good
6	UMATI OPC-U...	NS20|Numeric|...	CurrentState	"en", "Running"	LocalizedText	10:49:01.926	10:49:02.808	Good



Live Demo

Prospects for umati

Brief Outlook

- Profiles/Extensions
- Interoperability of/with basic machine specification (current working groups in OPC Foundation and VDMA)
- Connectivity with automation systems
- Extensive definition of transformation engine
- Tests/Certifications/Branding

Further Information

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