

OPC DAY FINLAND 2019

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#OPCUA #OPCDAY #OPCDAYFINLAND #AUTOMAATIO

OPC UA Technical Update and Future Trends



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Agenda

Technical Update

- Newly Released Profiles
- Amendments (Process)
- Released Amendments (1,2,3,5,6,7,11)
- Version 1.02 of OPC UA Devices (DI)
- Released Companion Specifications

Future Trends

- Amendments in Preparation
- More Parts in Version 1.05
- Semantic Validation
- Harmonization

Newly Released Profiles

> <https://opcfoundation.org/profilereporting/>

Transport Category

Facets

Client-Server

- UA-TCP UA-SC UA-Binary
- HTTPS UA-Binary
- HTTPS UA-XML
- HTTPS UA-JSON
- WSS UA-SC UA-Binary
- WSS UA-JSON

PubSub

- PubSub UDP UADP
- PubSub MQTT UADP
- PubSub MQTT JSON

Publisher Category

Facets

FullFeatured

- Publisher UDP UADP Periodic Fixed Profile
 - PubSub UDP UADP
 - Publisher UADP Periodic Fixed Layout Facet
 - Publisher Message Security Facet
 - Publisher Cyclic Limits Facet
- Publisher UDP UADP Dynamic Profile
 - PubSub UDP UADP
 - Publisher UADP Dynamic Data or Events Facet
 - Publisher Message Security Facet
 - Publisher Cyclic Limits Facet
 - Publisher Acyclic Limits Facet
- Publisher UDP UADP Flexible Layout Profile
 - PubSub UDP UADP
 - Publisher UADP Flexible Layout Facet
 - Publisher Message Security Facet
 - Publisher Cyclic Limits Facet
 - Publisher Acyclic Limits Facet

Subscriber Category

Facets

Core Characteristics

UADP

Configuration

- Subscriber Parameter Configuration Facet
- Subscriber Component Configuration Facet
- Subscriber Parameter Configuration Facet

FullFeatured

- Subscriber UDP UADP Periodic Fixed Profile
- Subscriber UDP UADP Dynamic Profile
- Subscriber UDP UADP Flexible Layout Profile

Full-Featured Profiles for:

- UDP UADP
- Publisher + Subscriber
- Fixed Layout, Dynamic Layout, Flexible Layout

Amendments (Process)

OPC UA Spec releases

- 2006 (v1.00), 2009 (v1.01), 2012 (v1.02), 2015 (v1.03), 2017/2018 (v1.04)
- Every 2-3 years a new version

New, self-contained features can be created much faster

Companion Specs need generic features

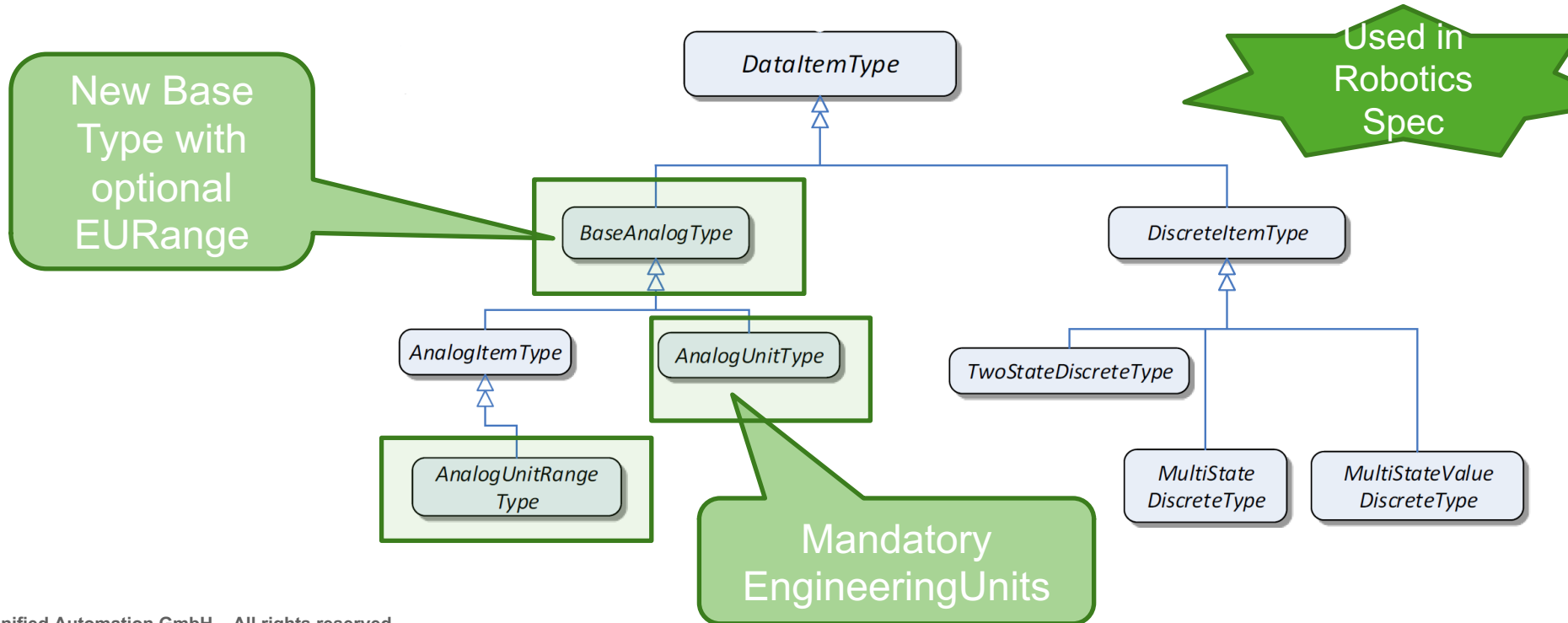
- Higher need for new, small features in base specification
- Must be released so Companion Spec can use it

Amendments will be released in between new versions of UA Spec

- Additional Document
- Might effect several parts of the specification
- Will be integrated into next version

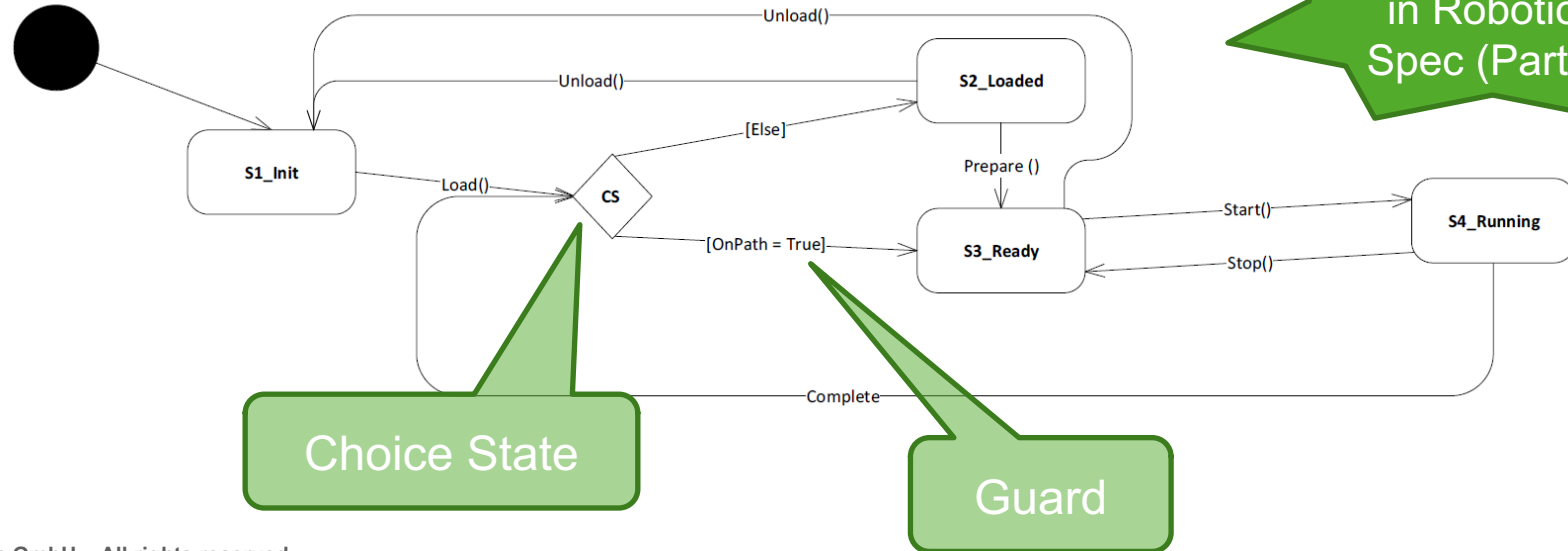
Released: Amendment 1 – AnalogItem Types

> Solves issue with Mandatory EURange in AnalogItemType



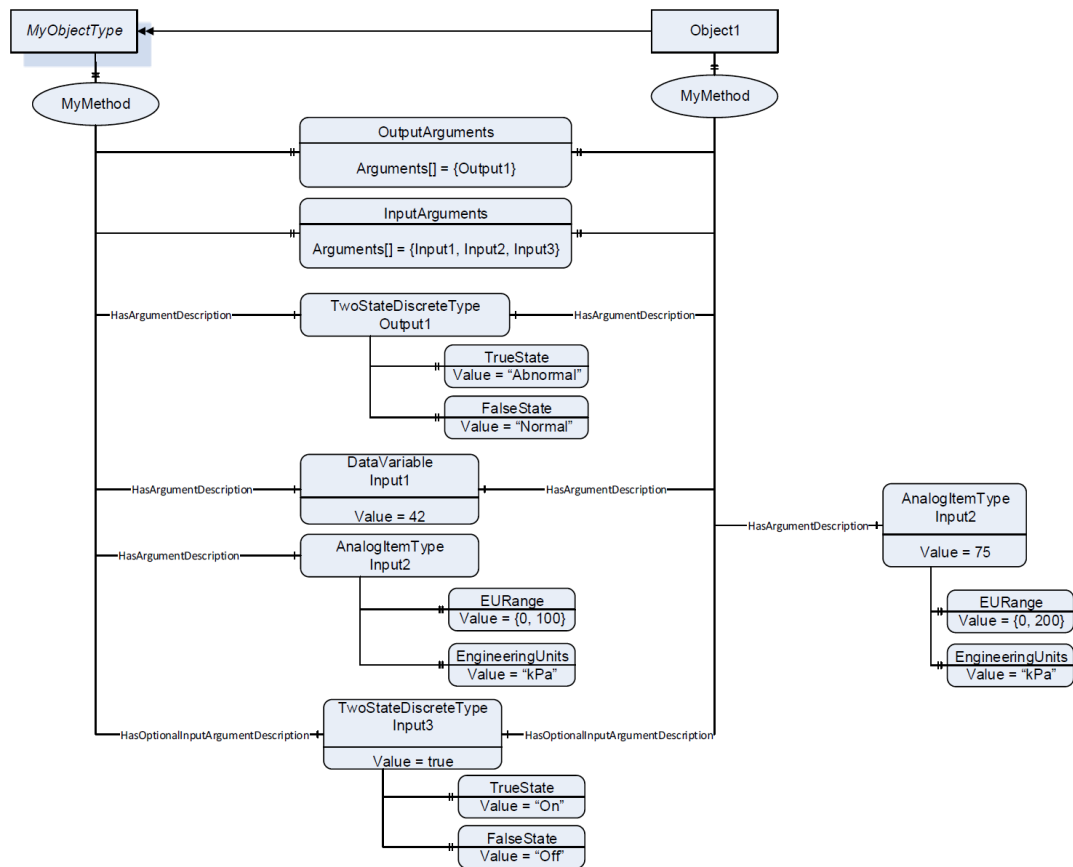
Released: Amendment 2 – Choice States and Guards

- > Additional Concepts for State Machines (from UML)
- > Feature Request exists to add all UML features for State Machines



Released: Amendment 3 – Method Metadata

- > **Metadata for Method Arguments**
 - > Units, Ranges
 - > Enum Values
- > **Optional Arguments for Methods**
 - > HasOptionalInputArgumentDescription
 - > Default Values

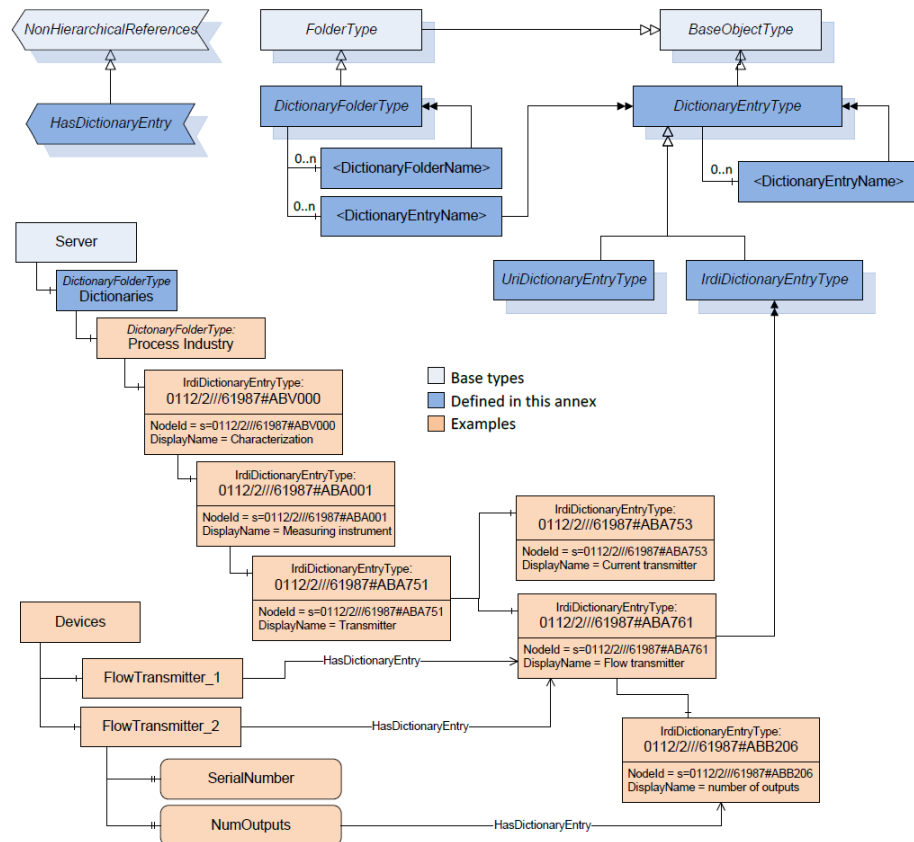


Released: Amendment 5 – Dictionary Reference

> References to external Dictionaries like

- > eCl@ss
- > IEC CDD
- > ISO 5598

Used in
PA-DIM
and I4AAS



Released: Amendment 6 – UADP Header Layouts

> Annex to Part 14 with reasonable Header Layouts

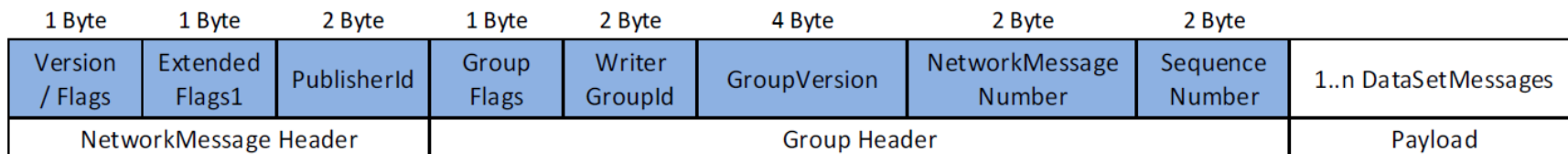


Figure C.1: UADP NetworkMessage header layout

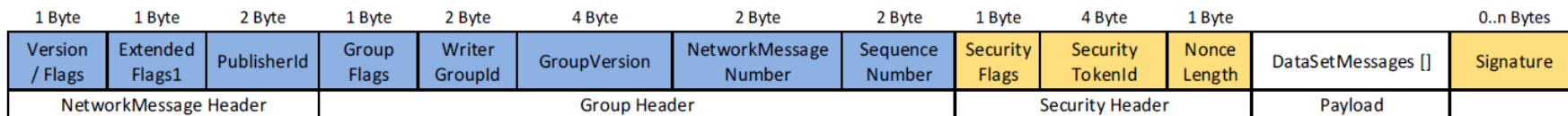


Figure C.2: UADP NetworkMessage header layout with integrity (signing)

Released: Amendment 11 – Spatial Types

> Various VariableTypes and DataTypes to represent spatial data

Attribute		Value			
BrowseName		3DVectorType			
IsAbstract		False			
ValueRank		Scalar			
DataType		3DVector			
References	NodeClass	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the VectorType defined in 7.21					
HasComponent	Variable	X	Double	BaseDataVariableType	Mandatory
HasComponent	Variable	Y	Double	BaseDataVariableType	Mandatory
HasComponent	Variable	Z	Double	BaseDataVariableType	Mandatory

Used in
Robotics
Spec

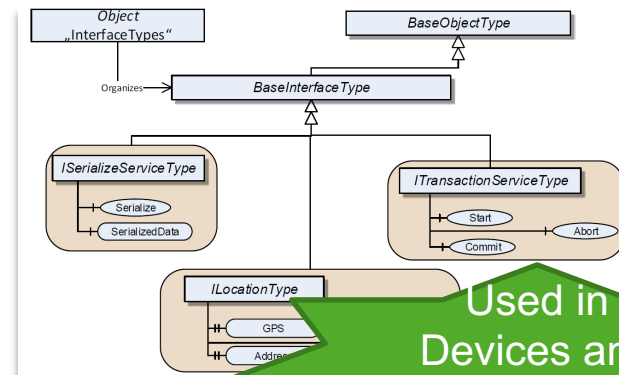
Generalized
from Robotics
Spec

Attribute		Value			
BrowseName		FrameType			
IsAbstract		True			
ValueRank		Scalar			
DataType		Frame			
References	NodeClass	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the BaseDataVariableType defined in 7.23					
HasComponent	Variable	CartesianCoordinates	Double	BaseDataVariableType	Mandatory
HasComponent	Variable	Orientation	Double	BaseDataVariableType	Mandatory
HasProperty	Variable	Constant	Boolean	BaseDataVariableType	Mandatory
HasComponent	Variable	BaseFrame	Frame	BaseDataVariableType	Mandatory
HasProperty	Variable	FixedBase	Boolean	BaseDataVariableType	Mandatory

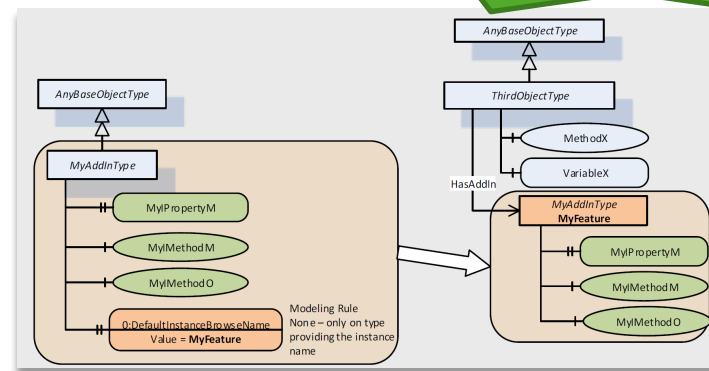
Attribute		Value			
BrowseName		3DCartesianCoordinatesType			
IsAbstract		False			
ValueRank		Scalar			
DataType		3DCartesianCoordinates			
References	NodeClass	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the CartesianCoordinatesType defined in 7.23					
HasComponent	Variable	X	Double	BaseDataVariableType	Mandatory
HasComponent	Variable	Y	Double	BaseDataVariableType	Mandatory
HasComponent	Variable	Z	Double	BaseDataVariableType	Mandatory

Released: Amendment 7 – Interfaces and AddIns

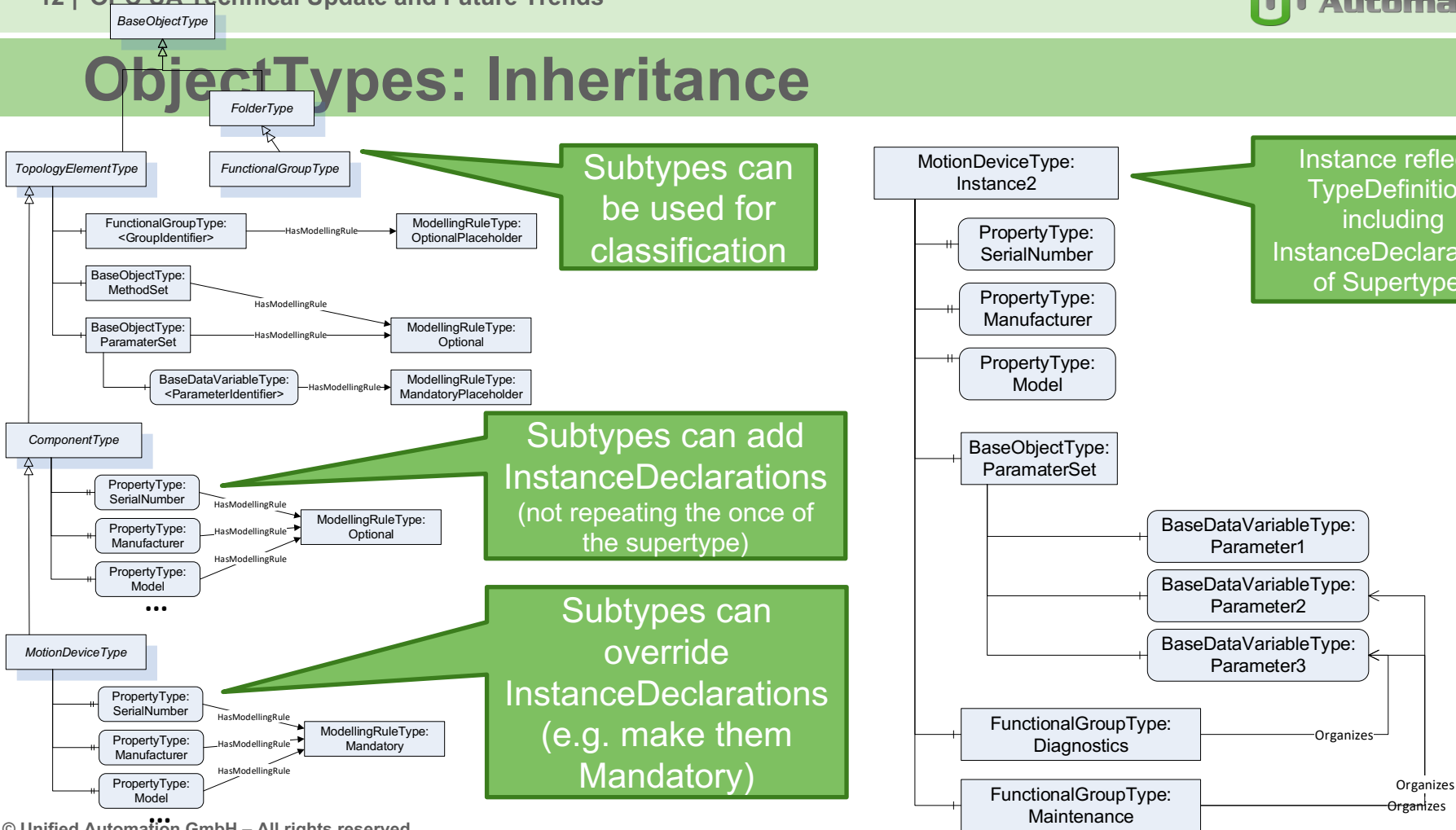
- > Added Concept of Interface
- > Added formal definition of AddIn (Composition)
 - > Whitepaper defined concept in 2011
 - > Formalized DefaultInstanceBrowseName
 - > Formalized ReferenceType HasAddIn
- > Solves issue of Multiple Inheritance



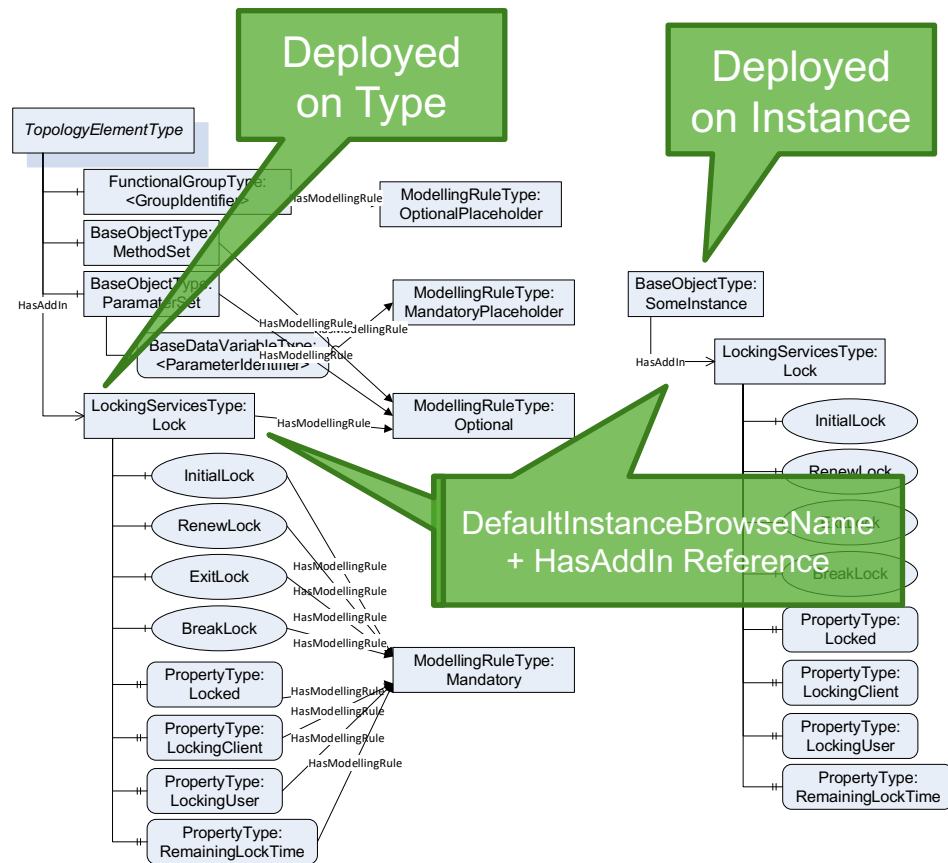
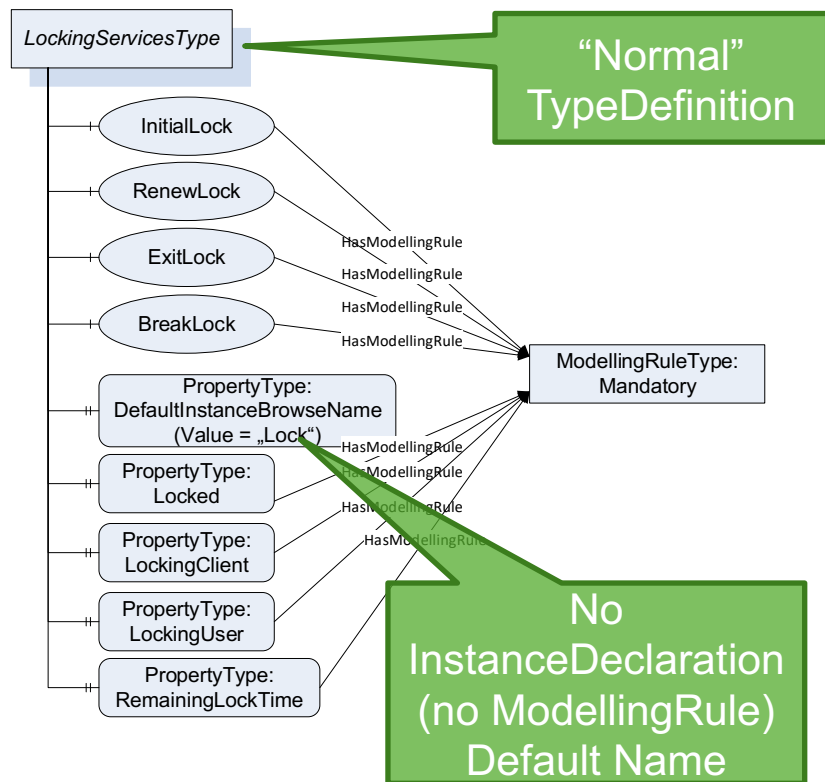
Used in
Devices and
Robotics Spec



ObjectTypes: Inheritance



ObjectTypes: AddIns



ObjectTypes: Interface

Types can implement Interface

- All InstanceDeclaration are repeated on Type

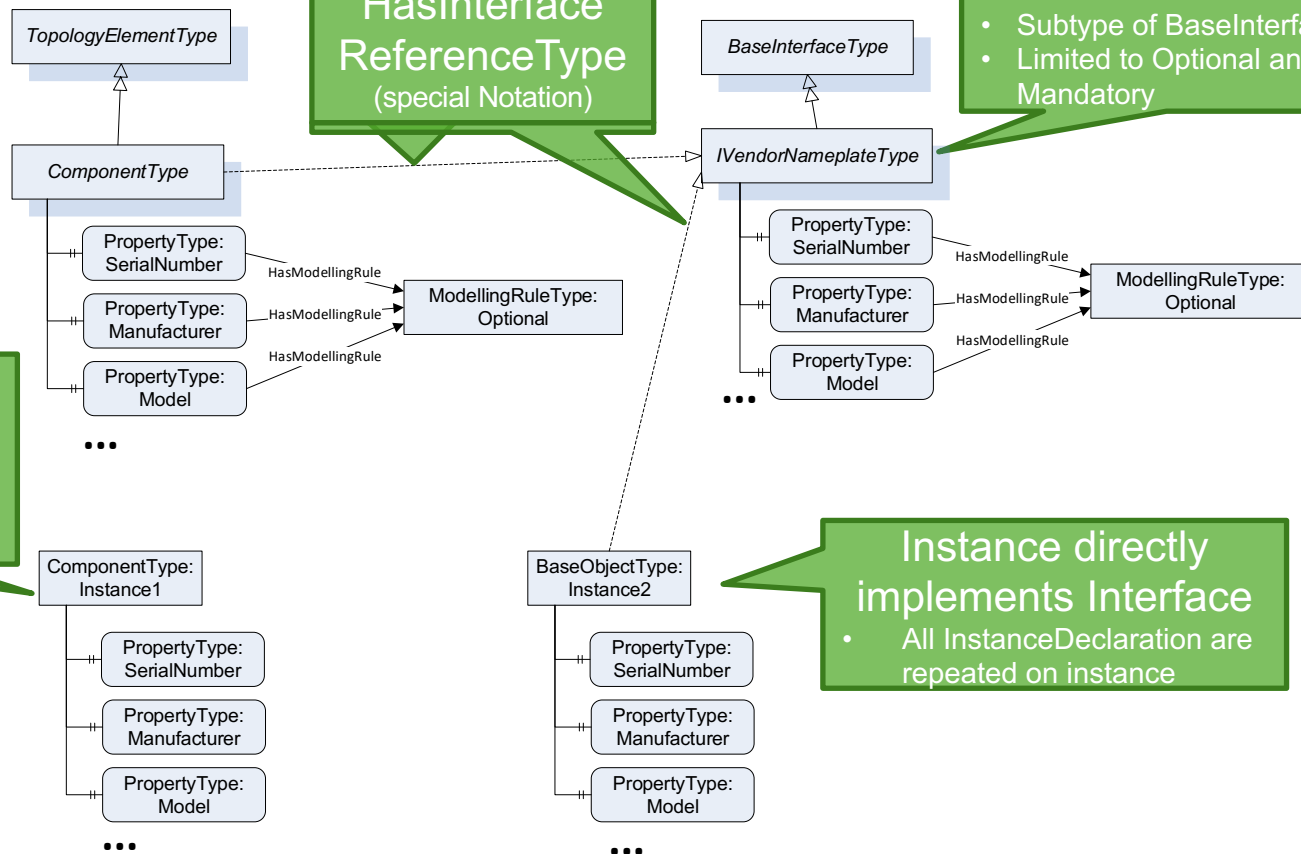
Instance of Type Implementing Interface:

- Normal Instance rules apply

HasInterface
ReferenceType
(special Notation)

Interface definition:

- Subtype of BaseInterfaceType
- Limited to Optional and Mandatory



Instance directly implements Interface

- All InstanceDeclaration are repeated on instance

Differences of Concepts

Inheritance

- Base type defines base features available by its subtypes
- No multiple inheritance – only one supertype

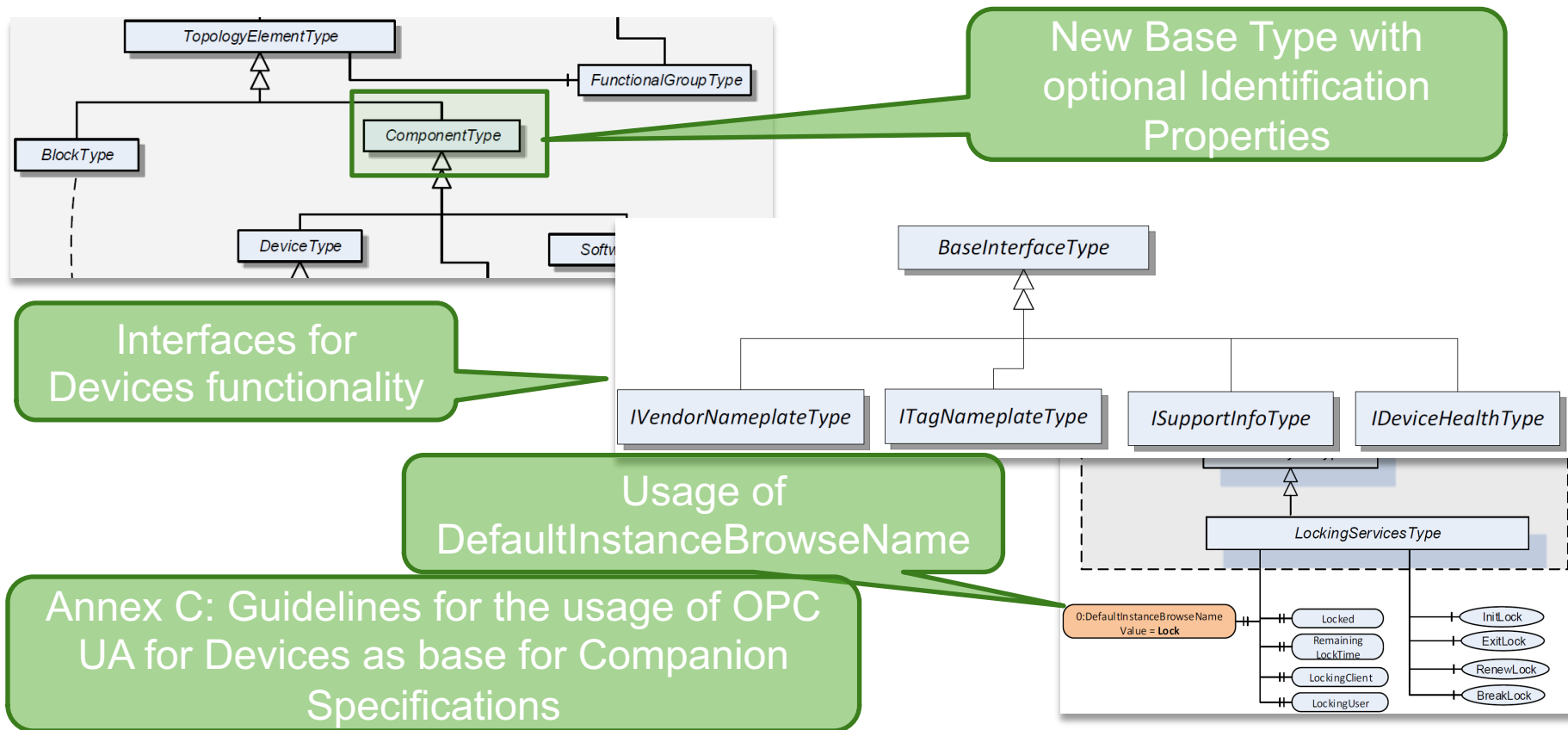
AddIn

- Add features used in several places of the type hierarchy or on individual instances
- Avoid multiple inheritance and explosion of type hierarchy
- Grouping object: All modelling aspects of feature are grouped
- All Modelling concepts available – standardized DefaultName

Interface

- Add features used in several places of the type hierarchy or on individual instances
- Avoid multiple inheritance and explosion of type hierarchy
- No grouping object: Simplified structure, but no grouping – good for simple things, not so good for complex things
- Limited to simple modelling concepts (Mandatory and Optional)
- Common base type for interfaces → Interface designed as Interface

OPC UA Devices v1.02



Released Companion Specifications

Over 20 released Companion Specifications

- SERCOS, ADI, AutomationML, ISA95, FDI, PLCOpen, IEC61850, CC-Link, Tabaco Machines, FDT, Powerlink, CNC Machines, MDIS, AutoID, EUROMAP

New Releases (last 12 Months)

- Machine Vision, Robotics, IO-Link, Kitchen Equipment, PackML, MTConnect

Release Candidates

- Profinet, Weighting, Plastics Rubbery Machines (EUROMAP)

Many Companion Specifications in Development

- More than 50 Companion Specifications when active WGs are finished

Amendments in Preparation

Amendment 4:

- Elliptical Curve Cryptography

Amendment 8:

- Device Provisioning -> Part 21

Amendment 9:

- Global Names -> Part 20 Alias Names

Amendment 10:

- Engineering Units and Currency (RC)

Amendment 12:

- PubSub over MQTT V5.0

New Parts in Preparation

Part 15:

- Safety (Release Candidate available)

Part 16:

- State Machines (Today Annex of Part 5)

Part 17:

- Alias Names (originally planned as Am. 9)

Part 18:

- User Authorization (Today Annex of Part 5)

Part 19:

- Dictionary References (Today Amendment 5)

Part 20:

- File Transfer (Today Annex of Part 5)

Part 21:

- Device Provisioning (originally planned as Am. 8)

Semantic Validation WG (subgroup of UA WG)

OPC UA has many rules not represented in a NodeSet-File

- Basic Rules: Property cannot have Properties
- Specific Rules: Restrictions on ReferenceTypes (e.g. HasSubtype only between TypeDefinitions)

Idea: Extend NodeSet-File to specify rules in a machine readable format

- Rules of base specification
- Allows Companion Specs defining their own rules

Testing of Information Models against the rules

- Specifications
- Concrete Implementations

Potential Technologies to define the rules

- OWL and SHACL
- OCL / AutomationML

Status

- Working group started in 2019
- First evaluations with OWL and SHACL exist

Harmonization WG

Idea

- OPC UA allows modelling similar things in different ways (events, methods, structures, ...)
- Companion Specs define modelling in one domain (e.g. CNC, Robot, Injection Molding)
- It is desirable that also across companion specs
 - Same things are handled the same way (e.g. Identification)
 - Similar things are handled in a similar way

Status

- WG started 2019, chair Wolfgang Mahnke
- Over 80 members, incl. representatives of CS WG
- Maintains template for Companion Specs
- Reviews Companion Specs for generic features (like Spatial Types from Robotics)
- Subteams doing specific work
 - Base Network Model (Information Model for IP addresses, etc.)
 - Best Practise
 - More to come
- Group is doing initial work – case by case decision where specs will be managed later on

Further Future Trends

Field Level Communication

TSN and deterministic Real-Time

Other Protocol Options: 5G, Quic, ...

Questions?



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Thank you!



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