



### **OPC UA Product Certification**

**UA Profiles and Certification** 



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### **OPC UA = Toolbox of Features**

### How to scale?

- UA Services function and features?
- Compatibility and compliance?
- Security and protocol variations?
- Information Models and domain extensions?
- Grouping sets of functions that logical belong together:
  - Full Featured Profiles
  - Profiles and Facets
  - Conformance Units
  - Exposing information about features in Address Space



### **OPC Profiles – Scale for Embedded**

### Conformance Unit

- Represents specific feature
- Defines a list of test cases for the feature

### Profile

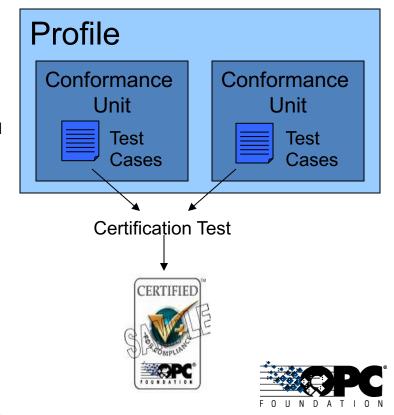
- Named grouping of features
- Full Featured Combination of Profiles and Conformance Units that can be used stand alone

#### • Facet

Profile that can be used only in combination with other Profiles

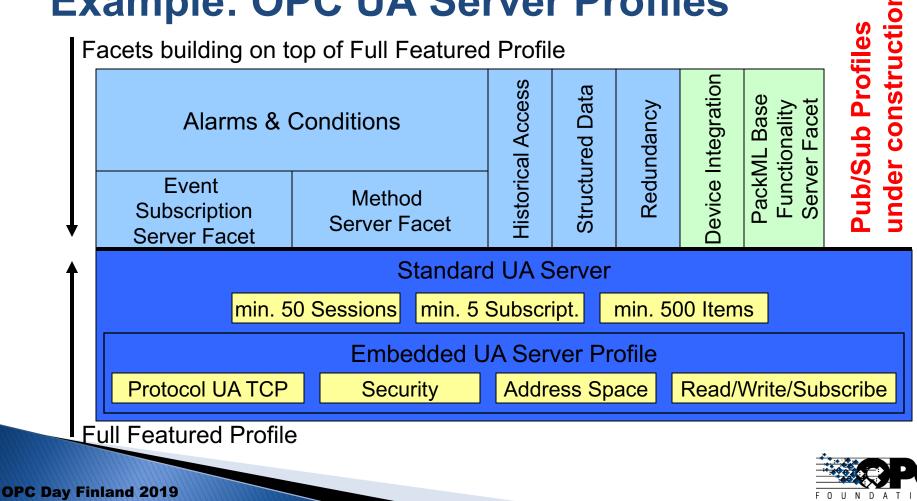
### Certification Test

- Vendor defines list of supported Profiles
- Certification Test executes test cases
- End users can rely on tested Profiles



### **Example: OPC UA Server Profiles**

Facets building on top of Full Featured Profile



### **Overview: Profiles for Pub/Sub**

### Full Featured Profiles

- UDP UADP Cyclic Fixed Profile
- UDP UADP Dynamic Profile
- UDP UADP Flexible Layout Profile
- MQTT UADP Profile
- AMQP UADP Profile
- MQTT JSON Profile
- AMQP JSON Profile

### Facets

- Information Model Facet
- Message Security Facet
- Parameter Configuration Facet
- Component Configuration Facet



### **OPC Foundation Website**

### https://www.opcfoundation.org/profilereporting

#### **OPC UA Profiles**

Following are the currently defined profiles, arranged according to their application category.

Server Category

- Facets
  - Core Characteristics
  - Data Access
  - Event Access
  - Alarm & Condition
  - Generic Features
  - Redundancy

Historical Access

Aggregates Programs Model

Query

EullFeatured

- Image: Mano Embedded Device 2017 Server Profile
- Micro Embedded Device 2017 Server Profile

Embedded 2017 UA Server Profile

- Standard 2017 UA Server Profile
  - Enhanced DataChange Subscription 201 User Token – X509 Certificate Server Fac
- Embedded 2017 UA Server Profile
- Im Global Discovery Server 2017 Profile
- Global Discovery and Certificate Mgmt 2017

Client Category

OPC

- E Facets
  - Core Characteristics
  - Data Access

#### "Standard 2017 UA Server Profile" Profile

Description	This Profile is a FullFeatured Profile that defines a minimum set of functionality required for PC based OPC UA servers. Compared to the embedded profiles, the Profile requires higher limits for Sessions, Subscriptions and Monitored Items. It also requires support of diagnostic information. This profile supersedes the "Standard UA Server Profile".	
URI	http://opcfoundation.org/UA-Profile/Server/StandardUA2017	

#### This page lists the conformance units of the selected profile with their name and description.

Conformance units that are inherited via included Profiles are not listed by default. Use the following radio buttons to change this default behaviour.

Show only explicitly included conformance units

- Show also conformance units from included profiles
- Show all existing conformance units

Show relationship of Conformance Units with Units and Profiles for Clients / Servers

#### Address Space Model

Include	Name	Opt.	Description	From Profile	Test Cases
	Address Space Base		Support the NodeClasses with their Attributes and References as defined in Part 3. This includes for instance: Object, Object Type, Variable, VariableType, References and DataType.	Core 2017 Server Facet	<u>Open</u>
	Address Space Dictionary Entries	<b>V</b>	Support external dictionaries by relating OPC UA Nodes to dictionary entries using the HasDictionaryEntry ReferenceType.	Core 2017 Server Facet	<u>Open</u>
<b>V</b>	Address Space Atomicity		Support setting the NonatomicRead and NonatomicWrite flags in the AccessLeveIEx Attribute for Variable Nodes to indicate whether Read or Write operations can be performed in atomic manner. If the flags are set to '1', atomicity cannot be assured.	Core 2017 Server Facet	<u>Open</u>
<b>V</b>	Address Space Full Array Only		Support setting the WriteFullArrayOnly flag in the AccessLevelEx Attribute for Variable Nodes of non- scalar data types to indicate whether write operations for an array can be performed with an IndexRance	Core 2017 Server Facet	<u>Open</u>

### **Server Capabilities**

- ServerProfileArray
  - Exposed in AddressSpace (ServerObject)
  - List of UA-Profile URLs
  - Examples:

http://opcfoundation.org/UA-Profile/Server/StandardUA http://opcfoundation.org/UA-Profile/Server/Methods

### OperationLimits

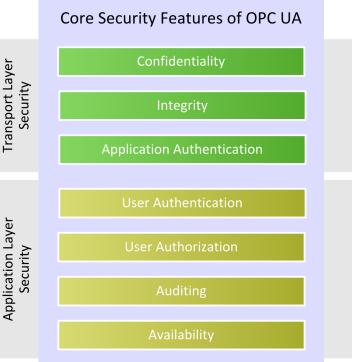
- Quantity limitation in UA-Server for certain operations
- Protect against resource exhaustion (memory, CPU load)
- Avoid long lasting operations (responsiveness)
- Informational, Client must adopt to limits (call again)

📄 Root Objects Demo DeviceSet DeviceTopology NetworkSet Server Auditing GetMonitoredItems Machine NamespaceArray Namespaces SampleEventNotifier ServerArray ServerCapabilities AggregateFunctions LocaleIdArray MaxArrayLength MaxBrowseContinuationPoints MaxByteStringLength MaxHistoryContinuationPoints MaxInactiveLockTime MaxQueryContinuationPoints MaxStringLength MinSupportedSampleRate ModellingRules OperationLimits ServerProfileArray SoftwareCertificates

# **Build-In Security Concept**

### Layered Security Architecture

- Encrypt/Sign (transport/message)
- Access protection (application specific)
- Authentication of Applications
- Authentication of Users
- User/Role based Authorization
- Auditing of relevant operations
- Availability
- Based on established Standards
  - AES, RSA, SHA, ECC
  - X509: 256+ Bit, 2048+ Key Length



[graphic: copyright Unified Automation GmbH]



## **OPC UA Security Policies - Concept**

- Security Policy specifies combination of
  - Used cryptographic algorithm
  - Used signature algorithm
  - Used key derivation algorithm
- UA Server announces which SecurityPolicies are supported
  - UA Client selects the SecurityPolicy it wishes to use
- UA Publisher associates SecurityPolicy with DataSet
  - UA Subscribers must utilize this same SecurityPolicy



# **Security Policies - Transport**

### URI uniquely defines SecurityPolicy

- #None
- #Basic128Rsa15
- #Basic256
- #Aes128\_Sha256\_RsaOaep
- #Basic256Sha256
- #Aes256\_Sha256\_RsaPss
- #PubSub-Aes128-CTR
- #PubSub-Aes256-CTR

(lowest security needs, disable) (deprecated) (deprecated) (average security needs) (high security needs) (high security needs) (average security needs) (high security needs)

### **OPC** Foundation may add new and deprecate weak policies over time !



### **Token Policies - Authorization**

### VRI uniquely defines UserToken

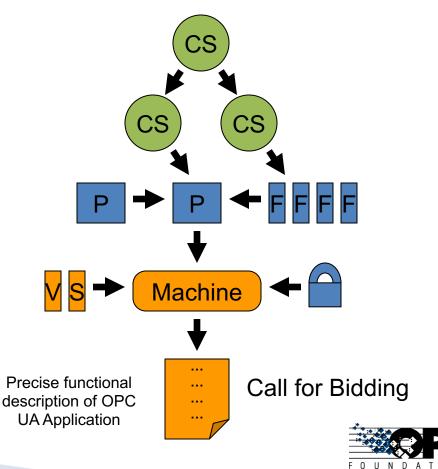
- #Anonymous
- #UserNamePassword
- #X509Certificate
- #IssuedToken
- #IssuedTokenWindows
- #JsonWebToken

(everybody, no user authorization) (user/pwd with appl. specific validation) (X509 user certificates to identify users) (encrypted Kerberos token for user identity) (encrypted Windows-Kerberos token) (JSON Web Token required in OAuth2 )



# **Requirements – Call for Bidding**

- Companion Specification
  - VDMA Robotics Specification
  - AIM RFID Specification
  - PLCopen UA Functions Blocks
- OPC UA Core Specification
  - Full Featured Profiles
  - Additional Facets
  - Security Profiles
- Quantity Measures
  - Data Volume
  - Speed



# **Issues without certification**

- Different quality standards
- Different understanding of requirements
- Low quality in UA core functionalities
- Everybody can claim support for a specification
- Those issues remain with self-certification as
  - Test applications can be tricked
  - Interpretation of the results may vary
  - Automatic testing can't cover all test cases



Compliance	Interoperability	Robustness	Efficiency	Usability
<ul> <li> to OPC UA Core Specifications</li> <li> to Companion Specifications</li> </ul>	With products of other vendors'	Recovery from disaster	CPU, Memory and bandwidth	• Good user- experience



Compliance

- ... to **OPC UA Core Specification**
- ... to Companion **Specifications**

- Test all REQUIRED functionality
- Test all OPTIONAL functionality
- Conduct test-to-pass and test-to-fail use-cases Validate behavior for multi-step processes

- Servers handle & respond to invalid Client requests
- Clients handle & report invalid Server responses



# **Compliance Test Tool (CTT)**

- Validates OPC UA Services
- Validates AddressSpace
- Validates Security
- > 1000 Test Scripts
- Extendable by users
  - Adding settings
  - Adding test scripts
- Available to all members of the OPC Foundation (including logo members)



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Compliance

- .... to OPC UA Core Specification
- ... to Companion Specifications

#### Interoperability

 With products of other vendors' • All products are tested against

5 products from other vendors

- All OPC UA services are tested
- All DataTypes are tested
- SecurityPolicies are tested
- IdentityTokens are tested

#### Usability

 Good userexperience



**OPC Day Finland 2019** 

- Handling lost communication
- Test communications recovery

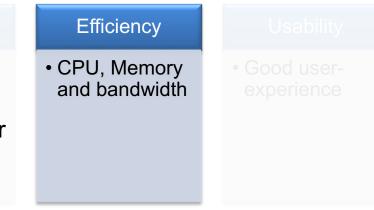
	Robustness	Problems are self-contained
	Recovery from disaster	<ul> <li>Quality codes are reported correctly</li> <li>Audit events log sufficient data</li> <li>End-user has access to critical</li> </ul>

information



- Place the product under some "load"
- Connect to 5 products from other vendors
- Force intermitted communication to one device
- Force intermitted communication to one partner
- Measure CPU, RAM, Threads, Handles

(and more) for 36-hours





- Record how products are delivered
- Validate product documentation accuracy
- Verify product uses OPC correctly (as-intended)
- Verify product behaves as an end-user would expect
  Ensure the end user experience will be positive!
- Ensure the end-user experience will be positive!



• Good userexperience



## **Certified "Marks"**







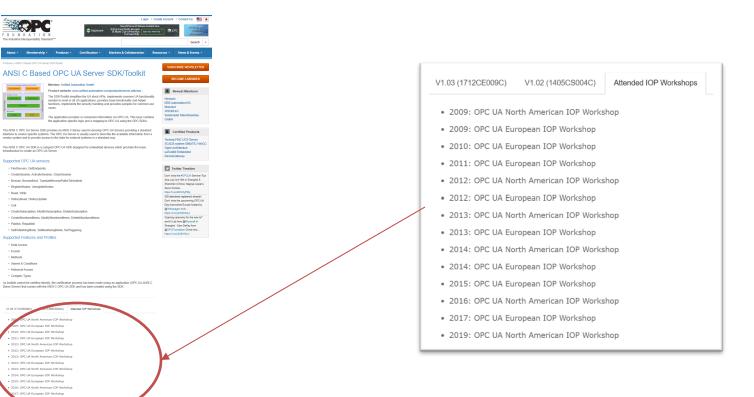
## **Certified Products**

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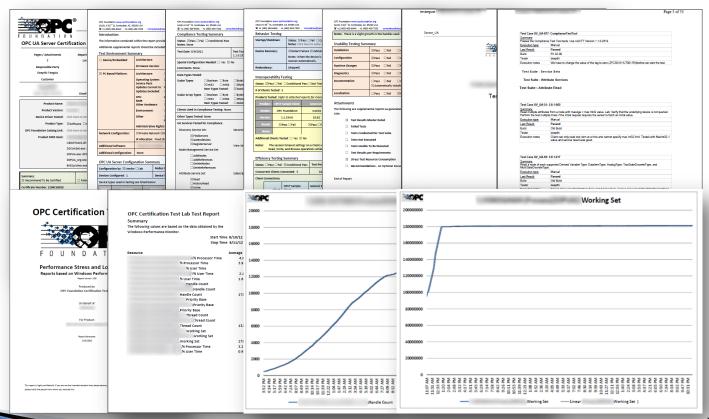


## **Certified Products**





# **Certification Test Reports**





## Thank your for your attention !







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### **Alexander Allmendinger**

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