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SIMATIC OPC UA
Web based training
Part 2 ➔ S7-1500 OPC UA Data Access Server

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Agenda

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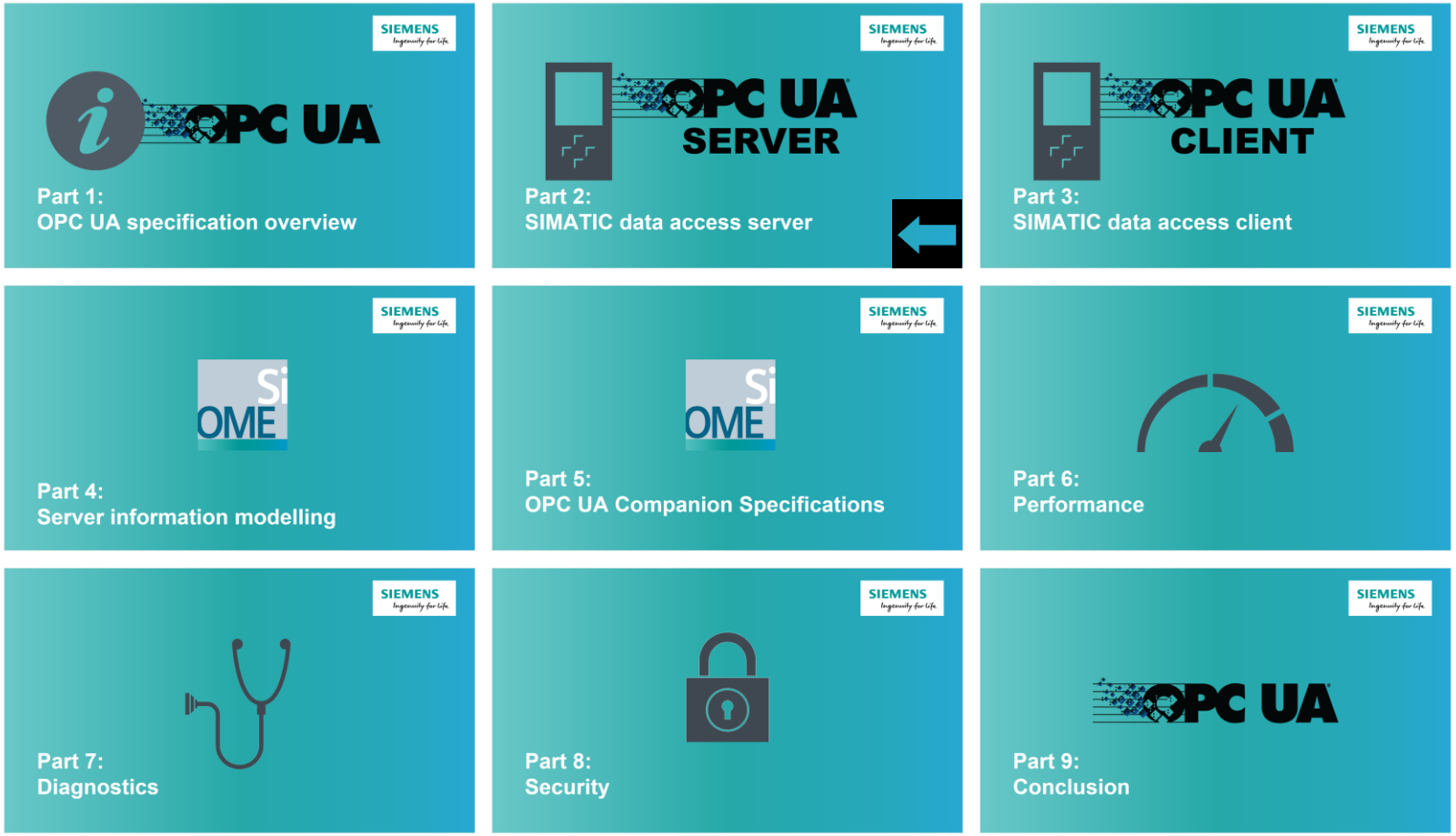

S7-1500 OPC UA data access server
Use cases

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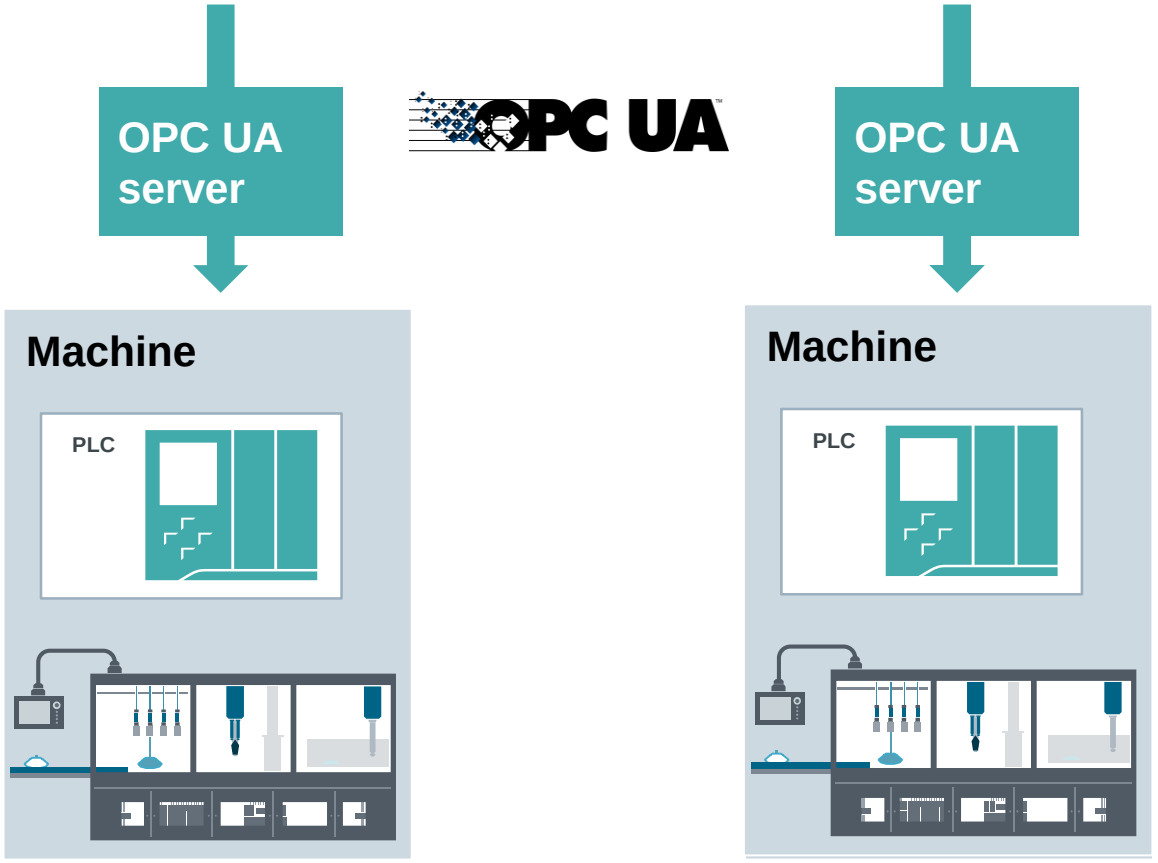
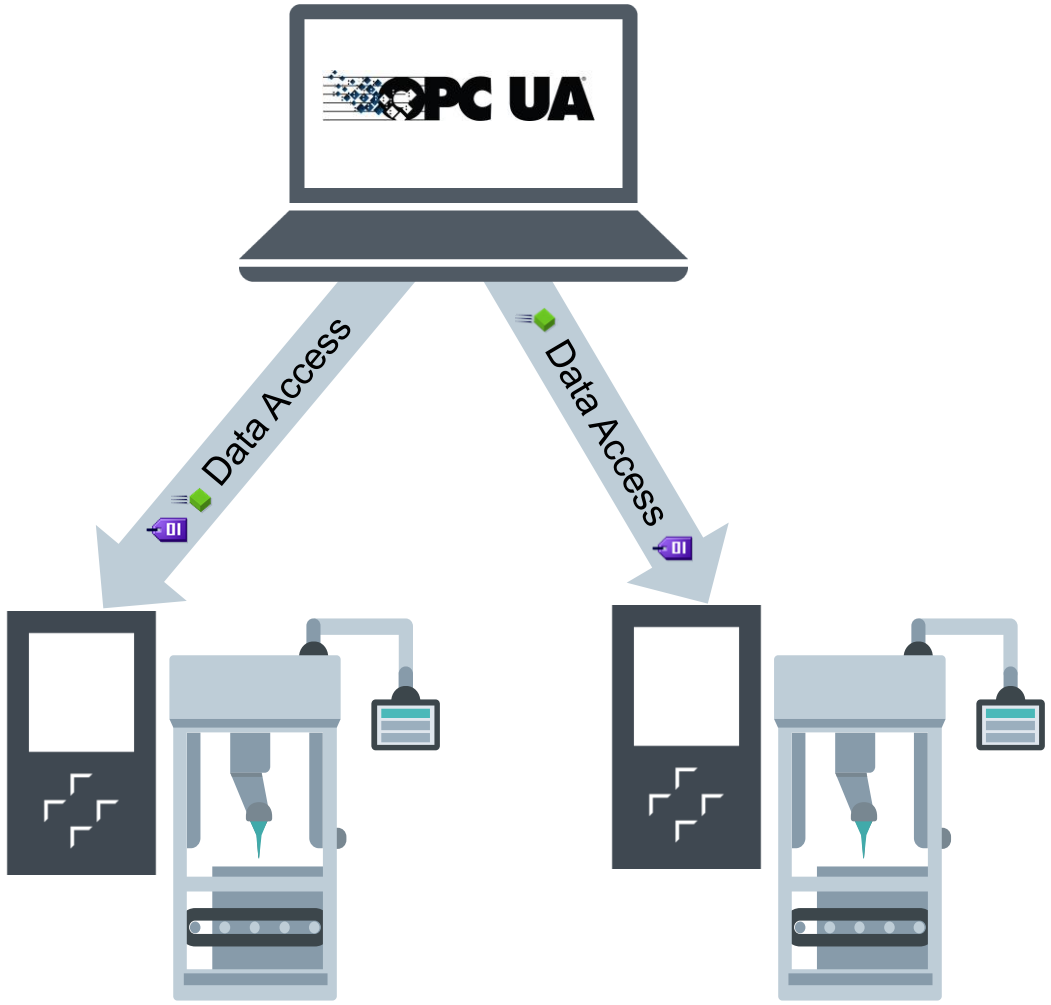
Vertical line integration: e.g. MES, SCADA





S7-1500 OPC UA Server
Feature Set with TIA V15.1 and FW 2.6

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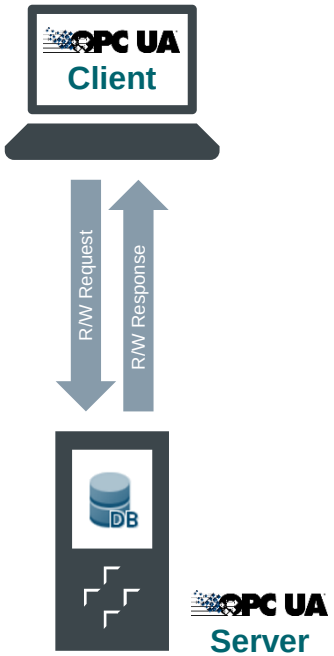
Browsing

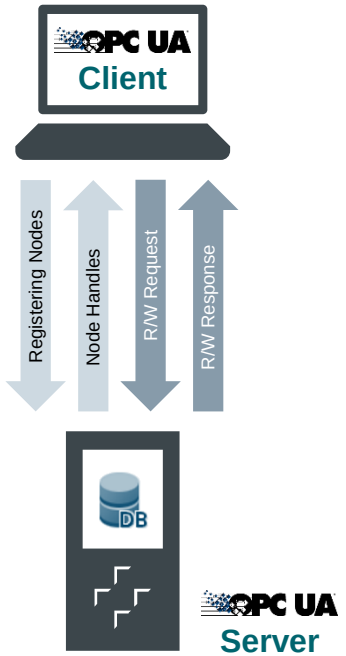
Browsing of PLC data

Read/Write



Acyclic access to data

Registered Read/Write

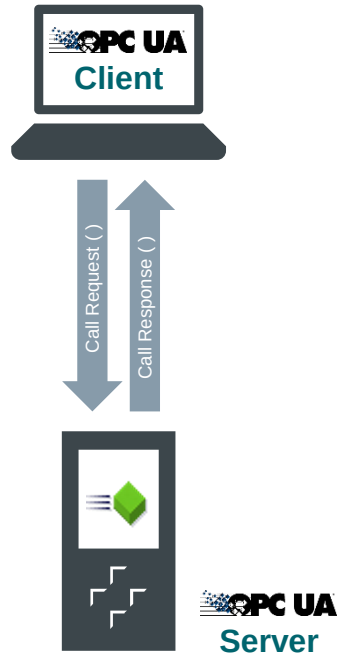


High performance with repeated acyclic access

Subscription

Load reduction for HMI / monitoring applications

Methods



Consistent data transfer through function call

OPC UA address space
NodeId and namespaces

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Node ID:

- Items in an OPC UA server are adressed by NodeIds.
- A NodeId is a unique identifier for an item inside a server
- NodeId = NamspaceIndex + IdentifierType + Identifier

Namespace:

- A server can holds multiple namespaces
- Namespaces are adressed with namespace indexes
- The OPC UA foundation namespace has index 0

NodeId
Namespace(Index)
IdentifierType
Identifier

ns=0;s=ServerState
3
String
ServerState

ns=0;i=2259
0
Numeric
2259

OPC UA address space
NodeId and Namespaces

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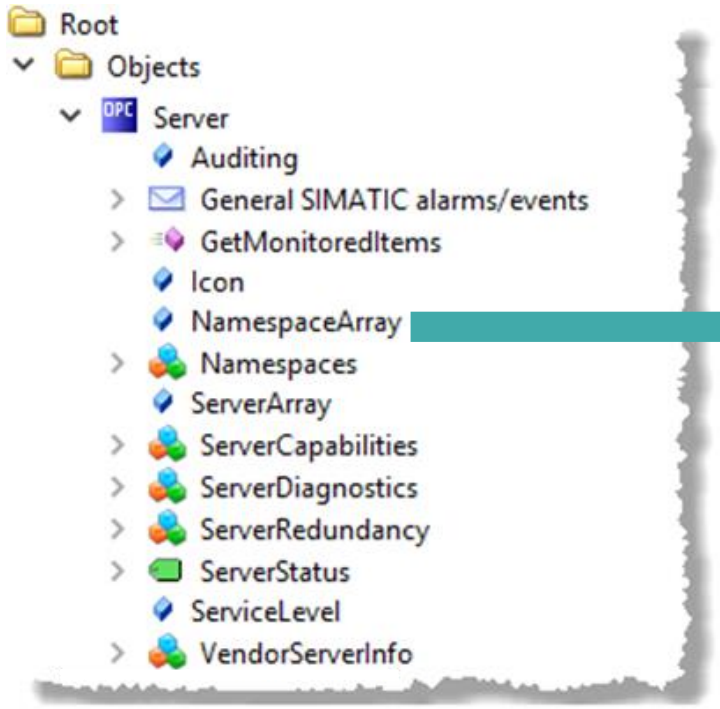
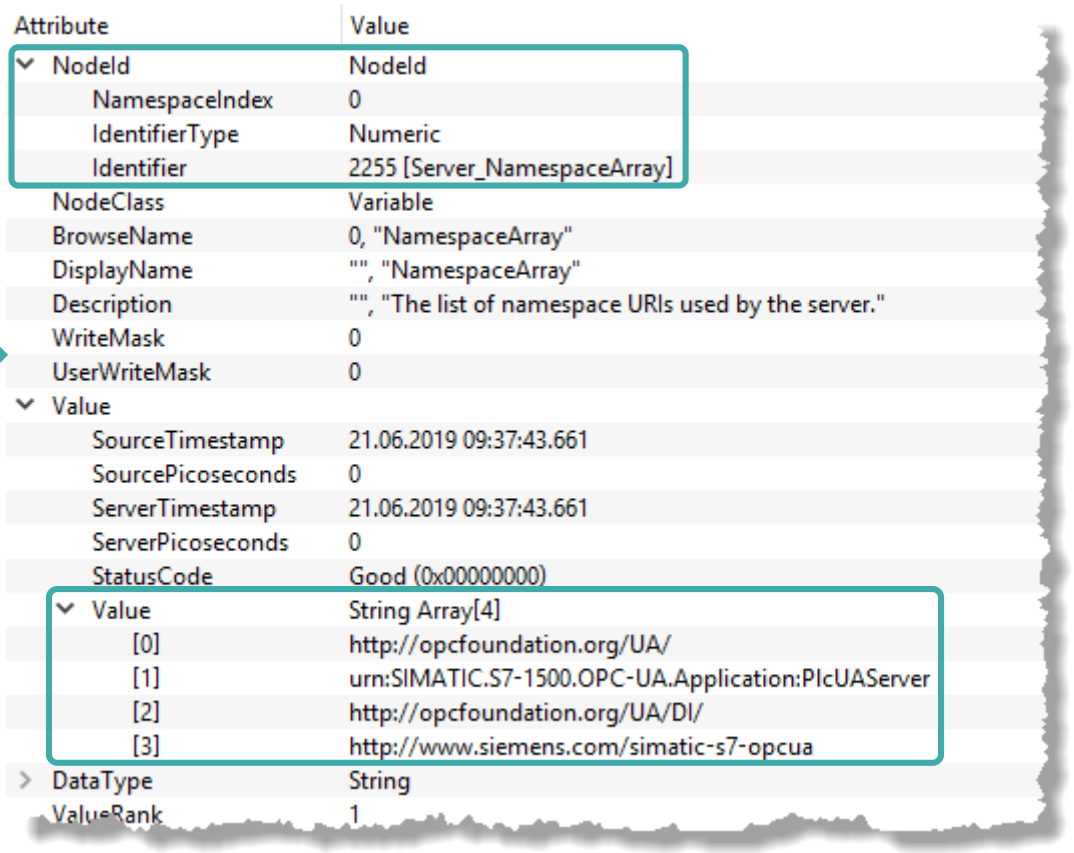
NamespaceArray:

- The NamespaceArray shows all namespaces URIs available on the server
- The array index of the Namspace URI is the NamespaceIndex





Attribute	Value
NodeId	NodeId
NamespaceIndex	0
IdentifierType	Numeric
Identifier	2255 [Server_NamespaceArray]
NodeClass	Variable
BrowseName	0, "NamespaceArray"
DisplayName	"", "NamespaceArray"
Description	"", "The list of namespace URIs used by the server."
WriteMask	0
UserWriteMask	0
Value	
SourceTimestamp	21.06.2019 09:37:43.661
SourcePicoseconds	0
ServerTimestamp	21.06.2019 09:37:43.661
ServerPicoseconds	0
StatusCode	Good (0x00000000)
Value	String Array[4]
[0]	http://opcfoundation.org/UA/
[1]	urn:SIMATIC.S7-1500.OPC-UA.Application:PlcUAServer
[2]	http://opcfoundation.org/UA/DI/
[3]	http://www.siemens.com/simatic-s7-opcua
DataType	String
ValueRank	1

S7-1500 OPC UA server
Functional scope

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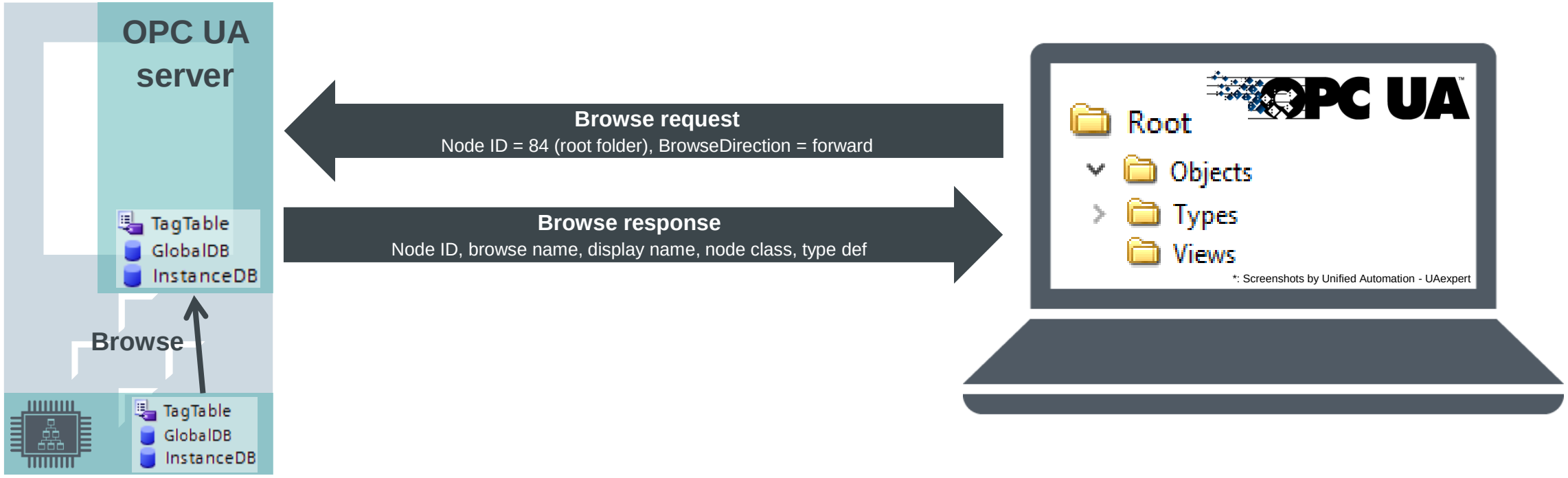
Browse



- Browsing of PLC data
- Dynamic adaptation of clients to data available on a server

S7-1500 OPC UA Server
Browsing

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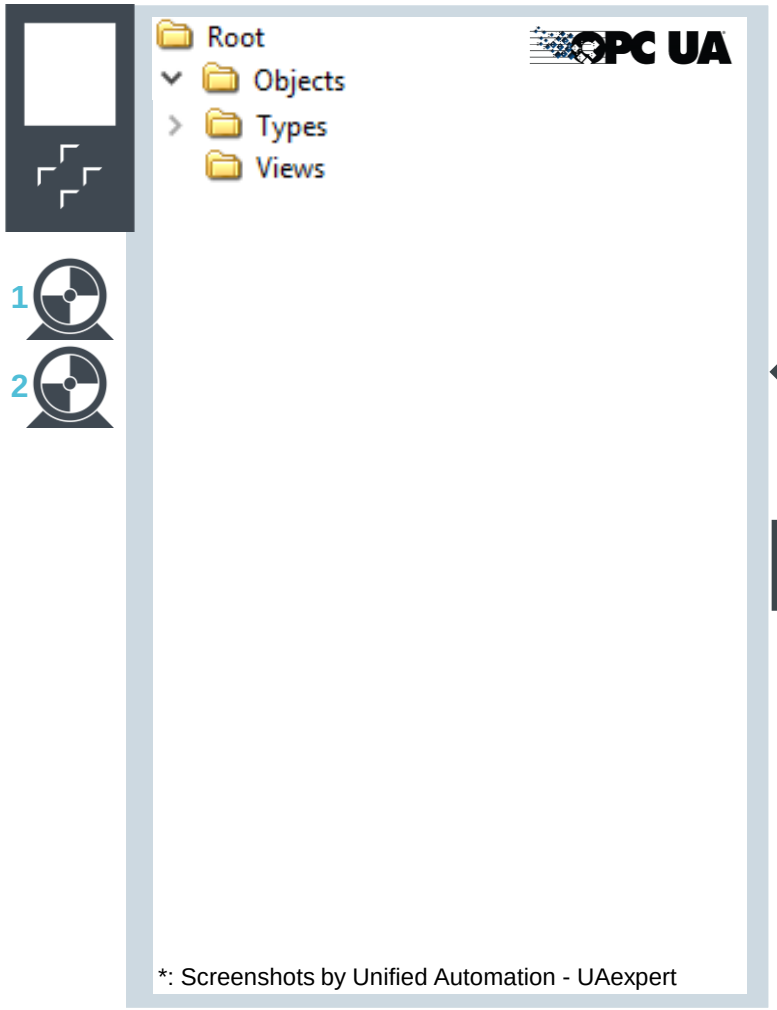

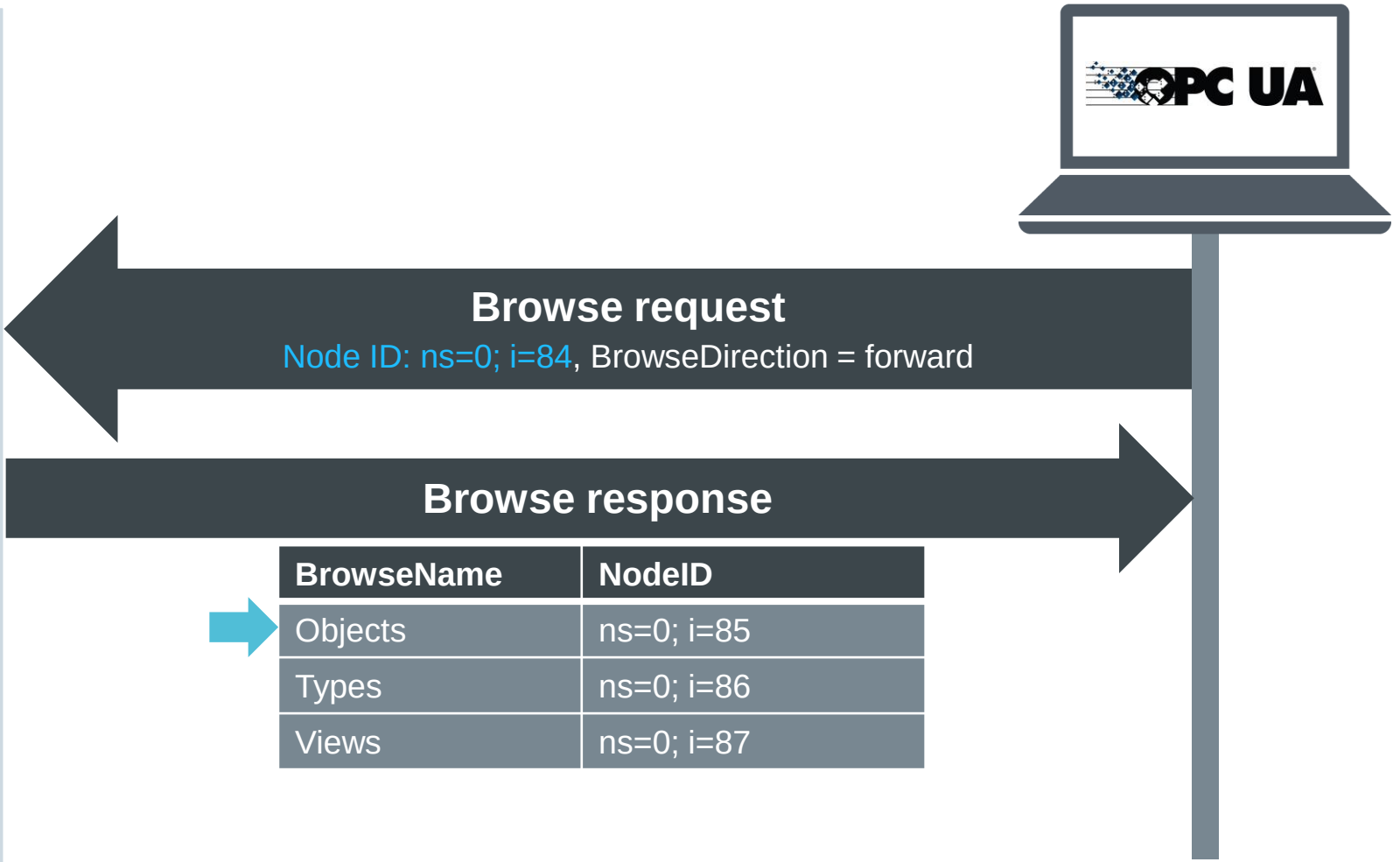

BrowseName	NodeID
Objects	ns=0; i=85
Types	ns=0; i=86
Views	ns=0; i=87

S7-1500 OPC UA Server
Browsing

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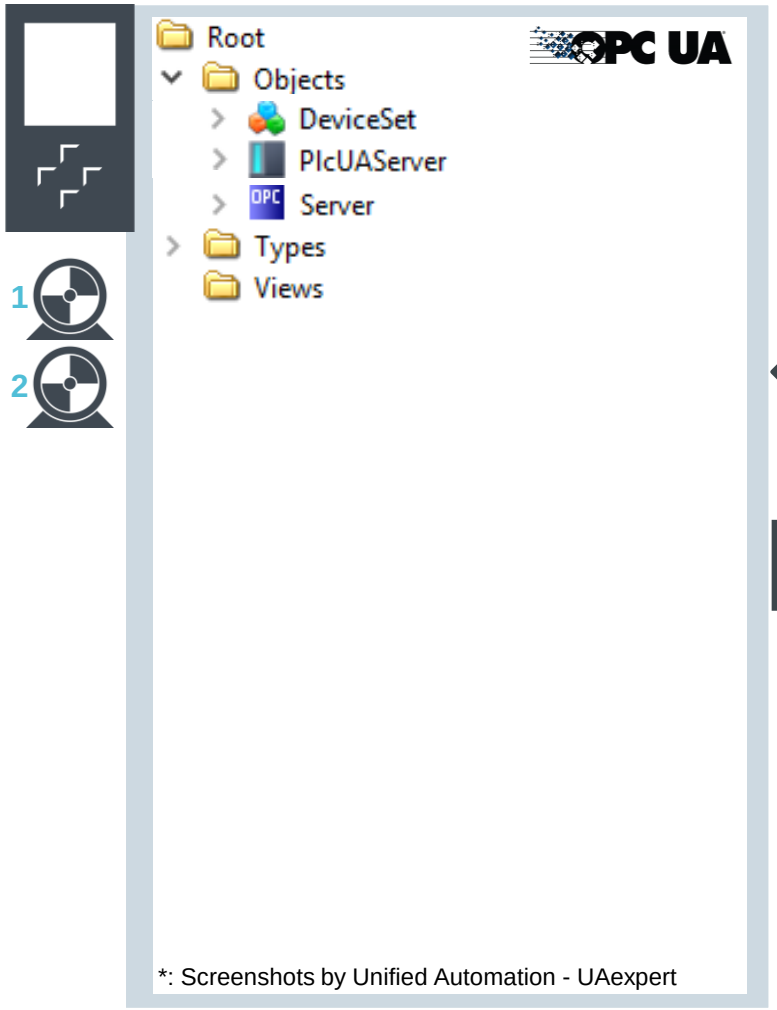

Browse request

Node ID: ns=0; i=85, BrowseDirection = forward

Browse response

BrowseName	NodeID
DeviceSet	ns=2; i=5001
PlcUAServer	ns=3; s=PLC
Server	ns=0; i=2253

S7-1500 OPC UA Server
Browsing

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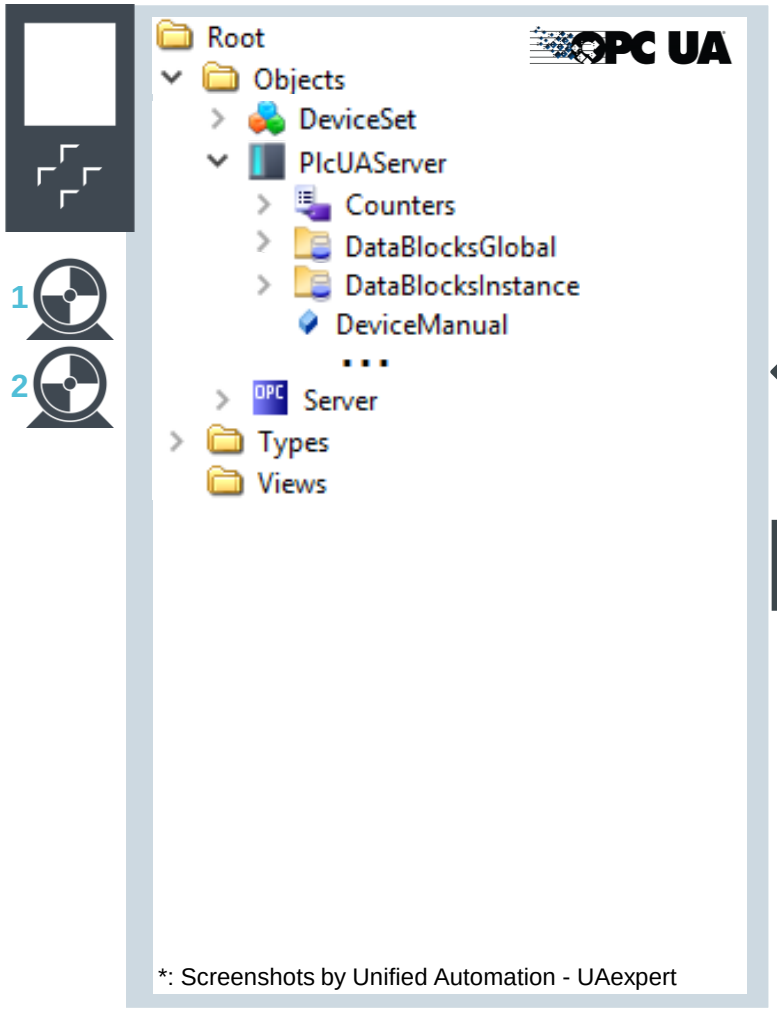

Browse request

Node ID: ns=3; s=PLC, BrowseDirection = forward

Browse response

BrowseName	NodeID
Counters	ns=3; s=Counters
DataBlocksGlobal	ns=3; s=DataBlocksGlobal
DataBlocksInstance	ns=3; s=DataBlocksInstance
DeviceManual	ns=3; s=DeviceManual
• • •	

S7-1500 OPC UA Server
Browsing

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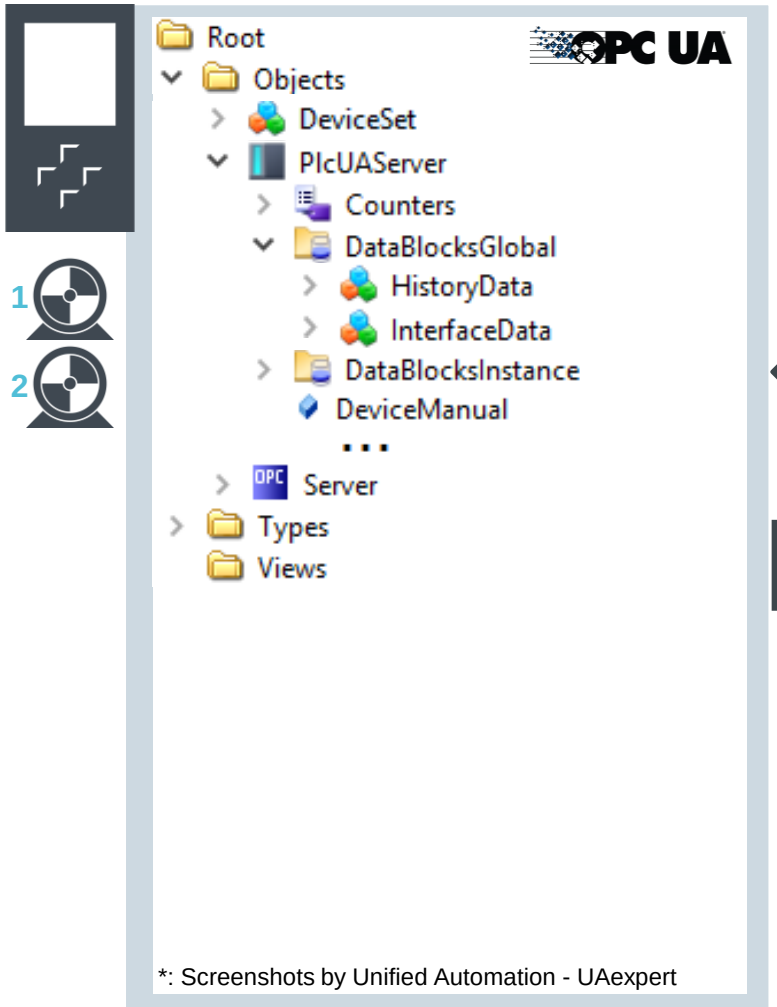

Browse request

Node ID: ns=3; s=DataBlocksGlobal, BrowseDirection = forward

Browse response

BrowseName	NodeID
HistoryData	ns=3; s="HistoryData"
InterfaceData	ns=3; s="InterfaceData"

S7-1500 OPC UA Server
Browsing

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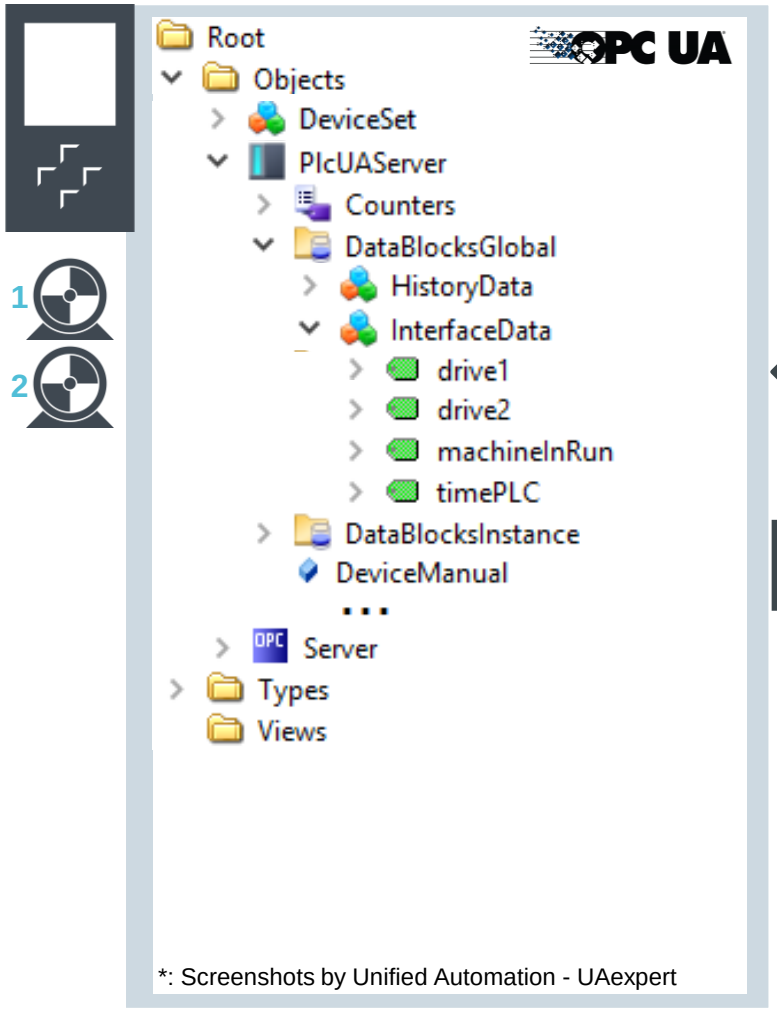

Browse request

Node ID: ns=3; s="InterfaceData", BrowseDirection = forward

Browse response

BrowseName	NodeID
drive1	ns=3; s="InterfaceData"."drive1"
drive2	ns=3; s="InterfaceData"."drive2"
machineInRun	ns=3; s="InterfaceData"."machineInRun"
timePLC	ns=3; s="InterfaceData"."timePLC"

S7-1500 OPC UA Server
Browsing

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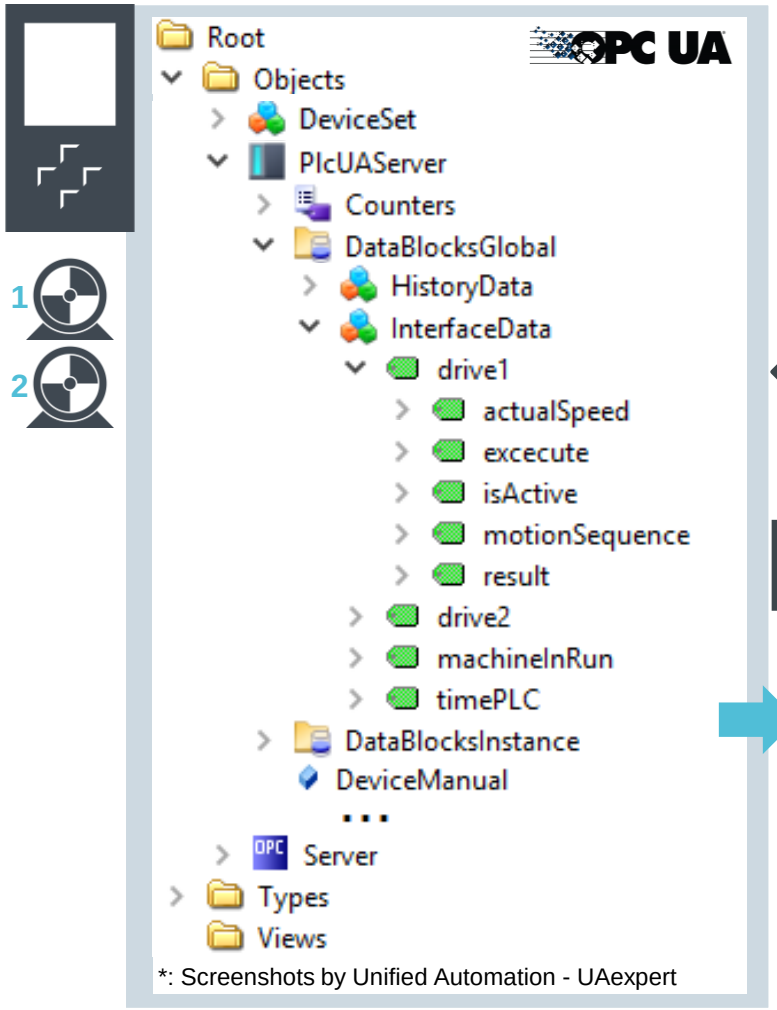

*: Screenshots by Unified Automation - UAexpert

Browse request

Node ID: ns=3; s="InterfaceData"."drive1", BrowseDirection = forward

Browse response

BrowseName	NodeID
actualSpeed	ns=3; s="InterfaceData"."drive1"."actualSpeed"
excecute	ns=3; s="InterfaceData"."drive1"."execute"
isActive	ns=3; s="InterfaceData"."drive1"."isActive"
motionSequence	ns=3; s="InterfaceData"."drive1"."motionSequence"
result	ns=3; s="InterfaceData"."drive1"."result"

S7-1500 OPC UA Server
Browsing

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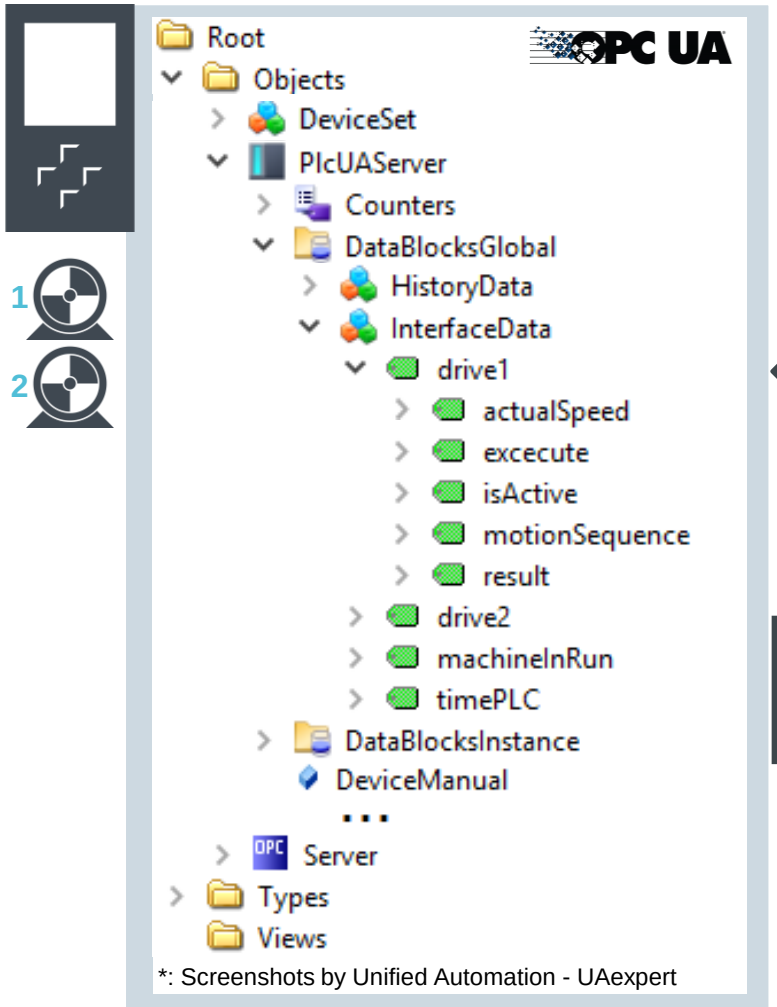
Ingenuity for life



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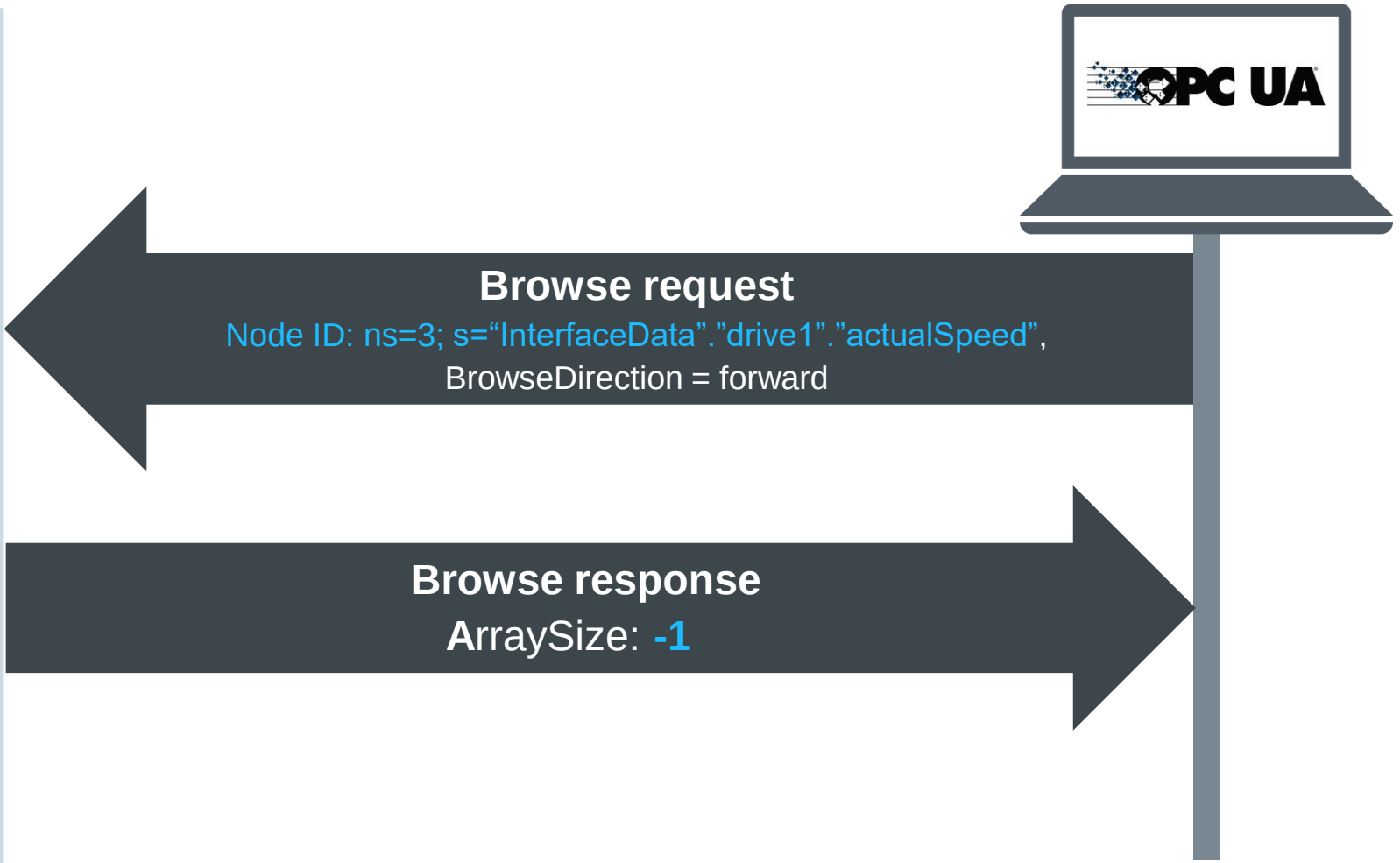

S7-1500 OPC UA server
Functional scope

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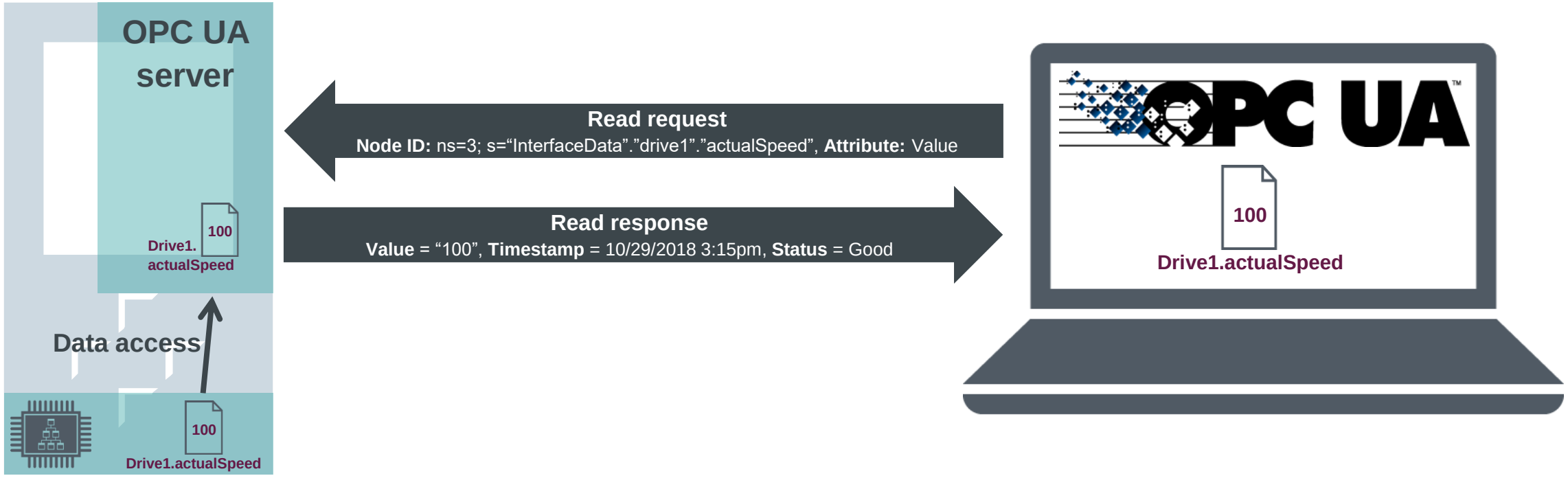
Read / Write



- Symbolic read / write access to PLC data

S7-1500 OPC UA server
Functional scope

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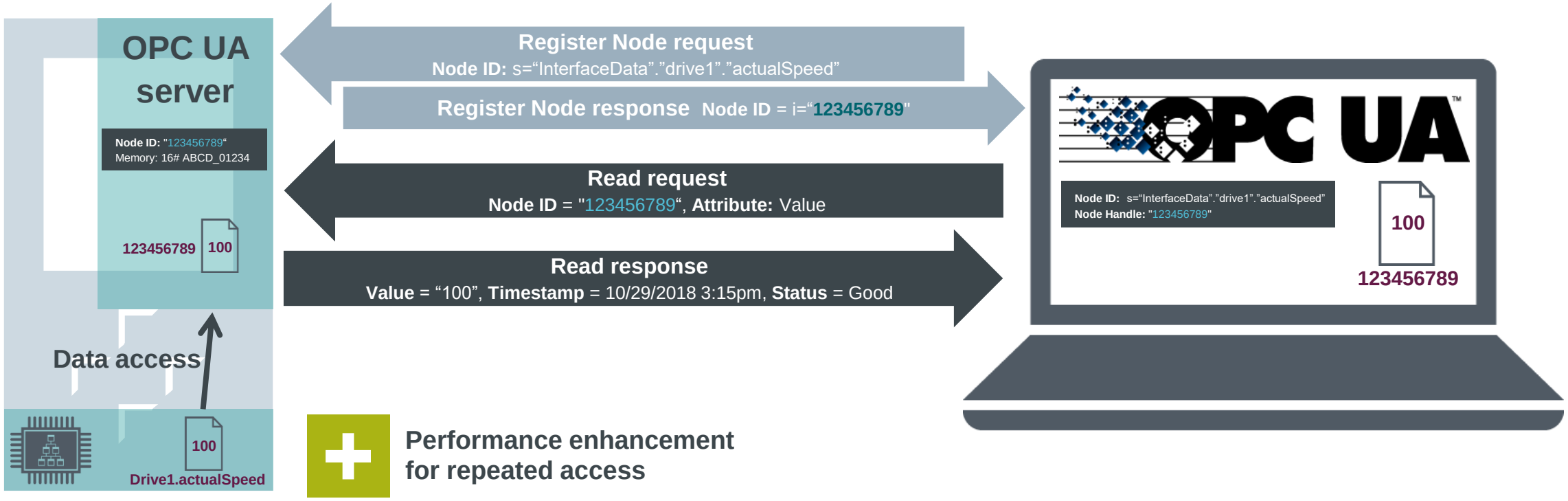
Registered Read / Write



Performance enhancement for repeated access

- Repeated read / write access to PLC data

S7-1500 OPC UA server
Functional scope

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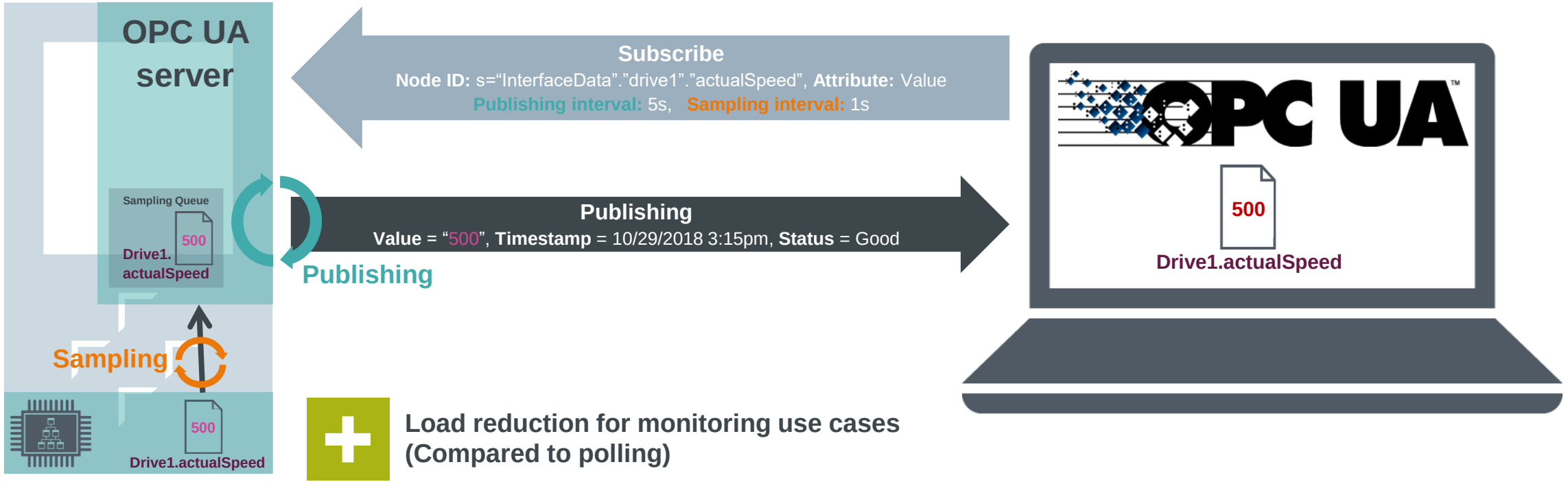
Subscribe



Load reduction for monitoring use cases (Compared to polling)

- **Load reduction for monitoring use cases**
- **Absolute filters possible**

*: Simplified illustration

S7-1500 OPC UA server
Functional scope

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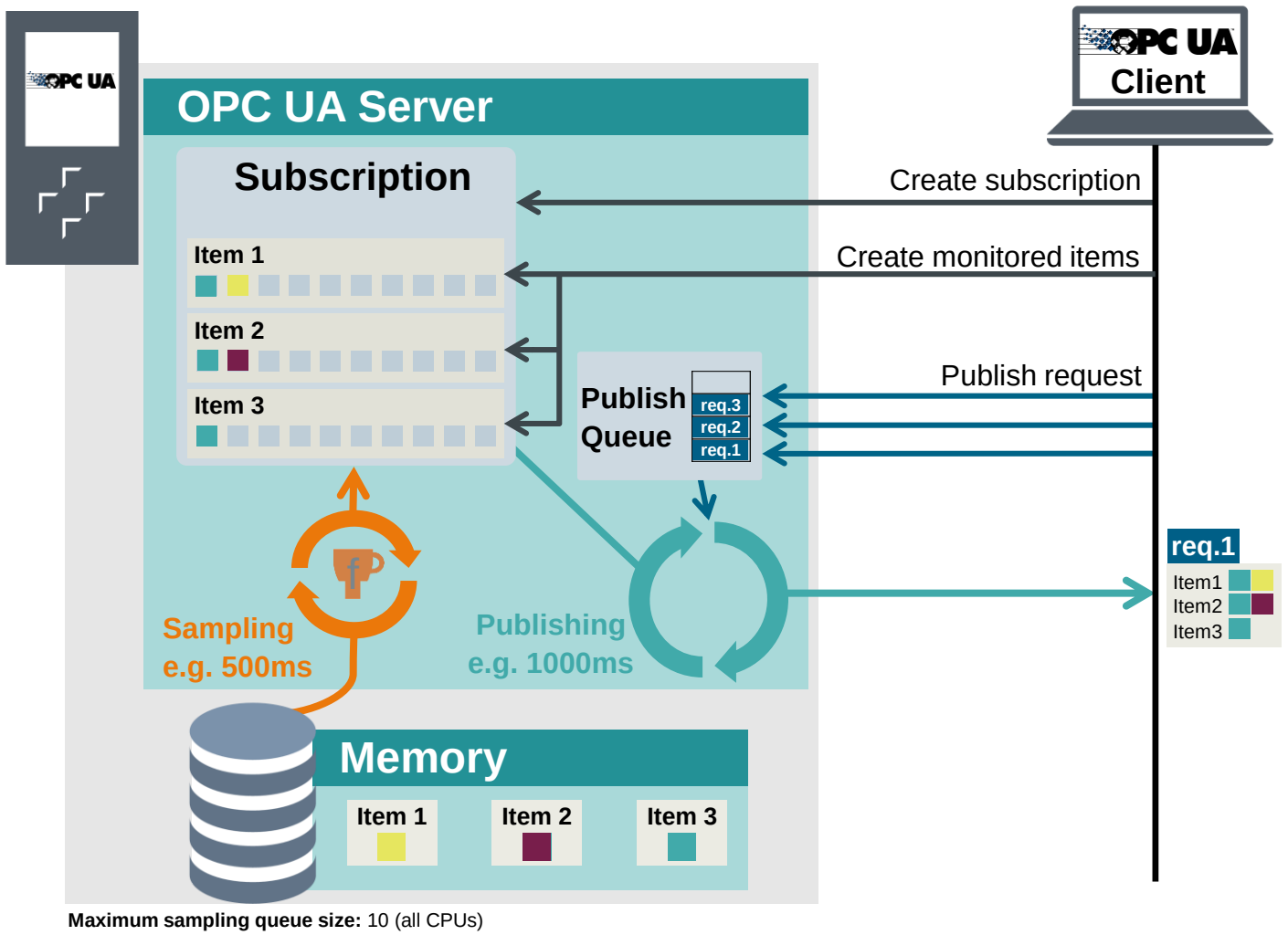

Maximum sampling queue size: 10 (all CPUs)

Parameters defined by the client:

- Queue size
- Sampling interval
- Publishing interval

Config parameters in the server:

- Min. possible sampling interval
- Min. possible publishing interval
- Max. number of monitored items

S7-1500 OPC UA server
Functional scope

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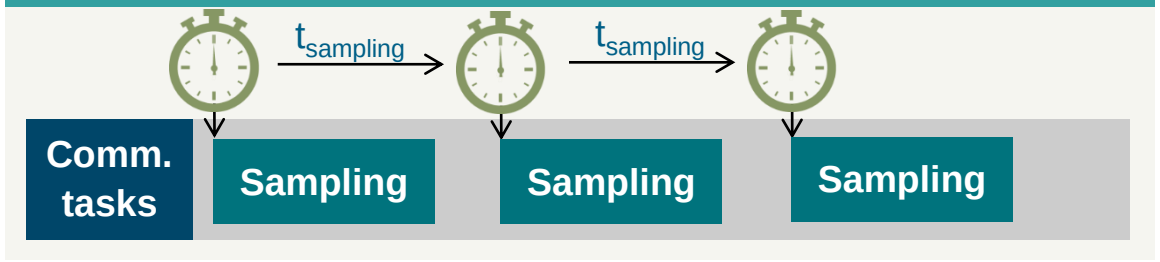
Normal behavior of sampling



- All items with the same sampling interval are linked to a timer-triggered list
- The sampling is only excecuted if the previous sampling task has been finished in time

Overload behavior of sampling

An overload behavior will cause two publishs with all items related to the affected sampling interval:

Publishing 1:
Good ➔ Good_Overload

Publishing 2:
Good_Overload ➔ Good

This may temporarily cause a high communication load

LiveDemo
Browse, Read, Subscribe

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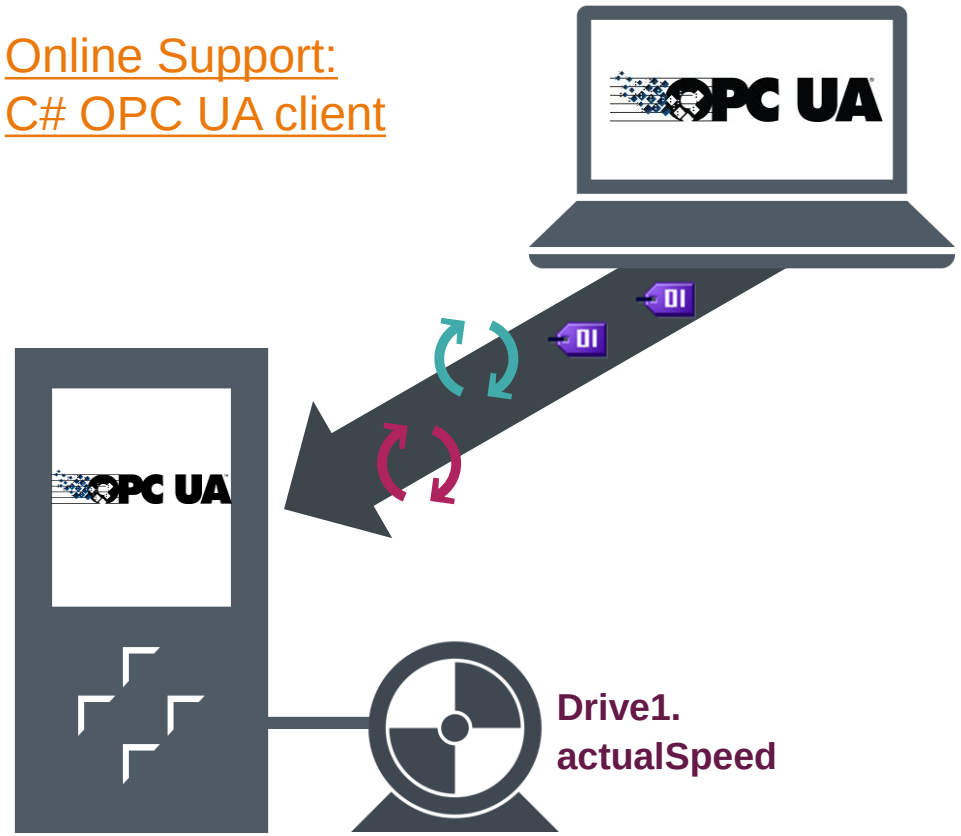
L I V E D E M O

Online Support:
C# OPC UA client



- Configuration in TIA Portal
- Connect a OPC UA client to the Server
- Browse of Node Ids
- Read of Data
- Registered Read of Data
- Subscription

LiveDemo
Browse, Read, Subscribe

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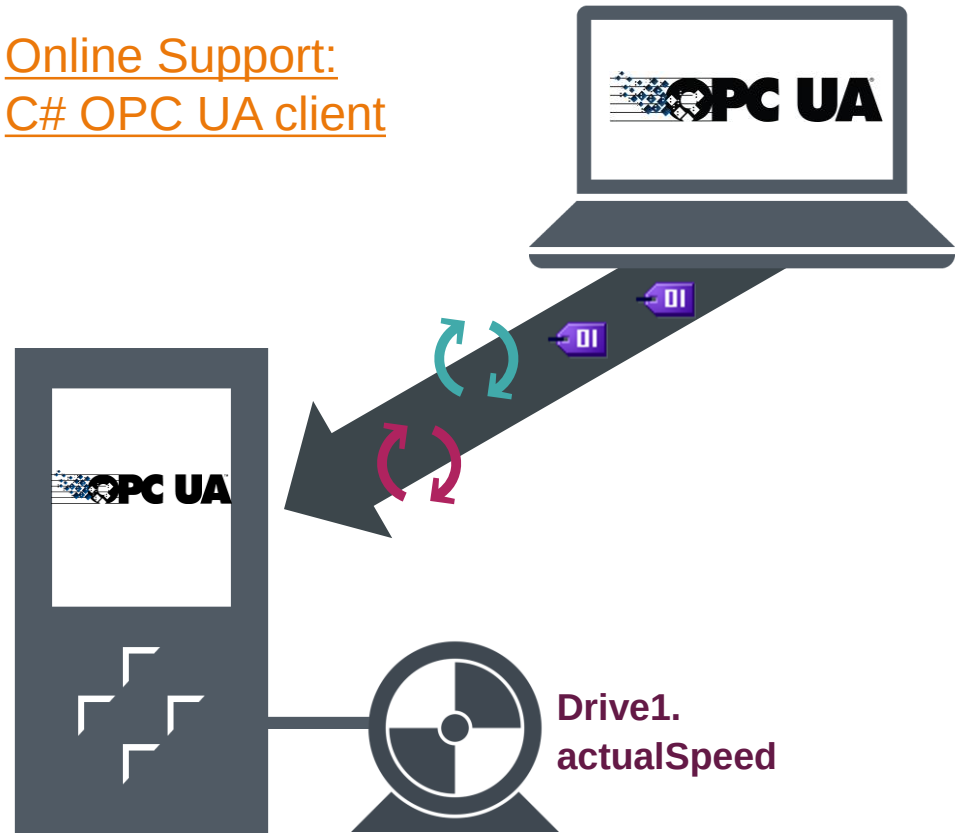
L I V E D E M O

Online Support:
C# OPC UA client



- Configuration in TIA Portal
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S7-1500 OPC UA server
Functional scope

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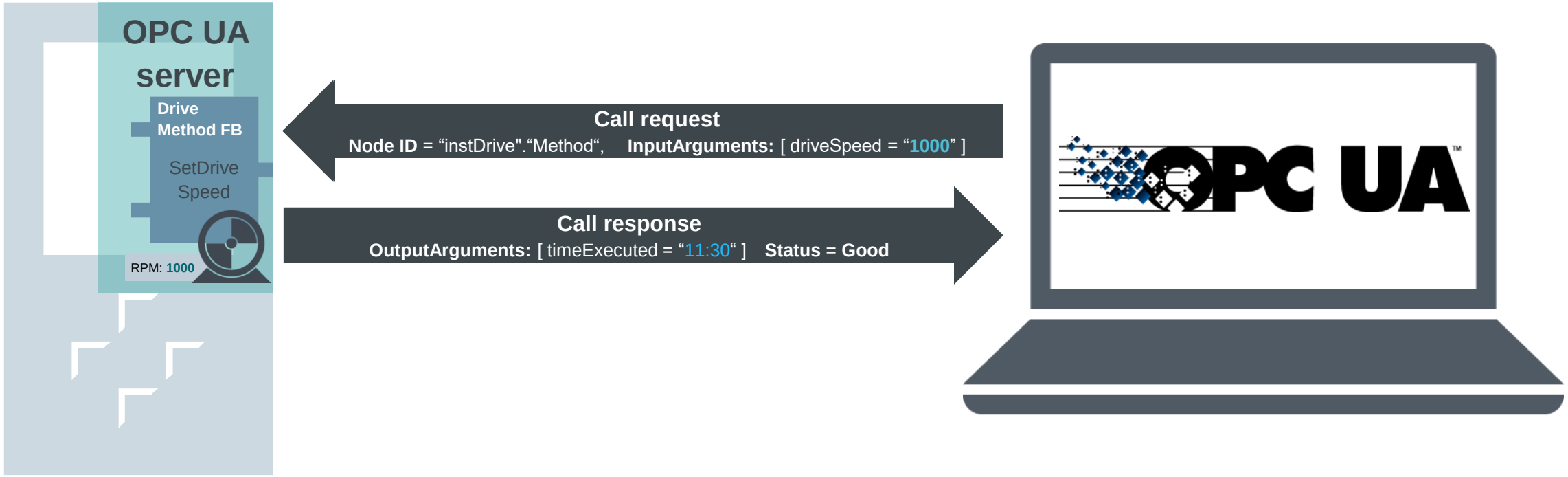
Methods



- Request based interaction with the user program
- Consistent data transmission without handshakes

S7-1500 OPC UA server
Functional scope

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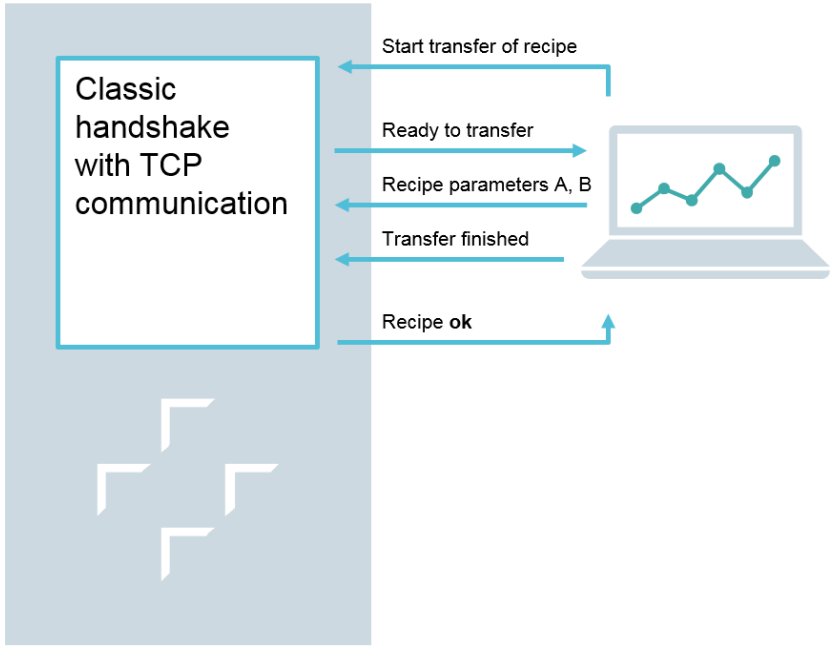
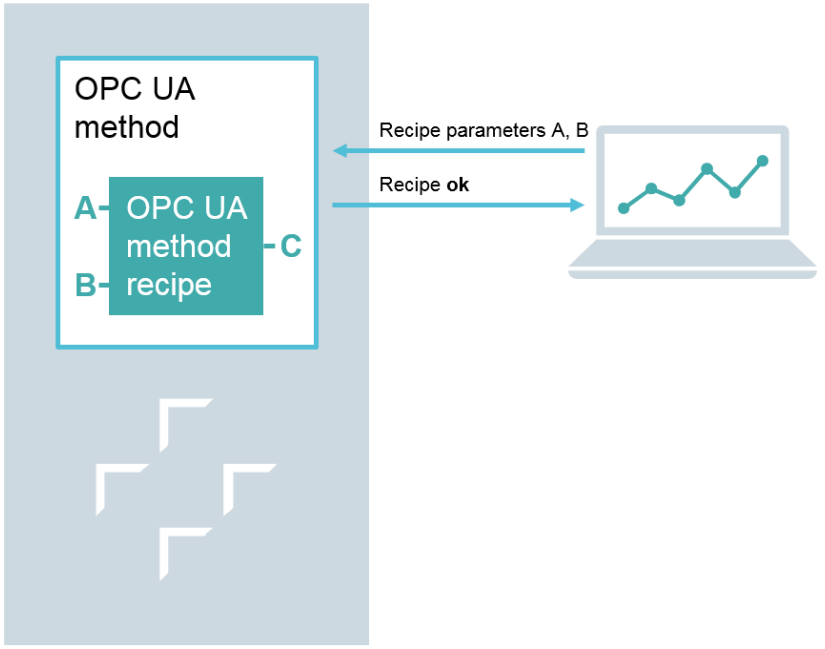
Methods

Classic handshake



OPC UA method call as efficient replacement



- Request based interaction with the user program
- Consistent data transmission without handshakes

LiveDemo
Method implementation

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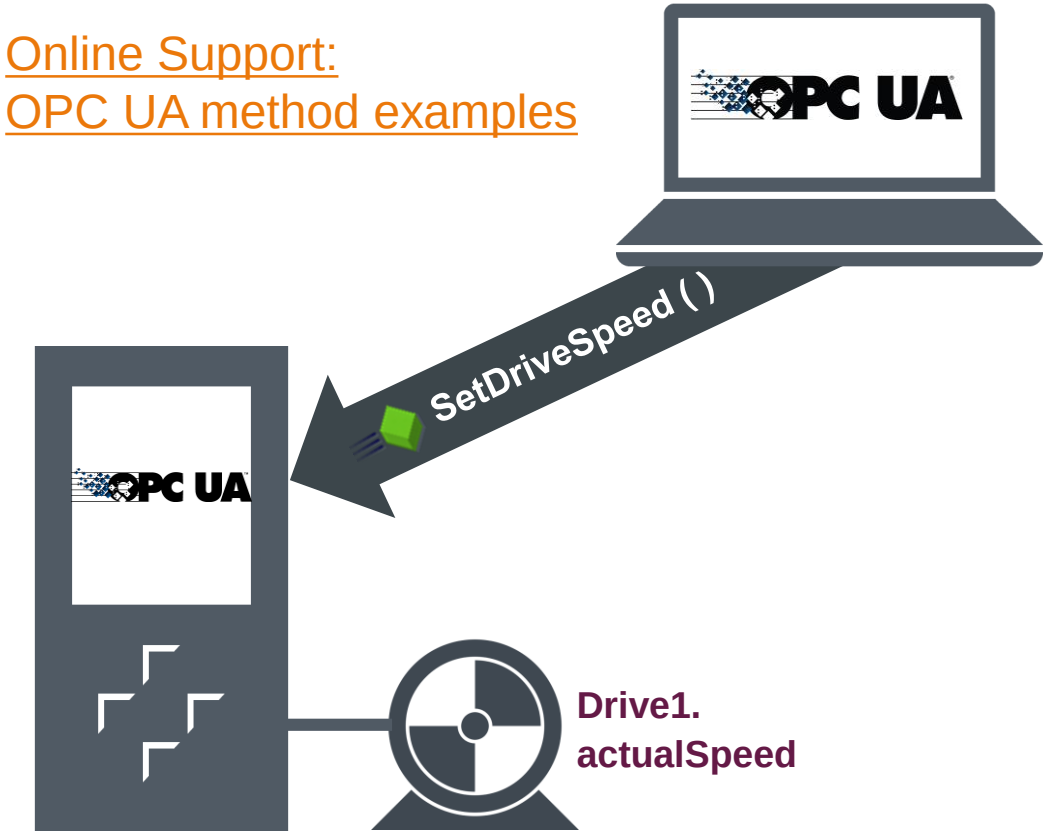
L I V E D E M O

Online Support:
OPC UA method examples



- OPC UA method implementation in TIA Portal
- OPC UA Method Call with a client

LiveDemo
Method implementation

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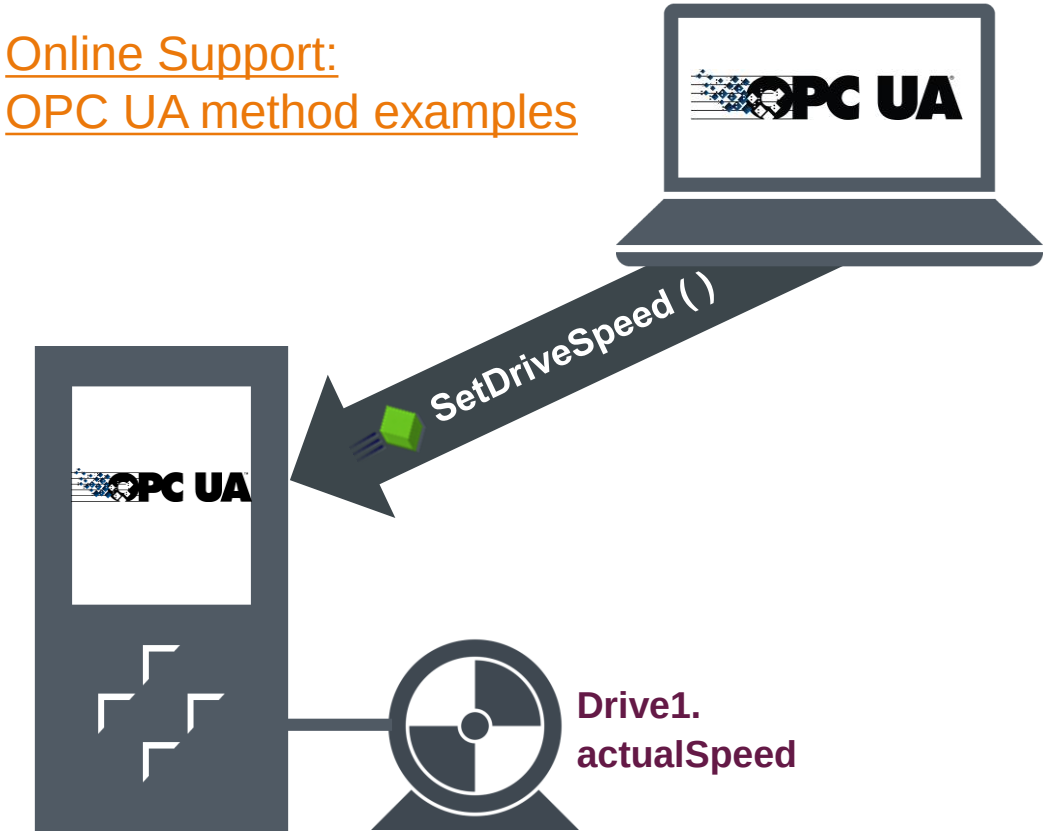
L I V E D E M O

Online Support:
OPC UA method examples



- OPC UA method implementation in TIA Portal
- OPC UA Method Call with a client

S7-1500 OPC UA server
General behaviors

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OPC UA server

Behavior of the OPC UA server:

- Starts - when the server is activated and the project is loaded
- The server is rebooted each time the CPU is loaded
- Remains activated, even with STOP of the CPU
  - Provides PLC tags as the operating mode is being changed (RUN > STOP)
  - Accepts values written by the client
  - Server methods in STOP issue error message "16#00AF_0000"

S7-1500 OPC UA server quantity structure
CPU 1516

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OPC UA	
• OPC UA server	Yes; Data access (read, write, subscribe), method call, custom address space
— Application authentication	Yes
— Security policies	Available security policies: None, Basic128Rsa15, Basic256Rsa15, Basic256Sha256
— User authentication	"anonymous" or by user name & password
— Number of sessions, max.	48
— Number of accessible variables, max.	100 000
— Number of registerable nodes, max.	20 000
— Number of subscriptions per session, max.	20
— Sampling interval, min.	100 ms
— Publishing interval, min.	200 ms
— Number of server methods, max.	50
— Number of inputs/outputs per server method, max.	20
— Number of monitored items, max.	2 000; for 1 s sampling interval and 1 s send interval
— Number of server interfaces, max.	10
— Number of nodes for user-defined server interfaces, max.	5 000

CPU 1516-3 PN/DP datasheet

S7-1500 OPC UA server quantity structure
CPU 1518

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OPC UA	
• OPC UA server	Yes; Data access (read, write, subscribe), method call, custom address space
— Application authentication	Yes
— Security policies	Available security policies: None, Basic128Rsa15, Basic256Rsa15, Basic256Sha256
— User authentication	"anonymous" or by user name & password
— Number of sessions, max.	64
— Number of accessible variables, max.	200 000
— Number of registerable nodes, max.	50 000
— Number of subscriptions per session, max.	20
— Sampling interval, min.	10 ms
— Publishing interval, min.	10 ms
— Number of server methods, max.	100
— Number of inputs/outputs per server method, max.	20
— Number of monitored items, max.	10 000; for 1 s sampling interval and 1 s send interval
— Number of server interfaces, max.	10
— Number of nodes for user-defined server interfaces, max.	30 000

CPU 1518-4 PN/DP datasheet

Use cases for PLC OPC UA servers

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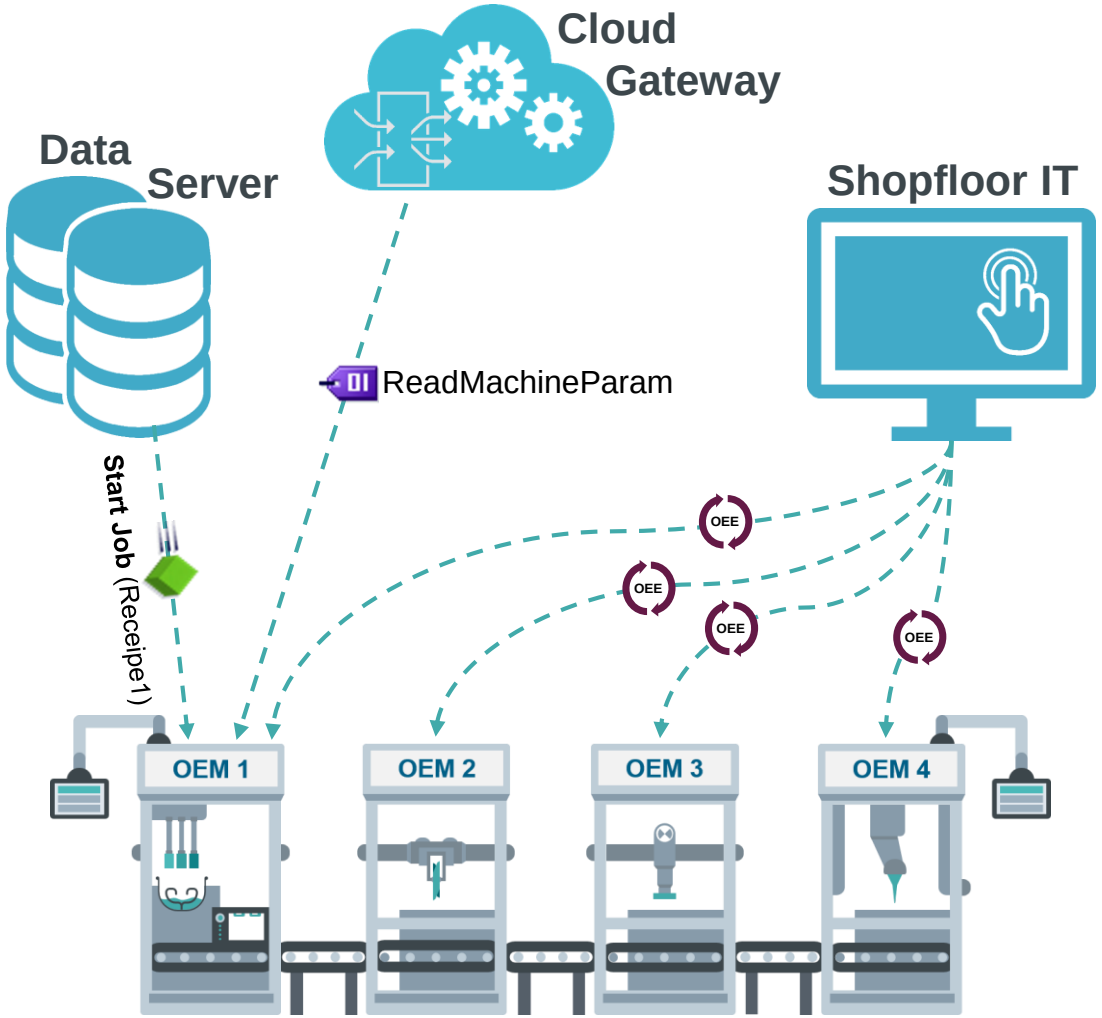

Methods could be used for consistent data which require interaction with the other system. (e.g. call a method to start a job in a machine)

**Subscriptions could be used to monitor machine data.
(e.g. monitor changes of OEE data)**

Read/writes could be used to do changes on machine parameters which don't require consistency

Agenda

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