https://www.halvorsen.blog

OPC UA Server Simulator

With Practical Examples using LabVIEW and MATLAB

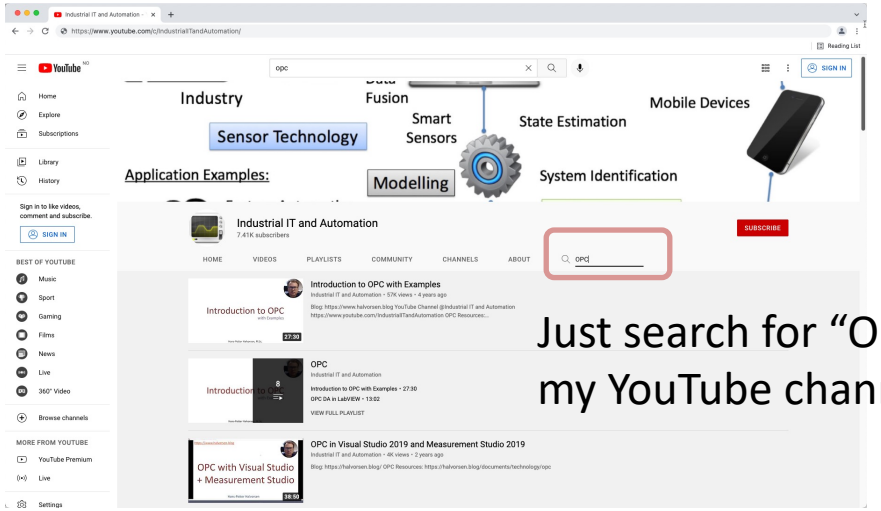
Hans-Petter Halvorsen

Contents

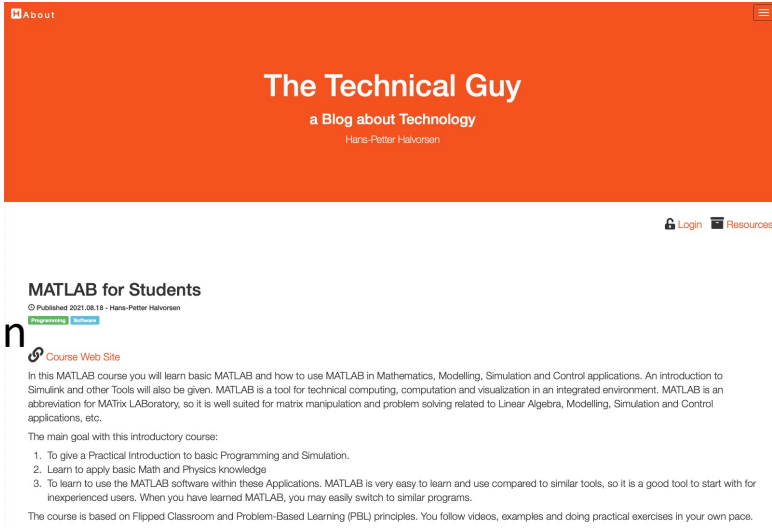
- OPC UA – A Short Introduction to OPC and OPC UA
- OPC UA Server Simulator
  - **Free OPC UA Server** (with limited features) from the company "Integration Objects" that supports Data Access and Historical Access of OPC UA
  - We will create different OPC UA Clients in different Programming Languages that communicates with the "OPC UA Server Simulator"
- OPC UA Client - **Free OPC UA Client** from the company "Integration Objects"
- LabVIEW OPC UA Toolkit
  - LabVIEW OPC UA Examples communicating with the OPC UA Server Simulator
- MATLAB OPC Toolbox
  - MATLAB OPC UA Examples communicating with the OPC UA Server Simulator and LabVIEW OPC UA Server

Other OPC Resources

- Blog: https://www.halvorsen.blog
- OPC Resources: https://www.halvorsen.blog/documents/technology/opc/
- YouTube: https://www.youtube.com/IndustriallTandAutomation



Just search for “OPC” within my YouTube channel



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OPC UA

Hans-Petter Halvorsen

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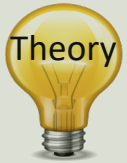
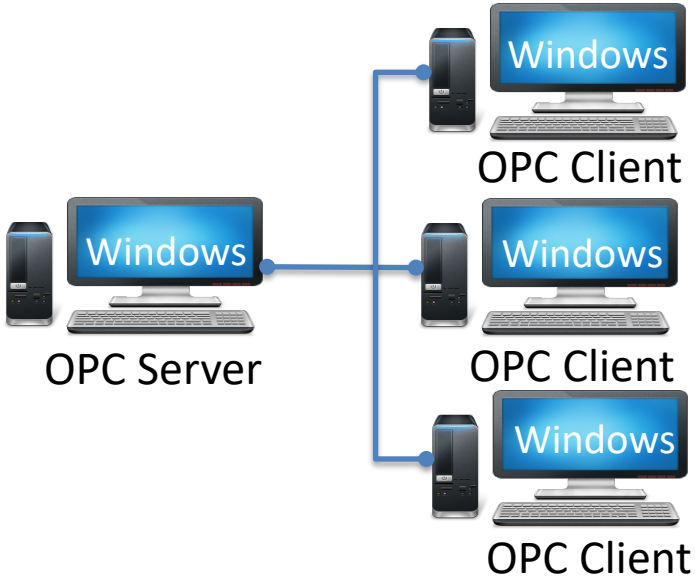
Classic OPC vs. OPC UA

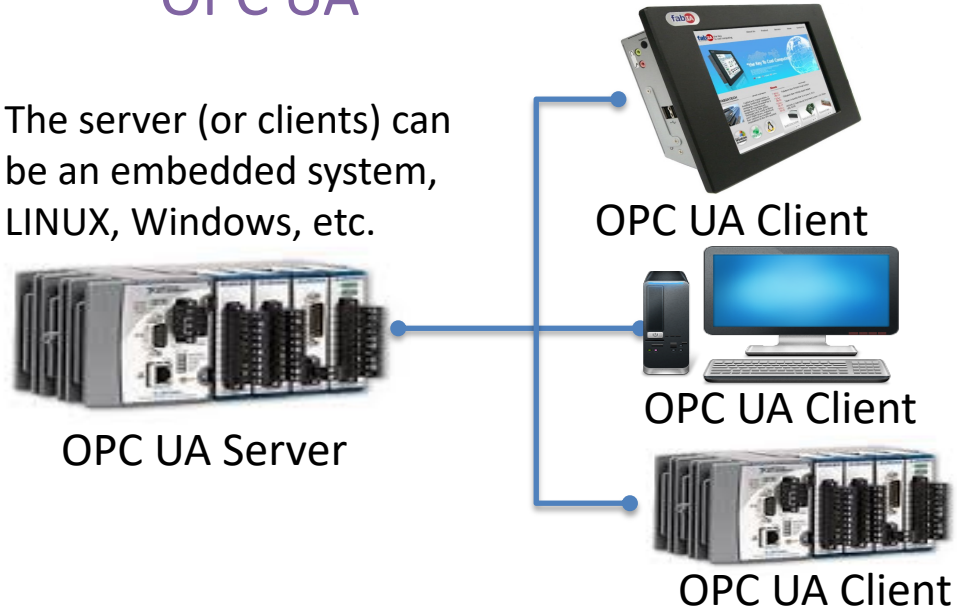


Classic OPC (DCOM)



OPC UA

The server (or clients) can be an embedded system, LINUX, Windows, etc.



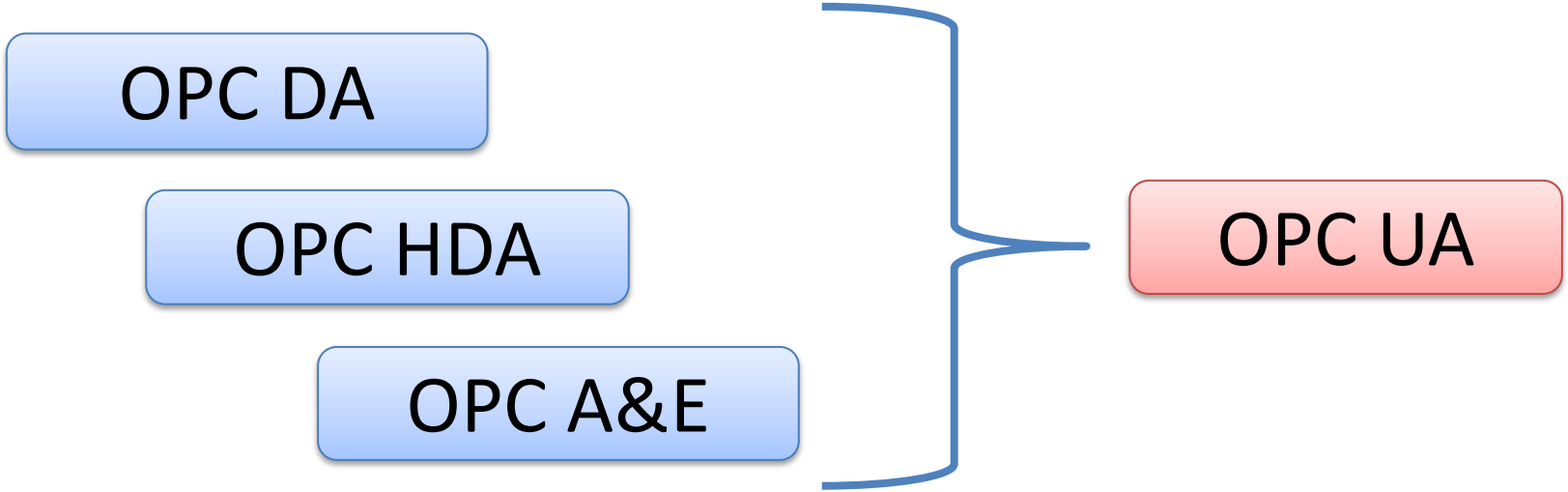
Classic OPC requires a Microsoft Windows operating system to implement COM/DCOM server functionality. By utilizing SOA and Web Services, OPC UA is a platform-independent system that eliminates the previous dependency on a Windows operating system. By utilizing SOAP/XML over HTTP, OPC UA can deploy on a variety of embedded systems regardless of whether the system is a general purpose operating system, such as Windows, or a deterministic real-time operating system.

http://www.ni.com/white-paper/13843/en/

OPC Specifications

"Classic" OPC

"Next Generation" OPC

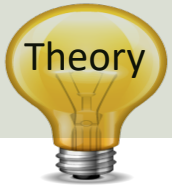


... (Many others)

OPC UA

- UA – Unified Architecture
- The Next Generation OPC
- Cross Platform. “Classic“ OPC works only for Windows
- Based on Modern Software/Network Architecture (No DCOM problems!)
- It makes it easier to transmit and receive data in a modern data network/Internet

Next Generation OPC



COM/DCOM

OPC Classic → Next Generation OPC → **OPC UA**

XML, HTTP, SOAP

Specifications:
- OPC DA
- OPC HDA
- OPC A&E

Windows only

Cross-platform
Windows, Linux, Mac, Embedded, VxWorks

All specifications collected in one (DA, HDA, A&E)

Protocols: “UA Binary” or “UA XML”

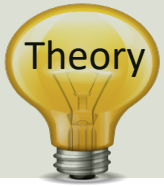
- OPC DA Server ⟷
- OPC HDA Server ⟷
- OPC A&E Server ⟷

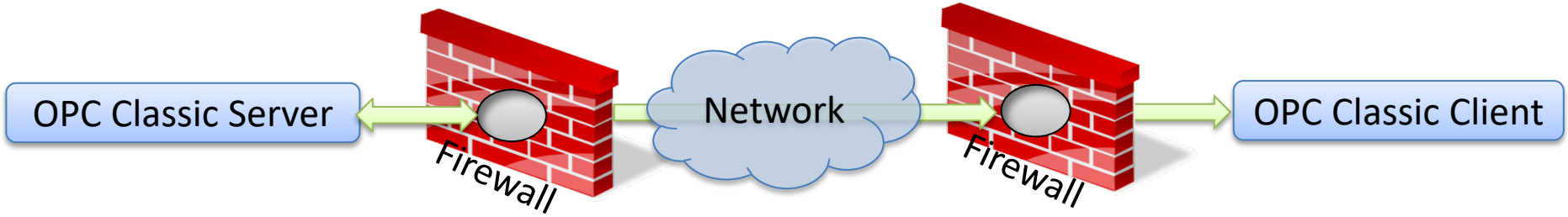
OPC Client (DCOM)

Simpler!!

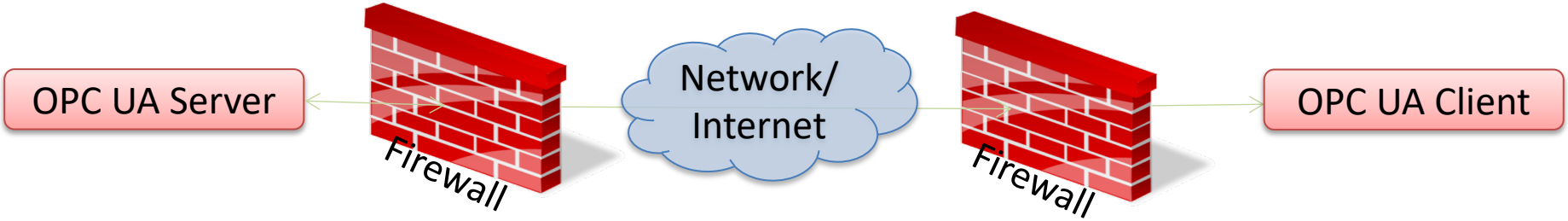
OPC UA Server ⟷ OPC UA Client

Next Generation OPC





To open DCOM through firewalls demanded a large hole in the firewall!
Impossible to route over Internet!



No hole in firewall (UA XML) or just a simple needle stick (UA Binary) is necessary
Easy to route over Internet!

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OPC UA Server Simulator

Free OPC UA Simulation Server from Integration Objects

Hans-Petter Halvorsen

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OPC UA Server Simulator

- This free OPC UA Server tool supports data access and historical access information models of OPC UA.
- Consequently, it provides simulated real-time and historical data.
- Moreover, users can configure their own tags and the data simulation via CSV files.
- OPC UA clients can monitor real-time data and explore history data from this simulator.
- https://opcfoundation.org/products/view/opc-ua-server-simulator

OPC UA Server Simulator

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OPC UA Server Simulator

Member: Integration Objects

Product website: integrationobjects.com/sioth-opc/sioth-opc-unified...

Integration Objects' **OPC UA Server Simulator** is a free to use and distribute OPC Unified Architecture server utility. Indeed, you can use this OPC UA simulator to play the role of OPC UA servers and test your OPC UA Client applications.

This free OPC UA Server tool supports data access and historical access information models of OPC UA. Consequently, it provides simulated real-time and historical data. Moreover, users can configure their own tags and the data simulation via CSV files. OPC UA clients can monitor real-time data and explore history data from this simulator.

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https://opcfoundation.org/products/view/opc-ua-server-simulator

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- OPC UA Server Simulator
- OPC UA Proxy
- OPC UA Wrapper
- OPC UA Client

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OPC Servers
OPC Client Toolkits
OPC Free Tools
OPC Server Toolkits

OPC UA Server Simulator

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Watch Demo Videos

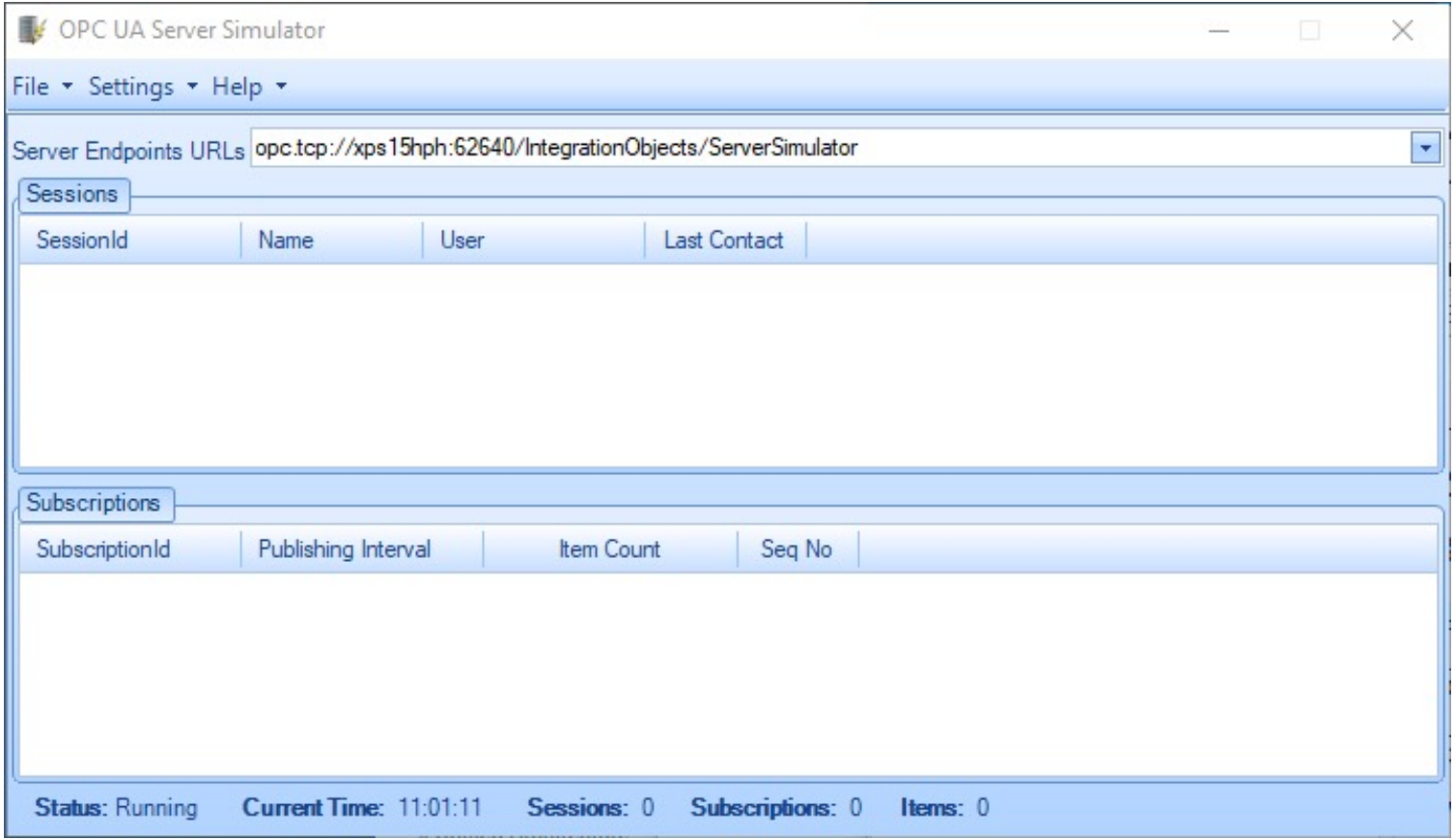
Simulate real-time and historical data using OPC UA Server Simulator!

Integration Objects' **OPC UA Server Simulator** is a free to use and distribute OPC Unified Architecture server utility. Indeed, you can use this OPC UA simulator to play the role of OPC UA servers and test your OPC UA Client applications.

This free OPC UA Server tool supports data access and historical access information models of OPC UA. Consequently, it provides simulated real-time and historical data. Moreover, users can configure their own tags and the data simulation via CSV files. OPC UA clients can monitor real-time data and explore history data from this simulator.

https://integrationobjects.com/sioth-opc/sioth-opc-unified-architecture/opc-ua-server-simulator/

OPC UA Server Simulator



OPC UA Server Simulator

The OPC UA Server Simulator uses 2 CSV simulation files:

- “**AddressSpace.csv**” used to build the address space of the OPC UA Server.
- “**ValueSpace.csv**” used to simulate the data values of the OPC UA items.
- Those two files are located at the following path: X:\Program Files (x86)\Integration Objects\Integration Objects' OPC UA Server Simulator\OPC UA Server Simulator\DATA

AddressSpace.csv

Tag Name	Data Type	AccessRights	Simulated
Tag1	IO_Int16	RW	FALSE
Tag2	IO_Int32	RW	FALSE
Tag3	IO_Int64	RW	FALSE
Tag4	IO_UInt16	RW	FALSE
Tag5	IO_UInt32	RW	FALSE
Tag6	IO_UInt64	RW	FALSE
Tag7	IO_Double	RW	FALSE
Tag8	IO_String	RW	FALSE
Tag9	IO_Byte	RW	FALSE
Tag10	IO_Boolean	RW	FALSE
Tag11	IO_Int16	R	TRUE
Tag12	IO_Int32	R	TRUE
Tag13	IO_Int64	R	TRUE
Tag14	IO_UInt16	R	TRUE
Tag15	IO_UInt32	R	TRUE
Tag16	IO_UInt64	R	TRUE
Tag17	IO_Double	R	TRUE
Tag18	IO_String	R	TRUE
Tag19	IO_Byte	R	TRUE
Tag20	IO_Boolean	R	TRUE

ValueSpace.csv

Tag11		Tag12		Tag13	
11	good	56	good	47	good
12	good	32	good	14	good
13	good	28	good	85	good
14	good	14	good	125	good
15	good	15	good	24	good
16	good	57	good	69	good
17	good	65	good	36	good
18	good	18	good	18	good
19	good	48	good	84	good
20	good	36	good	64	good

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OPC UA Client

Free OPC UA Client from Integration Objects

Hans-Petter Halvorsen

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OPC UA Client

- OPC UA Client is a free client tool that supports the main OPC Unified Architecture information models.
- These models are Data Access, Alarms & Conditions, and Historical Data Access
- https://integrationobjects.com/sioth-opc/sioth-opc-unified-architecture/opc-ua-client/

OPC Tunneling
OPC UA
- OPC UA Server Simulator – Full Edition
- OPC UA Server Toolkit
- OPC UA IoT Broker
- OPC UA Server for Databases
- OPC UA Client Toolkit
- OPC UA Server Simulator
- OPC UA Proxy
- OPC UA Wrapper
- OPC UA Client

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OPC Server Toolkits

OPC UA Client

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Download free OPC UA Client and start your OPC UA tests now!

OPC UA Client is a free client tool that supports the main OPC Unified Architecture information models. These models are Data Access, Alarms & Conditions, and Historical Data Access. In fact, it offers the capability to:

- Discover local and remote OPC UA servers
- Establish secure communication channels
- Browse the address space of any OPC UA compliant server
- Monitor real-time data and alarms & conditions
- Explore and update history data

Moreover, this OPC UA explorer allows you to generate its self-signed Application Instance Certificate in order to provide application level security and secure the connections with OPC UA servers.

View Tutorial Video of OPC UA Test Client & OPC UA Wrapper

Integration Objects' OPC UA Client

Home

New | Open | Save | Save as | Connect | Disconnect | Settings | UA Settings | Help | About | Define | Remove | Certificate Manager

File | Session | Configuration | Help

Sessions

Sessions

Address Space

Forward

Data View | Histo

Display Name | Subscription | Session

Attribute | Value

Message Type	Timestamp	Message
[Control]	2022-02-08 13:05:06	Disconnecting from session "
[Control]	2022-02-08 13:03:09	Read operation of the variab
[Control]	2022-02-08 13:01:03	A session "Session0" with the

3 Messages

Connection Settings

Session Information

Session Name: Session0

Server Information

Endpoint Url: opc.tcp://xps15hph:62640/IntegrationObjects/S

Discover

Transport Protocol

- (•) Opc.tcp
- ( ) Https

Message Encoding

- (•) Binary
- ( ) Xml

Security Mode

- (•) None
- ( ) Sign
- ( ) Sign _Encrypt

Security Policy

- (•) None
- ( ) Basic128RSA15
- ( ) Basic256
- ( ) Basic256Sha256

User Authentication Mode

- (•) Anonymous
- ( ) UserName
- ( ) Certificate

Certificate (.pfx)

Password

Apply | Cancel

Integration Objects' OPC UA Client

Home

New | Open | Save | Save as | Connect | Disconnect | Settings | UA Settings | Help | About | Define | Remove | Certificate Manager

File | Session | Configuration | Help | Default Configuration | Certificate

Sessions

- Sessions
  - Session0

Address Space

Forward

- Real Time Data
  - Tag1
  - Tag2
  - Tag3
  - Tag4
  - Tag5
  - Tag6
  - Tag7
  - Tag
  - Tag
  - Tag

References and Attributes
Read
Write
History Update
Monitor

Data View | History View | Event View

Display Name	Node Id	Value	Data Type	Server Timestamp	Source Timestamp	Status Code	Subscription	Session

Attribute	Value
NodeId	ns=2;s=Historical...
NodeClass	Object
BrowseName	2:Historicaldata
DisplayName	Historical Data
Description	
WriteMask	0
UserWriteMask	0
EventNotifier	Subscribe

Message Type	Timestamp	Message
[Control]	2022-02-08 13:03:09	Read operation of the variable [ns=2;s=Tag7] succeeded.
[Control]	2022-02-08 13:01:03	A session "Session0" with the Endpoint [opc.tcp://xps15hph:62640/IntegrationObjects/ServerSimulator - [None:None:Binary]] was successfully created.

2 Messages

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LabVIEW OPC UA Toolkit

Hans-Petter Halvorsen

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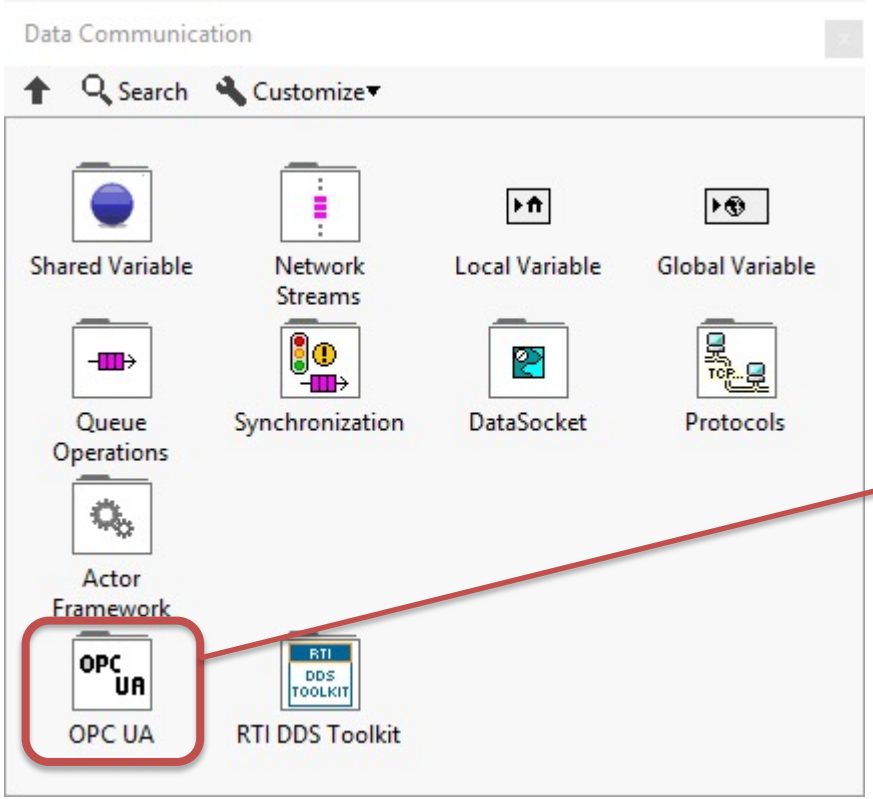
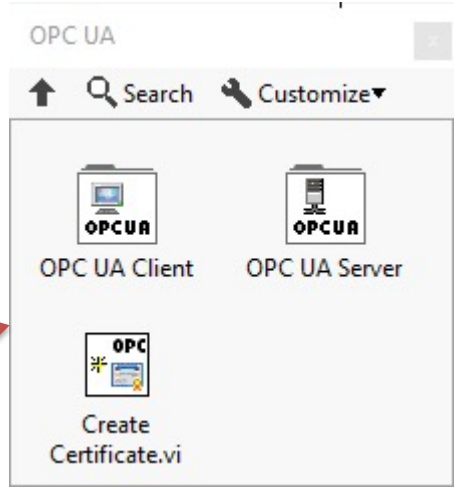
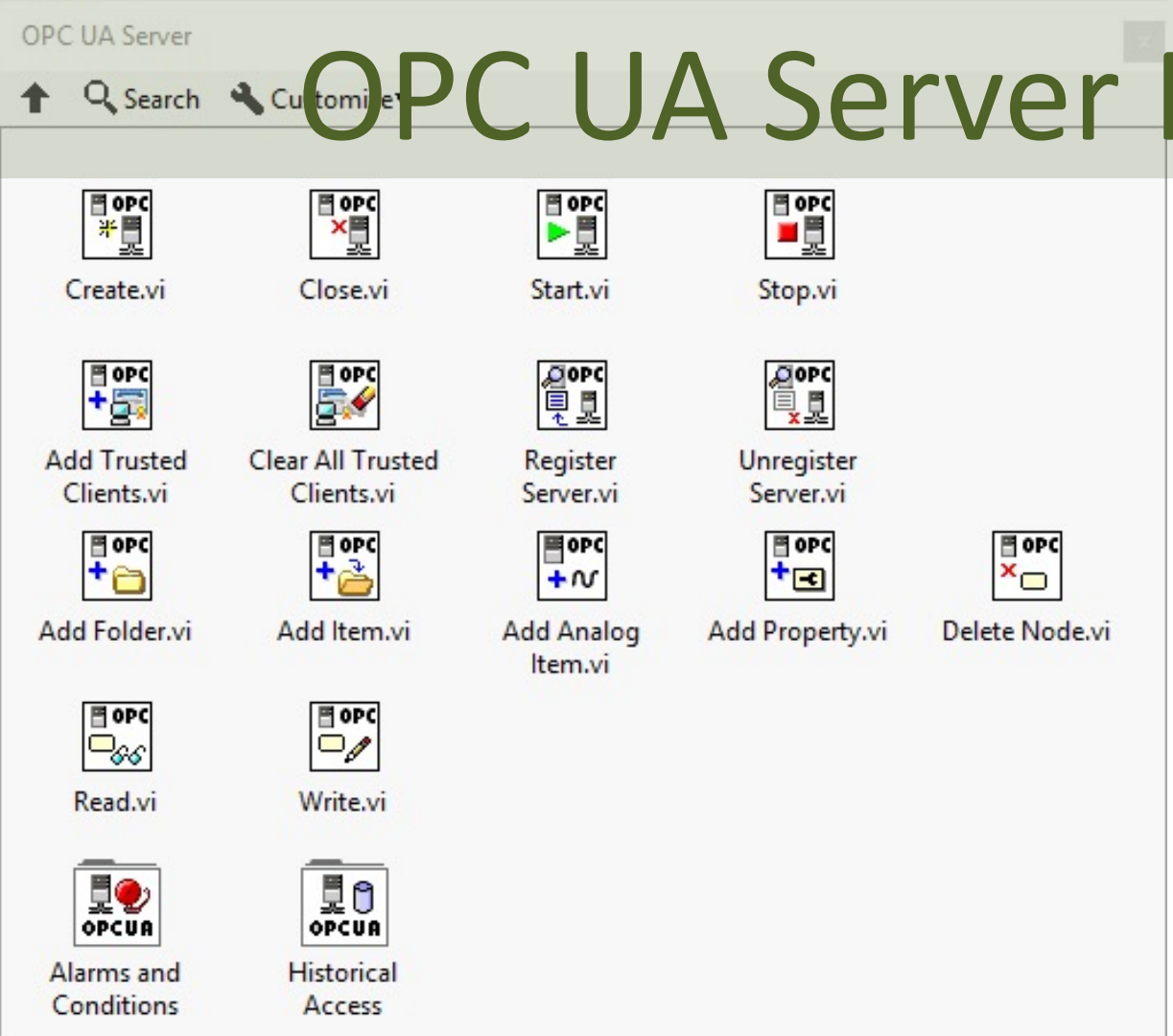
OPC UA Toolkit in LabVIEW





OPC UA Server Palette



QPC UA Client Palette

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LabVIEW Examples

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LabVIEW Example 1

Read Data from the OPC UA Server Simulator

Hans-Petter Halvorsen

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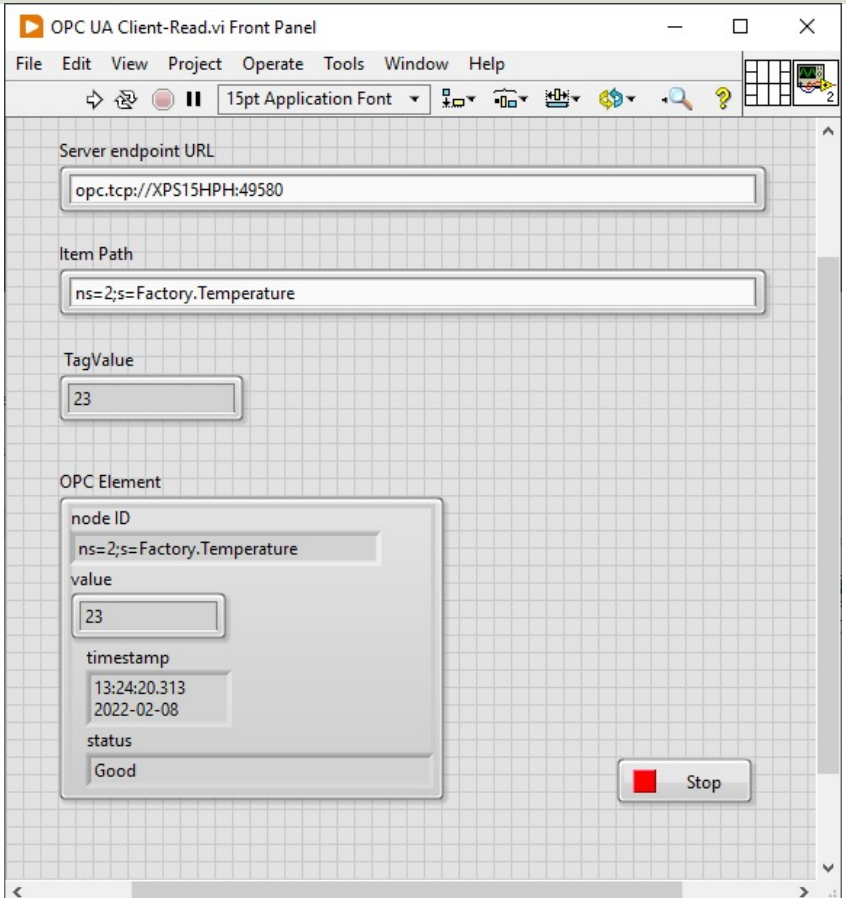
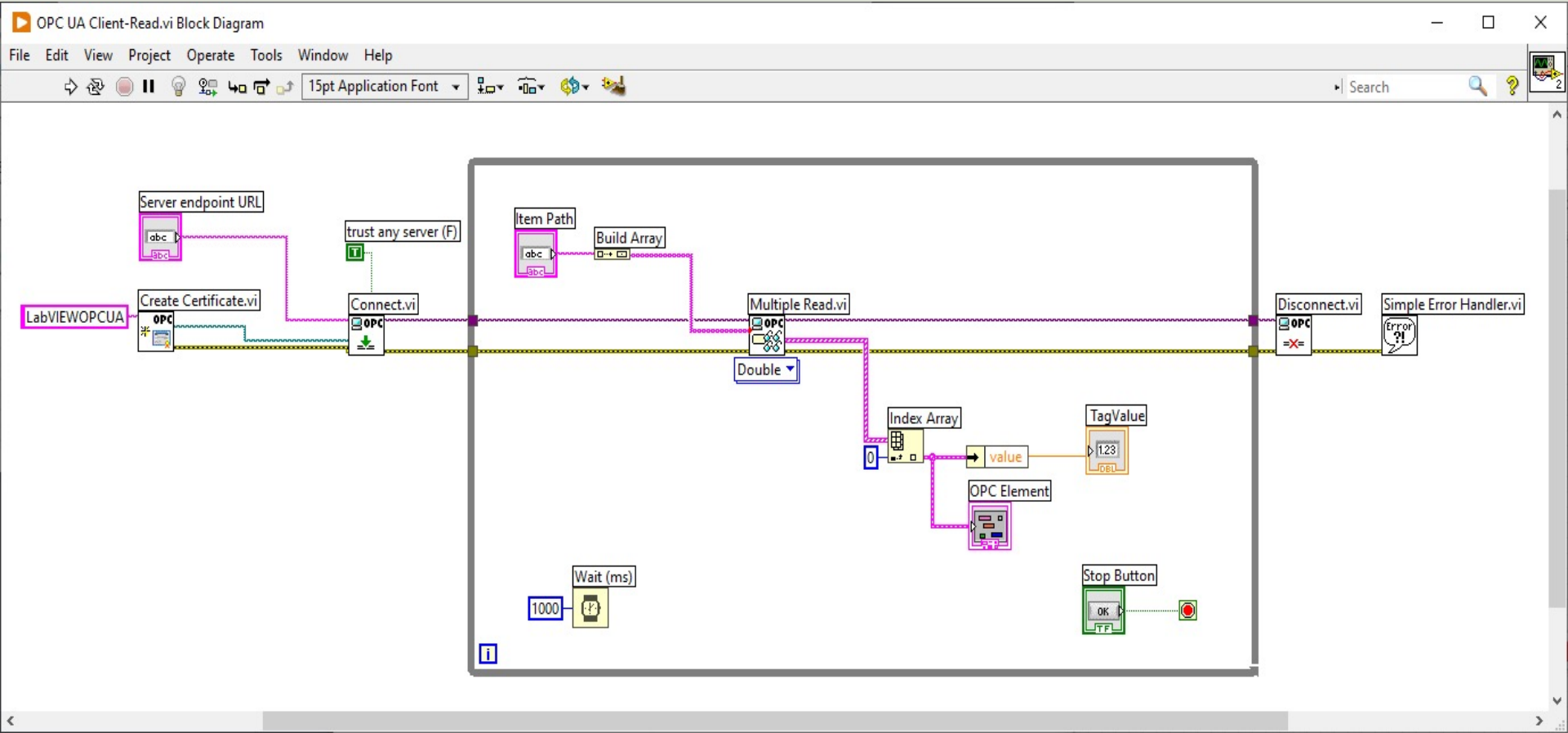
Example 1 - Read



Example 1 - Read



Example 1 - Read

AddressSpace.csv

	A	B	C	D
1	Tag Name	Data Type	AccessRights	Simulated
2	Tag1	IO_Int16	RW	FALSE
3	Tag2	IO_Int32	RW	FALSE
4	Tag3	IO_Int64	RW	FALSE
5	Tag4	IO_UInt16	RW	FALSE
6	Tag5	IO_UInt32	RW	FALSE
7	Tag6	IO_UInt64	RW	FALSE
8	Tag7	IO_Double	RW	FALSE
9	Tag8	IO_String	RW	FALSE
10	Tag9	IO_Byte	RW	FALSE
11	Tag10	IO_Boolean	RW	FALSE
12	Tag11	IO_Int16	R	TRUE
13	Tag12	IO_Int32	R	TRUE
14	Tag13	IO_Int64	R	TRUE
15	Tag14	IO_UInt16	R	TRUE
16	Tag15	IO_UInt32	R	TRUE
17	Tag16	IO_UInt64	R	TRUE
18	Tag17	IO_Double	R	TRUE
19	Tag18	IO_String	R	TRUE
20	Tag19	IO_Byte	R	TRUE
21	Tag20	IO_Boolean	R	TRUE
22				

Example 1 - Read

OPC UA Server Simulator

File Settings Help

Server Endpoints URLs opc.tcp://xps15hph:62640/IntegrationObjects/ServerSimulator

Sessions

SessionId	Name	User	Last Contact
urn:XPS15HPH:Nati..	Anonymous	ns=3;i=1837697707	12:22:22

Subscriptions

SubscriptionId	Publishing Interval	Item Count	Seq No

Status: Running Current Time: 12:22:23 Sessions: 1 Subscriptions: 0 Items: 0

OPC UA Client for OPC UA Server Simulator-Read.vi

File Edit View Project Operate Tools Window Help

Server endpoint URL

opc.tcp://xps15hph:62640/IntegrationObjects/ServerSimulator

Item Path

ns=2;s=Tag17

TagValue

-4.17524E+12

OPC Element

node ID

ns=2;s=Tag17

value

-4.17524E+12

timestamp

12:22:38.032
2022-02-08

status

Good

Stop

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LabVIEW Example 2

Write Data to the OPC UA Server Simulator

Hans-Petter Halvorsen

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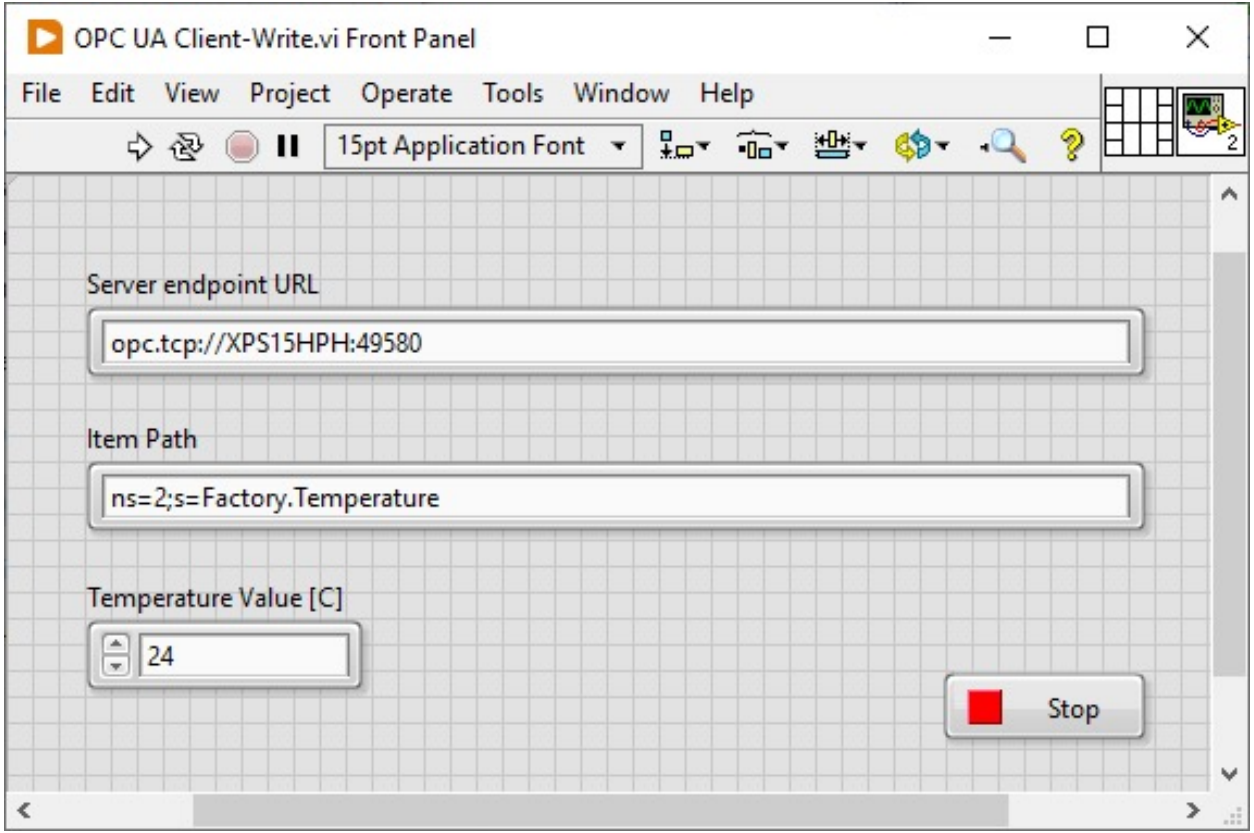
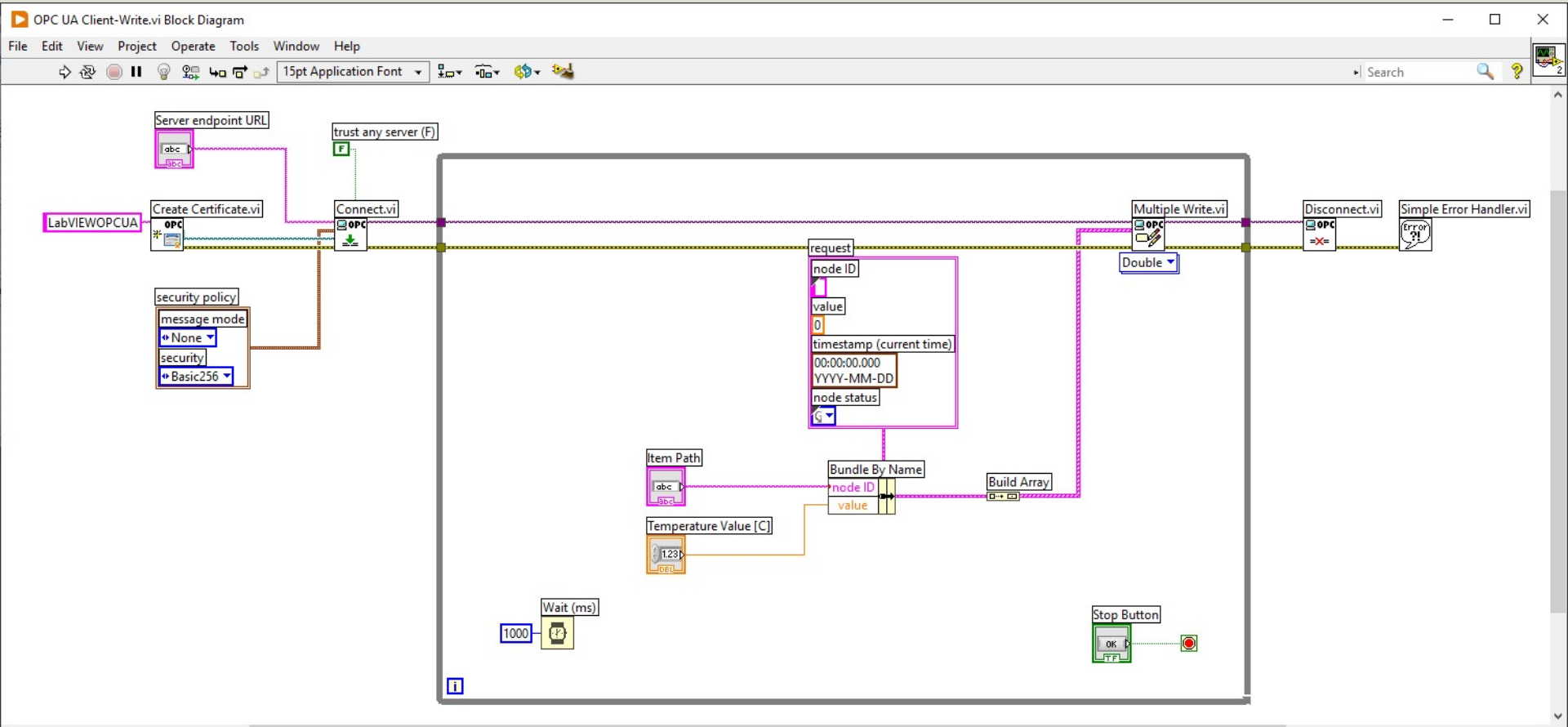
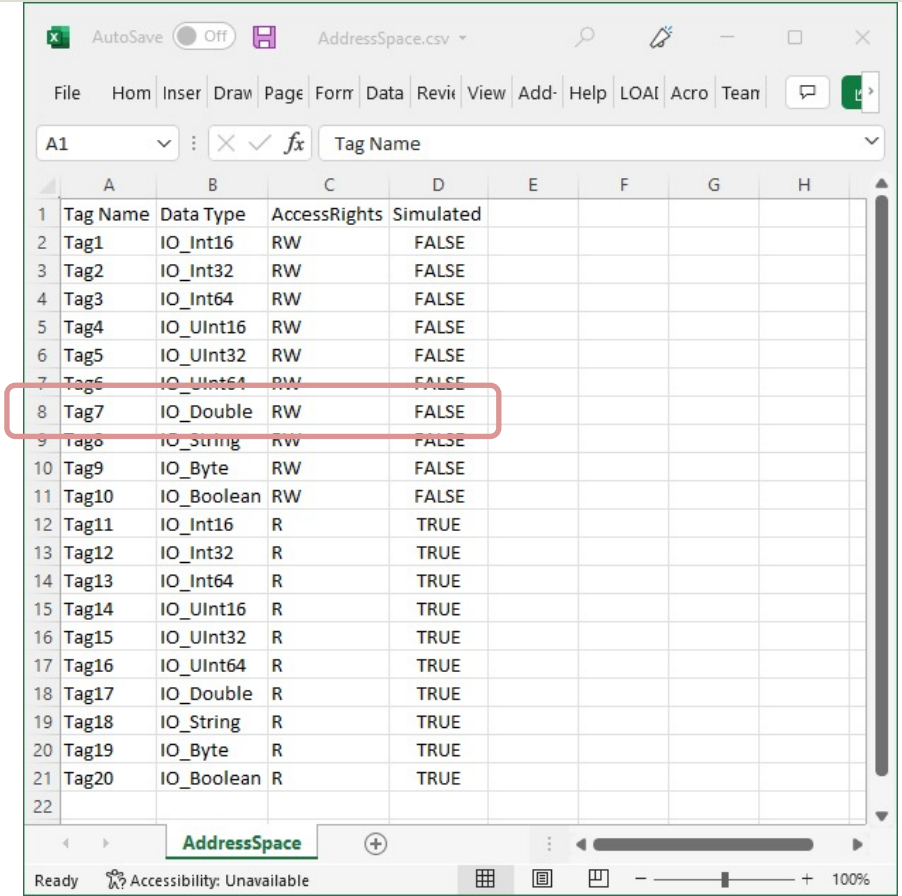
Example 2 – Write



Example 2 – Write



Example 2 – Write



	A	B	C	D
1	Tag Name	Data Type	AccessRights	Simulated
2	Tag1	IO_Int16	RW	FALSE
3	Tag2	IO_Int32	RW	FALSE
4	Tag3	IO_Int64	RW	FALSE
5	Tag4	IO_UInt16	RW	FALSE
6	Tag5	IO_UInt32	RW	FALSE
7	Tag6	IO_UInt64	RW	FALSE
8	Tag7	IO_Double	RW	FALSE
9	Tag8	IO_String	RW	FALSE
10	Tag9	IO_Byte	RW	FALSE
11	Tag10	IO_Boolean	RW	FALSE
12	Tag11	IO_Int16	R	TRUE
13	Tag12	IO_Int32	R	TRUE
14	Tag13	IO_Int64	R	TRUE
15	Tag14	IO_UInt16	R	TRUE
16	Tag15	IO_UInt32	R	TRUE
17	Tag16	IO_UInt64	R	TRUE
18	Tag17	IO_Double	R	TRUE
19	Tag18	IO_String	R	TRUE
20	Tag19	IO_Byte	R	TRUE
21	Tag20	IO_Boolean	R	TRUE
22				

OPC UA Client for OPC UA Server Simulator-Write.vi

File Edit View Project Operate Tools Window Help

Server endpoint URL

opc.tcp://xps15hph:62640/IntegrationObjects/ServerSimulator

Item Path

ns=2;s=Tag7

Temperature Value [C]

23

OPC UA Server Simulator

File Settings Help

Server Endpoints URLs opc.tcp://xps15hph:62640/IntegrationObjects/ServerSimulator

Sessions

SessionId	Name	User	Last Contact
urn:XPS15HPH:Nati..	Anonymous	ns=3;i=1837697819	12:24:52
urn:XPS15HPH:Nati..	Anonymous	ns=3;i=1837697763	12:24:52

Subscriptions

SubscriptionId	Publishing Interval	Item Count	Seq No

Status: Running Current Time: 12:24:52 Sessions: 2 Subscriptions: 0 Items: 0

OPC UA Client for OPC UA Server Simulator-Read.vi

File Edit View Project Operate Tools Window Help

Server endpoint URL

opc.tcp://xps15hph:62640/IntegrationObjects/ServerSimulator

Item Path

ns=2;s=Tag7

TagValue

23

OPC Element

node ID

ns=2;s=Tag7

value

23

timestamp

12:25:45.271
2022-02-08

status

Good

Stop

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LabVIEW Example 3

Create and use a LabVIEW OPC UA Server

Hans-Petter Halvorsen

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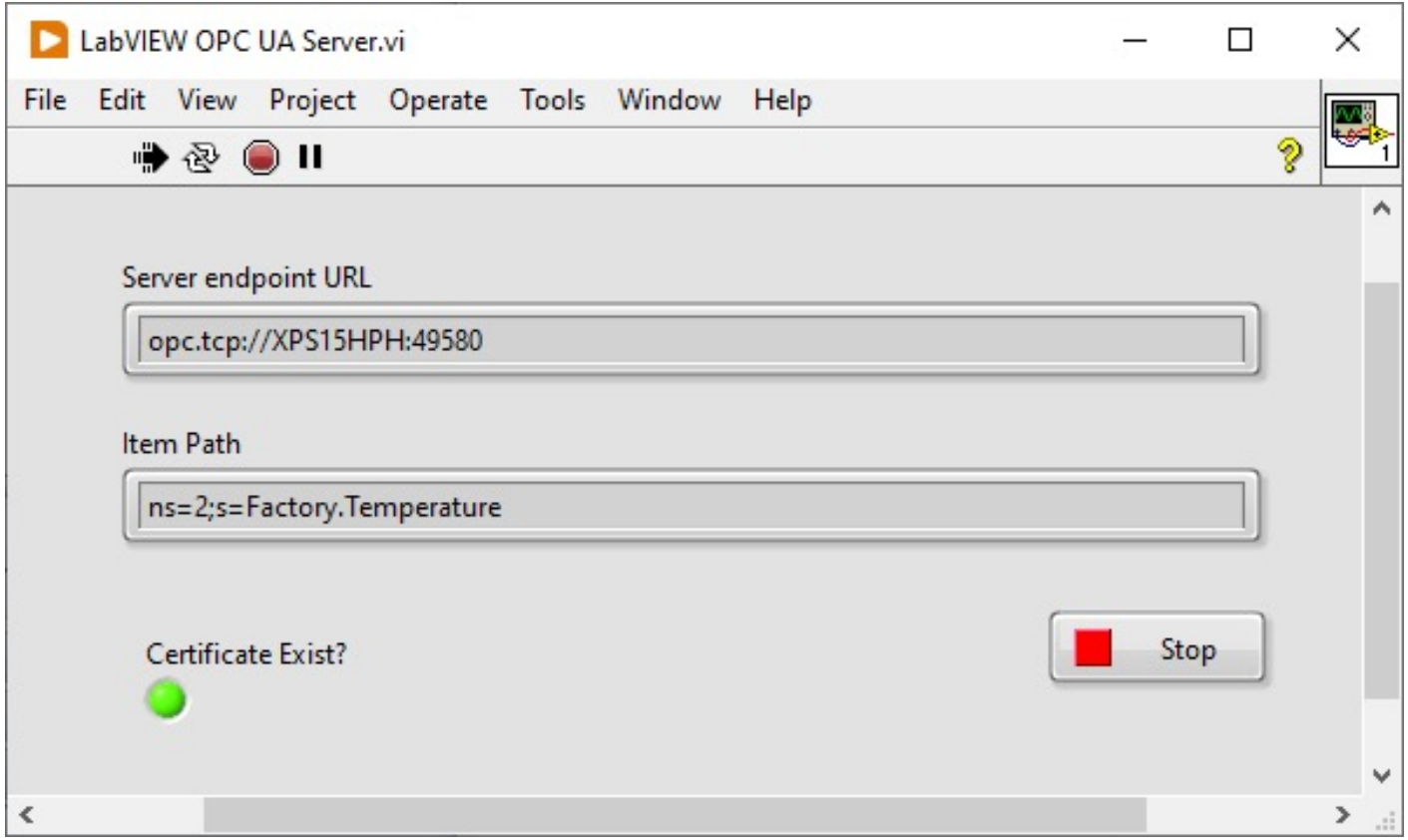
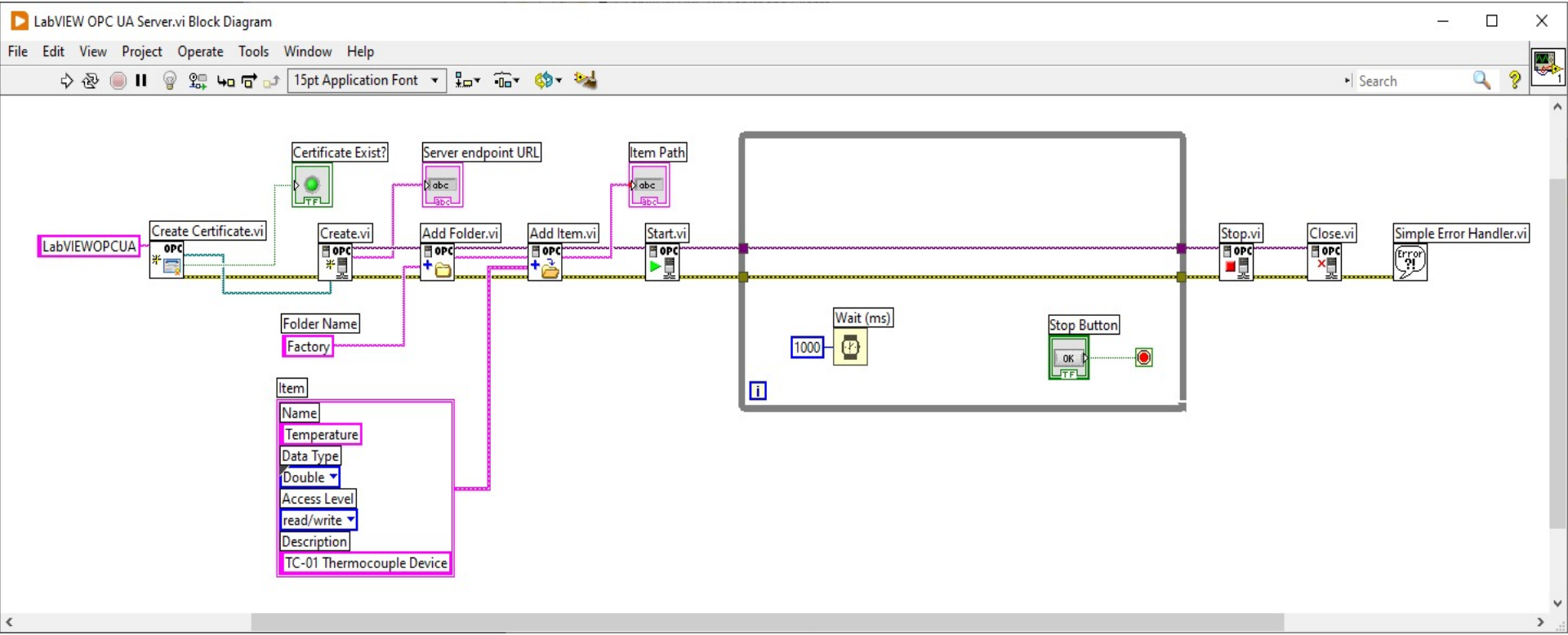
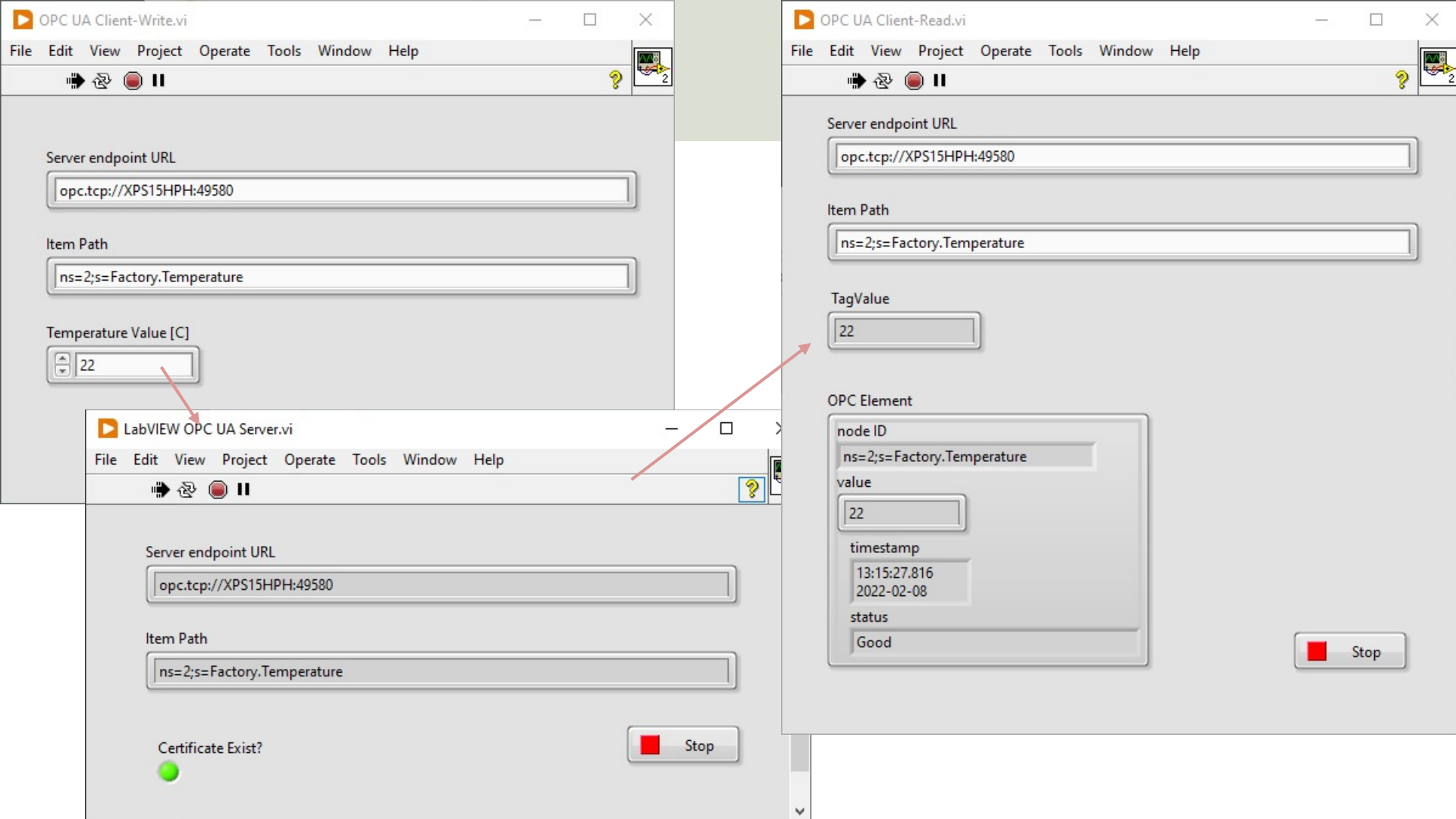
Ex3 – LabVIEW OPC UA Server



Ex3 – LabVIEW OPC UA Server




OPC UA Client-Write.vi
File Edit View Project Operate Tools Window Help
Server endpoint URL
opc.tcp://XPS15HPH:49580
Item Path
ns=2;s=Factory.Temperature
Temperature Value [C]
22
LabVIEW OPC UA Server.vi
File Edit View Project Operate Tools Window Help
Server endpoint URL
opc.tcp://XPS15HPH:49580
Item Path
ns=2;s=Factory.Temperature
Certificate Exist?
Stop
OPC UA Client-Read.vi
File Edit View Project Operate Tools Window Help
Server endpoint URL
opc.tcp://XPS15HPH:49580
Item Path
ns=2;s=Factory.Temperature
TagValue
22
OPC Element
node ID
ns=2;s=Factory.Temperature
value
22
timestamp
13:15:27.816
2022-02-08
status
Good
Stop

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LabVIEW Example 4

Use the free OPC UA Client from Integration Objects to Read/Write Data from the LabVIEW OPC UA Server

Hans-Petter Halvorsen

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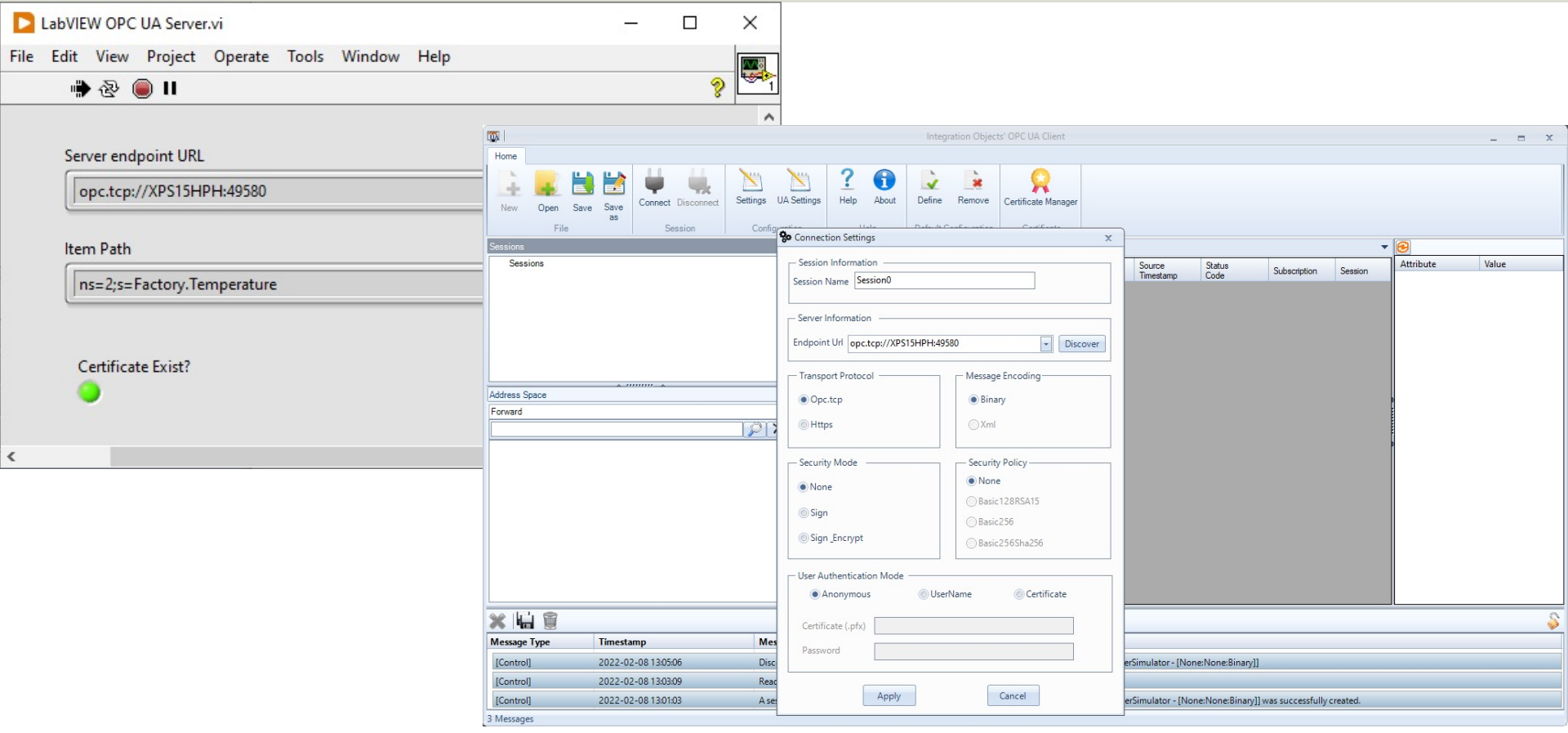
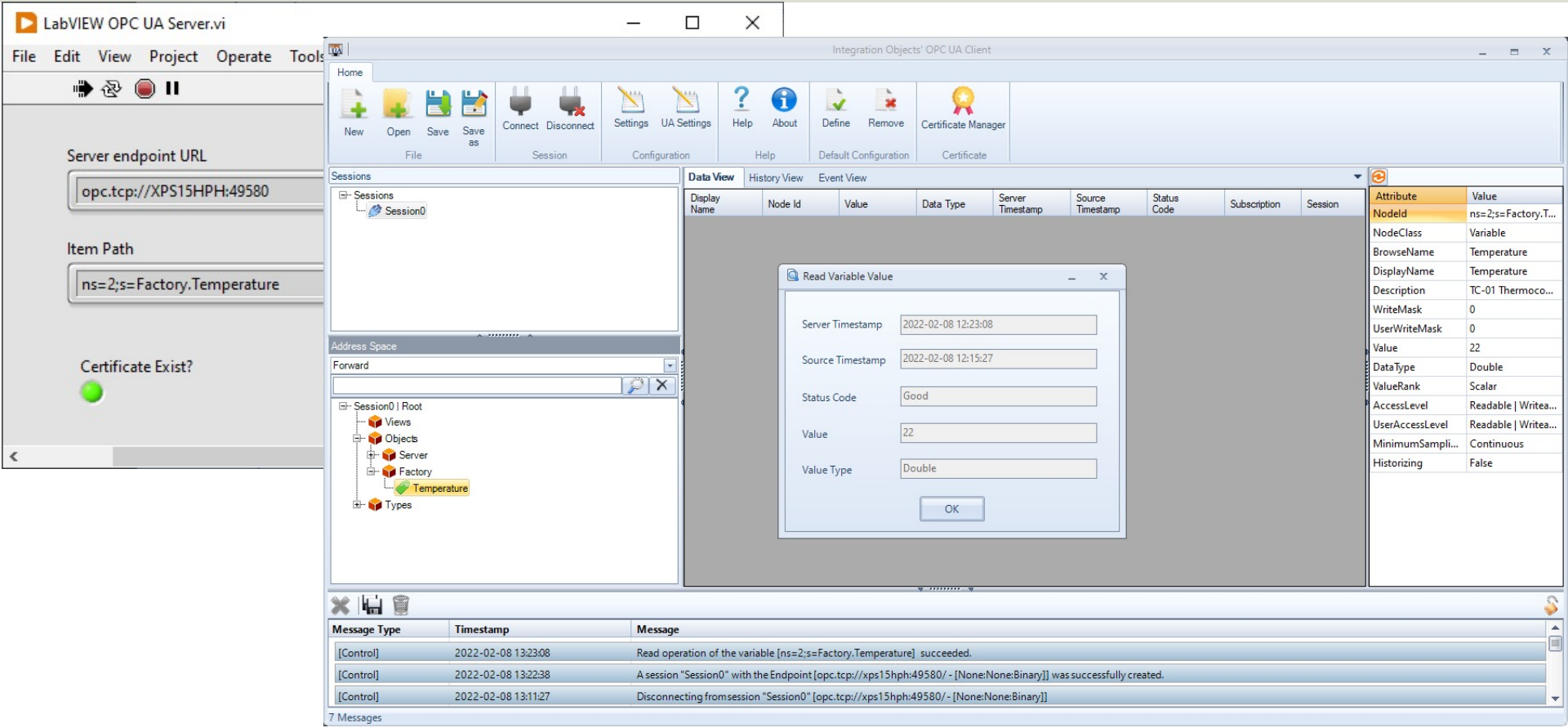
Ex4 – LabVIEW OPC UA Server



Ex4 – LabVIEW OPC UA Server



LabVIEW OPC UA Server.vi

File Edit View Project Operate Tools Window Help

Server endpoint URL

opc.tcp://XPS15HPH:49580

Item Path

ns=2;s=Factory.Temperature

Integration Objects' OPC UA Client

Home

New Open Save Save as | Connect Disconnect | Settings UA Settings | Help About | Define Remove | Certificate Manager

File Session Configuration Help Default Configuration Certificate

Sessions

Session0

Data View History View Event View

Display Name | Node Id | Value | Status Code | Subscriptio

Edit Numeric Value

23.000000000000000

OK Cancel

Address Space

Forward

Session0 | Root

Views

Objects

Server

Factory

Temperature

Types

Message Type	Timestamp	Message
[Control]	2022-02-08 13:24:20	Write operation of the variable [ns=2;s=Factory.Temperature] succeeded.
[Control]	2022-02-08 13:23:58	Write operation of the variable [ns=2;s=Factory.Temperature] succeeded.

OPC UA Client-Read.vi

File Edit View Project Operate Tools Window Help

Server endpoint URL

opc.tcp://XPS15HPH:49580

Item Path

ns=2;s=Factory.Temperature

TagValue

23

OPC Element

node ID

ns=2;s=Factory.Temperature

value

23

timestamp

13:24:20.313
2022-02-08

status

Good

Stop

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MATLAB OPC Toolbox

Hans-Petter Halvorsen

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MATLAB OPC Toolbox

- MATLAB OPC Toolbox lets you connect to OPC Servers using the MATLAB Environment and Programming Language
- MATLAB OPC Toolbox supports OPC DA, OPC HDA and OPC UA
- https://mathworks.com/products/opc.html

MATLAB OPC UA

- https://se.mathworks.com/help/opc/ug/access-data-from-opc-ua-servers.html

MATLAB OPC UA - Functions

1. Locate Your OPC UA Server
```
serverList = opcuaserverinfo('localhost’)
```
2. Create an OPC UA Client
```
uaClient = opcua('localhost’, port)
```
3. Connect to the Server
```
connect(uaClient)
```
4. Browse OPC UA Server Namespace
```
serverNodes = browseNamespace(uaClient)
```
5. Read Current Values from the OPC UA Server
```
[val,ts,qual] = readValue(uaClient,serverNodes)
```
6. Disconnect
```
disconnect(uaClient)
```

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MATLAB Examples

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MATLAB Example 1

OPC UA Server Simulator – Read Data

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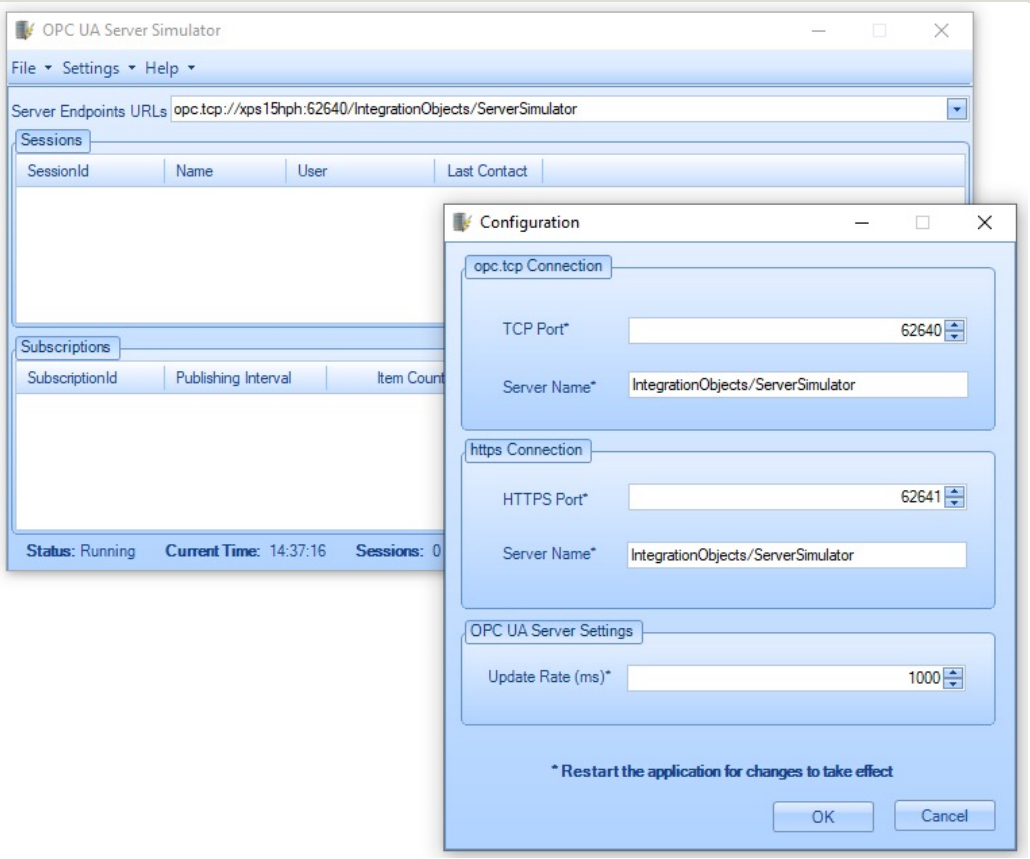
OPC UA Server Simulator

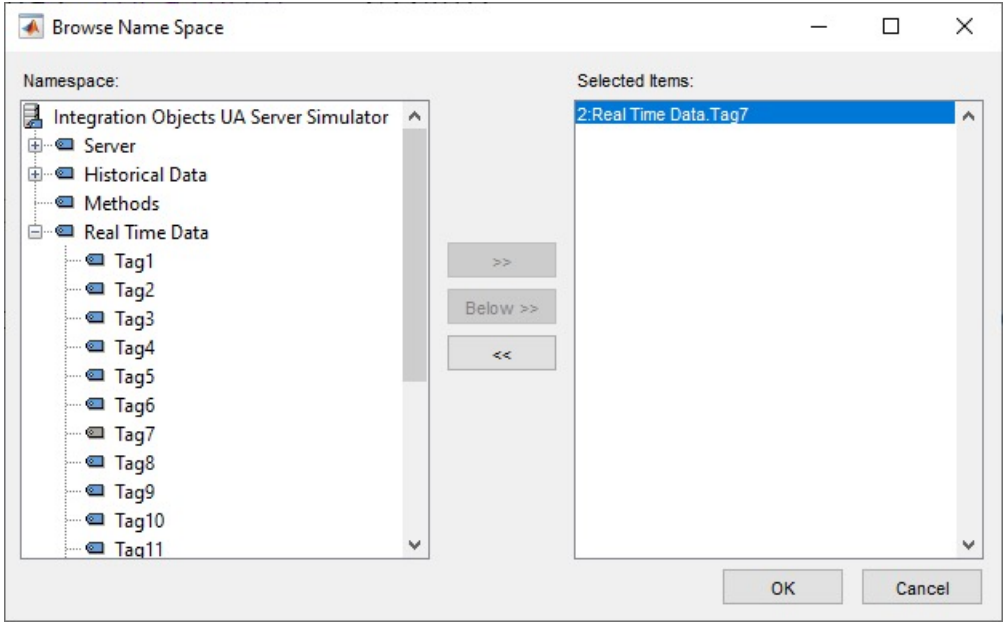


OPC UA Server Simulator

Read Data

```
clear, clc

uaClient = opcua('localhost', 62640)

connect(uaClient)

serverNodes = browseNamespace(uaClient)

[val,ts,qual] = readValue(uaClient,serverNodes)

disconnect(uaClient);
```

OPC UA Server Simulator



Command Window

```
value =

   1.3201e-37


timestamp =

  datetime

   08-Feb-2022 14:40:12


quality =

OPC UA Quality ID:
    Good
>>
```

Alternative Code

Read Data

```
clear, clc

uaClient = opcua('localhost', 62640)

connect(uaClient)
topNodes = uaClient.Namespace
serverChildren = topNodes(4).Children
findNode = findNodeByName(topNodes,'Tag7', '-once')

opcNode = opcuanode(2,'Tag7',uaClient)
[value,timestamp,quality] = readValue(uaClient,opcNode)

disconnect(uaClient);
```

Here you don’t need to select the Tag from the “Browse Name Space” window every time

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MATLAB Example 2

OPC UA Server Simulator – Write Data

Hans-Petter Halvorsen

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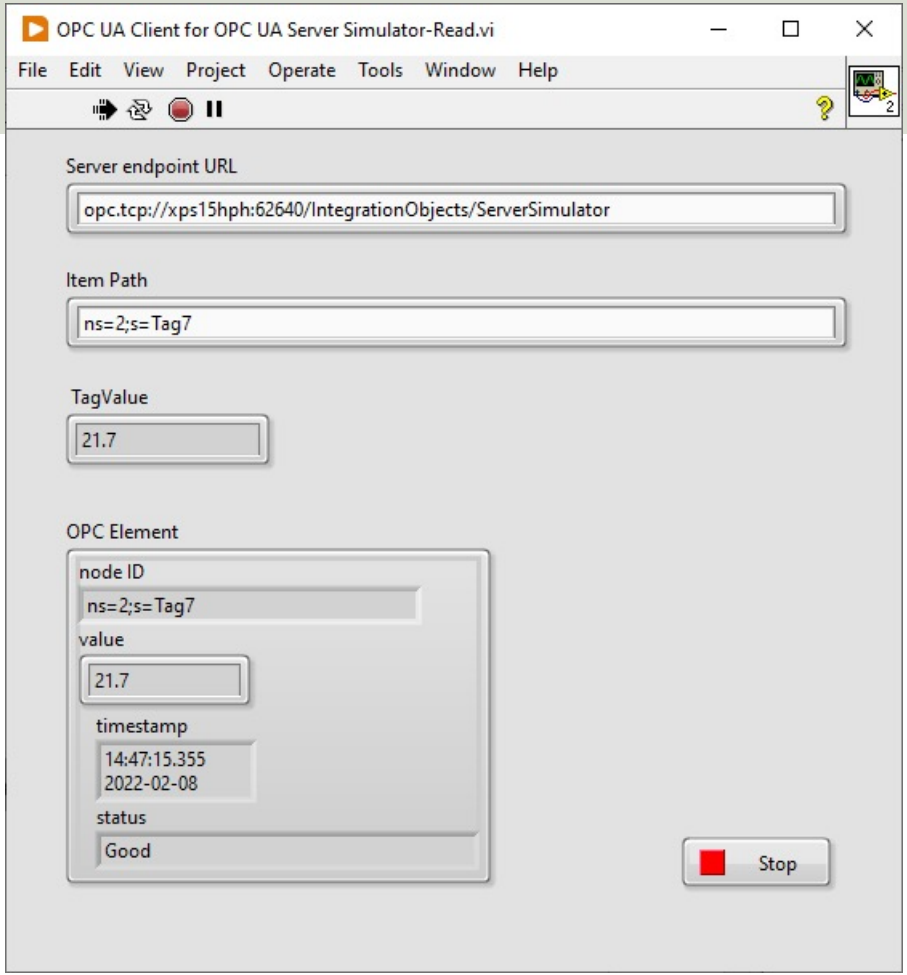
MATLAB OPC UA - Functions

1. Locate Your OPC UA Server
```
serverList = opcuaserverinfo('localhost’)
```
2. Create an OPC UA Client
```
uaClient = opcua('localhost’, port)
```
3. Connect to the Server
```
connect(uaClient)
```
4. Browse OPC UA Server Namespace
```
serverNodes = browseNamespace(uaClient)
```
5. Write Current Values to the OPC UA Server
```
newValue = 22.5
writeValue(uaClient, serverNodes, newValue);
```
6. Disconnect
```
disconnect(uaClient)
```

OPC UA Server Simulator

Write Data

```
clear, clc

uaClient = opcua('localhost', 62640)

connect(uaClient)

serverNodes = browseNamespace(uaClient)

newValue = 21.7;
writeValue(uaClient, serverNodes, newValue);

[value,timestamp,quality] = readValue(uaClient,serverNodes)

disconnect(uaClient);
```



We can use, e.g., LabVIEW to verify that that data has been written to the Server

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MATLAB Example 3

Write/Read Data from LabVIEW OPC UA Server

Hans-Petter Halvorsen

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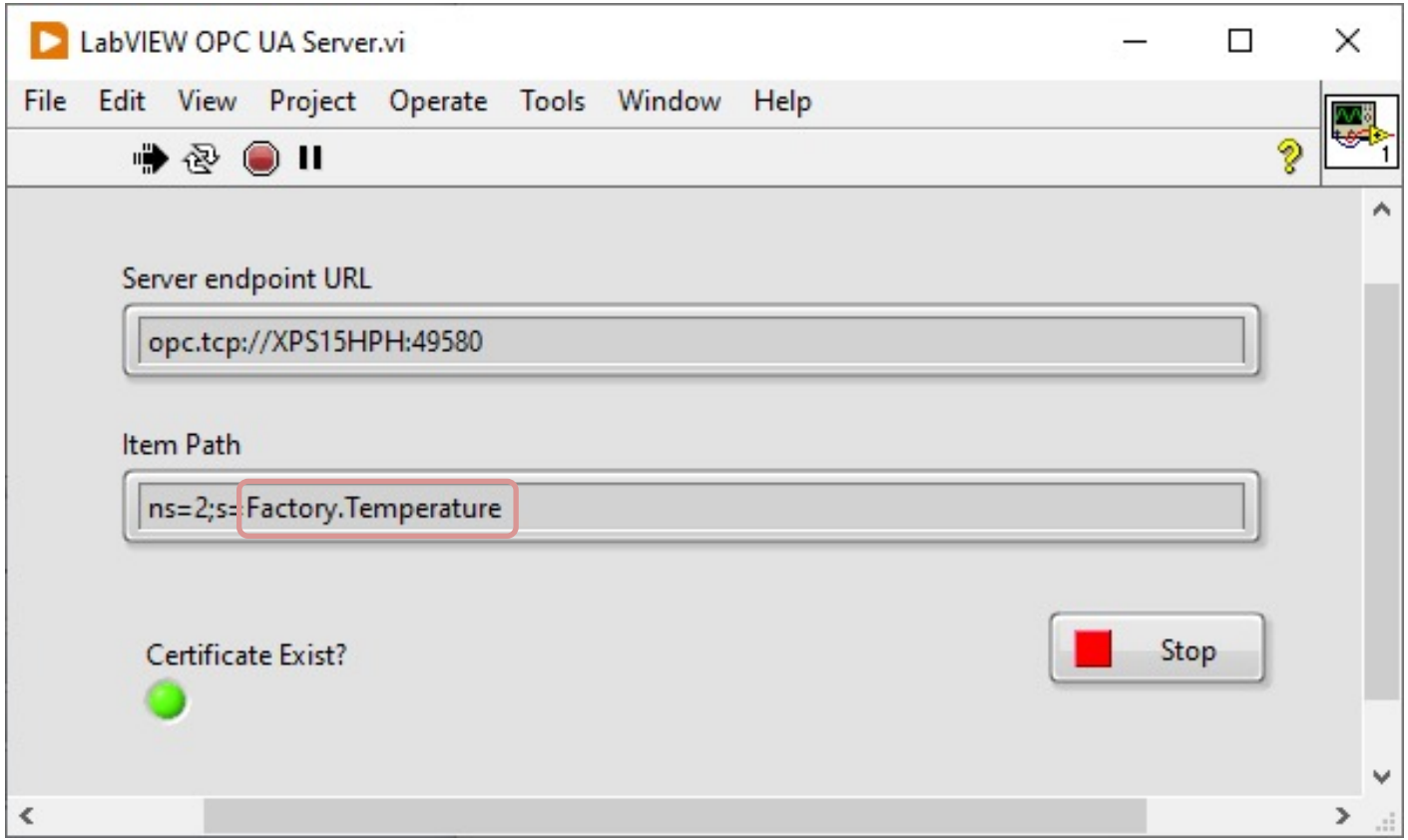
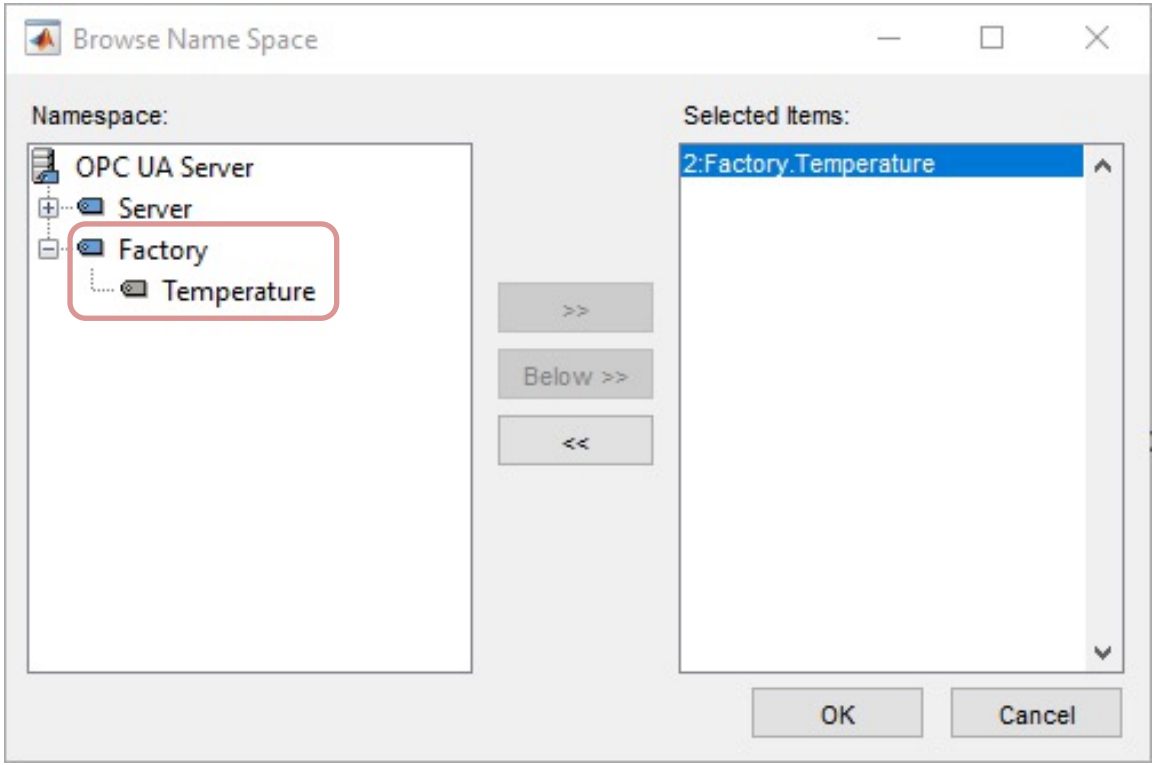
LabVIEW OPC UA Server



Read Data from LabVIEW OPC UA Server

```
clear, clc

uaClient = opcua('localhost', 49580)

connect(uaClient)

serverNodes = browseNamespace(uaClient)

[value,timestamp,quality] = readValue(uaClient,serverNodes)

disconnect(uaClient);
```

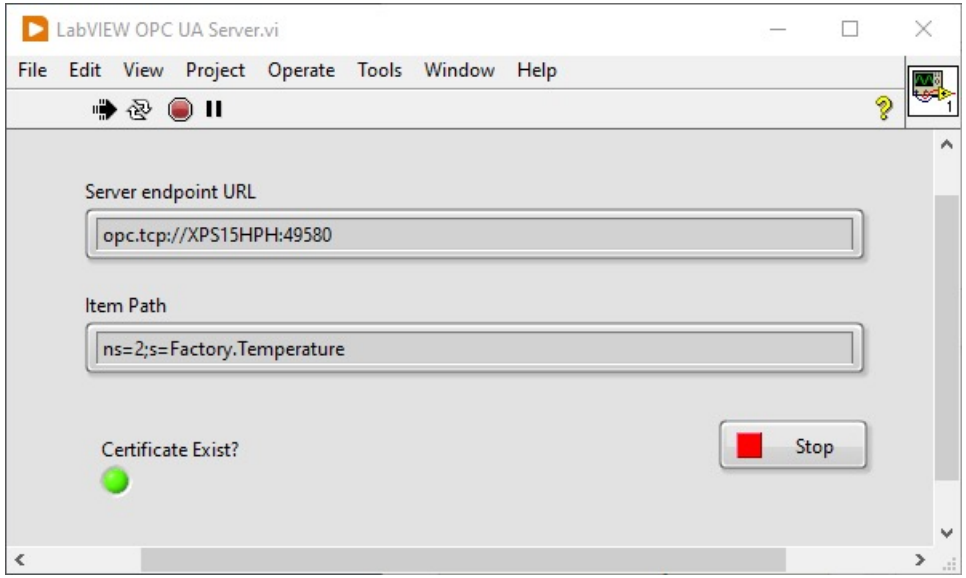
LabVIEW OPC UA Server

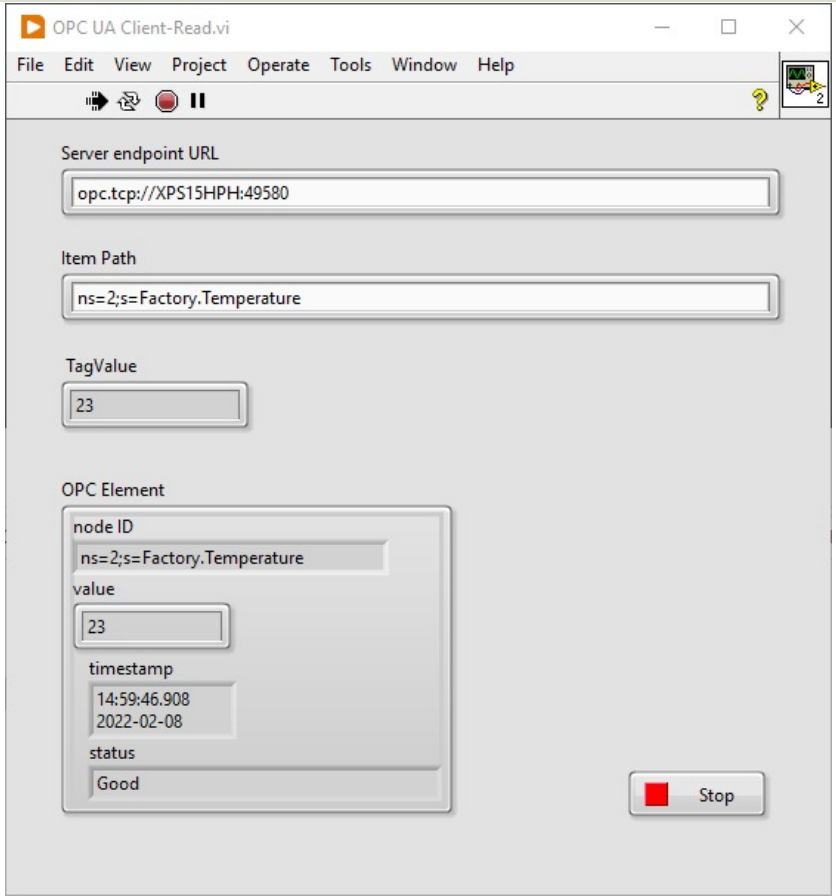


Command Window

```
value =

    23


timestamp =

  datetime

   08-Feb-2022 15:00:58


quality =

OPC UA Quality ID:
    Good
>>
```

LabVIEW OPC UA Server

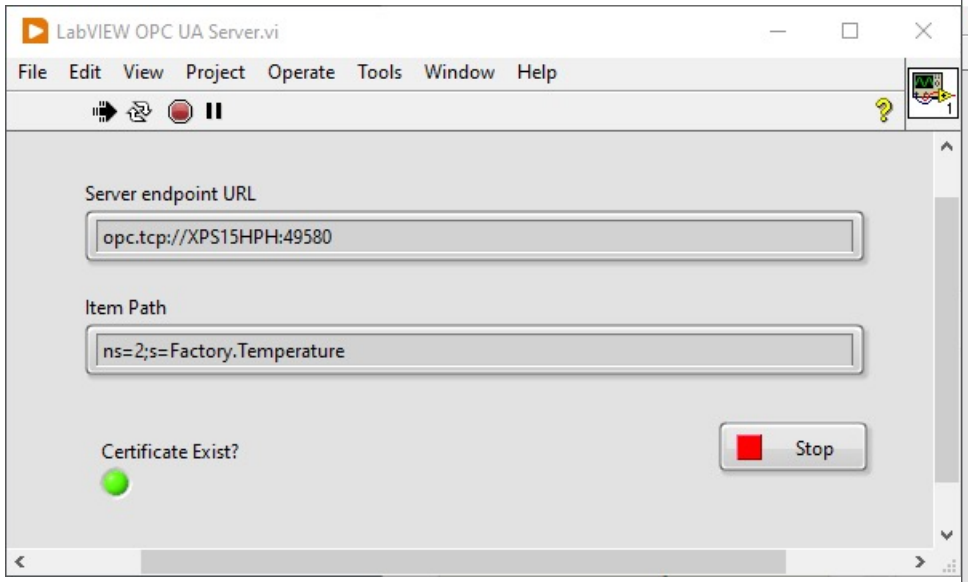


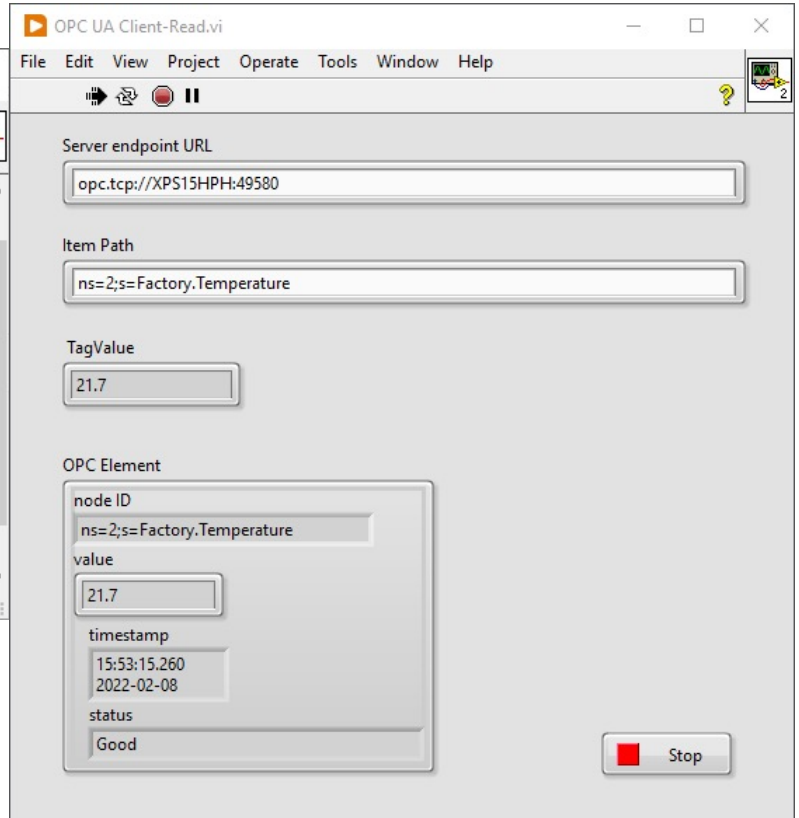


Write Data to LabVIEW OPC UA Server

```
clear, clc

uaClient = opcua('localhost', 49580)

connect(uaClient)

serverNodes = browseNamespace(uaClient)

newValue = 21.7;
writeValue(uaClient, serverNodes, newValue);

[value,timestamp,quality] = readValue(uaClient,serverNodes)

disconnect(uaClient);
```

LabVIEW OPC UA Server





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