

APPLICATION NOTE

AC500 V3 AND OPC UA CONFIGURATION AND HANDLING



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1 Introduction

1.1 Scope of the document

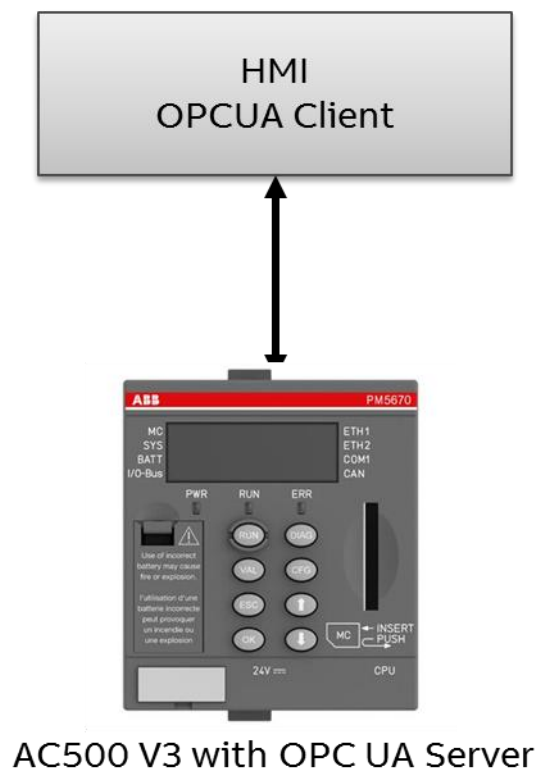
New generation of AC500 PLC's (V3) support OPC UA as a new Communication Opportunity. This document describes how to configure the AC500 to enable this protocol and also to work with UaExpert as an OPC UA Client.

1.2 Compatibility

The application example explained in this document have been used with the below engineering system versions. They should also work with other versions, nevertheless some small adaptations may be necessary, for future versions.

- AC500 V3 PLC
- Automation Builder 2.2.0 or newer

1.3 Overview



2 General

2.1 AC500 OPC UA Features

OPC UA server can be added as an Object below the Ethernet Interfaces ETH1 or ETH2. Then you can access the variable interface of the controller via a client. At the same time, communication can be protected by means of encryption.

The CODESYS OPC UA server supports the following features:

- Browsing of data types and variables
- Standard read/write services
- Notification for value changes: subscription and monitored item services
- Encrypted communication according to "OPC UA standard (profile: Basic256SHA256)"
- Imaging of the IEC application according to "OPC UA Information Model for IEC 61131-3"
- Supported profile: Micro Embedded Device Server Profile
- Sending of Events according to the OPC UA standard

2.2 Key Figures for OPC UA Server

	PM5032	PM5052	PM5072	PM5630	PM5650	PM567x
No of Tags	125	250	1000	1000	5000	30000
No of Clients	5	5	10	10	20	50
Min. Sample Rate (ms)	1000	1000	1000	500	100	50
Queue Size	50	50	50	50	50	50

This figures always must be used in the context of the Application

- CPU/PLC Load
- Task Cycle Times
- Publishing Interval

2.3 Operation Modes

Different Modes are possible with OPC UA

Polling

- With a defined interval, the objects will be continuously updated
- Create higher load than Subscription
- Recommended only for a few Symbols

Subscription

- Updated objects depending on the Publishing Interval and Filters
- Method to reduce Load
- Different Intervals
- Filter possible

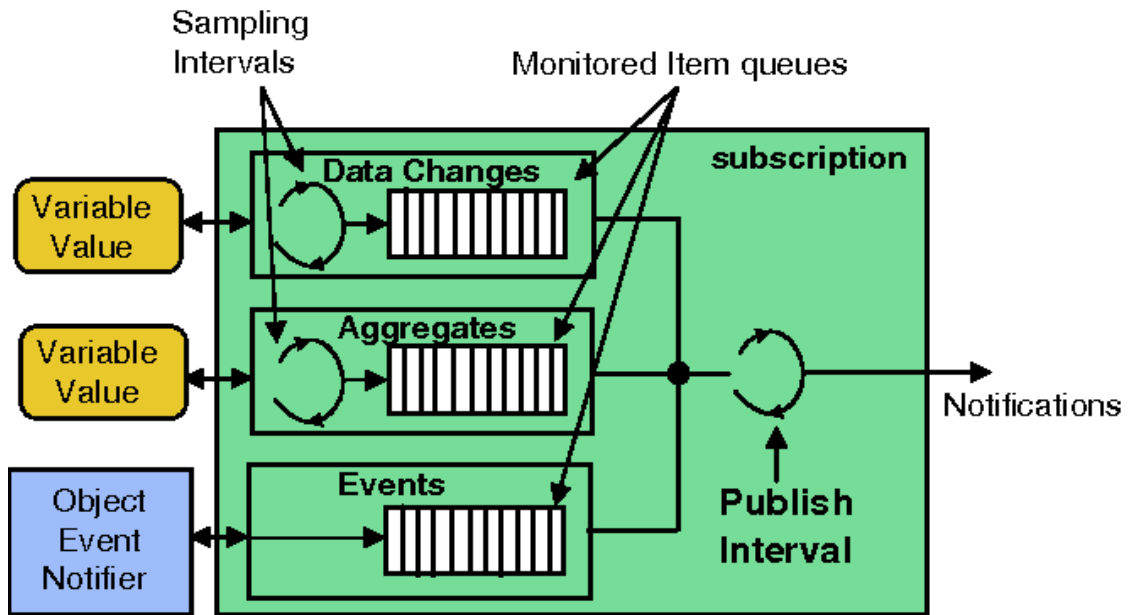
Pub/Sub not yet supported

Further Descriptions are referencing to Subscriptions

2.3.1 Subscription

Client defines a group of Symbols with

Publishing Intervall	Interval, in which server publish Data to Client
Sampling Intervall	Interval for sampling (and storing) Data at Server and send in each Publishing Interval
Queue Size	Array of Data to save Data if sampling Interval is faster than Publishing Interval
Data Change Filter	Can be used to reduce traffic from Server to Client. Criteria are Change of Data, Change of Status, Change of Time Stamp. (AC500 is fix configured for Change of Data and Change of Status)



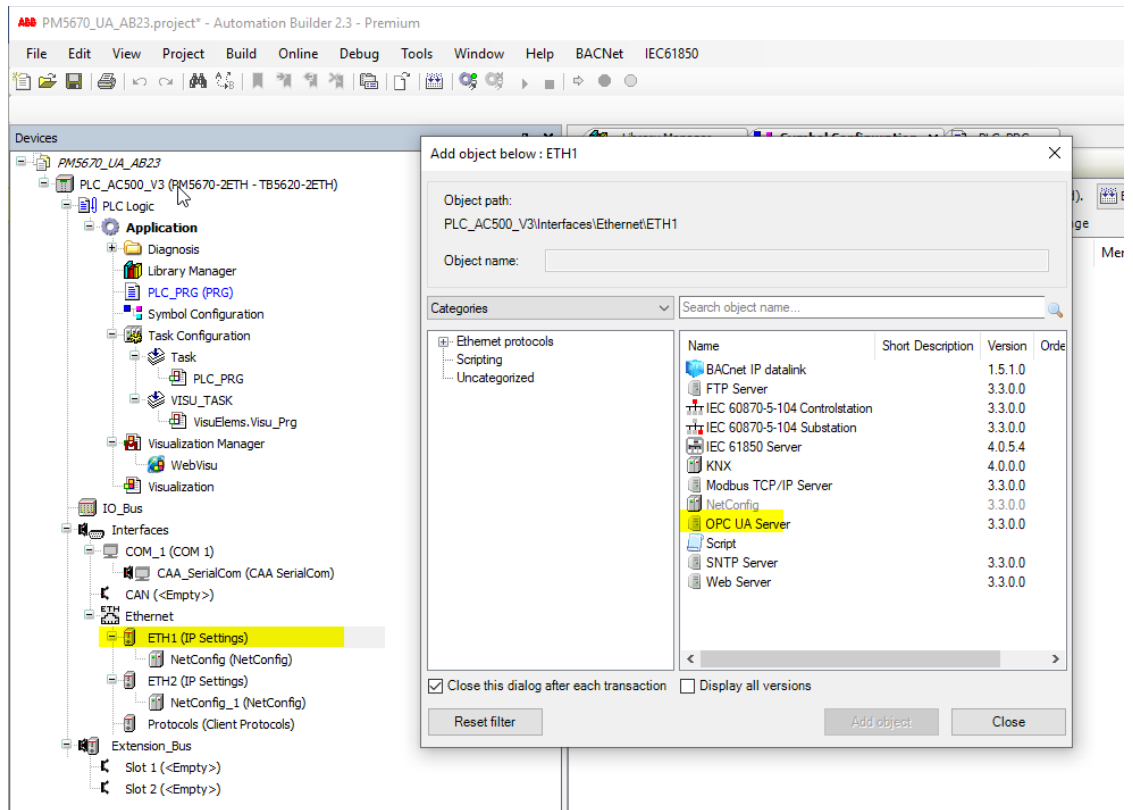
2.4 Recommendations for Using OPC UA

- Define only Variables you need as Symbols
- Do not configure Publishing Intervals to small (increase load)
- Use different Subscriptions with different Publishing Intervals in order to decrease load
- Do not use Sampling intervals faster than Publishing Interval as long as AC500 OPC UA Server don 't support Queue Size different from 1
- Be careful: Setting „0“at Sampling Interval at Client will be interpreted in Server as „as fast as possible “, (see table in chapter 2.2) at AC500 and create a high load.

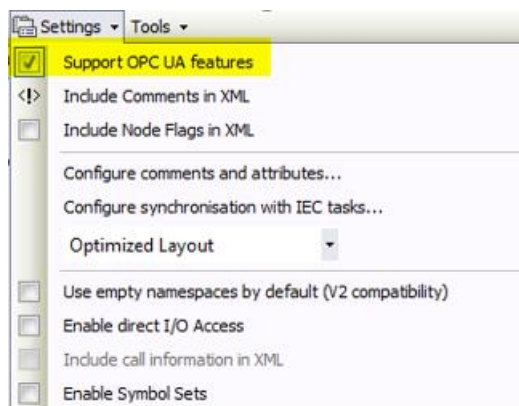
3 Basic Communication

3.1 Preparing AC500 Project

- Create a new project in Automation Builder 2.1 or newer. Choose AC500 V3 PLC (PM5630, PM5650, PM5670 or PM5675)
- Add OPC UA Server to the Ethernet Port you want to use

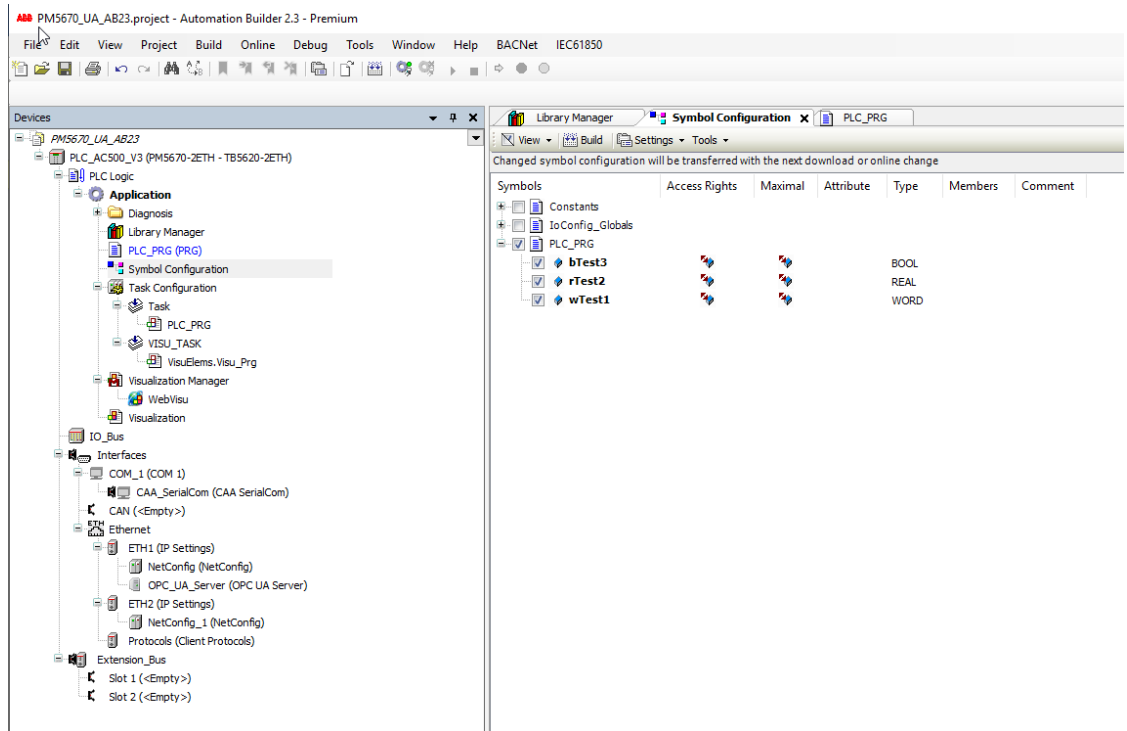


- Declare some variables of different types in the PLC_PRG program.
- Add a “Symbol configuration” object below the application.
- Activate the option “Support OPC UA Features” in the dialog “Add symbol configuration”.



- Open the symbol configuration in the editor.
- Click “Build”.
- The variables are displayed in a tree structure.

- Activate the variables that you want to change with an OPC UA client. Specify the access rights.

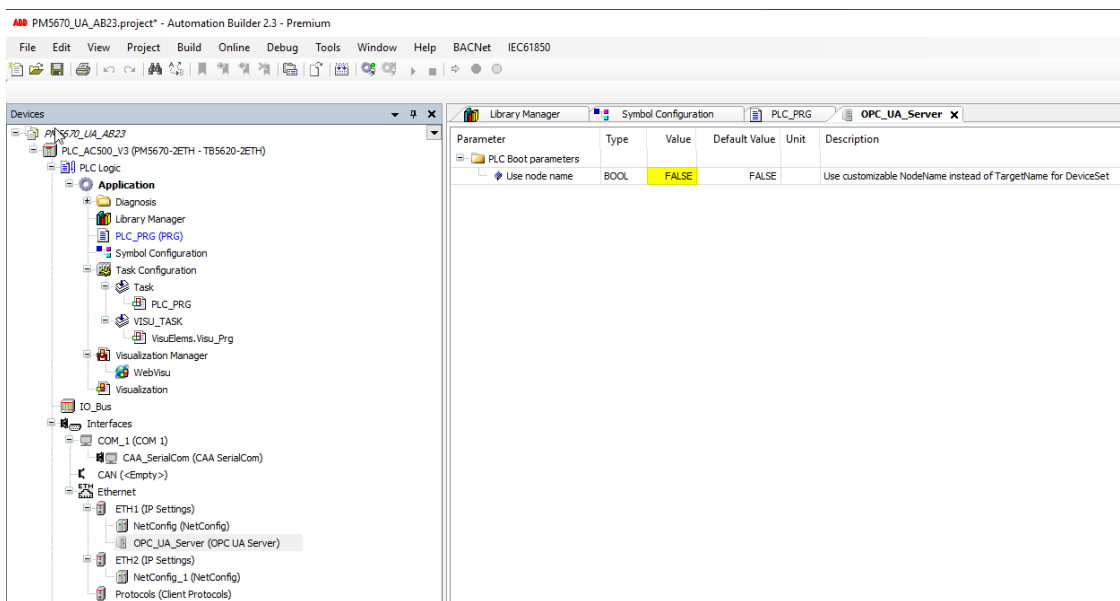


- Download the project to the controller.

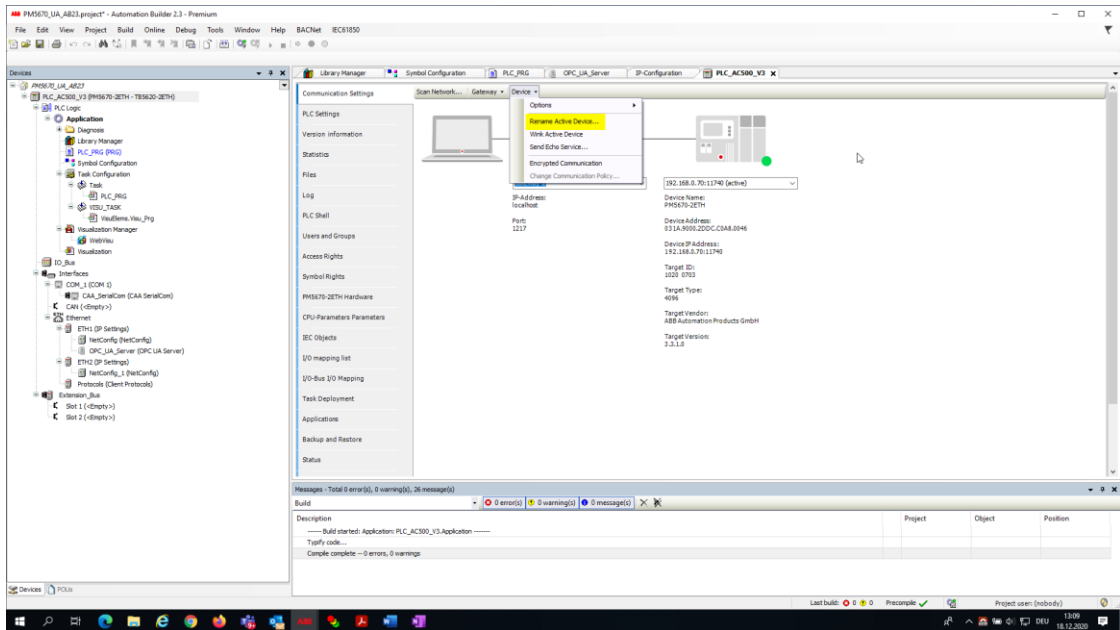
3.2 Assign PLC Name

Depending on the application it could be necessary, that the PLC get a dedicated name instead of the default name

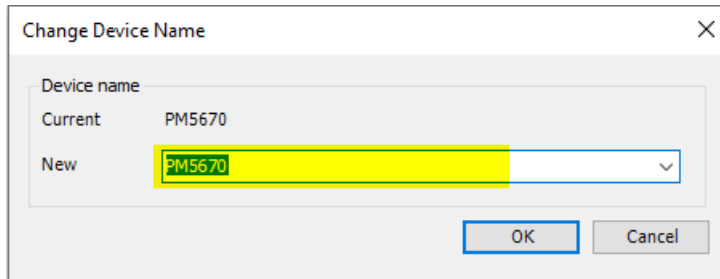
- Double Click to the OPC UA server



Set this parameter to True



- Choose “Rename Active Device”

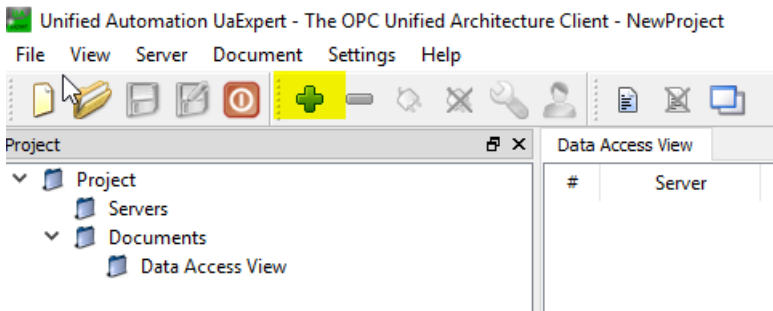


- Define new Name and OK
- Name will be transferred to PLC

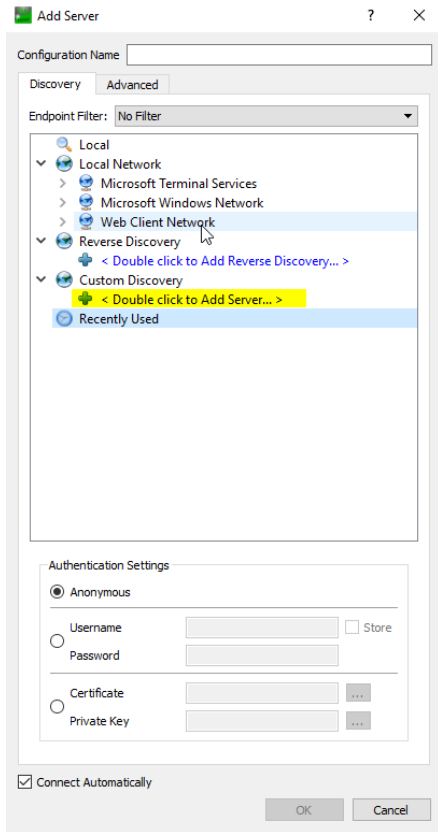
3.3 Configure OPC UA Test client UaExpert

The OPC UA client "UaExpert" is freely accessible software that you can download from the Internet. Using this client, you can connect to the AC500 OPC UA server. The following description refers to this program. Other OPC UA clients work in the same way.

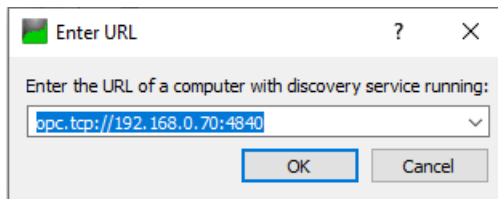
- Start UaExpert



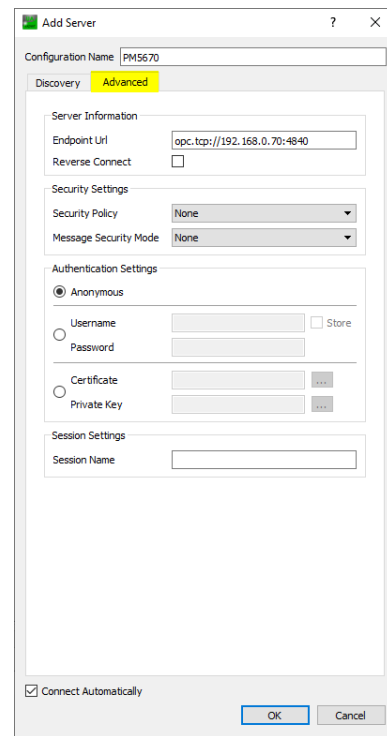
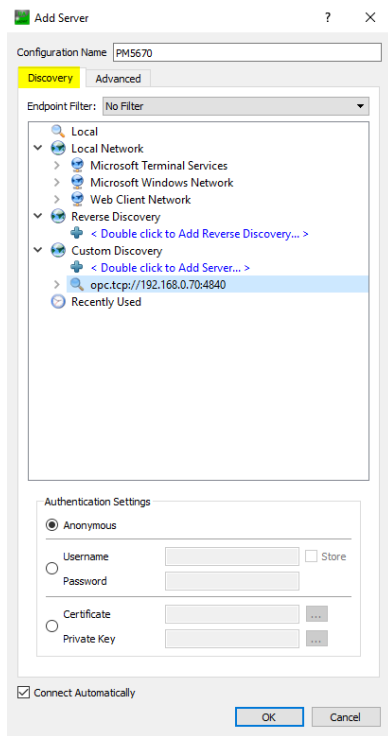
- Add server



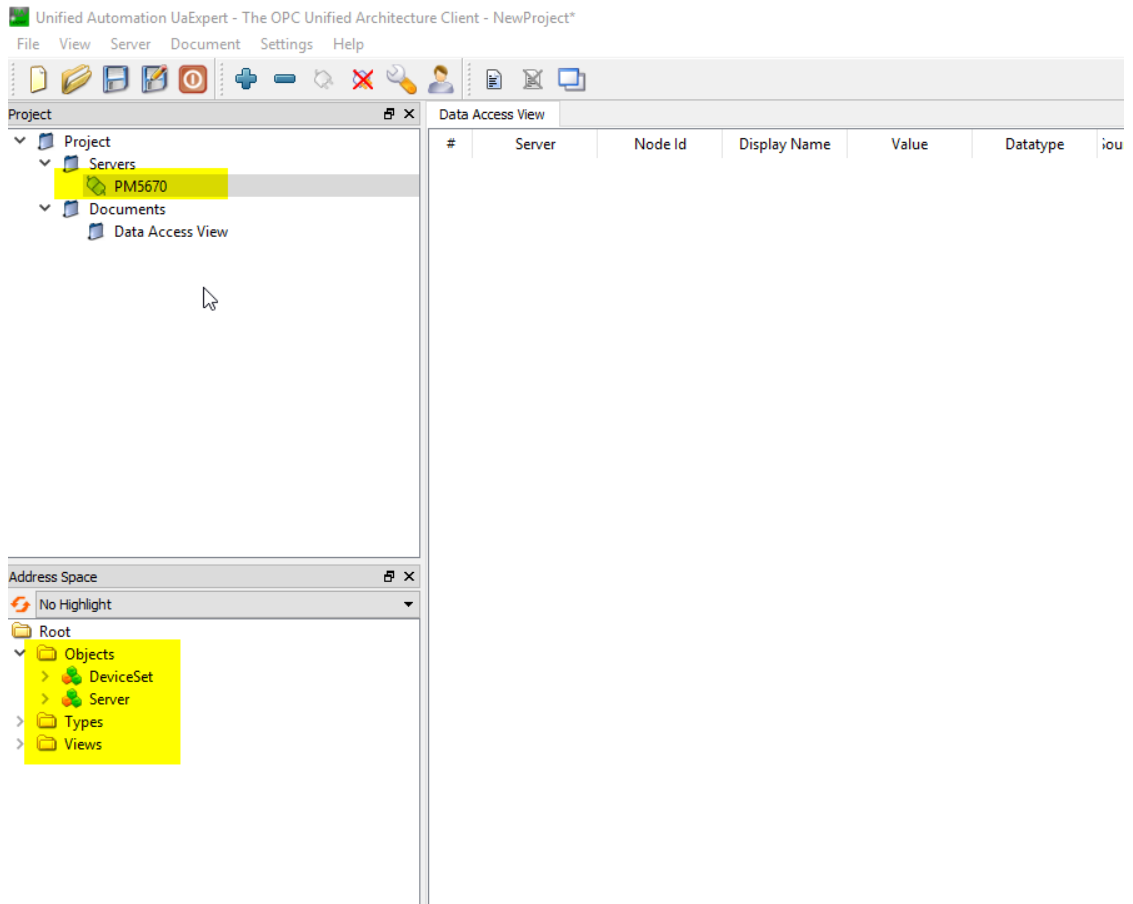
- Add server



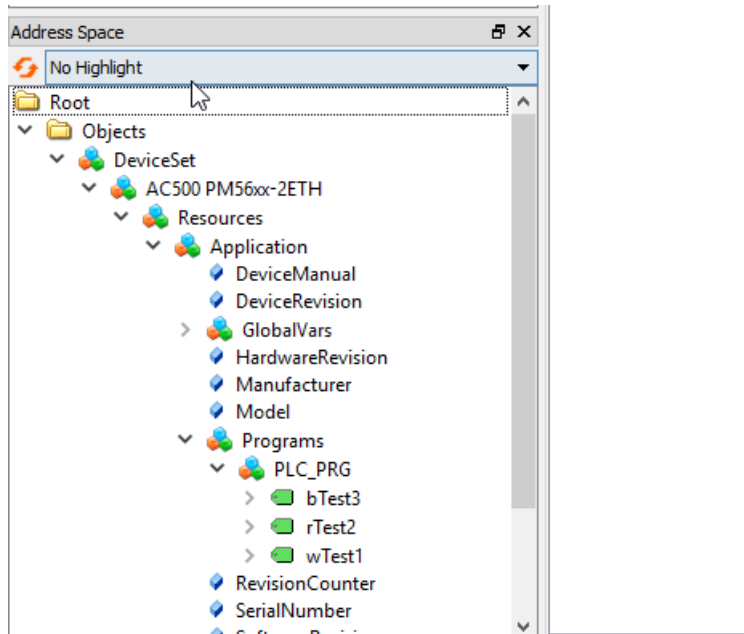
- Fill in the TCP/IP Address of AC500 and Port 4840 (Default Port)



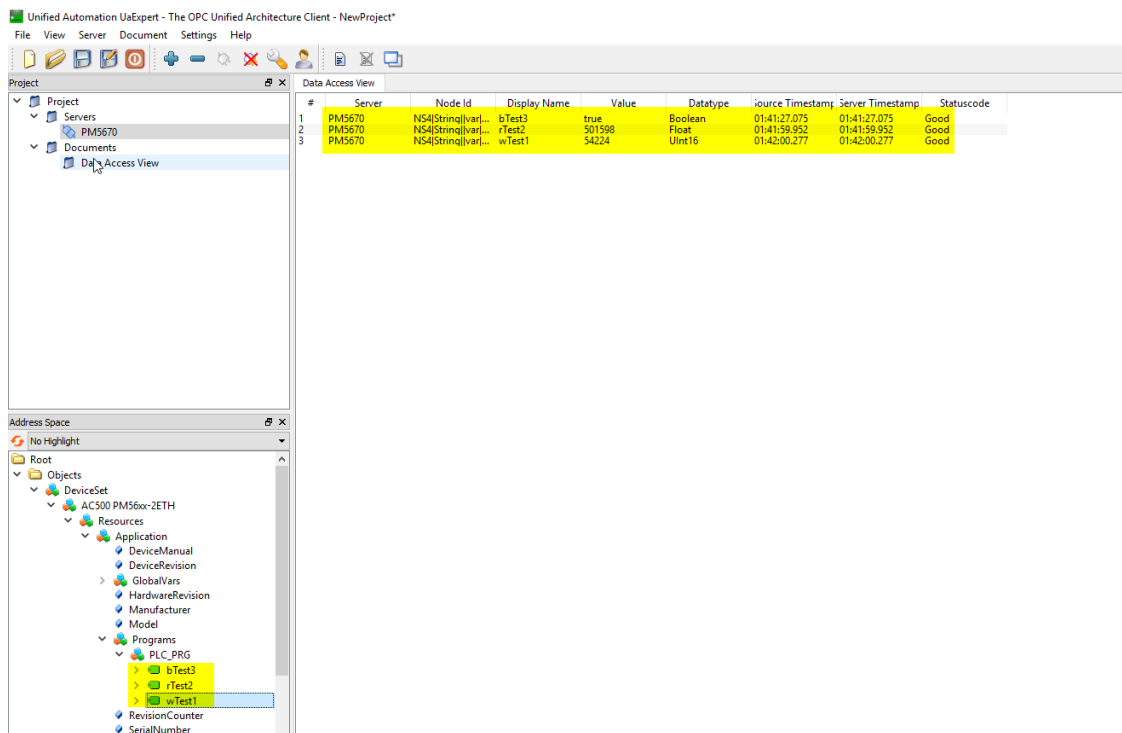
- Take care also to the Advanced Tab
- OK
- Server will be automatically connected



- Open the Project tree in Address Space Window



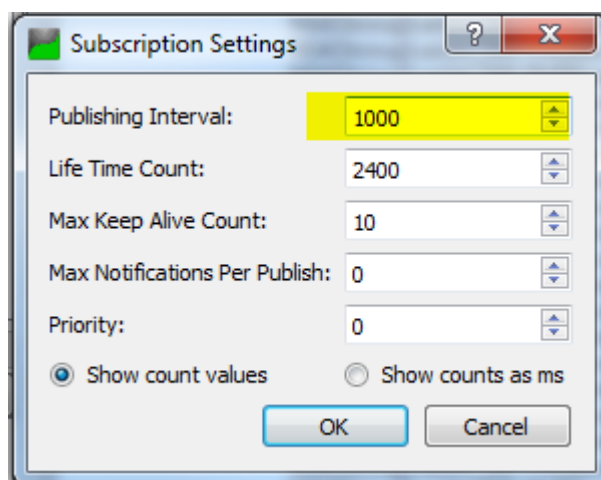
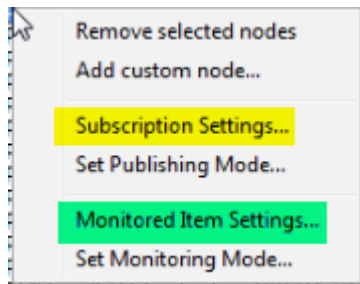
- Drag and drop the need Symbols to “Data Access View”



3.4 Change Subscription or Sampling Rate

Publishing and Sampling Intervals configured in UAexpert

Right Mouse Click on an Item in “Data Access View”

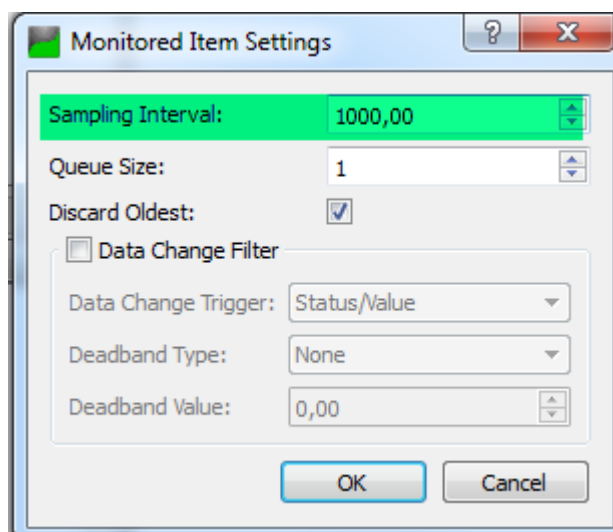


Life Time Count:

Number of Publishing Intervals in which Client must send Publish requests to the Server. After this period without request from Client, subscription in Server will be deleted

Max Keep Alive Count:

If there are no new data to send, Server can skip an Publish Interval. After the Alive Count, Server must send, even if there are no new data.

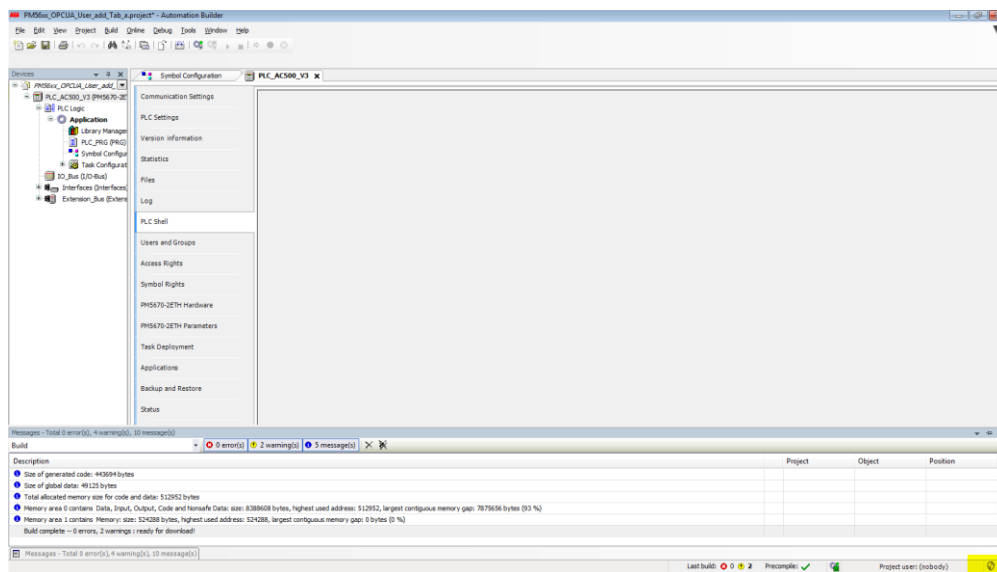


4 Certificate based Communication with anonymous Account

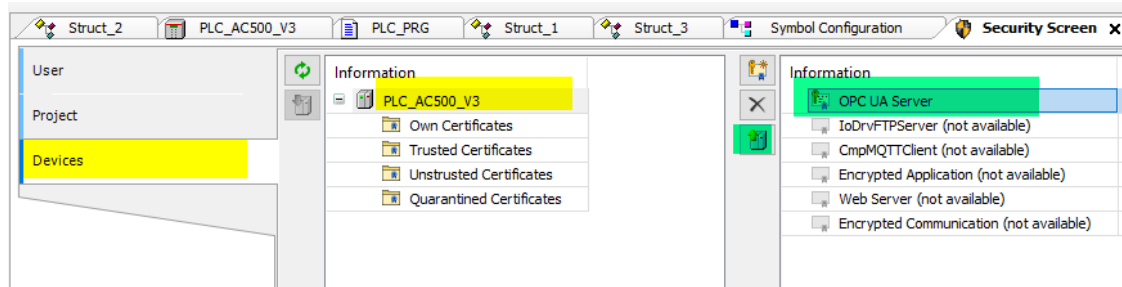
4.1 Create certificate at AC500

Prerequisite: Battery is inserted, and Clock is set to actual Time

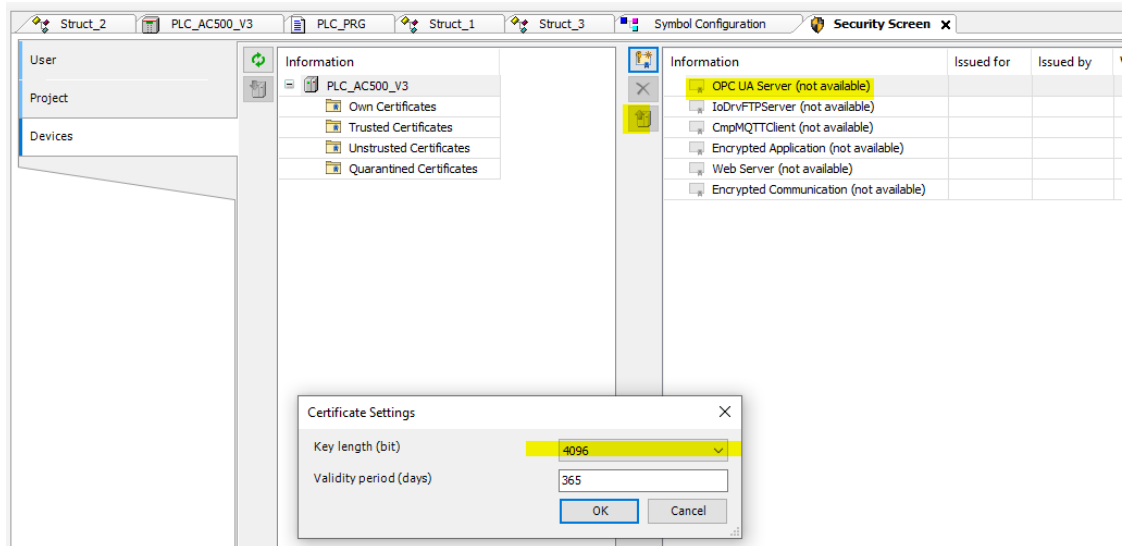
To work with encrypted communication with certificates the first step is to create a certificate for OPCUA Server.



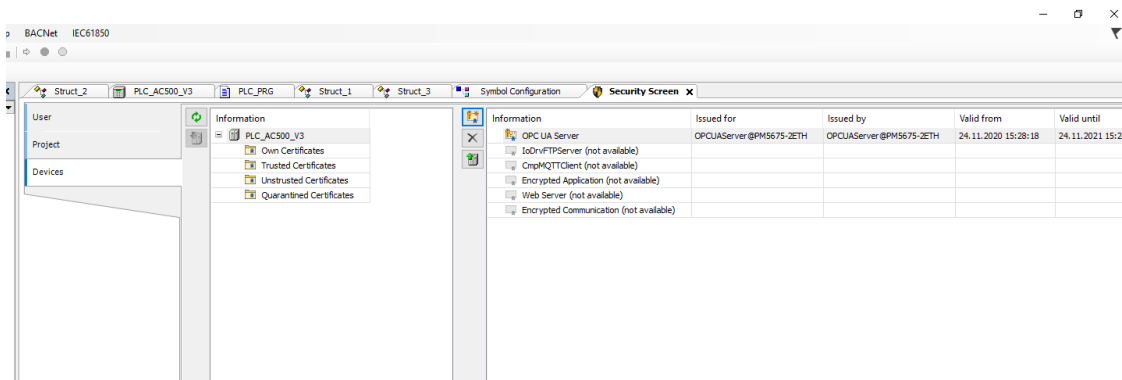
- Double Click to Security Screen Button



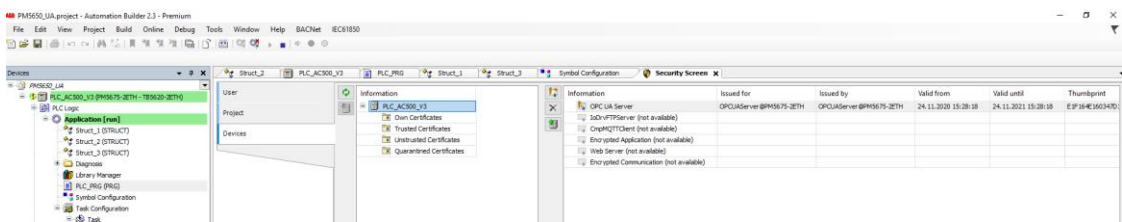
- If the Information Windows are empty push Refresh Button
- Go to Devices
- Select PLC_AC500_V3
- Go to the Right Window and select “OPC UA server (not available)” and push the upper Button (Create a new certificate on this device)



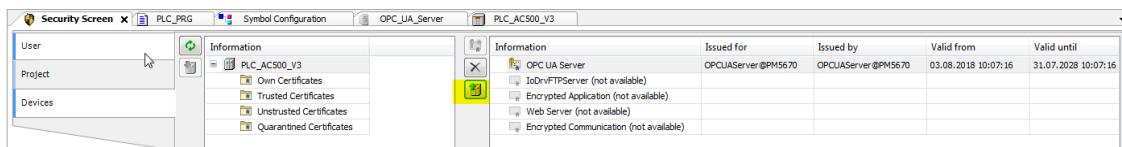
- Choose 4096 as Key Length and push OK
- Creation lasts about 2-3 Minutes



- Logout
- Cycle Power
- Login



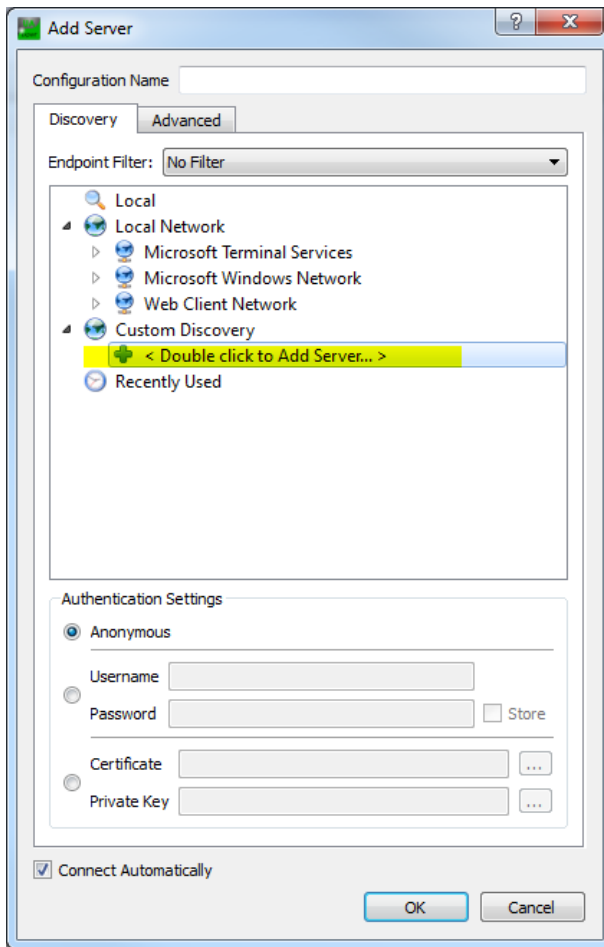
- Certificate is created on the Controller



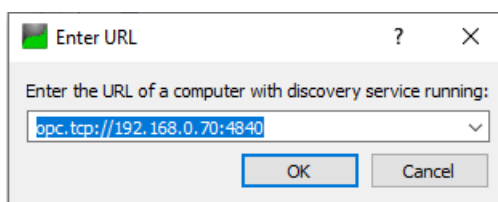
- Upload the Certificate to your PC

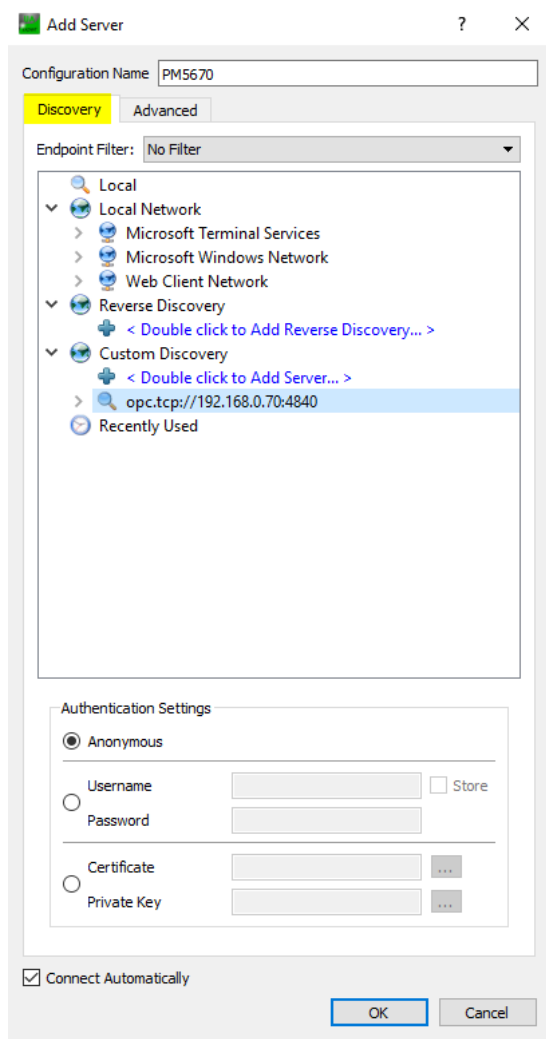
4.2 Create certificate at UaExpert and download to AC500

A new Server Configuration is necessary



Add server





- Switch to Advanced

Server Settings - PM5670

Configuration
Configuration Name: PM5670

Server Information
Endpoint Url: opc.tcp://192.168.0.70:4840
Reverse Connect:

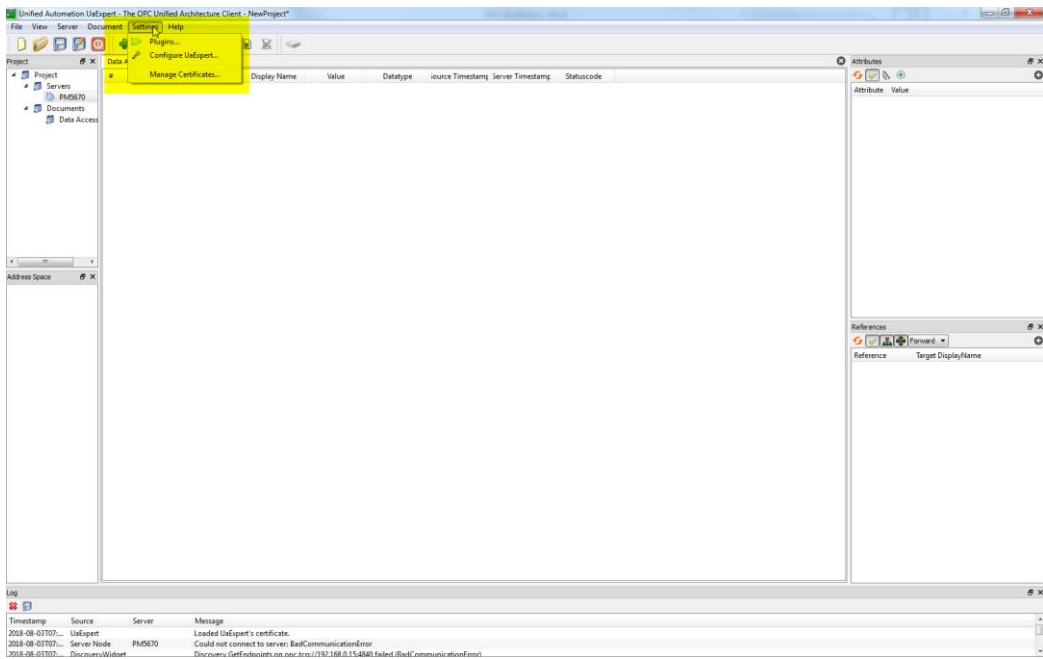
Security Settings
Security Policy: Basic256Sha256
Message Security Mode: Sign & Encrypt

Authentication Settings
 Anonymous
 Username: Store
Password:
 Certificate: ...
Private Key: ...

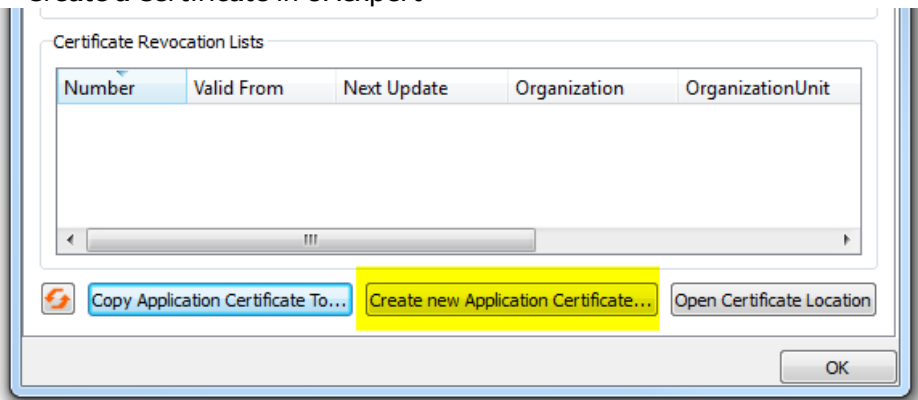
Session Settings
Session Name:

OK Cancel

- UAexpert Setting
- Manage Certificates



- Create a Certificate in UAexpert



New Application Instance Certificate

Subject:

Common Name: UaExpert@ACP3 ✓

Organization: ABB Automation Products GmbH ✓

Organization Unit: ✖

Locality: Heidelberg ✓

State: Baden ✓

Country: DE ✓
(Two letter code, e.g. DE, US, ...)

OPC UA Information

Application URI: urn:DE-L-0235700:UnifiedAutomation:UaExpert ✓

Domain Names: DE-L-0235700 ✓

IP Addresses: ✖

Certificate Settings

RSA Key Strength: 4096 bits Signature Algorithm: Sha1 Certificate Validity: 5 Years

Password protect private key

Password: ✖

Password (repeat): ✖

OK Cancel

Manage Certificates

Trusted Issuers TLS Issuers

Certificates

Status	Name	Valid From	Valid To	Organization
Trusted ✓	MatrikonOPC UA ...	12.08.2015 15:...	12.08.2025 ...	
Trusted ✓	Matrikon Industri...	17.03.2016 17:...	15.03.2026 ...	
Own Certificate	UaExpert@ACP3	03.08.2018 09:...	02.08.2023 ...	ABB Automatio

Certificate Revocation Lists

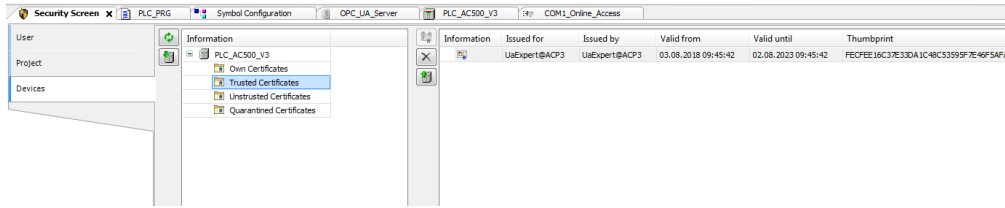
Number	Valid From	Next Update	Organization	OrganizationUnit

Copy Application Certificate To... Create new Application Certificate... Open Certificate Location

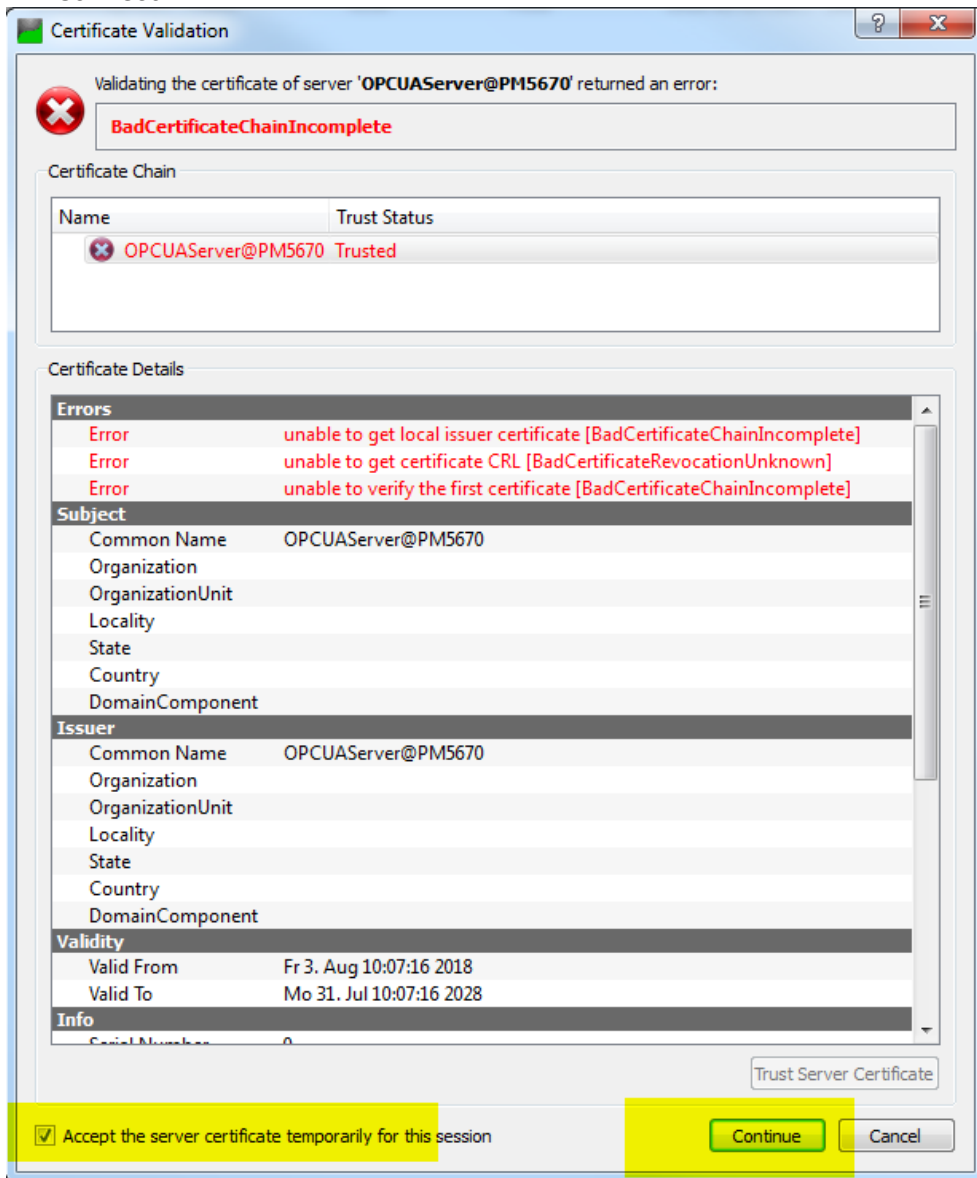
OK

- Copy this Certificate to your PC

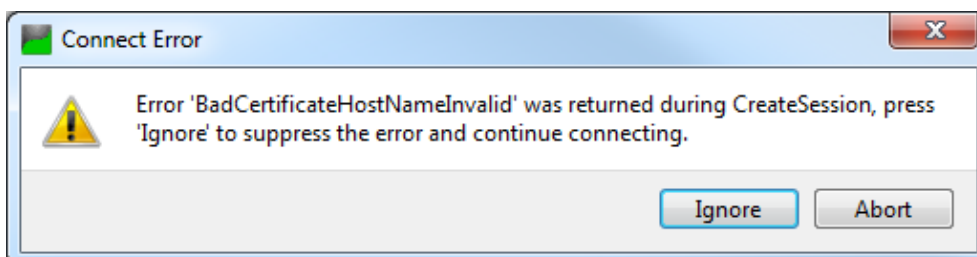
- Upload to AC500



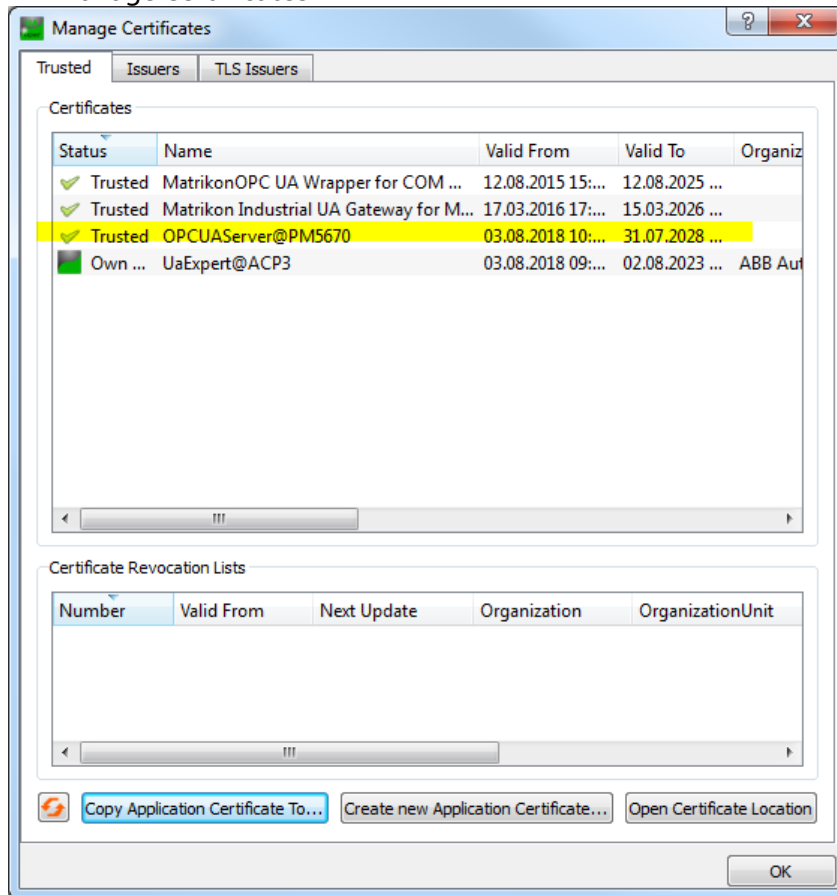
- Connect



- Accept and Continue



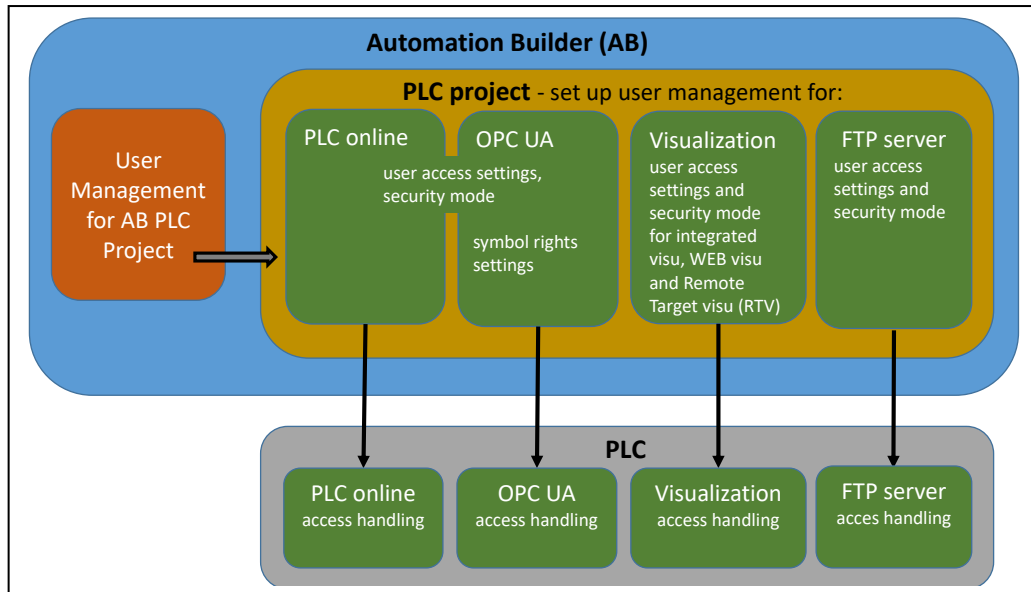
- Push Ignore
- Check in UAexpert
- Settings
- Manage Certificates



5 User-management-based communication

User Management gives the opportunity to have different rights for different user groups, e.g. a user group Operator is able to see all Values in a HMI system and give some commands to the process behind. Another user group Maintenance have the same rights but in addition the group has the Right to change Parameter which have influence to the function of the process or machine.

To avoid reading of username and password from the Network it is recommended to use encrypted communication when inserting username and password.



Working with AC500 V3 and Automation Builder V2 enables a couple of opportunities:

Automation Builder

- Encryption of a project
- Working with User Groups and Users within one Project

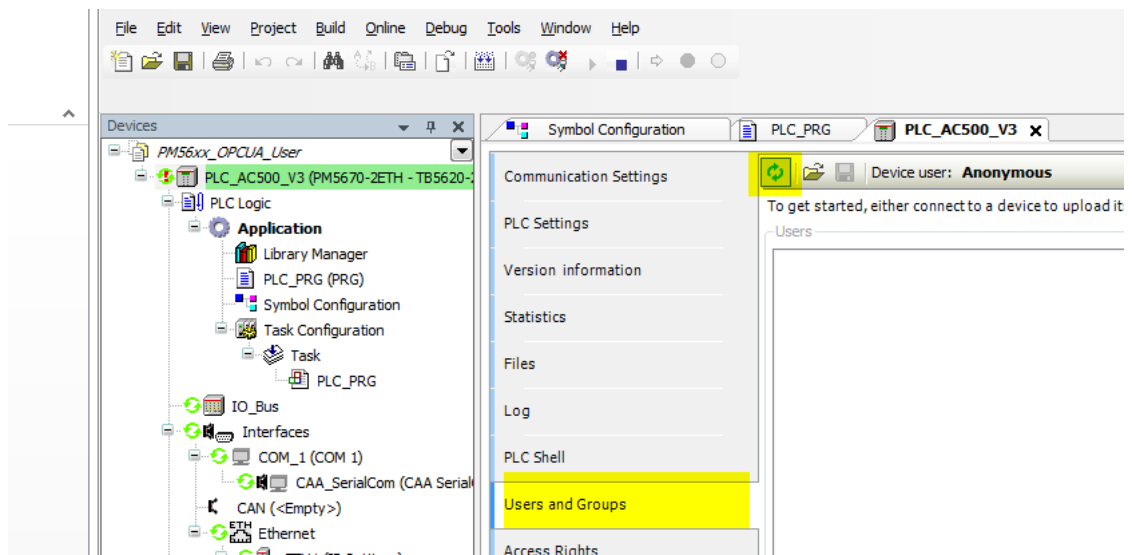
AC500 PLC

- General User management for one PLC (mostly Login)
- Encrypted Communication for Login
- OPCUA Server (different symbol sets for different User Groups, different rights on symbols for different Groups)
- Encrypted Communication between OPCUA Client and Server
-

5.1 Certificates

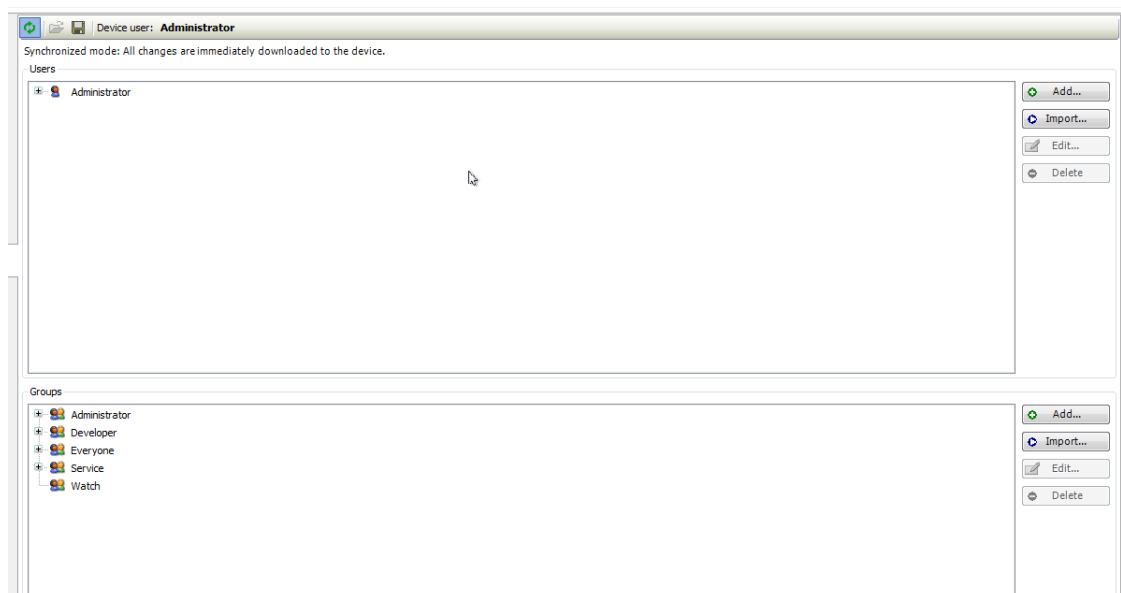
See also Chapter 4

5.2 Create and configure User Management at AC500

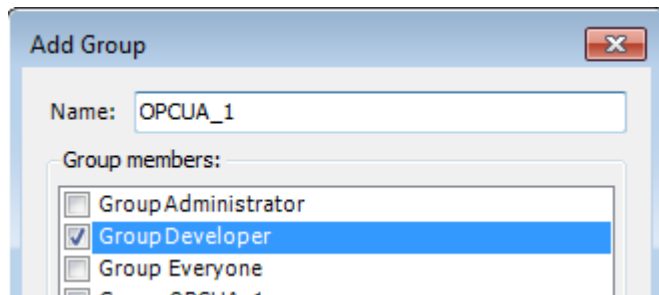


- Push the refresh Button
- You will be asked for a Username and Password
- Insert “Administrator” for Username and Password
- Then you will be asked for a new Password
- After doing this you get a Default user management System
- Be aware, that with a activated User Management always User Name and Password is needed to connect to PLC.

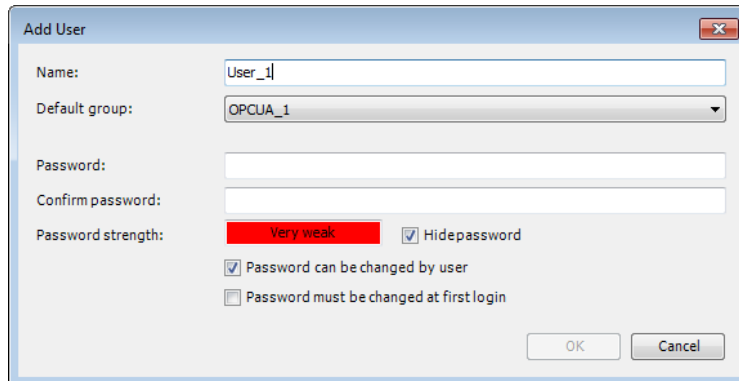
5.2.1 Create User Groups and User



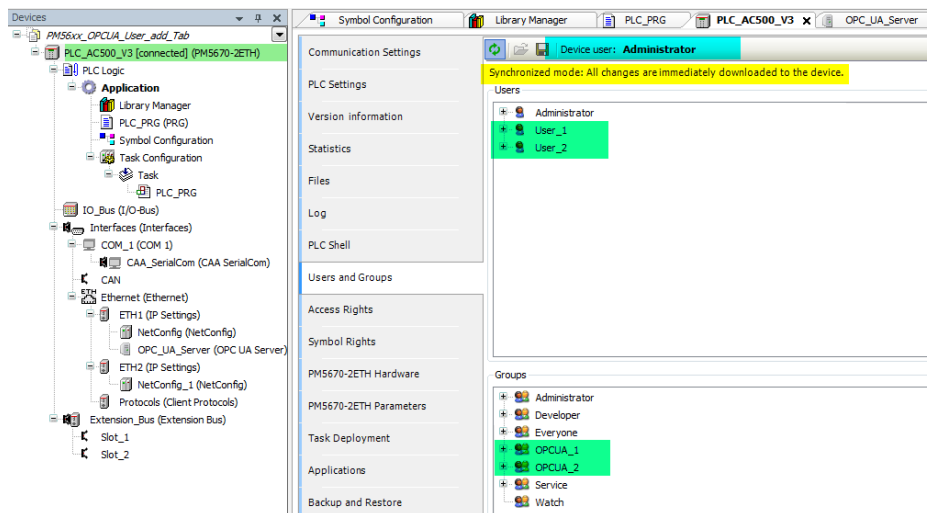
Push “Add” in Groups Area



Push "Add.." in Users Area



Fill in User Name and Password

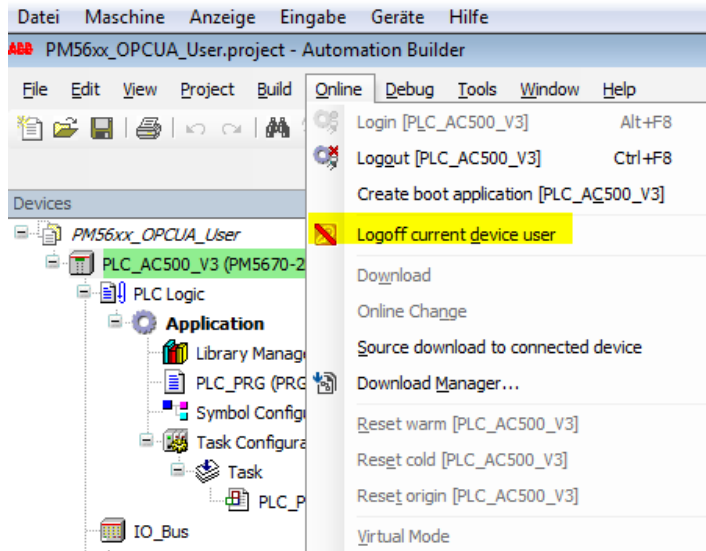


Be sure that the Refresh Button is activated, because all the User, User Groups and Access Rights will be transferred directly to PLC and will be saved only directly in PLC.

Actual PLC User can be seen in the Headline of the Dialog.

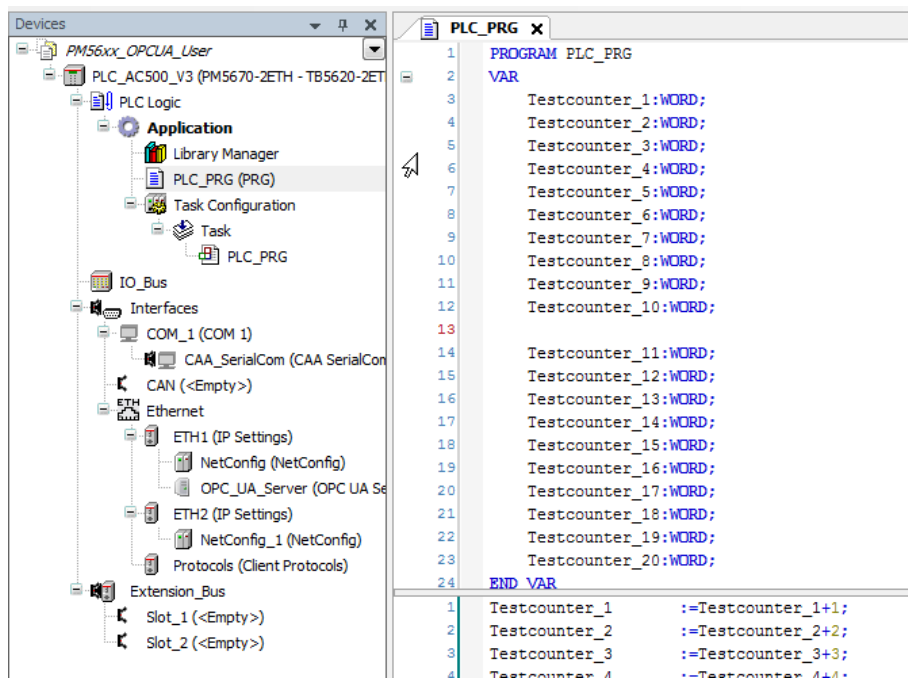
As long as no Power Cycle is made at PLC and Automation Builder was not closed and reopened you can connect without inserting Username and Password (same User).

To change User please use Menu Online



Next time you want Login, you will be asked for User Name and Password

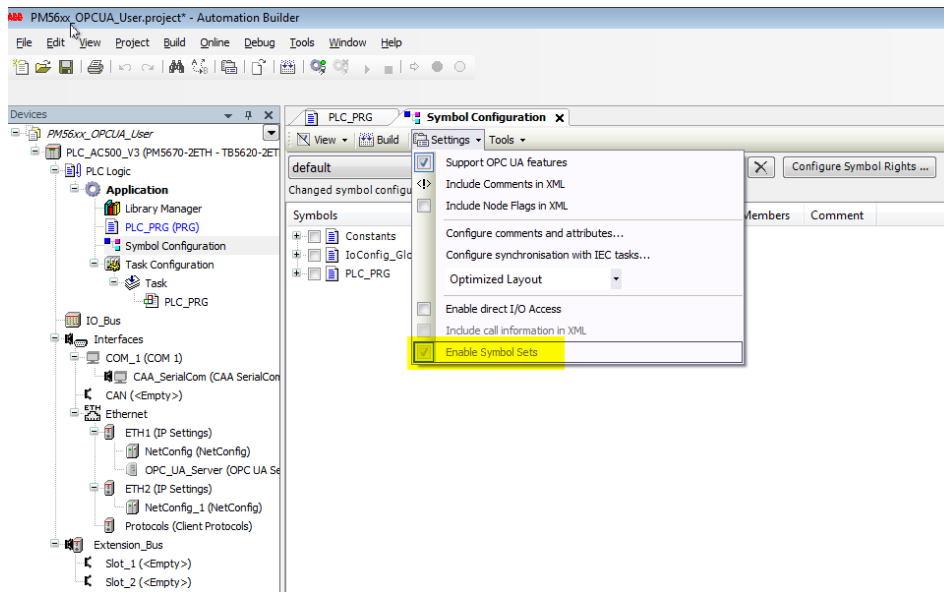
5.3 Create different “Symbol Sets”



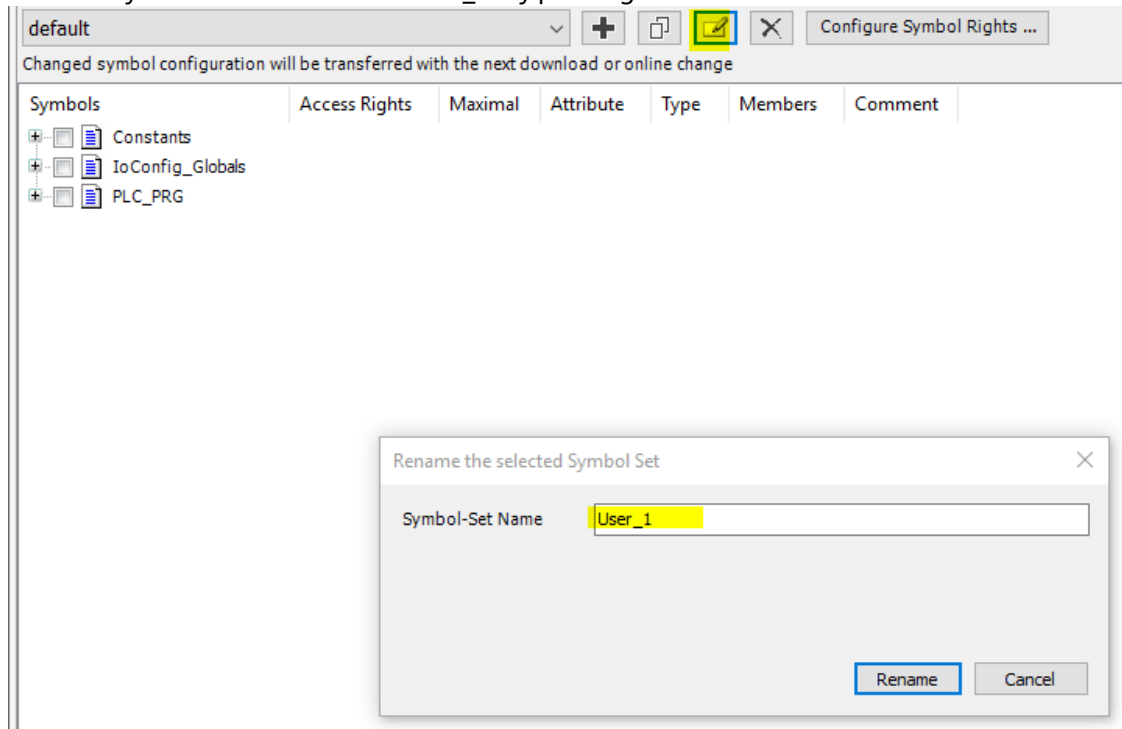
Add Symbol Configuration to Application

Push „Build“ Button

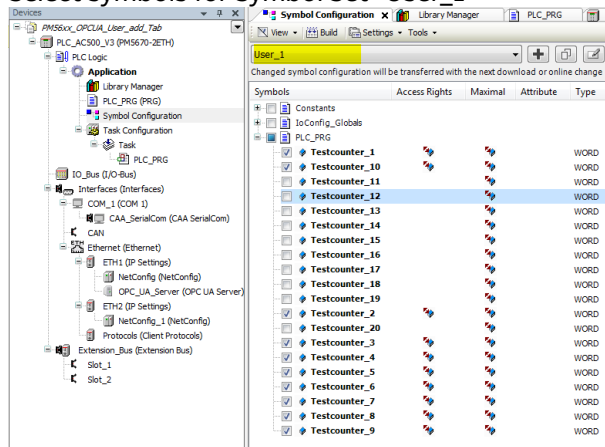
Enable Symbol Sets



Rename Symbol Set “Default” to “User_1” by pushing Button and fill in Name

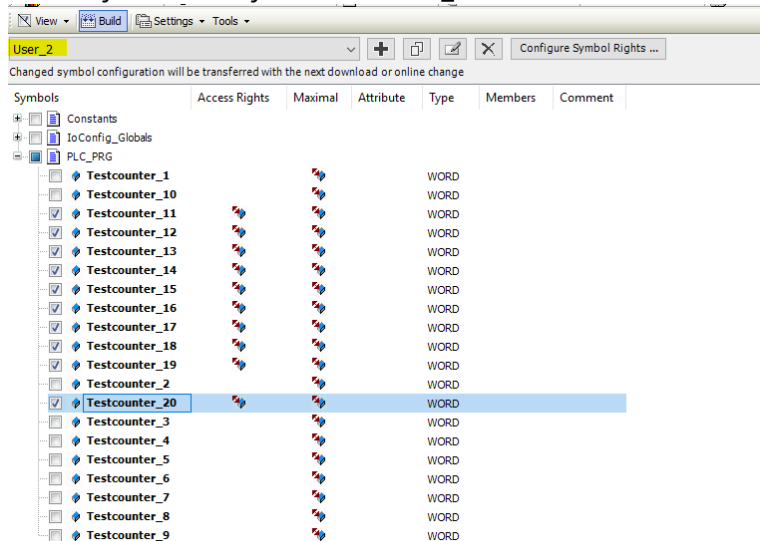


Select symbols for Symbol Set “User_1”



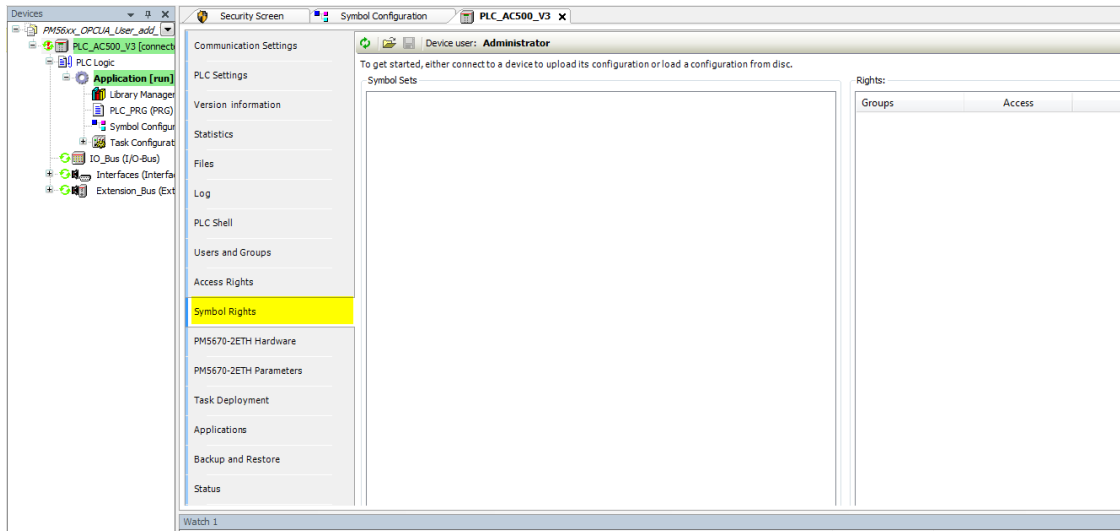
Add 2. Symbol Set “User_2” by pushing Button “+” and fill in Name

Select Symbols for Symbol Set “User_2”



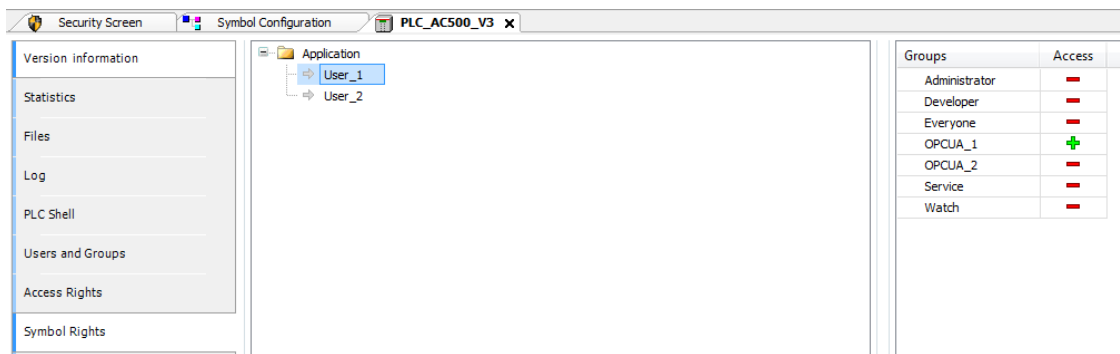
5.4 Match Symbol Sets with User

- Select Symbol Rights



Push Refresh Button

Give Access Rights for the different Symbol Sets to the User Groups

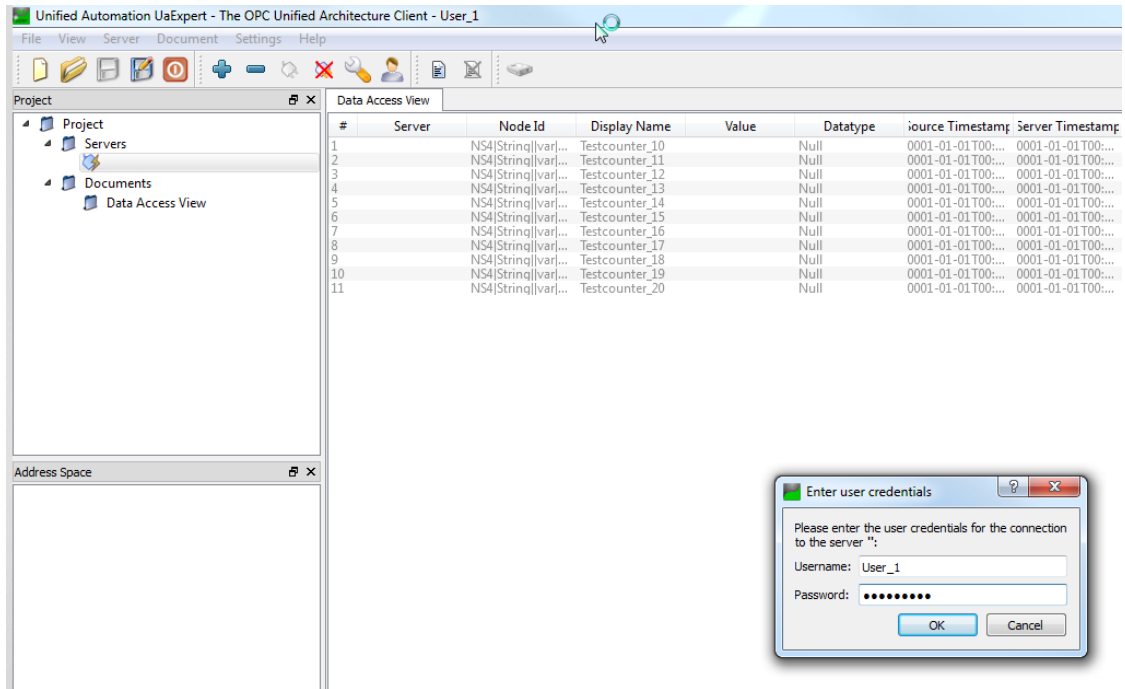


Do the same for User_2

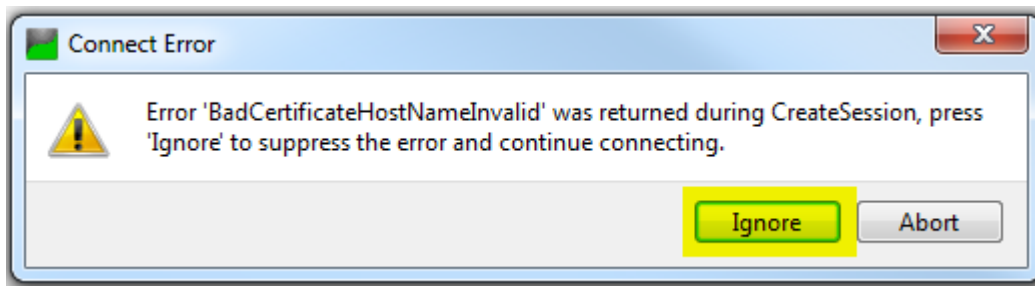
5.5 Connect with UaExpert

Configuration of UaExpert is the same as with Anonymous Account

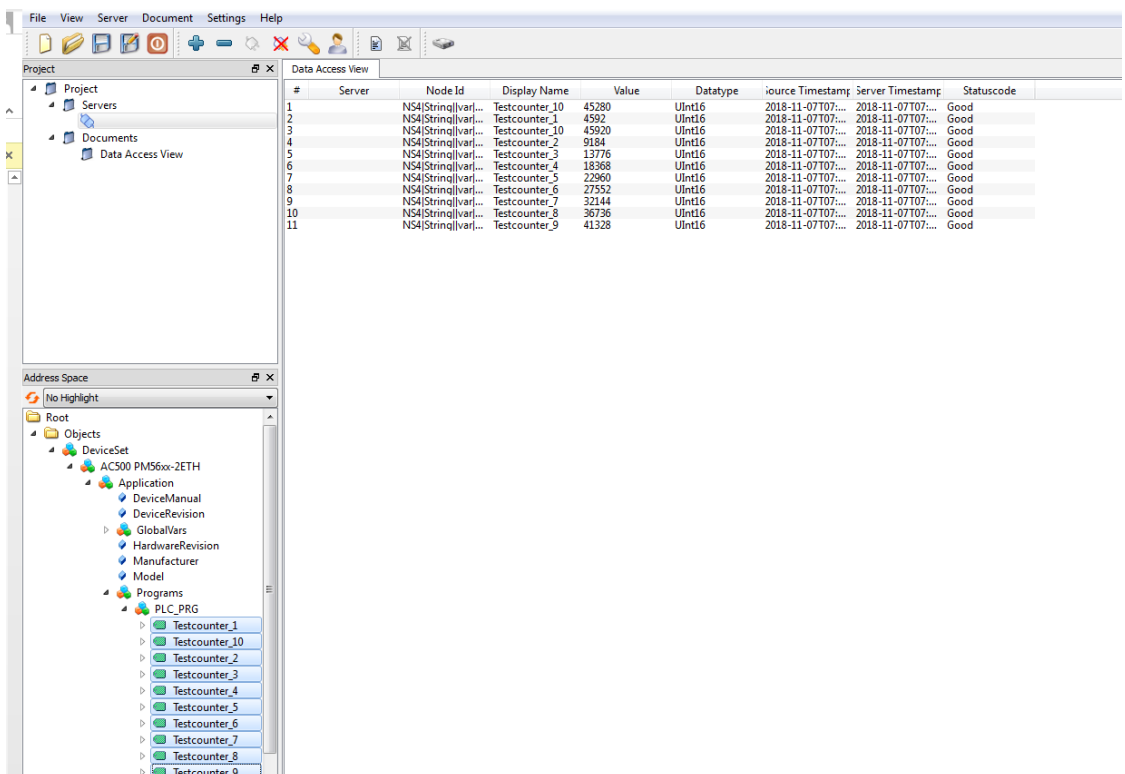
OPC UA Client can now connect with different Users



A window appears



Push Ignore

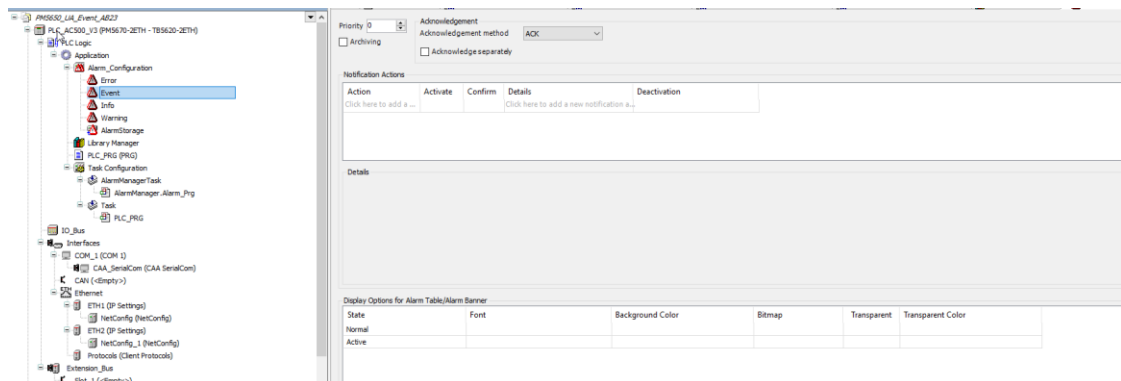


6 Events with OPC UA

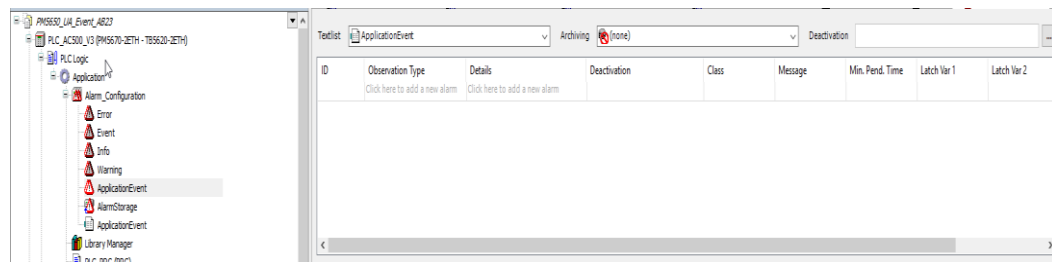
6.1 Create/program events at AC500

The CODESYS OPC UA server provides the capability of sending standard OPC UA events

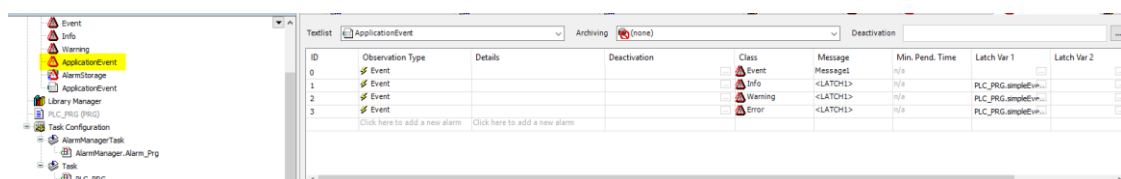
- Create a new project with a PM56xx controller
- Add an “*Alarm configuration*” object below the application
- Add an “*Alarm class*” object below the “*Alarm configuration*”. Specify a name, for example `Event`



- Select the acknowledgement method “*REP*”
- Add an “*Alarm group*” object below the “*Alarm configuration*”. Specify a name, for example
 - `ApplicationEvent`.



- The new alarm group opens in the editor
- Add Events and change the following parameters:

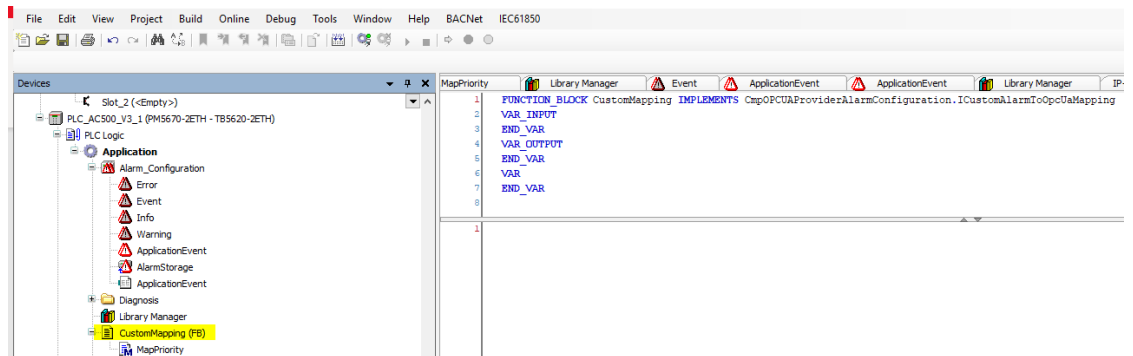


- Add an “*Visualization*” object below the “*Application*”

- Add a “Symbol configuration” object below the application

Symbols	Access Rights	Maximal	Attribute	Type	Members	Comment
Constants						
CompilerVersion				VERSION	...	the compiler version as defined in the build options (not OEM Customized Version!
RuntimeVersion				VERSION	...	the runtime version number as defined by the device description.
IoConfig_Globals						
PLC_PRG						
Alarm1				BOOL		
Alarm2				BOOL		
Counter1				WORD		
Eventbool				BOOL		
TBool				BOOL		
myMapping				customMapping	...	
simpleEvents				SimpleEvent	...	
xChangeMapping				BOOL		

- Add the library CmpOPCUAProviderAlarmConfiguration to the library manager
- When the library is added, it connects automatically as a client to the alarm configuration and sends the events to the OPC UA server
- Define FB SimpleEvent with the different Trigger Methods



```

1  METHOD TriggerError
2  VAR_INPUT
3    error:STRING;
4  END_VAR
5
6  message := error;
7  Alarmmanager.AlarmGlobals.g_AlarmHandler.RaiseEvent(Alm_AlarmConfiguration_Alarmgroup_IDs.ID_ApplicationEvent, Alm_ApplicationEvent_Alarm_IDs.ID_3);
8
9  METHOD TriggerWarning
10 VAR_INPUT
11   warning : STRING;
12 END_VAR
13
14 message := warning;
15 Alarmmanager.AlarmGlobals.g_AlarmHandler.RaiseEvent(Alm_AlarmConfiguration_Alarmgroup_IDs.ID_ApplicationEvent, Alm_ApplicationEvent_Alarm_IDs.ID_2);

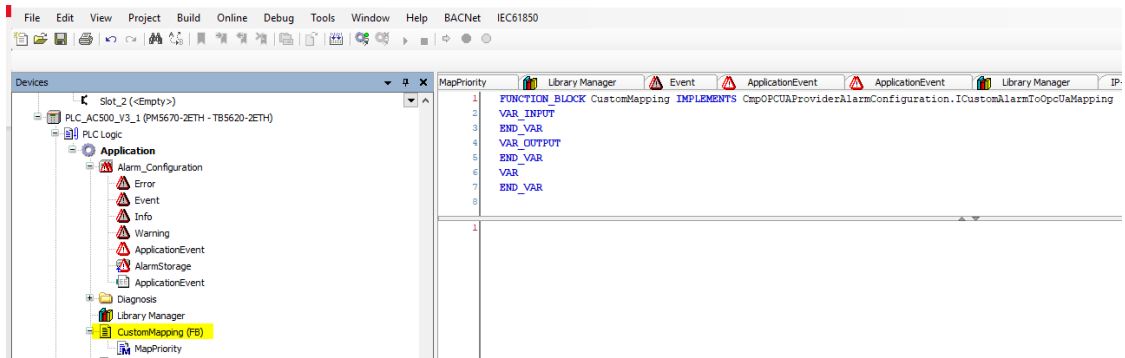
```

```

1  METHOD TriggerWarning
2  VAR_INPUT
3    warning : STRING;
4  END_VAR
5
6  message := warning;
7  Alarmmanager.AlarmGlobals.g_AlarmHandler.RaiseEvent(Alm_AlarmConfiguration_Alarmgroup_IDs.ID_ApplicationEvent, Alm_ApplicationEvent_Alarm_IDs.ID_2);

```

- Define FB CustomMapping with Method



```

METHOD MapPriority : UDINT
VAR_INPUT
    SeverityAlarm : USINT;
END_VAR
1 MapPriority := SeverityAlarm;
    
```

- In the Program (for example, POU PLC_PRG), add a program call for triggering the event alarm

```

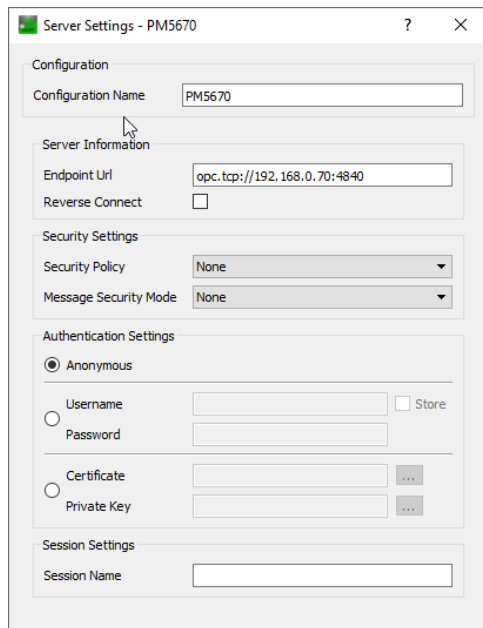
1  PROGRAM PLC_PRG
2  VAR
3      simpleEvents : SimpleEvent;
4      myMapping : customMapping;
5      xChangeMapping : BOOL;
6
7      Eventbool:BOOL;
8      TBool:BOOL;
9      Counter1: WORD;
10     Alarm1: BOOL;
11     Alarm2: BOOL;
12 END_VAR
13
14 IF xChangeMapping THEN
15     CmpOPCUAProviderAlarmConfiguration.SetCustomMapping(myMapping);
16     xChangeMapping := FALSE;
17 END_IF
18 simpleEvents();
19 IF Counter1>1000 THEN
20     simpleEvents.TriggerInfo('Hallo Welt');
21     Counter1 :=0;
22 end_if
23
24 IF Alarm1 THEN
25     simpleEvents.TriggerWarning('5010');
26     Alarm1 :=FALSE;
27 END_IF
28
29 IF Alarm2 THEN
30     simpleEvents.TriggerError('5020');
31     Alarm2 :=FALSE;
32 END_IF
33
34 Counter1 :=Counter1+1;
35 Eventbool :=TBool;

```

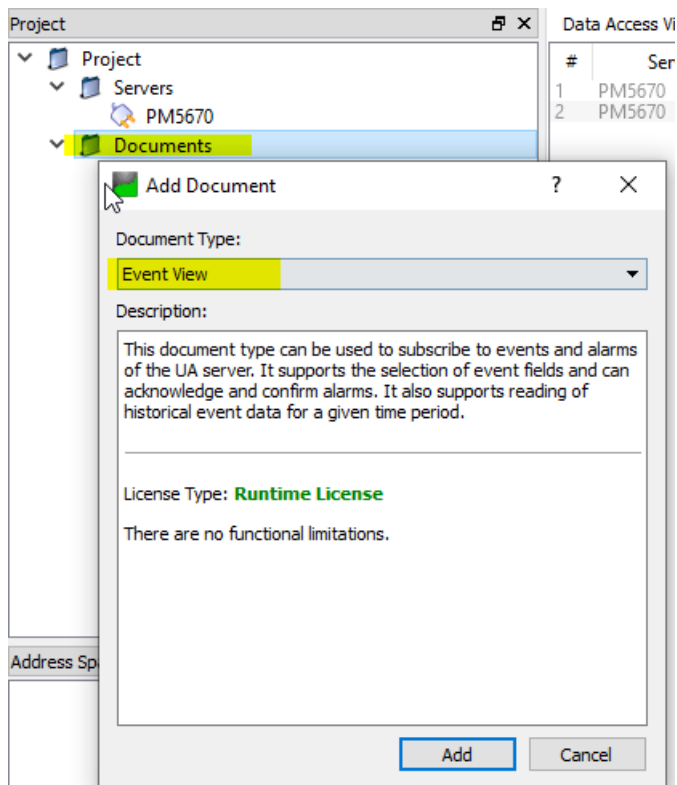
- Send the project to the controller and start it

6.2 Monitoring of events with the OPC UA client "UaExpert"

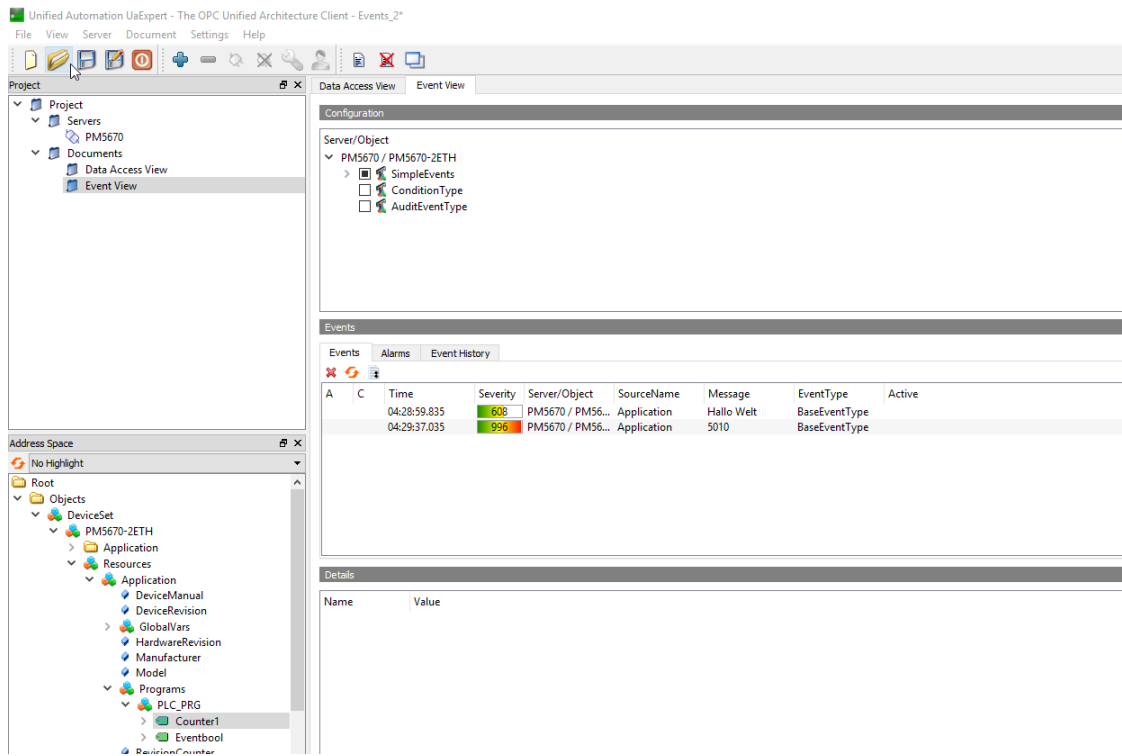
- Start the "UaExpert" Program
- Click "Server Add"
 - The "Add server" dialog opens.



- Click *“Server Connect”*
- An object tree is shown in the *“Address Space”* view
- Click *“Documents Add”*



- The *“Add documents”* dialog opens
- Select the *“Document Type”* *“Event View”*
- Expand the object *“Objects DeviceSet PM5670”* in the *“Address Space”* view
- Select the object *PM5670* in *“Address Space”* and drag it to the *“Event View”*
- The events are displayed



The described example for the Events is available from Technical Support.

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