OPC UA Solution.NET Installation

Installation and Administration of .NET 5.0 and .NET Core 3.1 based OPC UA Applications

Document Control

Version	Date	Comment
1.0.8	18-MAY-2019	Initial version based on V1.0.8
1.0.9	31-MAY-2019	Enhanced Manual Installation chapter and added the Prerequisites chapter
1.1.0	10-JUN-2019	Enhanced OPC UA Security and Configuration Tool chapters
1.1.1	26-JUL-2019	Updated to new evaluation downloads
1.2.0	11-OCT-2019	- Added informationen for .NET Core 2.0 on Linux, macOS - Changed to .NET 4.6.2 - Removed OPC UA Client Gateway (no longer supported) - Removed Sample Binary Installer (no longer supported)
1.3.0	05-JAN-2020	- Added informationen for .NET Core 2.1 - Added information for .NET 4.8
1.4.0	24-JUN-2020	Updated to V 1.4
1.4.10	16-OCT-2020	Updated with information for .NET Core 3.1
2.0	14-NOV-2020	Updated to V2.0
2.1	06-JAN-2021	Added support for .NET 5.0

Purpose and audience of document

This document describes how to deploy and administer OPC UA Applications from Technosoftware GmbH and applications build on either the OPC UA Client .NET or the OPC UA Server .NET. The target audience for this document are systems administrators.

Referenced OPC Documents

Documents
This document partly uses extracts taken from the OPC UA specifications to be able to give at least a short introduction into the specifications. The specifications itself are available from: http://www.opcfoundation.org/Default.aspx/01_about/UA.asp?MID=AboutOPC#Specifications
OPC Unified Architecture Textbook, written by Wolfgang Mahnke, Stefan-Helmut Leitner and Matthias Damm: http://www.amazon.com/OPC-Unified-Architecture-Wolfgang-Mahnke/dp/3540688986/ref=sr_1_1?ie=UTF8&s=books&qid=1209506074&sr=8-1
[OPC 10000-1] OPC UA Specification: Part 1 – Overview and Concepts https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-1-overview-and-concepts/
[OPC 10000-2] OPC UA Specification: Part 2 – Security Model https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-2-security-model/
[OPC 10000-3] OPC UA Specification: Part 3 – Address Space Model https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-3-address-space-model/
[OPC 10000-4] OPC UA Specification: Part 4 – Services https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-4-services/
[OPC 10000-5] OPC UA Specification: Part 5 – Information Model https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-5-information-model/
[OPC 10000-6] OPC UA Specification: Part 6 – Mappings https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-6-mappings/
[OPC 10000-7] OPC UA Specification: Part 7 – Profiles https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-7-profiles/
[OPC 10000-8] OPC UA Specification: Part 8 – Data Access https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-8-data-access/
[OPC 10000-9] OPC UA Specification: Part 9 – Alarm & Conditions https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-9-alarms-and-conditions/
[OPC 10000-10] OPC UA Specification: Part 10 – Programs https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-10-programs/
[OPC 10000-11] OPC UA Specification: Part 11 – Historical Access https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-11-historical-access/
[OPC 10000-12] OPC UA Specification: Part 12 – Discovery and Global Services https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-12-discovery-and-global-services/
[OPC 10000-13] OPC UA Specification: Part 13 – Aggregates https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-13-aggregates/
[OPC 10000-14] OPC UA Specification: Part 14 – PubSub https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-14-pubsub/
[OPC 10000-100] OPC UA Specification Part 100 - Devices https://opcfoundation.org/developer-tools/specifications-unified-architecture/part-100-device-information-model/

Other Referenced Documents

SOAP Part 1: SOAP Version 1.2 Part 1: Messaging Framework

http://www.w3.org/TR/soap12-part1/

SOAP Part 2: SOAP Version 1.2 Part 2: Adjuncts

http://www.w3.org/TR/soap12-part2/

XML Encryption: XML Encryption Syntax and Processing

http://www.w3.org/TR/xmlenc-core/

XML Signature: XML-Signature Syntax and Processing

http://www.w3.org/TR/xmldsig-core/

WS Security: SOAP Message Security 1.1

http://www.oasis-open.org/committees/download.php/16790/wss-v1.1-spec-os-SOAPMessageSecurity.pdf

WS Addressing: Web Services Addressing (WS-Addressing)

http://www.w3.org/Submission/ws-addressing/

WS Trust: Web Services Trust Language (WS-Trust)

http://specs.xmlsoap.org/ws/2005/02/trust/WS-Trust.pdf

WS Secure Conversation: Web Services Secure Conversation Language (WS-SecureConversation)

http://specs.xmlsoap.org/ws/2005/02/sc/WS-SecureConversation.pdf

SSL/TLS: RFC 2246: The TLS Protocol Version 1.0

http://www.ietf.org/rfc/rfc2246.txt

X200 : ITU-T X.200 – Open Systems Interconnection – Basic Reference Model

http://www.itu.int/rec/T-REC-X.200-199407-I/en

:X509: X.509 Public Key Certificate Infrastructure

http://www.itu.int/rec/T-REC-X.509-200003-I/e

HTTP: RFC 2616: Hypertext Transfer Protocol - HTTP/1.1

http://www.ietf.org/rfc/rfc2616.txt

HTTPS: RFC 2818: HTTP Over TLS

http://www.ietf.org/rfc/rfc2818.txt

IS Glossary: Internet Security Glossary

http://www.ietf.org/rfc/rfc2828.txt

NIST 800-12: Introduction to Computer Security

http://csrc.nist.gov/publications/nistpubs/800-12/

NIST 800-57: Part 3: Application-Specific Key Management Guidance

http://csrc.nist.gov/publications/nistpubs/800-57/sp800-57_PART3_key-management_Dec2009.pdf

NERC CIP: CIP 002-1 through CIP 009-1, by North-American Electric Reliability Council

http://www.nerc.com/page.php?cid=2|20

IEC 62351: Data and Communications Security

http://www.iec.ch/heb/d_mdoc-e050507.htm

SPP-ICS: System Protection Profile
Industrial Control System, by Process Control Security Requirements Forum (PCSRF)

http://www.isd.mel.nist.gov/projects/processcontrol/SPP-ICSv1.0.pdf

SHA-1: Secure Hash Algorithm RFC

http://tools.ietf.org/html/rfc3174

PKI: Public Key Infrastructure article in Wikipedia

http://en.wikipedia.org/wiki/Public_key_infrastructure

X509 PKI: Internet X.509 Public Key Infrastructure

http://www.ietf.org/rfc/rfc3280.txt

EEMUA : 2nd Edition EEMUA 191 - Alarm System - A guide to design, management and procurement
(Appendixes 6, 7, 8, 9).

http://www.eemua.co.uk/

Table of Contents

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1 Installation .NET 5.0 or .NET Core 3.1

The OPC UA Client & Server .NET can be used not only on Windows but also on Linux and macOS. The Solutions includes a client and server application targeting .NET Core 3.1 or .NET 5.0. To be able to use them you need to install .NET Core on your system.

Please follow instructions in this article to setup the dotnet command line environment for your platform. As of today, .Net Standard 2.1 or .NET 5.0 is required. The article describes the installation of .NET 5.0.101 for Windows, Linux and macOS. This version also works with the OPC UA Client and Server Solutions we provide in th GitHub repository at https://github.com/technosoftware-gmbh/opcua-solution-net

Please follow at least the sections

- Intro
- Download and Install

to install the .NET Core. You find the different .NET Core versions also at https://dotnet.microsoft.com/download/dotnet-core

How to build and use the example applications provided is explained in the documents

- OPC UA Client Development with NET Standard
- OPC UA Server Development_with NET Standard

2 Installation OPC UA Solution .NET

For starting with OPC UA Development you can download the ***OPC UA Solution .NET*** from:

OPC UA Solution .NET
The OPC UA Solution .NET offers a fast and easy access to the OPC UA Client & Server technology. Develop OPC compliant UA Clients and Servers with C# targeting .NET 5.0, .NET Core 3.1 or .NET Standard 2.1. For backward compatibility we also provide .NET 4.8, .NET 4.7.2 and .NET 4.6.2 support. You can download it from https://github.com/technosoftware-gmbh/opcua-solution-net

This GitHub repository is automatically tested with the following environments:

a. Linux Ubuntu 16.04
   - .NET 5.0.101
   - Mono 6.10.0

b. Mac OS X 10.13
   - .NET 5.0.101
   - Mono 6.10.0

c. Windows Server 2019
   - .NET 5.0.101

2.1 Directory Structure

The repository contains the following basic directory layout:

- **bin/**
  - **net5.0/**
    Standard Executables and DLL's for .NET 5.0
  - **net462/**
    Model Compiler based on.NET 4.6.2
  - **netstandard2.1/**
    Standard Executables and DLL's for .NET Standard 2.1 and .NET Core 3.1
- **documentation/**
  Additional documentation like:
  - **OPC_UA_Solution_NET_Installation_Guide.pdf**
    Installation of development and run-time system
  - **OPC_UA_Solution_NET_Introduction.pdf**
    Introduction in Developing OPC UA Clients and OPC UA Servers with C# / VB.NET
  - **OPC_UA_Client_Development_with_NET.pdf**
    Tutorial for Developing OPC UA Clients with C# for of .NET 5.0 and .NET Core 3.1
  - **OPC_UA_Server_Development_with_NET.pdf**
    Tutorial for Developing OPC UA Servers with C# for of .NET 5.0 and .NET Core 3.1
- **examples/**
  Sample applications
  - **Workshop/**
- **schema/**
  XSD files like the UAModelDesign.xsd used for the Model Designer
- **Workshop/**
  OPC UA Workshop content as PDF

2.2 DLL's used by applications

The solution consists of the following main components

- **Opc.Ua.Core.dll**
- **Opc.Ua.Security.Certificates.dll**
- **Opc.Ua.Bindings.Https.dll**
- **Technosoftware.UaConfiguration.dll**

These two DLL's are used by all applications using the solution. In addition, one or several of the following DLL's might be required:

- **Technosoftware.UaClient.dll**
  Client Applications require this DLL.
- **Technosoftware.UaServer.dll**
  Server Applications require this DLL.

These DLL's can be found in

- **bin/**
  - **net5.0/**
    Standard Executables and DLL's for .NET 5.0
  - **netstandard2.1/**
    Standard Executables and DLL's for .NET Standard 2.1 and .NET Core 3.1

The main components require the following additional DLL's which you should add as package reference to your project file:

- BouncyCastle.Crypto.dll
- Newtonsoft.Json.dll

Example:

```
<ItemGroup>
  <PackageReference Include="Newtonsoft.Json" Version="12.0.3" />
  <PackageReference Include="Portable.BouncyCastle" Version="1.8.8" />
</ItemGroup>
```

2.3 OPC UA Local Discovery Server

The Local Discovery Server (LDS) is a DiscoveryServer that maintains a list of all UA Servers and Gateways available on the host/PC that it runs on and is the UA equivalent to the OPC Classic OPCENUM interface.

An LDS is a service that runs in the background. UA Servers will periodically connect to the LDS and Register themselves as being available. This periodic activity means that the list of available UA servers is always current and means that a Client can immediately connect to any of them (security permissions pending).

The OPC UA Local Discovery Server is an installation from the OPC Foundation and delivered as installation executable and as merge module. You can download it via

https://opcfoundation.org/developer-tools/samples-and-tools-unified-architecture/local-discovery-server-lds/

3 Test your installation with .NET Core

The main OPC UA Solution can be found in the root of the repository and is named

- NetCoreSamples.sln

The solution contains two sample clients, as well as two sample server examples used by these clients.

3.1 Prerequisites

Once the ***`dotnet`*** command is available, navigate to the following folder:

/

and execute

```
dotnet restore NetCoreSamples.sln
```

This command restores the tree of dependencies.

3.2 Start the server

1. Open a command prompt.
2. Navigate to the folder `examples/Workshop/SimpleServer`.
3. To run the server sample type

   dotnet run --no-restore --framework netcoreapp3.1 --project Technosoftware.SimpleServer.csproj -a

   - The server is now running and waiting for connections.
   - The `-a` flag allows to auto accept unknown certificates and should only be used to simplify testing.

3.3 Start the client

1. Open a command prompt
2. Navigate to the folder `examples/Workshop/SimpleClient`.
3. To run the client sample type

   dotnet run --no-restore --framework netcoreapp3.1 --project Technosoftware.SimpleClient.csproj -a

   - The client connects to the OPC UA console sample server running on the same host.
   - The `-a` flag allows to auto accept unknown certificates and should only be used to simplify testing.
4. If not using the -a auto accept option, on first connection, or after certificates were renewed, the server may have refused the client certificate. Check the server and client folder `%LocalApplicationData%/OPC Foundation/pki/rejected` for rejected certificates. To approve a certificate copy it to the `%LocalApplicationData%/OPC Foundation/pki/trusted`.

3.4 Check the output

If everything was done correctly the client should show the following lines:

```
Technosoftware .NET Core OPC UA Simple Client
 1 - Create an Application Configuration.
 2 - Discover endpoints of opc.tcp://localhost:55550/TechnosoftwareSimpleServer.
    Selected endpoint uses: Aes256_Sha256_RsaPss
 3 - Create a session with OPC UA server.
 4 - Browse address space.
 5 - Read a single value.
Node Value:1.020668067406195E-26
 6 - Read multiple values.
Status of Read of Node ns=2;s=Scalar_Simulation_Number is: Good
```

You can abort the running application with Ctrl-C.

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