Introduction to OPC
with Examples

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OPC

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What is OPC?

• A standard that defines the communication of data between devices from different manufactures
• Requires an **OPC server** that communicates with the **OPC clients**
• OPC allows “plug-and-play”, gives benefits as reduces installation time and the opportunity to choose products from different manufactures
• Different standards: “Real-time” data (**OPC DA**), Historical data (**OPC HDA**), Alarm & Event data (**OPC AE**), etc.
OPC

OPC Server

Data Storage

OPC Client

Read/Write Data
OPC - Server

Network

Typical OPC Scenario

PLC, PAC, DCS, SCADA

Process Data

Driver

Actuators

Sensors

Process

Data Acquisition

OPC-Server

OPC-Client

OPC-Client

OPC-Client

Typical OPC Scenario

Driver

Sensors

Actuators

Process

Data Acquisition

PLC, PAC, DCS, SCADA
OPC Specifications

“Classic” OPC
- OPC DA
- OPC HDA
- OPC A&E

“Next Generation” OPC
- OPC UA

... (Many others)
OPC Specifications

• **OPC DA** (Data Access)
The most common OPC specification is OPC DA, which is used to read and write “real-time” data. When vendors refer to OPC generically, they typically mean OPC DA.

• **OPC HDA** (Historical Data Access)

• **OPC A & E** (Alarms & Events)
  • ... (many others)

These OPC specification are based on the OLE, COM, and DCOM technologies developed by Microsoft for the Microsoft Windows operating system family. This makes it complicated to make it work in a modern Network! Typically you need a Tunneller Software in order to share the OPC data in a network (between OPC Servers and Clients)

• **OPC UA** (Unified Architecture)
OPC UA eliminating the need to use a Microsoft Windows based platform of earlier OPC versions. OPC UA combines the functionality of the existing OPC interfaces with new technologies such as XML and Web Services (HTTP, SOAP)
Next Generation OPC

**OPC Classic**
- OPC DA
- OPC HDA
- OPC A&E
- COM/DCOM
- Windows only

**Next Generation OPC**
- OPC UA
- XML, HTTP, SOAP
- Cross-platform
  - Windows, Linux, Mac, Embedded, VxWorks
- All specifications collected in one (DA, HDA, A&E)
- Protocols: “UA Binary” or “UA XML”
- Simpler!!
  - OPC UA Server
  - OPC UA Client
  - (everything built into one)

**OPC Client (DCOM)**

**Specifications**
- OPC DA Server
- OPC HDA Server
- OPC A&E Server
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 needlestick (UA Binary) is necessary Easy to route over Internet!
Classic OPC vs. OPC UA

Classic OPC (DCOM)

- OPC Server
- Windows
- OPC Client
- OPC Client
- OPC Client

OPC UA

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

OPC UA Client

OPC UA Client

OPC UA Client

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. 

Matrikon OPC Simulation Server

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Matrikon OPC Explorer – Connect to Server

1. Connect

2. Add Tags

- **OPC Security**
  - **OPC SECURITY CHECKED**
  - **Explanation:** This Matrikon OPC server or data protection when configured correctly. Protect non-Matrikon OPC Servers with the Matrikon OPC Security Gateway.
Matrikon OPC Explorer - Add Tags

1. Double-click to select a tag to add.
2. Double-click to add the selected tag.
3. Enter the tag information in the dialog box.
4. Click to add the tag.
5. Click to finish adding tags.

Finished
MatrikonOPC Explorer (OPC Client)

The MatrikonOPC Explorer is useful for testing. You can use it for writing and reading OPC Tags.
Practical Examples

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Programming Examples

• You can create OPC Clients (and OPC Servers) in most Programming Languages
• You can create it totally from Scratch using the OPC specifications
• Or you can create them using existing Libraries and APIs
  – We will show some examples created in LabVIEW, Visual Studio and MATLAB
The OPC Functions in LabVIEW

You can use LabVIEW as an OPC client by connecting to an OPC server through a DataSocket connection.

The DataSocket palette in LabVIEW:

- Write Data to OPC
- Read Data from OPC
- Open Connection to OPC Server
- Close Connection to OPC Server
- Browse OPC Servers and OPC Items

You can use LabVIEW as an OPC client by connecting to an OPC server through a DataSocket connection.
MATLAB OPC Toolbox

• OPC Toolbox provides access to live and historical OPC data directly from MATLAB and Simulink

• You can read, write, and log OPC data from devices, such as distributed control systems (DCS), supervisory control and data acquisition systems (SCADA), and programmable logic controllers (PLS)
Measurement Studio

• Add-on package to Visual Studio created by National Instruments
• Same vendor as LabVIEW
• Makes it possible to communicate with an OPC DA Server from Visual Studio Code
• Uses the DataSocket Library (same as in LabVIEW)
OPC Read Examples

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Read from OPC Server using LabVIEW

Or specify URL directly:

Example
Read OPC - Visual Studio Example

Matrikon OPC Server/OPC Explorer

Visual Studio App

Click Button to get latest Value from OPC Server
OPC Write Examples
Write to OPC Server using LabVIEW

Or specify URL directly: While Loop

Use the **BucketBrigade** Items – because they can be used for both reading and writing
Write OPC – Visual Studio Example
OPC Write/Read Example

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Write/Read Example
Example: Trending Data from OPC

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Visual Studio Example
clear, clc
% Connect to OPC Server
da = opcda('localhost', 'Matrikon.OPC.Simulation.1');
connect(da);
% Create Group
grp = addgroup(da, 'DemoGroup');
% Add Tags
itmIDs = {'Random.Real8'};
itm = additem(grp, itmIDs);
% Set Properties
logDuration = 60; logRate = 0.2;
numRecords = ceil(logDuration./logRate);
grp.UpdateRate = logRate;
grp.RecordsToAcquire = numRecords;
% Acquire Data
start(grp), wait(grp);
% Retrieve Data
[logIDs, logVal, logQual, logTime, logEvtTime] =
getdata(grp, 'double');
% Plot Data
plot(logTime, logVal);
axis tight
datetick('x', 'keeplimits')
legend(logIDs)
% Clean Up
disconnect(da)
delete(da)

This simple Example uses some of the more advanced features in the MATLAB OPC Toolbox. No For/While Loop needed!
OPC UA Example
UA – Unified Architecture

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OPC UA

- UA – Unified Architecture
- The Next Generation OPC
- Based on Modern Software/Network Architecture (No DCOM problems!)
OPC UA in LabVIEW


Note! You need to install the “LabVIEW DSC Module” or the “LabVIEW Real-Time Module”
In this Example LabVIEW Application #1, #2 and #3 are on the same computer. Normally they are located on different computers or devices in a Network.
DEMO
Summary

• This Video has given you an Overview of OPC

• Some Examples has been shown
  – Matrikon OPC Simulation Server
  – LabVIEW, Visual Studio, MATLAB Examples
  – I go through these Examples in detail in a set of Videos