OPC with Visual Studio

Hans-Petter Halvorsen, M.Sc.

Software

- MatrikonOPC Simulation Server
- Visual Studio
- Measurement Studio
  - Add-on package to Visual Studio created by National Instruments (same vendor as LabVIEW)

Measurment 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

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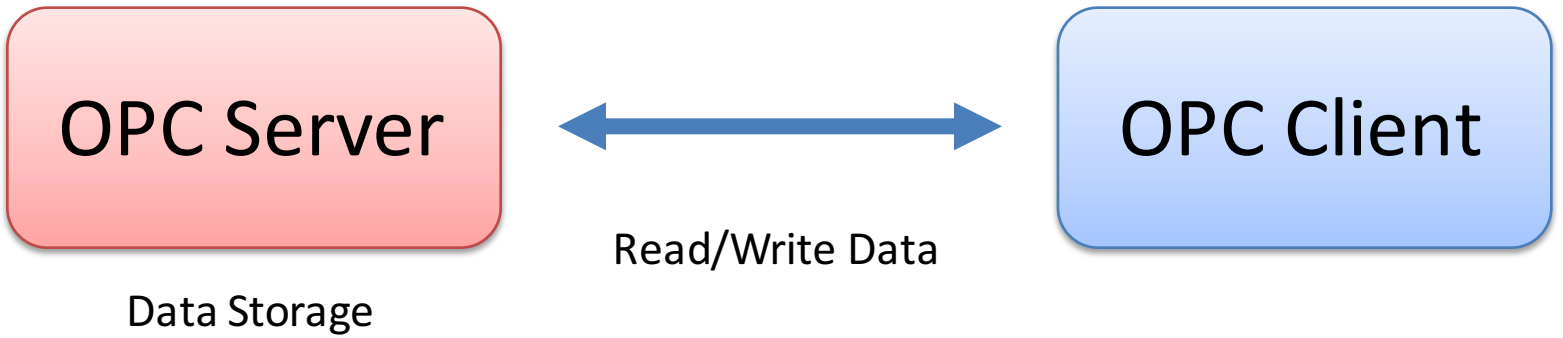
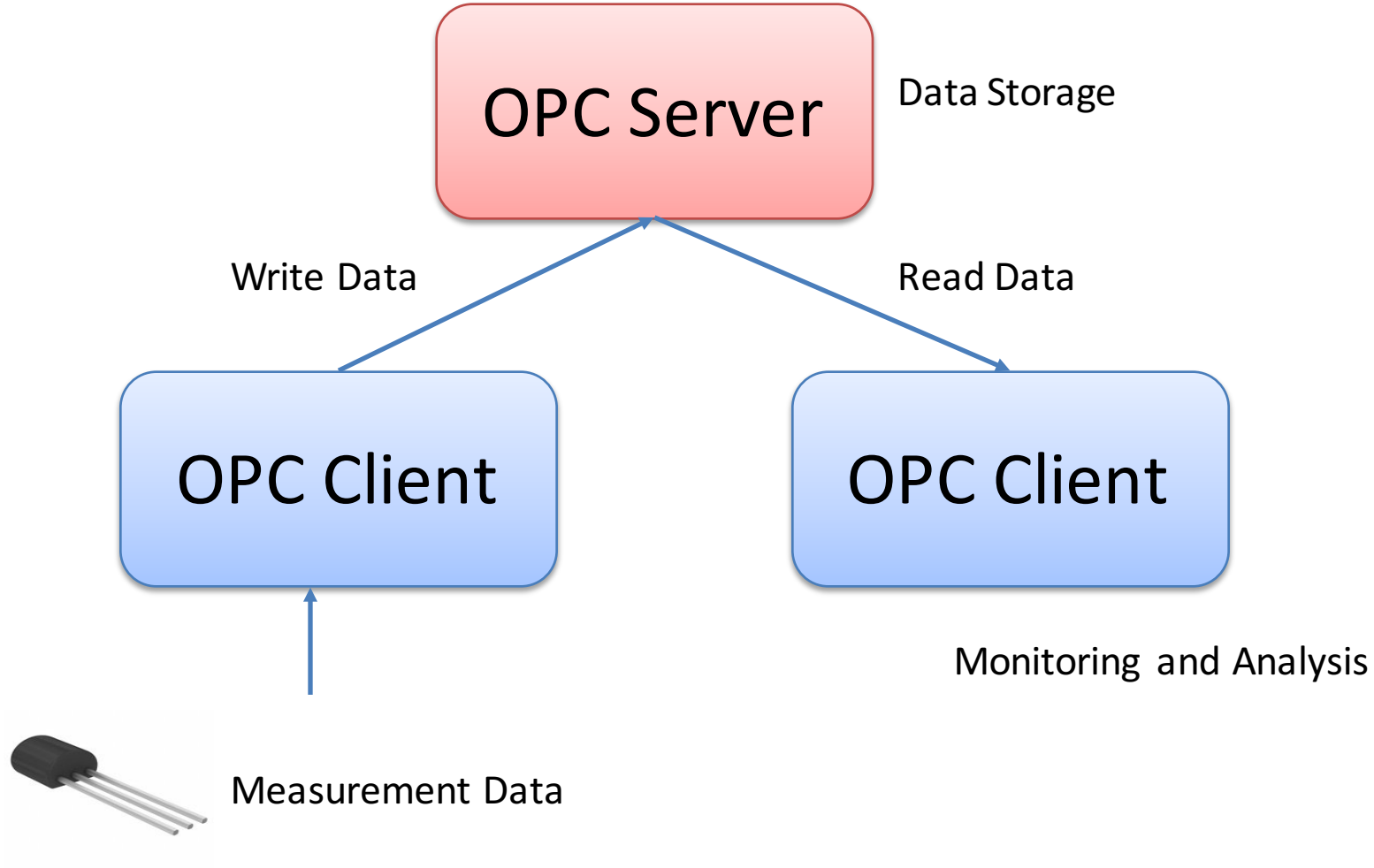
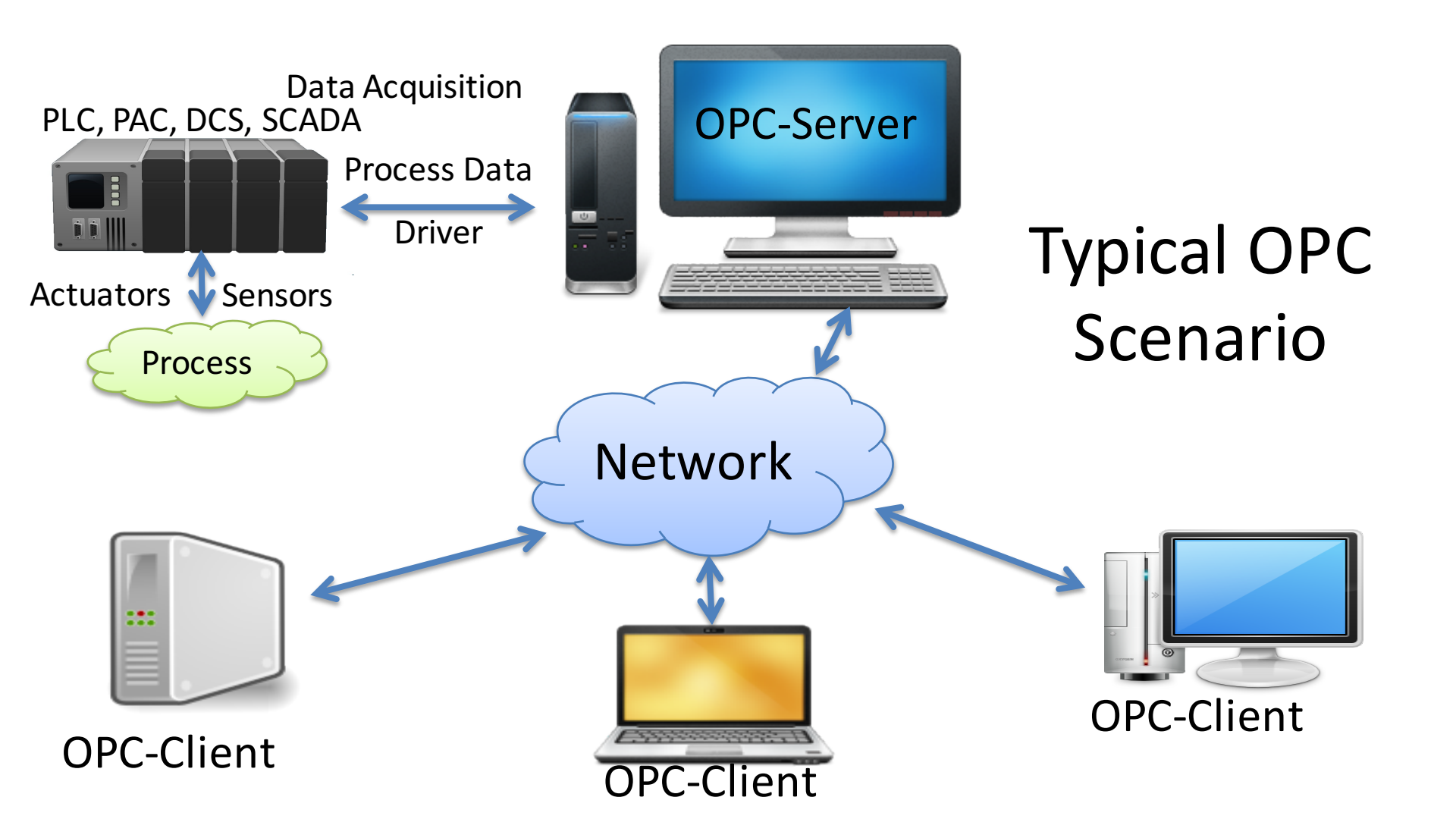
What is OPC?

- **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

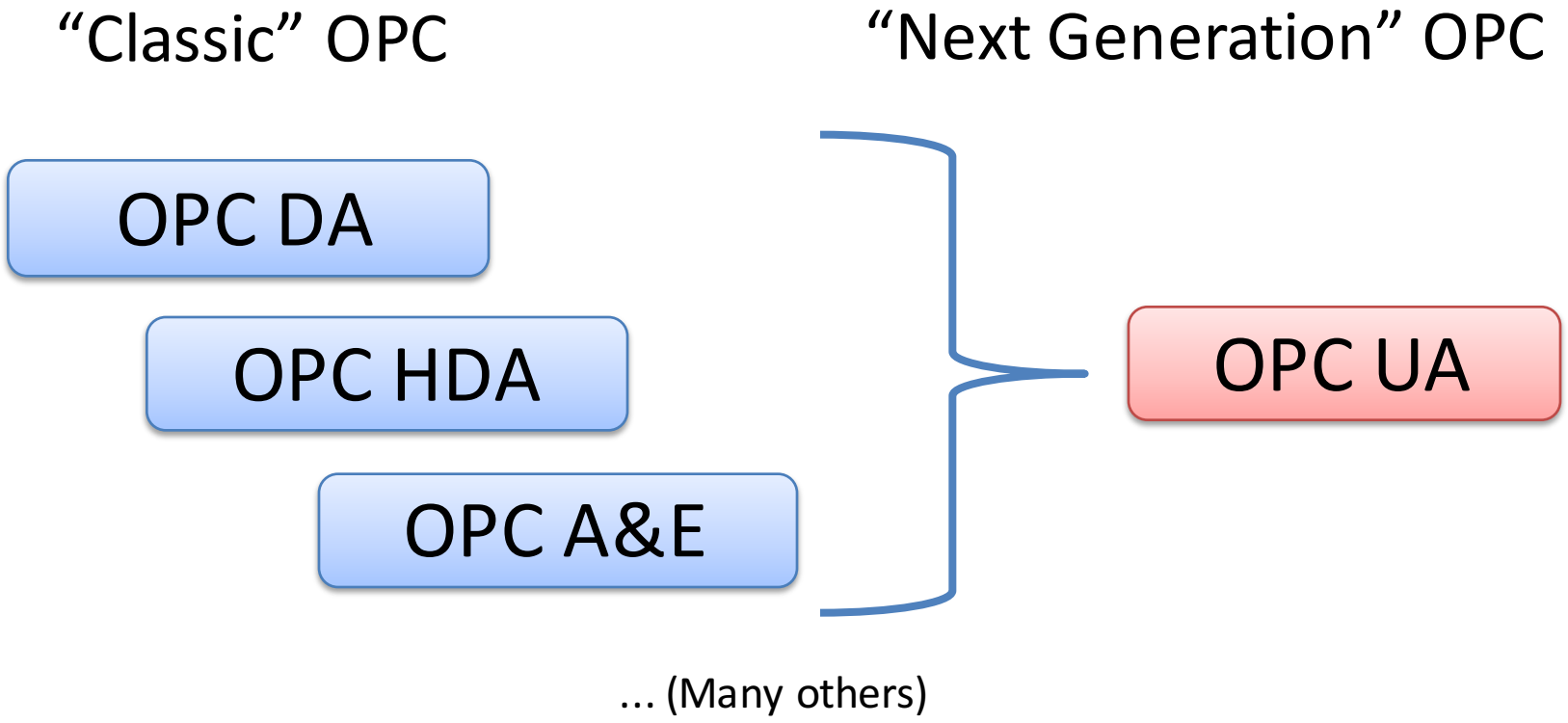



OPC Server
Data Storage
Write Data
Read Data
OPC Client
OPC Client
Monitoring and Analysis
Measurement Data



Typical OPC Scenario

OPC Specifications



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.

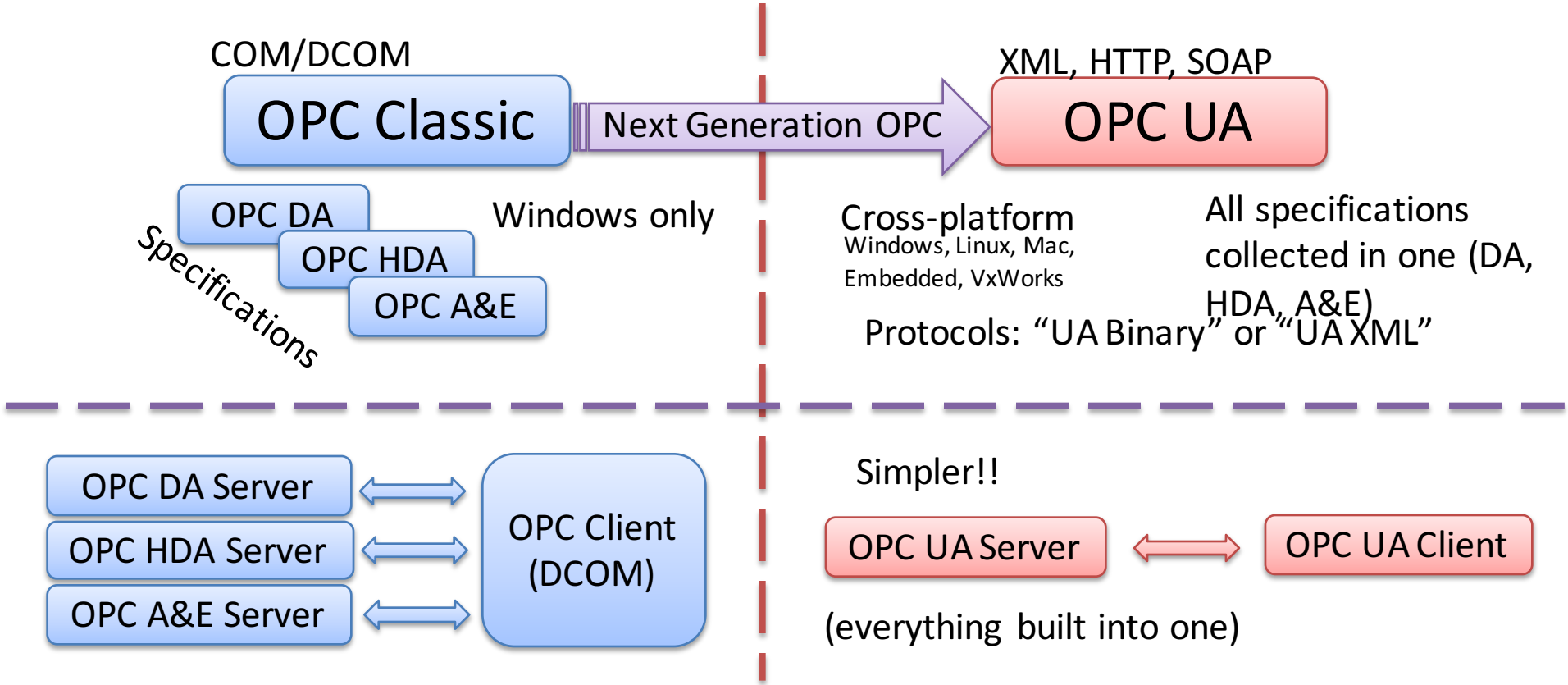
- OPC HDA (Historical Data Access)
- OPC A & E (Alarms & Events)
- … (many others)

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)

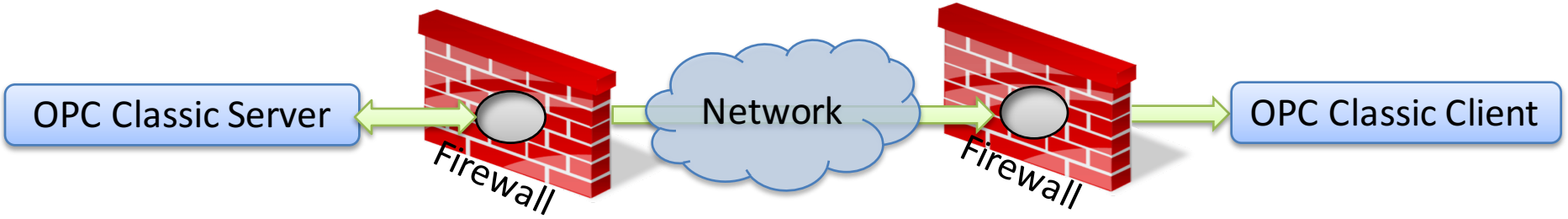
- **OPC UA** (Unified Architecture)

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)

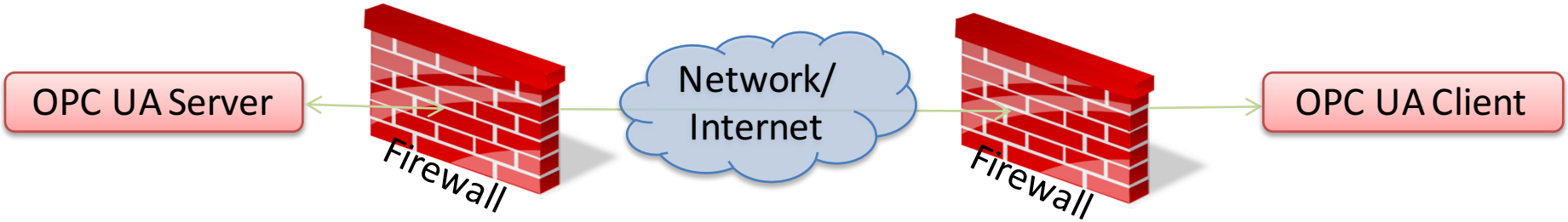
Next Generation OPC



Next Generation OPC



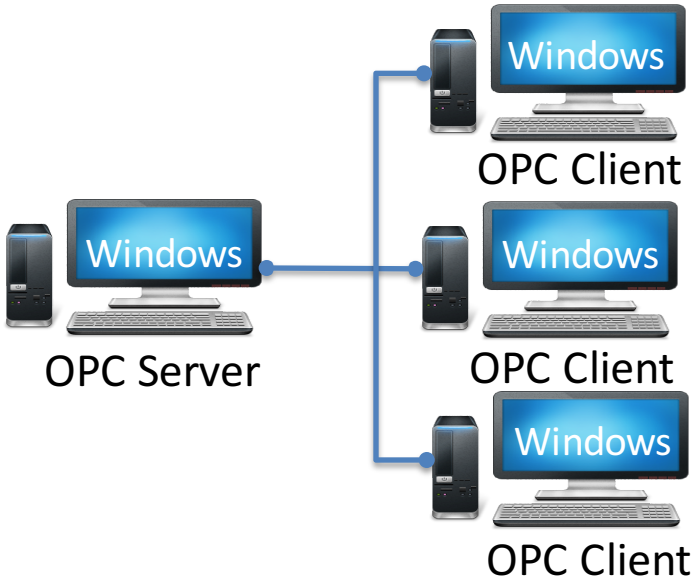
To open DCOM through firewalls demanded a large hole in the firewall!
Impossible to route over Internet!



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

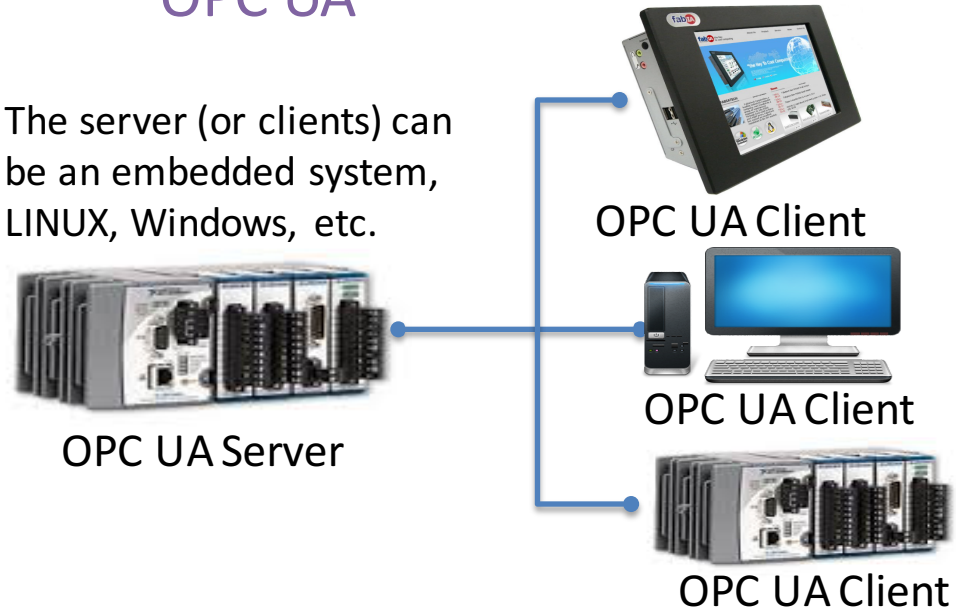
Classic OPC vs. OPC UA

Classic OPC (DCOM)



OPC UA

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



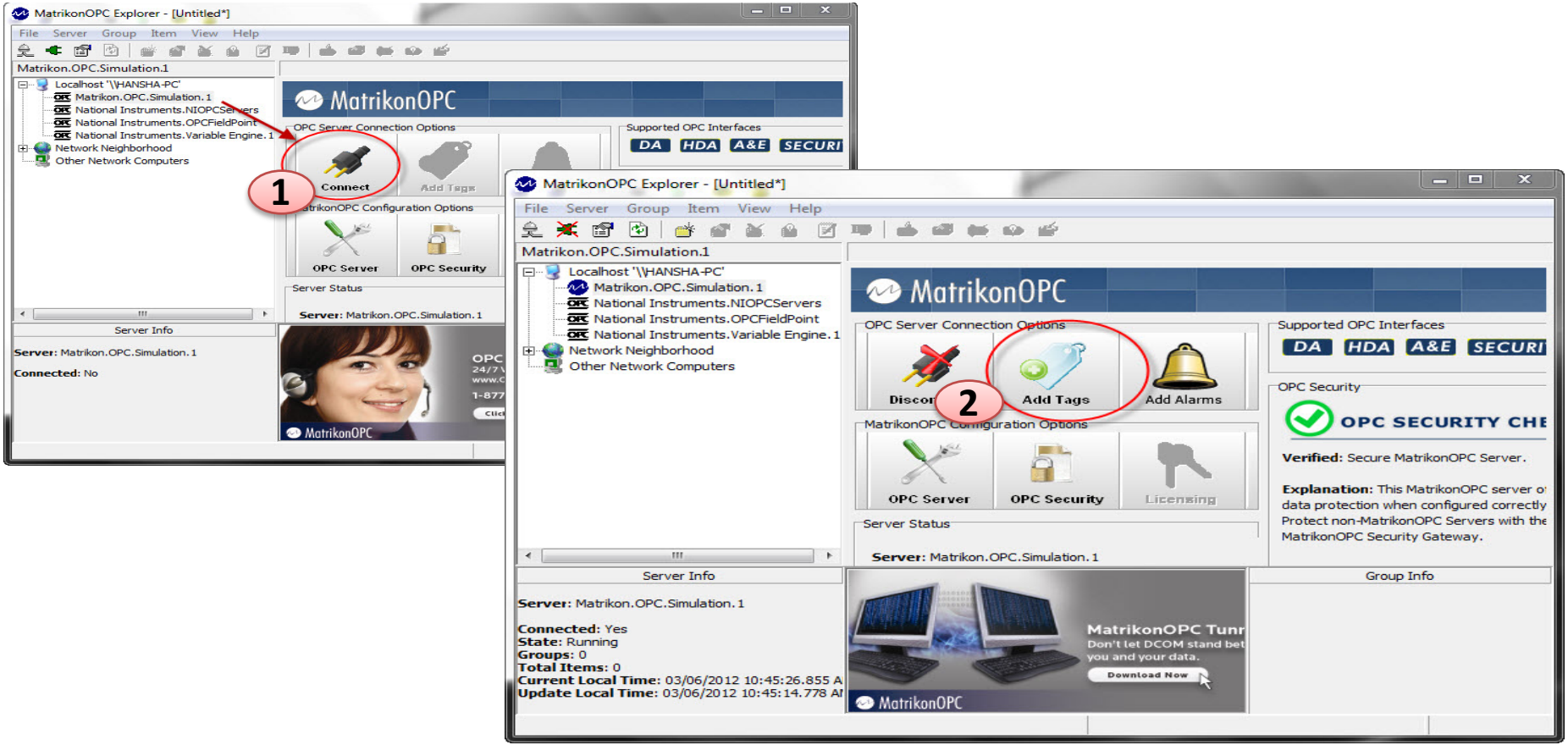
Classic OPC requires a Microsoft Windows operating system to implement COM/DCOM server functionality. By utilizing SOA and Web Services, OPC UA is a platform-independent system that eliminates the previous dependency on a Windows operating system. By utilizing SOAP/XML over HTTP, OPC UA can deploy on 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/

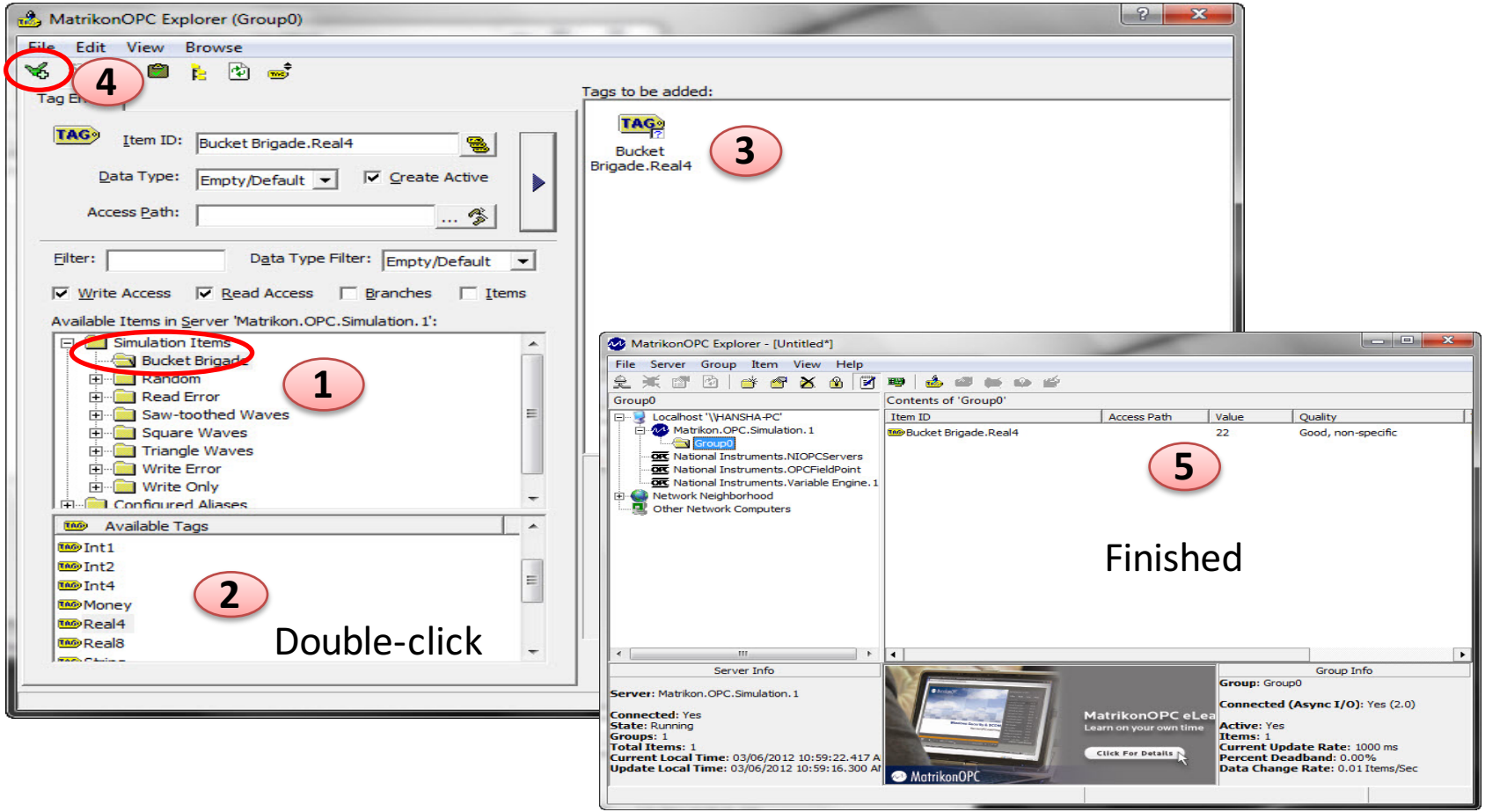
Matrikon OPC Simulation Server

Hans-Petter Halvorsen, M.Sc.

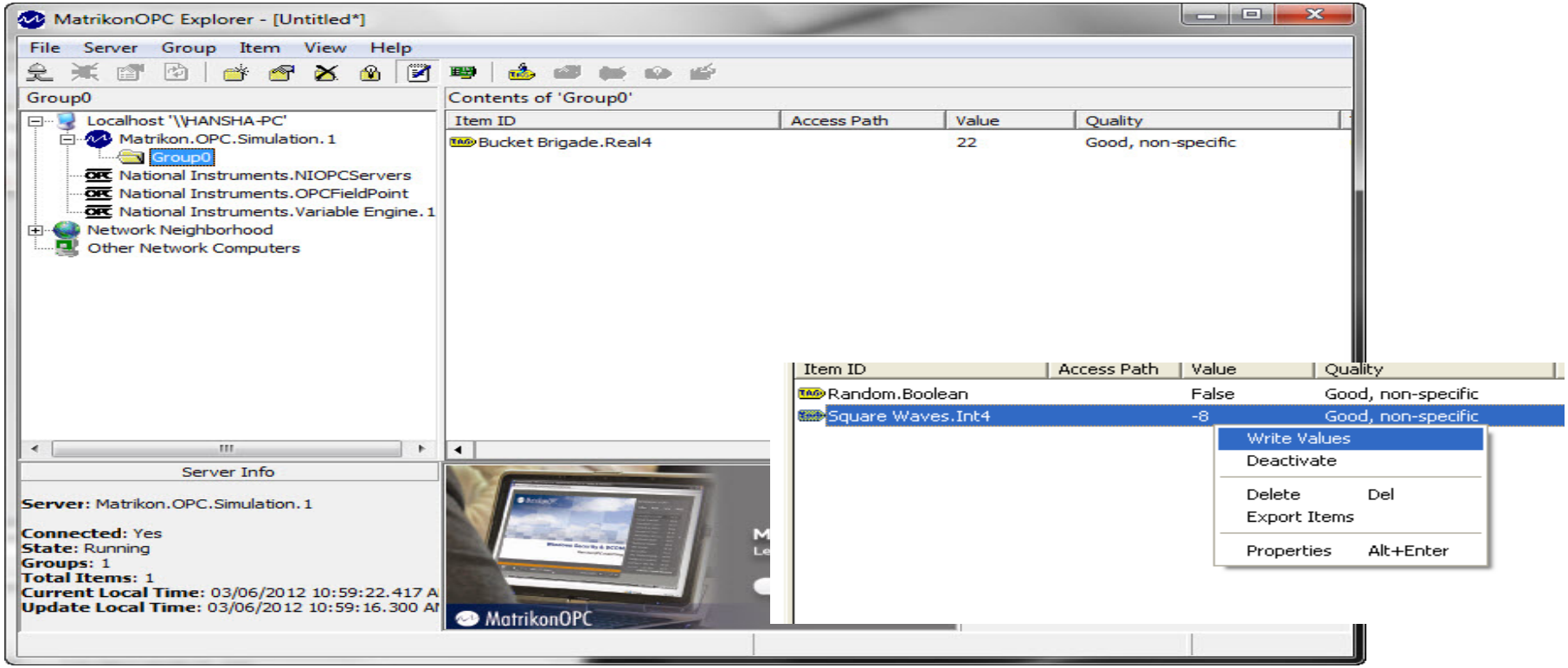
Matrikon OPC Explorer – Connect to Server



Matrikon OPC Explorer - Add Tags



MatrikonOPC Explorer (OPC Client)



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

Measurement Studio

Hans-Petter Halvorsen, M.Sc.

Measurment 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)

Measurement Studio

- Measurement Studio is an add-on to Visual Studio.
- Measurement Studio is used for development of measurement, control and monitoring applications using .NET and Visual Studio.
- Measurement Studio has a library (DataSocket library) that makes it possible to communicate with OPC DA servers that we will use is this lab work
- Download Software here: http://www.ni.com/academic/download

Measurement Studio

Visual Studio Editions

❑ I have Visual Studio 2013

- You can Install and use Measurements Studio 2015 without problems

❑ I have Visual Studio 2015

- Measurement Studio 2015 is designed to work with Visual Studio 2013 (and older editions). Therefore, Measurement Studio 2015 does not install shipping examples and does not integrate with Visual Studio 2015
- This means, if you install Measurement Studio 2015 with Visual Studio 2015, the Measurement Studio .NET controls are not in the Toolbox, and you do not have a Measurement Studio menu item in the Visual Studio 2015 toolbar.
- Follow these guidelines to do this manually:

http://home.hit.no/~hansha/documents/control/opc/resources/Using%20Measurement%20Studio%202015.pdf

Measurement Studio 2015

Measurement Studio 2015 does not have integration features for Visual Studio 2015. If you install Measurement Studio 2015 with Visual Studio 2015, the Measurement Studio .NET controls are not in the Toolbox, you do not have a Measurement Studio menu item in the Visual Studio 2015 toolbar, and .licx will not be automatically generated. We have plans to make changes to Measurement Studio that will help us better keep up with new versions. Unfortunately, these changes are a quite a bit more costly than it would seem, particularly the Visual Studio Help integration, so these changes may not come soon.

This situation is the same as previous Measurement Studio software as in the following article 'Using Measurement Studio 2013 with Microsoft Visual Studio 2013': http://digital.ni.com/public.nsf/allkb/C51E3B38578FAD2786257C070069F386

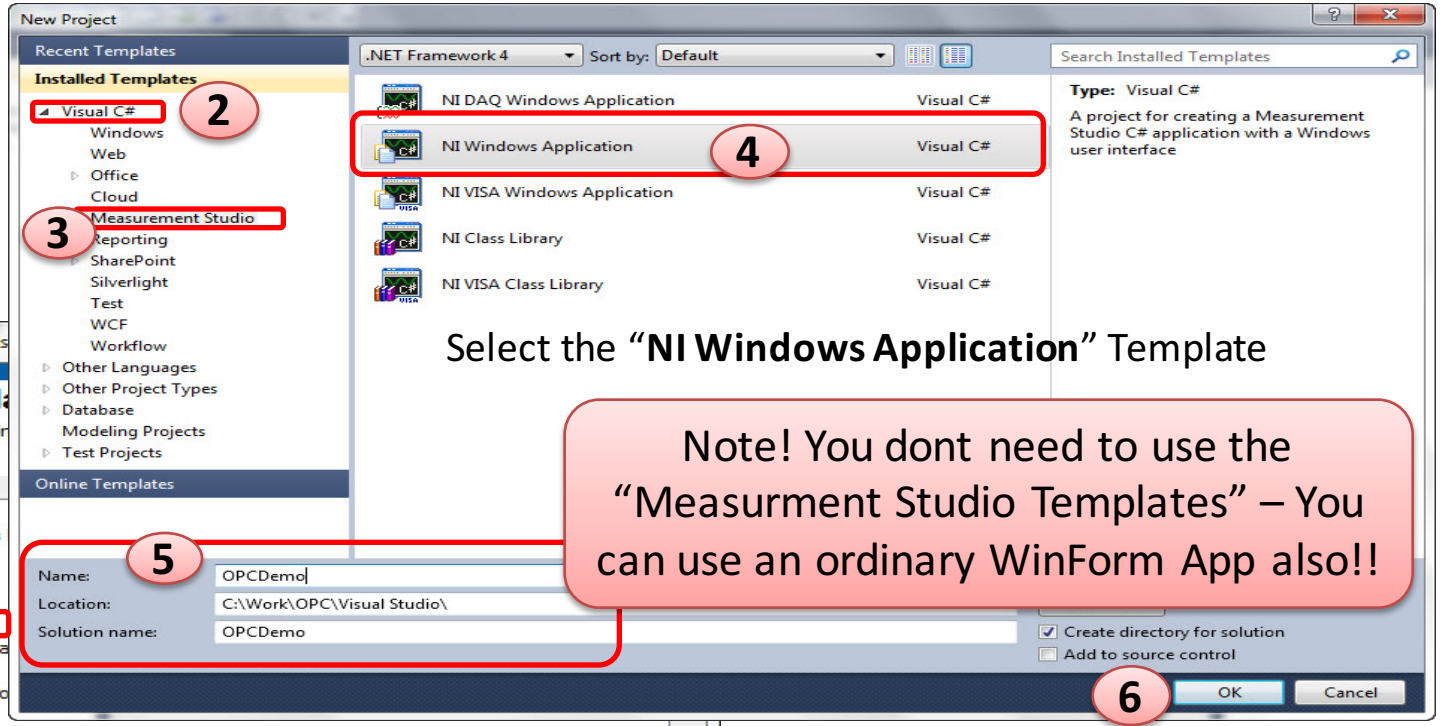
Visual Studio 2015 is not supported officially in Measurement Studio 2015; however, as in the above article, you can add the Measurement Studio .NET controls to the Toolbox manually and can create.licx files manually. I have attached a Help Document on this topic so you can refer to the Adding Measurement Studio 2015 User Interface Controls to the Toolbox section for more information on How to Add controls. This section also describes how these controls are licensed. The following sections discuss additional topics to consider when using Measurement Studio 2015 with Visual Studio 2015.

Rebecca Costin
National Instruments
Applications Engineering
www.ni.com/support

Visual Studio 2013 + Measurement Studio

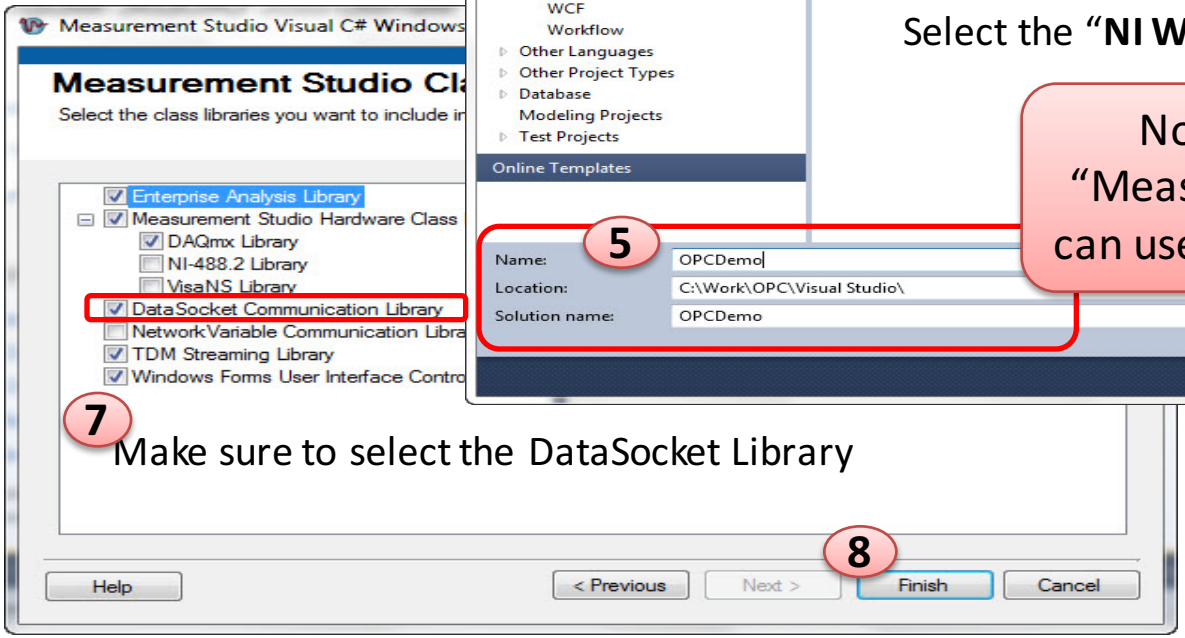
1

Select
“New Project”
in Visual Studio:



Select the “**NI Windows Application**” Template

Note! You dont need to use the “Measurment Studio Templates” – You can use an ordinary WinForm App also!!

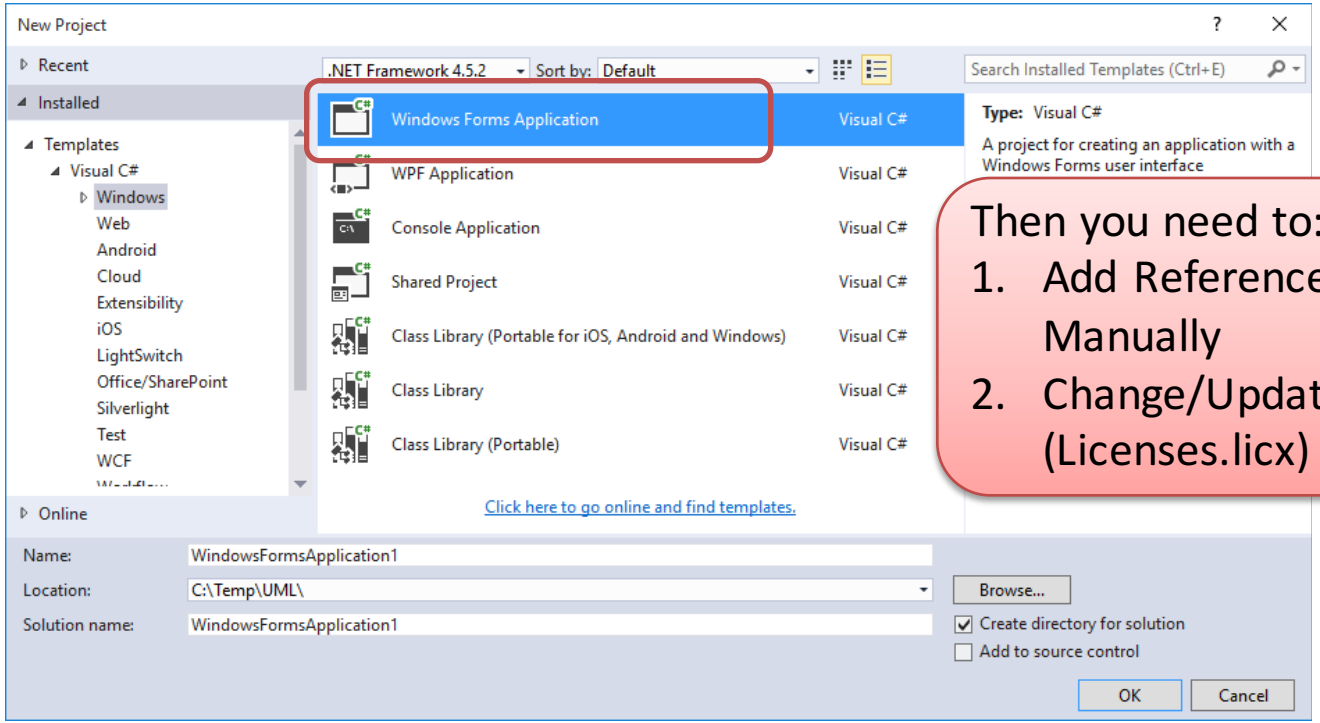


Make sure to select the DataSocket Library

Measurement Studio is an “Add-in” for Visual Studio created by National Instruments.

Visual Studio 2015 + Measurement Studio

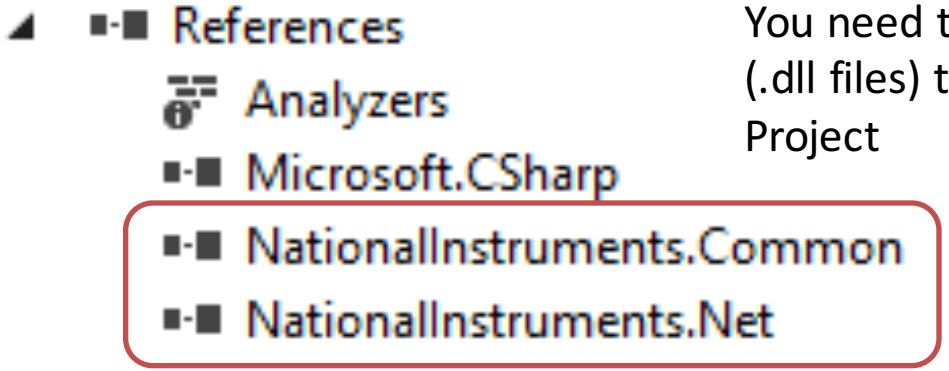
You can use an ordinary WinForm App



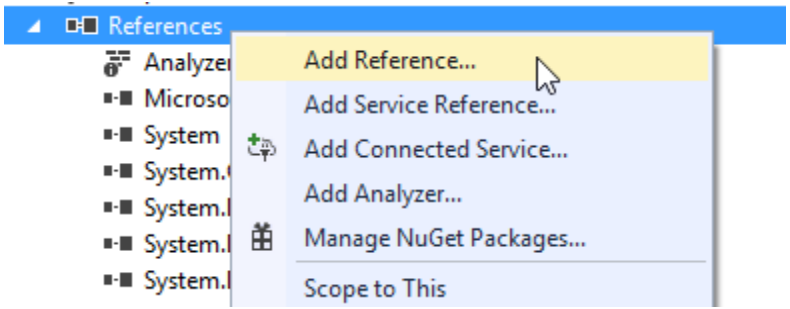
Then you need to:

1. Add References (Assemblies) Manually
2. Change/Update the License File (Licenses.licx)

Adding References to your Project



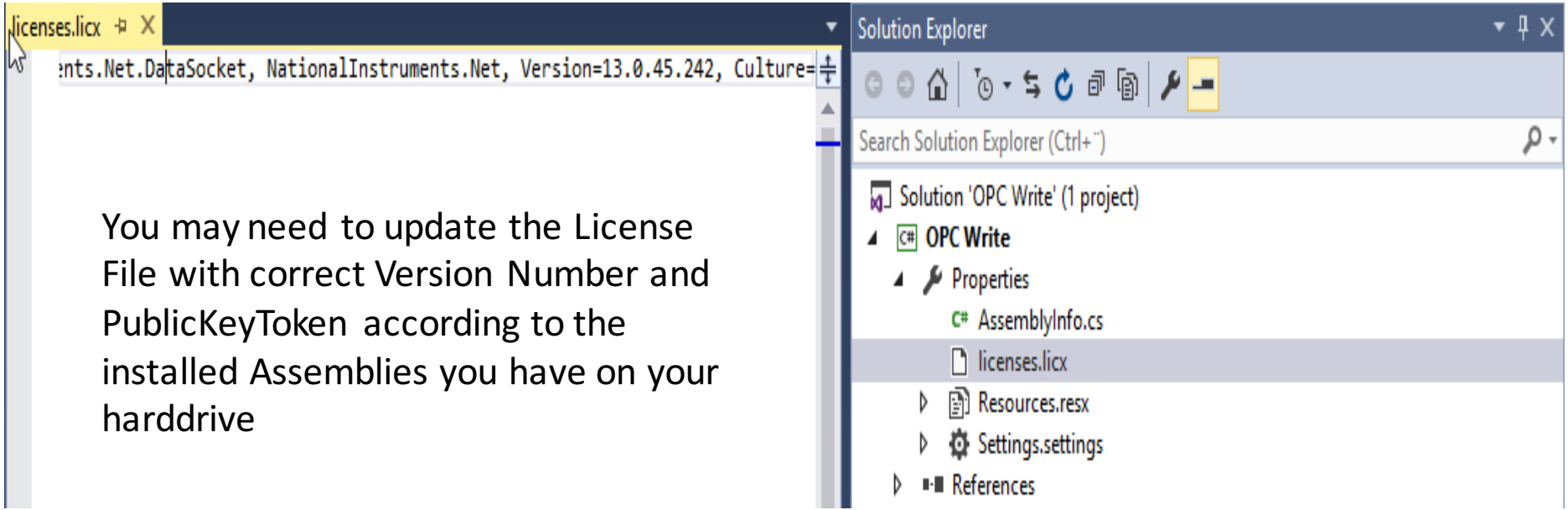
You need to add these Assemblies (.dll files) to your Visual Studio Project



Locate the following Assemblies on your harddrive:
NationalInstruments.Common.dll
NationalInstruments.Net.dll

C:\Program Files...\National Instruments\MeasurementStudioVSXXXX\DotNET\Assemblies\Current\...

License File



You may need to update the License File with correct Version Number and PublicKeyToken according to the installed Assemblies you have on your harddrive

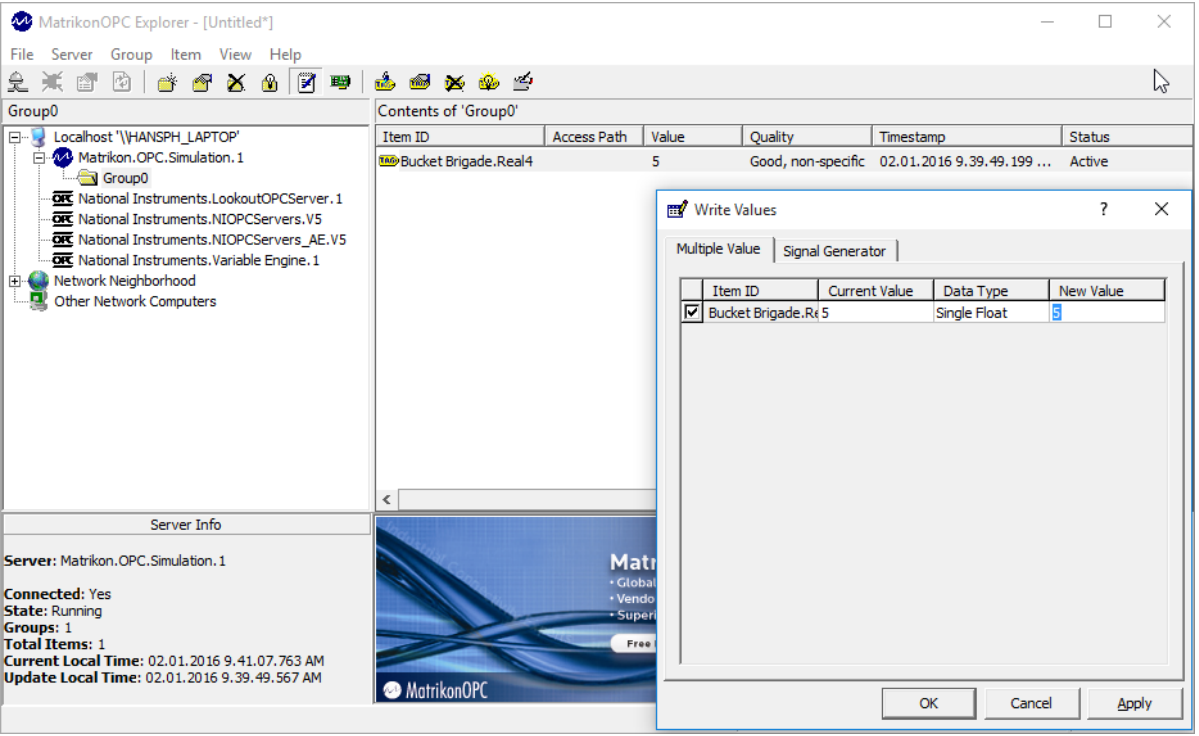
NationalInstruments.Net.DataSocket, NationalInstruments.Net, Version=13.0.45.242, Culture=neutral, PublicKeyToken=4febd62461bf11a4

OPC Read Example

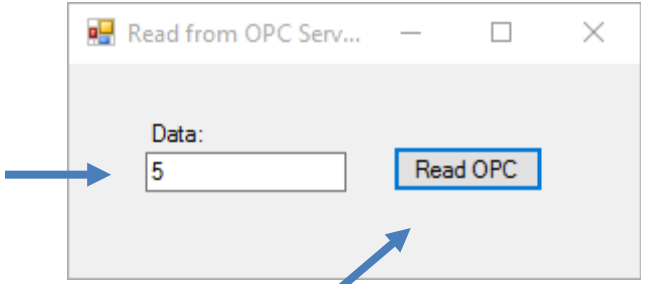
Hans-Petter Halvorsen, M.Sc.

OPC Read

Matrikon OPC Server/OPC Explorer



Visual Studio App



Click Button to get latest Value from OPC Server

Read from OPC Server using Visual Studio

```
using NationalInstruments;
using NationalInstruments.Net;
…
string opcUrl;
double opcValue;

opcUrl = "opc://localhost/Matrikon.OPC.Simulation/Bucket Brigade.Real4";

DataSocket dataSocket = new DataSocket();

if (dataSocket.IsConnected)
        dataSocket.Disconnect();

dataSocket.Connect(opcUrl, AccessMode.Read);
dataSocket.Update();
opcValue = Convert.ToDouble(dataSocket.Data.Value);
```

Note! This Code Snippet reads only one value once, you can use e.g. a **Timer** in order to read values at specific intervals.

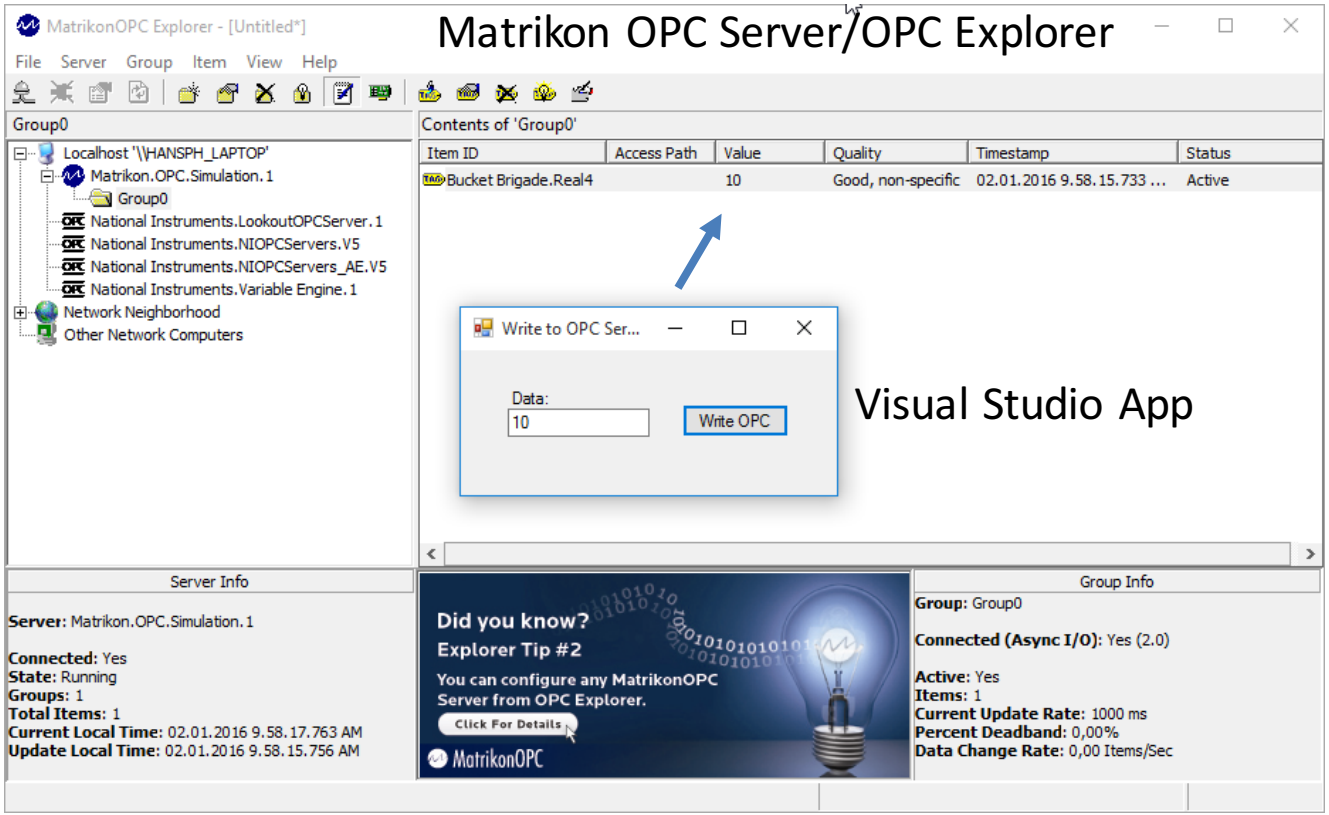

DEMO

```
using NationalInstruments;
using NationalInstruments.Net;
using System;
using System.Windows.Forms;

namespace OPC_Read
{
   public partial class Form1 : Form
   {
      DataSocket dataSocket = new DataSocket();

      public Form1()
      {
         InitializeComponent();

         string opcUrl;
         opcUrl = "opc://localhost/MATRIKON.OPC.Simulation/Bucket Brigade.Real4";

         if (dataSocket.IsConnected)
            dataSocket.Disconnect();

         dataSocket.Connect(opcUrl, AccessMode.Read);
      }

      private void btnReadOpc_Click(object sender, EventArgs e)
      {
         dataSocket.Update();

         txtReadOpcValue.Text = dataSocket.Data.Value.ToString();
      }
   }
}
```

OPC Write Example

Hans-Petter Halvorsen, M.Sc.

Write OPC Example



Write from OPC Server using Visual Studio


```
using NationalInstruments;
using NationalInstruments.Net;
…
string opcUrl;
double opcValue;

opcUrl = "opc://localhost/Matrikon.OPC.Simulation/Bucket Brigade.Real4";

DataSocket dataSocket = new DataSocket();

if (dataSocket.IsConnected)
                dataSocket.Disconnect();

dataSocket.Connect(opcUrl, AccessMode.Write);

opcValue = Convert.ToDouble(txtWriteOpcValue.Text);
dataSocket.Data.Value = opcValue;
dataSocket.Update();
```

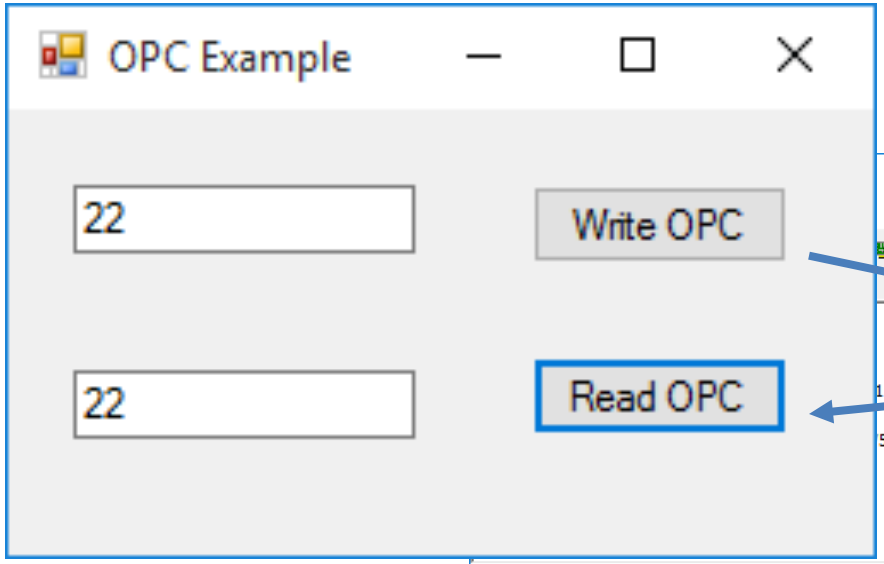

DEMO

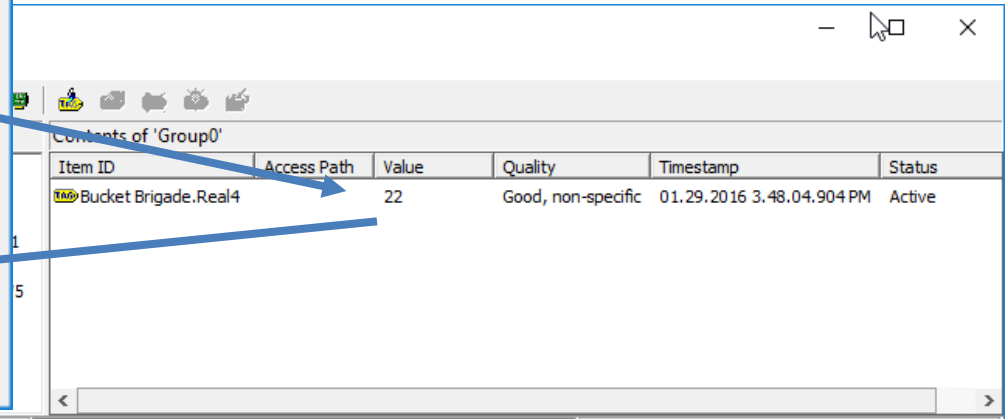
```
using NationalInstruments;
using NationalInstruments.Net;
using System;
using System.Windows.Forms;

namespace OPC_Write
{
   public partial class Form1 : Form
   {
      DataSocket dataSocket = new DataSocket();

      public Form1()
      {
         InitializeComponent();

         string opcUrl;
         opcUrl = "opc://localhost/MATRIKON.OPC.Simulation/Bucket Brigade.Real4";

         if (dataSocket.IsConnected)
            dataSocket.Disconnect();

         dataSocket.Connect(opcUrl, AccessMode.Write);
      }

      private void btnWriteOpc_Click(object sender, EventArgs e)
      {
         double opcValue = 0;

         opcValue = Convert.ToDouble(txtWriteOpcValue.Text);

         dataSocket.Data.Value = opcValue;

         dataSocket.Update();
      }
   }
}
```

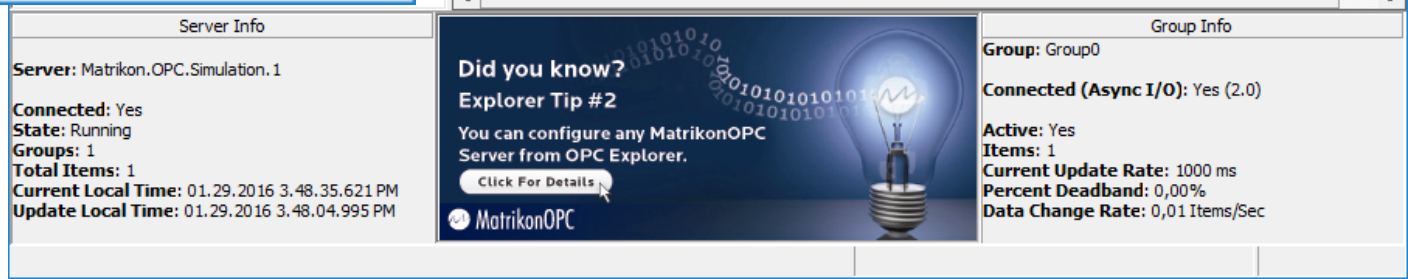
OPC Write/Read Example

Hans-Petter Halvorsen, M.Sc.

Write/Read Example







```
using System;
using System.Windows.Forms;
using NationalInstruments;
using NationalInstruments.Net;

namespace OPCExample
{
   public partial class Form1 : Form
   {

      DataSocket dataSocketRead = new DataSocket();
      DataSocket dataSocketWrite = new DataSocket();

      public Form1()
      {
         InitializeComponent();

         string opcUrl;
         opcUrl = "opc://localhost/MATRIKON.OPC.Simulation/Bucket Brigade.Real4";


         if (dataSocketRead.IsConnected)
            dataSocketRead.Disconnect();

         dataSocketRead.Connect(opcUrl, AccessMode.Read);

         if (dataSocketWrite.IsConnected)
            dataSocketWrite.Disconnect();

         dataSocketWrite.Connect(opcUrl, AccessMode.Write);

      }

      private void btnReadOpc_Click(object sender, EventArgs e)...

      private void btnWriteOpc_Click(object sender, EventArgs e)...

   }
}
```

```
private void btnReadOpc_Click(object sender, EventArgs e)
{

   dataSocketRead.Update();

   txtReadOpcValue.Text = dataSocketRead.Data.Value.ToString();

}

private void btnWriteOpc_Click(object sender, EventArgs e)
{

   double opcValue = 0;

   opcValue = Convert.ToDouble(txtWriteOpcValue.Text);

   dataSocketWrite.Data.Value = opcValue;

   dataSocketWrite.Update();
}
```


DEMO

Additional Features

Hans-Petter Halvorsen, M.Sc.

Additional Features

- Using a Timer in order to read/write Data from/to the OPC Server at specific Intervals
- Trending/Plotting Data
  - Using the ”WaveformGraph” Control included with Measurment Studio
- Using OOP, i.e., Create and Use Classes in your Code

Timer

In Visual Studio you may want to use a Timer instead of a While Loop in order to read values at specific intervals.

1

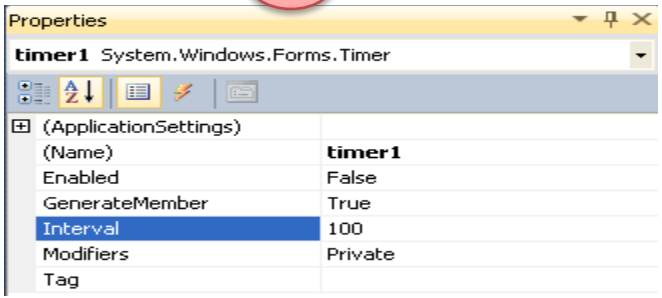
Select the "Timer" component in the Toolbox

2 **Initialization:**

```
public Form1()
    {
        InitializeComponent();

        timer1.Start();
    }
```

Double-click on the Timer object in order to create the Event

3 **Properties:**



You may specify the Timer Interval in the Properties Window

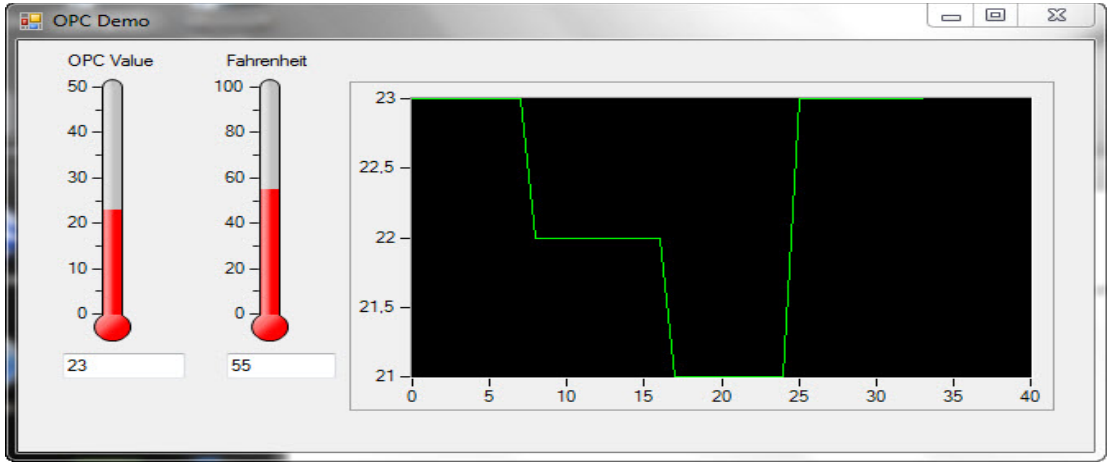
4 **Timer Event:**

```
private void timer1_Tick(object sender, EventArgs e)
    {
      … //Read from OPC
      … //Scaling
      … //Plot Data
    }
```

Structure your Code properly!!
Define Classes and Methods which you can use here

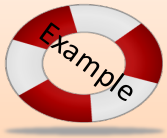
Trending Data with Measurement Studio

You may use the "**WaveformGraph**" Control included with Measurement Studio



You only need one line of code, e.g. in the Timer Event:

```
…
{
        …

        waveformGraph.PlotYAppend(analogDataIn);

}
```



Name of your WaveformGraph Control

Name of the Method to use

Name of the variable with Temperature data

Example:

OOP: Classes, Fields and Methods

1

```
class Car //Class
{
        public string color; //Field

        //Method
        public void ShowCarColor()
        {
            MessageBox.Show("My Car is: " + color);
        }

}
```

You should use OOP techniques in your application! Create your own classes, fields and Methods

3

OOP: Object Oriented Programming

2

```
Car myCar = new Car(); //We create an Instance of the Class

myCar.color = "blue"; //We set a value for the color Field

myCar.ShowCarColor(); //We call the Method
```

Make sure to use OOP (Object Oriented Programming) in your solutions


DEMO

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